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Message from the Editor-in-Chief

Dear Colleagues,

Welcome to TOJET

TOJET extends a warm welcome to all our readers.

Today, technology is advancing rapidly across the globe, significantly impacting many aspects of our lives. Technological advancements, both in hardware and software, create important interactions between society, culture, organizations, machines, technical processes, and phenomena. Educators must understand these connections as technology directly affects teaching and learning processes. Consequently, educators increasingly integrate technology into all aspects of their professional lives, including curriculum development, classroom instruction, and student assessments. For this process to progress efficiently, educators need to be informed about the cultural and cognitive dimensions of technology and technical knowledge, as well as evaluate its contributions and limitations to education and human development.

The Concept of Technology:

When people think of "technology," they often envision machines, electronic devices, scientific tools, or industrial systems. However, formal sources (such as collegiate dictionaries) suggest that the concept of technology has a broader meaning. Technology is defined as the "practical application of knowledge" or the "method of accomplishing a task using technical processes, methods, or knowledge." In this context, technology emerges as a tool that enables humans to apply their knowledge and skills to solve problems and enhance their quality of life.

Definition of Technology:

1. The practical application of knowledge, particularly within a specific field.
2. The method or process of accomplishing a task through technical means, expertise, or procedures.
3. The specialized aspects inherent to a particular area (**such as educational technology**).

The use of technology is not limited to machines (e.g., computer hardware) and tools. It also encompasses structured relationships between individuals, machines, and the environment. Therefore, technology is more than just tools and equipment; it reflects the complex interplay of human cognition, sociocultural environments, and technological artifacts. Moving beyond superficial understandings of technology requires a deep exploration of human cognitive processes, social contexts, and interactions with technology.

Educational Technology and Its Importance:

Educational technology refers to the integration of technological tools and innovations into educational processes. This field includes various innovations such as digital platforms, AI-assisted learning tools, online course materials, virtual classrooms, and augmented reality to enhance the learning experience for teachers and students. The primary goal of educational technology is to make learning more accessible, effective, and engaging.

Advantages of Educational Technology:

- **Personalized Learning:** Technology provides content that aligns with students' individual learning paces and styles.
- **Flexibility in Time and Space:** Online learning tools enable education independent of location.
- **Interactive and Engaging Learning:** Virtual classrooms and digital platforms foster greater interaction among students.
- **Resource Diversity:** Digital libraries, video lectures, and simulations offer students a wealth of resources.

Challenges in Educational Technology:

- **Access and Digital Divide:** Not all students may have equal access to technology.
- **Teacher Competency:** Educators must adapt to new technologies and use these tools effectively.
- **Technological Dependency:** Over-reliance on technology in education may negatively impact students' social skills and creative thinking abilities.

TOJET and Educational Technology:

TOJET plays a significant role in disseminating new advancements in educational technology on a global scale, contributing to educators and researchers. These contributions foster innovation in the field of education and support technological transformation.

As an editor, I am always honored by TOJET's valuable contributions to the field of educational technology.

TOJET, in collaboration with international universities, will host the IETC 2025 Conference (www.iet-c.net) in Rabat, Morocco between July 10-11, 2025

Call for Papers:
TOJET welcomes academic studies in the field of educational technology. Submitted articles may address topics such as the use of technology in classrooms, the impact of technology on learning, and the perspectives of students, teachers, administrators, and the community on educational technology. Such studies will enhance the quality of theoretical and practical approaches in educational technology.

Article Submission Criteria:
- Submitted articles must be original, unpublished, and not under consideration by another publication.
- Articles may cover a wide range of topics, including assessment, attitudes and beliefs, curriculum design, equity, applied research, learning theories, sociocultural issues, and educational practices for special populations.

January 01, 2025

Editors,

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Editorial Board

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A Bibliography Study on Academic Publications about Artificial Intelligence in Music Education

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ABSTRACT
Research has indicated that the ever-changing emerging technologies have different impacts on music education from many perspectives such as; music pedagogy, instruction methods, evaluation approaches. For almost 30 years the online learning and education platforms based on Artificial Intelligence (AI) provides both teachers and students with rich personal teaching/learning environments, methods, educational tools and improve the efficiency of music education. Although there has been extensive publication in the field of AI in education and AI in the music industry, it has been observed that publications on AI in music education have gained momentum since 2019. This situation is the most important motivation for conducting this research.

In this research, a bibliographic study was conducted through the document review method. Data were obtained by scanning published scholar books/book chapters (n=1), articles (n=58) and conference papers (n=19) in selected online databases and, were grouped and presented according to certain criteria. Studies between 2019-2023 that included the terms "music education/teaching/learning" and "Artificial Intelligence (AI)" together in their titles and abstracts (including keywords) both in English and Turkish were scanned. It was determined that 18 of the 58 articles examined were retracked and, most of the publications did not contain information about the research design and method. Also it is found out that; most of the research focus on theoretical subjects such as; musical analysis, composition, algorithmic systems, and a few on instrumental-mostly piano or vocal pedagogy. It has been observed that studies on music education applications with AL are insufficient.

The importance and use of AI is increasing day by day, and research will continue to be conducted as long as this issue is on the agenda. The main aim of this research is to provide a resource for experts and academics studying in the field and shed light on future scientific studies on music education and AI. The scanning process in this study is limited, therefore, in future research, it may be recommended to examine publications in different languages and scientific theses in larger databases, within the framework of different criteria.
Keywords: Music education, Teaching Music, Artificial Intelligence, AI, Bibliography.

INTRODUCTION

Researchers have indicated that the ever-changing emerging technologies have different impacts on music education from many perspectives such as; music pedagogy, instruction methods, evaluation approaches (Liu et al., 2023; Liu et al., 2021). For almost 30 years the online learning and education platforms based on artificial intelligence (AI), which is in fact coined in 1955 by John McCarthy (Zulić, 2019; Arıcı, 2023) provides both teachers and students with rich personal teaching/learning environments, methods, educational tools and improve the efficiency of music education. It is quite clear that we have moved from the digital age to the age of AI.

AI, an emerging discipline based on computer science and integrated by computers, psychology, philosophy and other disciplines, is a new technical science that studies and develops theories, methods, techniques and application systems that simulate, and extend and expand human intelligence. (Zhang, 2023). It mainly uses computer-related technologies that can interact with human activities to imitate human thinking and some intelligent behaviors, such as search, reasoning, memory, speech recognition, knowledge expression, and processing of information, so that it can behave like humans, as well as advanced intelligence and thinking to achieve higher-level computer applications. It is an extension of human's existing ability and has high intelligent technology beyond the scope of manpower (Jiang, 2021, Dai, 2023, Manman, 2021). As for Yau and Qian (2024) AI algorithms can analyze learners' performance data and provide personalized learning paths based on their strengths, weaknesses and learning preferences. Artificial intelligence-powered chatbots and virtual assistants can provide instant support to learners, answering questions and guiding them through course material (p.811).

The integration of AI into music education is started with musical instruments, software, smart classrooms, and teaching/learning online/mobile applications. Due to the combination and development of music education, AI

technology has become the future trend of music education, exerting a huge influence on traditional teaching concepts and methods and forming a diversified and multi-level development direction (Yu et al., 2023). The implementation of AI in music education has enhanced the level of the music instruction and enlarged the music teaching model as mentioned in several resources (Zhang, 2023, Ma, 2021, Yang, 2021, Jiang, 2021, Liu, 2022, etc.). Combined with learning analytics, AI can indeed be harnessed to create powerful personalised tutoring tools, especially when selfregulated learning is desired (Chong, 2019). In this evolving paradigm, traditional music education methods are enhanced and enriched through the integration of data-driven technologies and tools. Through the collection and analysis of data, educators gain valuable insights into student progress, preferences, and needs, allowing for personalized instruction and curriculum adaptation (Bresler, 2021). Teachers can also fully integrate network resources to innovate their own courses, and with the help of new ideas, they can bring better help to students. Students can combine the complex network information to find useful content for themselves, and with the contribution of new technologies, they can create a new learning model to improve their professional quality and comprehensive ability (Jiang, 2021). AI supported tools, "deep learning models/algorithms" as mentioned in Zhang (2023), provide highly personalized feedback and guidance to individual students; making real-time assessments on musical performances, enabling students to explore composition and different musical styles and structures, fostering their creative abilities.

However, as AI becomes widespread - especially in the field of education – and AI-based methods have many advantages such as the ability to teach theoretical foundations of music teaching, it also brings some issues of concern. The use of AI in education has both positive and negative effects on both students' learning and teacher teaching. This is also mentioned in some studies whose full text is available. (Zheng & Dai, 2022). Zhang (2023) states that, most music teachers have limited computer technology, so it is difficult to combine the current teaching content with AI technology. On the other hand, it requires interactive electronic devices in music classrooms, and it is also difficult to achieve the popularization of these educational technology. Most teachers believe that the application of technology in the classroom will distract students in the classroom, and will also increase the burden of teaching content, indirectly causing students to be difficult to adapt, reducing learning efficiency and further hindering the progress of teaching. Han et al. (2023) present the restrictions and drawbacks as follows; lack of human interaction, strict restrictions on creativity and expression, cultural and historical context, technical dependencies and accessibility, ethical issues, and overreliance on technology. For Yang (2021) most music teachers still unaware of this new intelligent musical instrument, or even just that it would play a significant role in the future development of music education. He draws attention to another topic that future AI may be able to effectively comprehend a music teacher's speech and emotion, as well as follow the music teacher's humanized teaching technique. He adds that because of the constraints of music education's uniqueness AI's potential application in music education may have several limitations when it comes to emotional aspects of music teaching, such as music emotion, music content expression, and tone. Botella (2023) says that "certain elements are inherent to music learning and performing, including human expression and communication… the practices that AI promotes should always consider the intra and interpersonal aspects of music learning" and finally Wei et. Al, (2022) summarize the argument as follows: "intelligent tutoring solutions are insufficient to teach an open-ended subject" (p.3).

In the literature review on the relationship between music and AI, it was determined that publications related to the music industry, production and publishing processes and the impact of AI technologies on these processes (music production/composition, music composition/editing, music recording-editing/mixing/mastering, music printing etc.) have increased since 1992. An anthology written by a team of experts in the field is one of the first publications. 26 contributions in the book (chapters drawn from two international workshops held in 1988 and 1989) explore the intersection of music and AI on a base of musical composition, analysis, performance, perception and learning and tutoring (Balaban & Ebcioglu, 1992). There are many books and publications with similar content published in the literature on music and AI. For instance "*Handbook of Artificial Intelligence for Music - Foundations, Advanced Approaches, and Developments for Creativity*" edited by Eduardo Reck Mirada is one of them. This book presents comprehensive coverage of the latest advances in research into enabling machines to listen to and compose new music including the development of interactive musical robots and emerging new approaches to AI-based musical creativity, brain–computer music interfaces, bio-processors and quantum computing and subjects around music industry, from management systems for recording studios to recommendation systems for online commercialization of music through the Internet (Miranda, 2021).

During the research, a book entitled "Music Education: An Artificial Intelligence Approach" published in 1994 by Smith at al. (Eds.). consisting of papers originated from the proceedings of a workshop held as part of a conference on AI was encountered. Although the title and foreword of the book indicate the relationship between music education and AI, it has been observed that the titles and contents of the 10 chapters in the book do not coincide with the publication. In an article Holland (2000) reviewed critically some of the principal problems and

possibilities of a variety of AI-ED approaches including; Intelligent Tutoring Systems for Music; Music Logo Systems; Cognitive Support Frameworks. This paper also published as a book chapter in 2013.

Although there has been extensive publication in the field of AI in education and AI in the music industry, it has been observed that publications on AI in music education have gained momentum since 2019. This situation is the most important motivation for conducting this research. As Yılmaz (2021) stated; whether science is considered a cumulative or punctuated process, previous research is of great importance in the production of scientific knowledge. In this sense, monitoring, evaluating, and reproducing previous research, even if not exactly the same, has an important function in terms of the scientific research process (p.1458). With a bibliographical literature review on AL in music education, the main aim of this research is to provide a resource for experts and academics studying in the field and shed light on future scientific studies on music education and AI. For this purpose, the research will seek answers to the following questions:
1. What is the distribution of publications by years?
2. What is the distribution of nationalities of the authors of the publications?
3. What are the keywords used in the publications?
4. What are the subject areas of the publications?
5. What is the distribution of research methods used in publications?
6. What is the distribution of research designs used in publications?
7. What is the distribution of the study groups in the publications?

METHODOLOGY
In this research, a bibliographical study was conducted through the document review method. Document review method, one of the qualitative research methods, is the process of analyzing and collecting data by examining a real-life case and written documents containing information about that case (Yıldırım and Şimşek, 2008; Karataş, 2017). Ocaña-Fernández and Fuster-Guillén (2021) define bibliographic review article as; A methodology of observational research, retrospective, systematica, oriented to the selection, analysis, interpretation and discussion of theoretical positions, results and conclusions embodied in scientific articles disclosed in recent years on a topic of choice in order to obtain relevant information that contributes to the solution of problems (p.1). This study is not a biometric study since the citation statistics of the publications or the biometric information of the journals are not included. Therefore, this is a systematic review based on a bibliographic study. Considering the classification made by Ergan while defining "bibliography"; This work is a "completed" bibliyography according to its duration (created from materials published between or by certain dates); a"special" bibliyography according to its scope (created from materials published on a subject or related subjects); and a chronologically arranged (in order to the publication dates of the materials) bibliographic study (Ergan 1994: 13).

Data selection
The data in the research were obtained by scanning published scholar books, book chapters, articles and conference papers in online databases; Tr-Dizin, Ulakbim Keşif, ERIC, ProQuest, Semantic Scholar, Google Scholar, Hindawi.com and IOP.org. The studies to be evaluated in the research were selected according to certain criteria. First of all; Only the studies published between 2019-2023 were examined. Since 2024 is not over yet, publications from this year are not included in the study. Second; The search includes only publications written in Turkish and English. Third; Studies that included the terms "music education/teaching/learning" and "Artificial Intelligence (AI)" together in their titles and abstracts (including keywords) both in English and Turkish were scanned; Publications that contained only the word "music" or "education" and, were not directly related to music education were excluded from the research. Fourth; Only publications whose full text or abstract was accessible were examined.

Data Analyze
In the research, data were grouped and presented in an order according to certain criteria mentioned in the problem questions. The quantitative data gethered from the publications are presented directly and with frequency (*f*) and percentage (%) tables. In the analysis of the data regarding the 3rd and 4th research questions (keywords and subject area distribution), the content analysis technique was used and, the data were classified under certain themes, and presented with graphic tables. The Word "Null" was used to express the data that could not be reached.

FINDINGS
Distribution of Publications by Year

	Articles	Papers	Book Chapters	Books
■ 2023	17	4	0	0
■ 2022	15	3	0	0
■ 2021	5	3	0	0
■ 2020	1	7	1	0
■ 2019	2	2	0	0
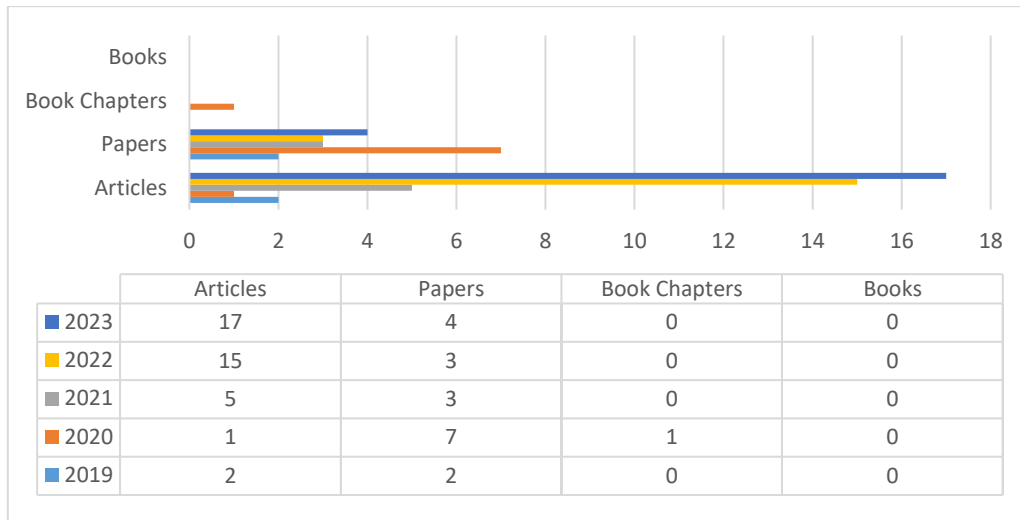
Graph 1. Distribution of Publications by Year

According to Graph 1, when the distribution of publications between 2019-2023 is examined, it is seen that 32 (80%) of the 40 scientific articles were published in 2022 (n=15) and 2023 (n=17). There are 5 scientific articles published in 2021, 2 in 2019, and 1 in 2020.

Of the 19 congress papers accessed between 2019-2023, 7 were published in 2020; 4 in 2023; 3 in 2022; 3 in 2021, and 2 in 2019. Apart from 1 Book Chapter published in 2020, it is also seen that no book or book chapter was written on the subject between 2019-2023.

The distribution of nationalities of the authors of the publications
As seen in Table 1, 1 of the two articles from 2019 is from Singapore and 1 from Canada. It is seen that there was one publication from Türkiye in 2021 and 2023, and one from Spain in 2022 and 2023. Apart from these, it was determined that authors from France, Pakistan and Saudi Arabia were included twice each, and authors from India and Poland were included once each in multi-authored publications from 2022 and 2023. It is seen that 19 authors in 2022, 14 in 2023, 4 in 2021 and 1 in 2020 were of Chinese origin.

One of the papers written in 2019 was by an Italian author and one by a Chinese author. All 7 papers published in 2020 and 3 papers published in 2021 and 2022 belong to Chinese authors. While 4 out of 4 papers from 2023 include Chinese authors, one publication was found to be a joint publication of China and the United Kingdom. It was also determined that the only book chapter published in 2020 belonged to a Chinese author. According to this table; Between 2019-2023, 1 paper in 2019; 1 article, 1 book chapter in 2020 (n=2); 4 articles, 3 papers in 2021 (n=7); 19 articles, 3 papers in 2022 (n=22) and 14 articles, 4 papers in 2023 (n=18), totaling 50 publications belong to Chinese authors. This result shows that 83% of the 60 publications analyzed in the study are of Chinese origin.

Table 1. The distribution of nationalities of the authors of the publications

Years	Countries	Article	Paper	Book Ch.
2019	Singapore	1		
	Canada	1		
	Italy		1	
	China		**1**	
2020	**China**	**1**	**7**	**1**
2021	**China**	**4**	**3**	
	Türkiye	1		
2022	**China**	**19**	**3**	
	Spain	1		
	India	1		
	Saudi Arabia			
	Poland			
	France			

2023	Pakistan		
	Spain	1	
	Philippines	1	
	China	**14**	**4**
	United Kingtom		1

Keyword analysis

According to Graph 2, in the *Technological Words and Terms Category* the word "Artificial Intelligence" is used 21 times in articles and 17 times in conference papers. "Technology" is used in three forms in articals and used only in one paper as AI technology. "Vector" is used within 3 terms in articals; "Deep Learning" is used 2 times and, 22 other words and terms appear only once as follows: "Augmented Reality, Interactive Interfaces, Internet, Multimodal Network Model, Big Data Analytics, Data Fusion, Digital Learning, Intelligent Learning Systems, Clustering Algorithm, Resource Availability Algorithm, Automatic Music Generation, Co-creation, KNN Dynamic Expansion Query, Process (AHP), Whale Optimization, AI-based Decision Support Systems, Applications, Mobile Apps, Messenger, Chatbot, Gesture Interactive Robot, Heterogeneous Online. In papers the word "Intelligent (I)" is used four times as "I piano, I hearing, I systems, I Tutoring System". The technology related words that are used once in papers are follows: Assisted System, Big Data, Cloud Computing, Internet, Online, Interactive.

The most used keyword related to educational words and terms is "Music Education (ME)", which was used 12 times in articles and nine times in papers. Three of them were used as "Rural ME", ME Perception" and "Musical Education" in articles and once as "University ME Model" in a paper. When analyzing the keywords of articles it is found out thet the word "Teaching" is used five times as "Music Teaching", "Teaching Mode", "Teaching Virtual Reality", "Network Teaching" and "Vocal Teaching Model" are the other terms containing "Teaching". "Education" is used three times; both alone and in "Education Platform", "Educational Psychology" term forms. "Training" is used two times as "Skill Training" and "Talent Training" and "Music Learning" used two times. Other words and terms that are classified as educational words in the field of education and have been used once in article keywords are as follows: "Curriculum Optimization, Flipped Classroom, Interactive Course, Online Course, Middle School Music, Literacy, Student Innovation, Student Teacher". On the other hand when the papers analysed it was seen that "Education" and "Teaching" are the second most common word in this category (n=6). The Word "Teaching" doesn't used alone such as; "Interactive Teaching, Chamber Music Teaching, Music Assisted Teaching, Teaching Efficiency, Teaching I system, The Quality of Teaching". "Training" and "Learning Motivation" are also used once.

	Technological	Educational	Musical	Other	Null
■ Book Chapters	3		2		
■ Conference Papers	27	26	9	16	2
■ Articals	50	27	12	12	18
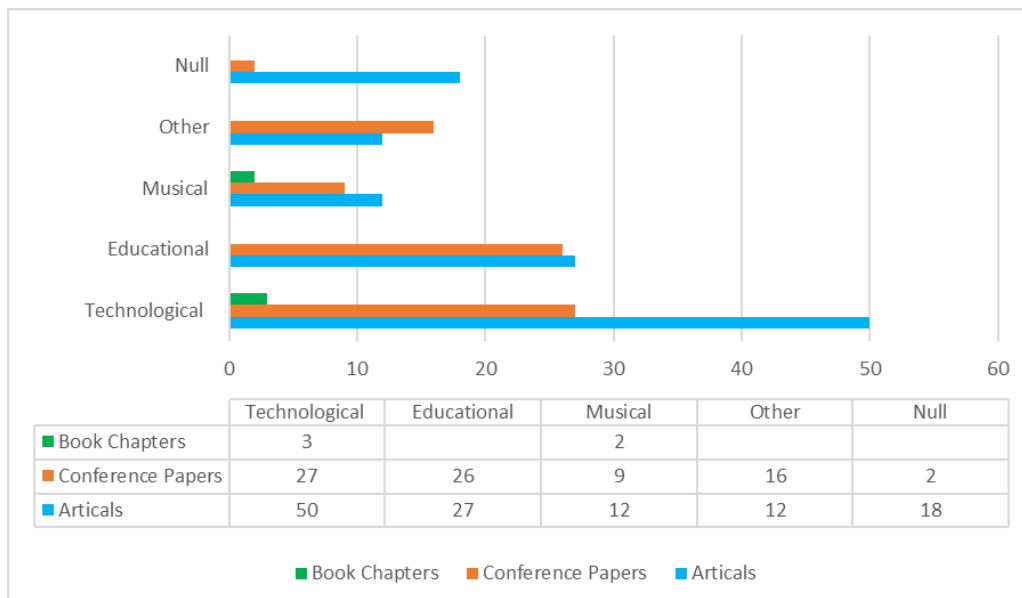
Graph 2. Key Word Analysis of the Publications

In the keyword analysis, some words were classified under the "Musical Words and Terms" category. According to this, in the articles; Word "Performance" used three times; "Composition" is used three times, both alone and in "Composing Music"and "Assisted Music Composition" term forms. Word "Makam" is used two times as; "Classical Turkish Music Makams" and "Makam Detection". It was determined that in four studies conducted in the field of musical instruments the names of the relevant instruments were given as keywords; "Piano", "Learning

To Play The Piano", "Trumpet Pedagogy" and "Vocal Teaching Model". As for the conference papers; the word "Music" is used seven times both alone and in " Preschool Music", "Music I System", "Music Listening Learning", "Music Perception" and, "Music Cognition" term forms. "Musical Composition" and "Musicology" are also appear once.

An unexpected result that was revealed from the analysis was that 18 of the 40 articles and two of the conference papers did not have keywords added to the abstract section. The fact that this number is quite high is quite thought-provoking. In this case, the data is entered as "Null". Finally, in the articles 12 and in the papers 16 words and terms that were used only once could not be classified under any category. These are: Scoping Review, Innovation Research, Analytic Hierarchy, Classification, Developments, Effect Assessment, Employability Skills, Least Squares, Personalized Recommendation, Involvement, Human, and, Human–Machine from the articles and, Comparative Experiment, Application, Optimization Analysis, Practicality, RBF algorithm, System, TPACK framework, Promotion strategies, Market research, Content Design, Convenience, Dyslexia, Pedagogical advancements, Emotional interaction, NN and, Limitations from the papers.

Subject Area Analysis
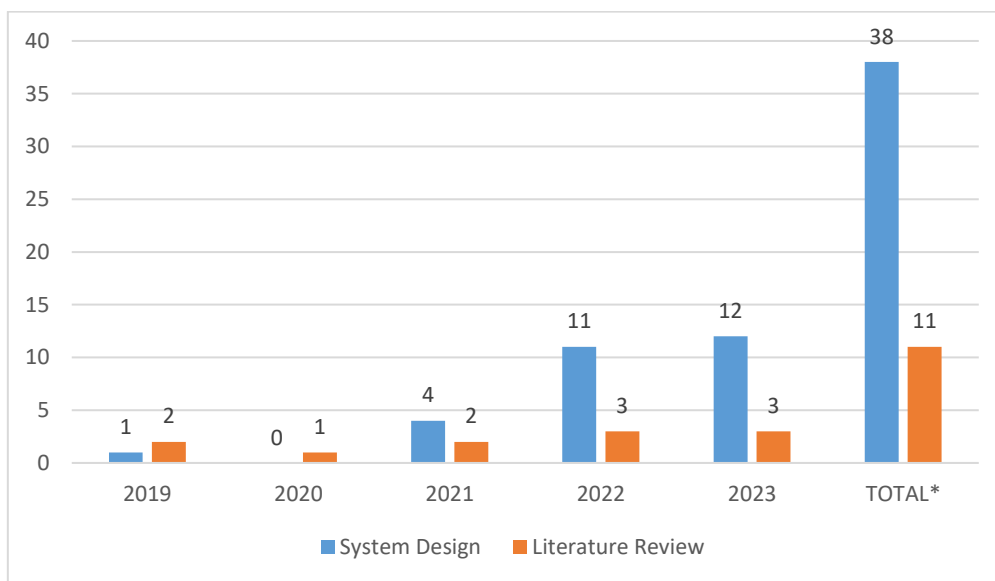
Graph 3. Distribution of the subject area of the artices
*The total value in the table is more than 40 because two or more subject areas is mentioned in some articles.

Through the years of 2019-2023 it is found that the main subject area of the articles is "designing or proposing algoritmic systems, programs or applications". Some of those were only evaluated by data analyze (1 in 2021, 3 in 2022 and 5 in 2023); some of them were designed for general music education (4 in 2023 and 2 in 2022); 4 of them were designed for piano education (3 in 2023 and 1 in 2022); 2 of them were designed for voice education in 2022. Other subject areas the authors designed programs for and evaluated are follows; A personal tutor to learn harmonic theory in 2019; a MIR system that determines the makam of the songs in Classical Turkish Music Education, an emotion algorithm system to analyze and evaluate classroom music teaching behavior, a method for music teaching evaluation, an AI based Speech Recognition Simulation System in 2022 (n=4); And an interactive AI- supported platform for teaching country music education in 2023. In an article in 2023 a music-teaching classroom was constructed with gesture interaction based on RNN, analyzing the EEG signals to detect the physiological state of autistic children who are receiving different music perception treatment projects (Zhang atAll, 2023). The other common subject of the articles are "literature review on AI and AI technologies in music education" (2 in 2019, 1 in 2020, 2 in 2021, 3 in 2022 and 2023).

As in articles, the subject area distribution in papers is divided into two main categories. In 8 papers, studies were carried out on the construction of AI-supported algorithmic systems and programs. In one paper in 2021, 2022 and 2023, a music teaching system is proposed based on RBF algorithm. In 2 papers in 2022 and 1 paper in 2023, music teaching models and, in one paper in 2022 an intelligent piano teaching method were constructed and discussed. In a paper in 2019 the impact of the use of the software CAMA (Computer Added Musical Analysis) in the dyslexic student's learning process was investigated. In 11 papers, the possible contributions of AI technologies to music education and their current status were reviewed and discussed. Specifically, in 2023 the

place and importance of AI in chamber music teaching, and in 2020 in preschool music education and professional music education were discussed.
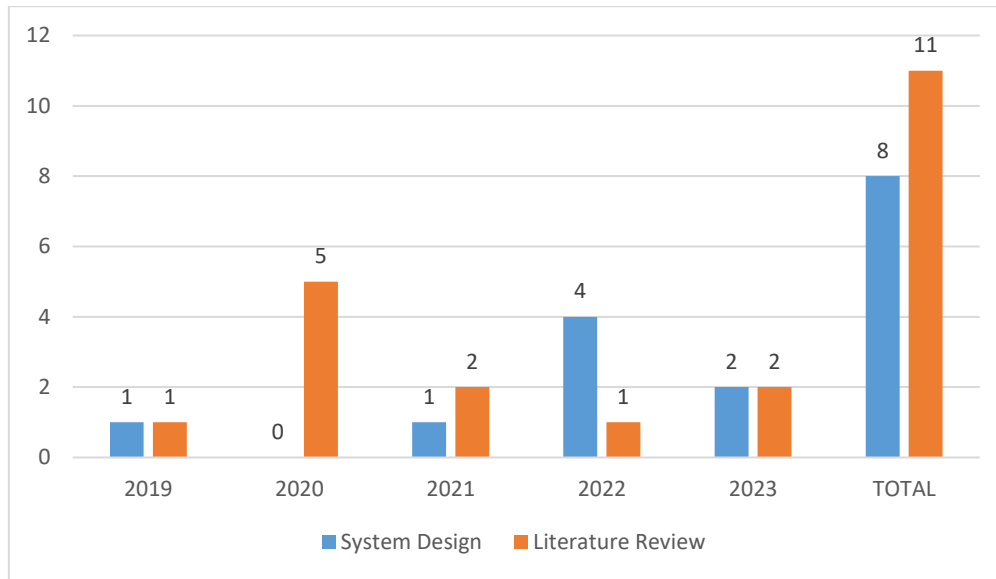
Graph 4. Distribution of the subject area of the papers

And finally in the book chapter written in 2020 the impact of a mobile application designed to facilitate the practising of scales and arpeggios that enables students to record themselves and view their mistakes and prepare for examinations for five instruments (violin, flute, clarinet, trumpet and saxophone) was investigated.

The Distribution of Research Methods

Table 6. Distribution of the research methods of publications

Research Methodology	Articles		Papers		Book Chapter		Pub. Total	
	n	f (%)	n	f (%)	n	f (%)	n	f (%)
Quantitative Research Method	22	55	8	42	0	0	30	50
Qualitative Research Method	10	25	4	21	0	0	14	23
Mixed Research Method	6	15	2	10	1	100	9	15
Unspecified-Null	2	5	5	27	0	0	7	12
Total	40	100	19	100	1	100	60	100

According to table 6, the most widely used research method in the publications is the quantitative research method (50%) with 22 (55%) articles; 8 papers (%42). This method is followed by the qualitative research method (23%) with 10 (25%) articles; 4 (21%) papers and the mixed research method (15%) with 6 (15%) articles, 2 papers (3%) and a book chapter. In 7 publications (12%), the reasearch method used was not stated but according to the text they were examined that the studies were conducted with a qualitative methodology.

The Distribution of Research Designs/Models

Table 7. Distribution of the research designs/models of publications

Research Design/Model	Articles		Papers		Book Chapter		Pub. Total*	
	n	f (%)	n	f (%)	n	f (%)	n	f (%)
Descriptive Model	10	50	9	45	1	5	20	100
Experimental Model	13	81	3	19	0	0	16	100
Data Analysis	15	75	4	20	1	5	20	100
Unspecified-Null	2	29	5	71	0	0	7	100

*The total value of publications in the table refers to the total number of models used because more than one model is used in some publications.

When the table is examined, it is understood that the data analysis model and descriptive model is the most used model in the publications. This model is followed by the experimental model. Although most of the descriptive research publications didn't mention about the design or model, the auther of this article considered them in this cathegory depending on the review of literature or scanning model they used. Besides them it was not specified clearly which design/model was used for 7 publications.

The Distribution of Study Groups

Table 7. The distribution of study groups of the publications

Study Groups	Articles		Papers		Book Chapter	
	n	f (%)	n	f (%)	n	f (%)
University students	10	25	7	37		
High School Students	1	2,5				
Middle School Students	1	2,5				
Children	1	2,5				
Primary School Teachers	1	2,5				
Expert teachers	1	2,5				
University Teachers University Students	4	10				
University Teachers			1	5		
App users-(Individuals) University Teachers					1	100
Null (unspecified)	21	52,5	11	58		
TOTAL	40	100	19	100	1	100

In the table it is obviously seen that % 52,5 (n=21) of articles and %58 (n=11) of paper didn't specified the study groups. Considering that the methodology sections of the studies are quite incomplete and insufficient, it can be said that this result is not surprising. It is also thought that this situation is due to the fact that the study group is not mentioned in most of the studies in which literature review and data analysis were conducted.

CONCLUSION & DISCUSSION

The integration of Artificial Intelligence (AI) in music education marks a transformative era, where traditional pedagogical methods are increasingly enhanced by cutting-edge technological advancements. This study provides a comprehensive review of academic publications between 2019-2023, shedding light on the progress, challenges, and future possibilities in this domain. A literature spanning from the integration of AI into music pedagogy and instructional methods to its broader implications on educational technologies was reviewed. Key themes include the enhancement of personalized learning environments; the utilization of AI in musical instrument technology and software. While acknowledging the significant advancements AI brings to music education, such as personalized feedback and enhanced instructional tools, the study also addresses concerns regarding technological limitations, teacher readiness, and the potential for reduced human interaction and creativity. The main aim of this research is to provide a comprehensive resource for academics and experts in the field, shedding light on future avenues for scientific inquiry and development in AI-enhanced music education.

Conclusion

The findings indicate that AI's role in music education is multifaceted, ranging from algorithmic tools for composition and musical analysis to interactive platforms for personalized instruction. The reviewed studies demonstrate significant advancements in implementing AI to enrich learning environments and pedagogical practices. However, the research also highlights gaps, such as limited empirical studies on instrumental pedagogy and a lack of focus on long-term impacts of AI on creativity and emotional aspects of music learning. Future research should address these gaps by incorporating diverse educational contexts, broader datasets, and multi-disciplinary approaches.

The first book on AI in music education was identified as a book of proceedings from a conference held in Edinburgh, Scotland on August 25, 1993. In the examination, it was determined that although the words "music education" and "AI" were used together in the foreword of the book, a different dimension of music (production and dissemination) was addressed in the conference; all 10 papers presented were written on music production, harmonic analysis, composition and music systems through music technologies. It was seen that the first studies

conducted in the field after 1993 and directly related to the subject were in 1999, where the name AI began to be used more widely. Types of studies varied widely and included literature reviews, qualitative and quantitative studies of various designs, mixed method studies, instrument development studies, and case studies on data-driven learning-based algorithms. Researchers analyze the data gathered from the designed AI sapported algorithms and evaluate the data only. Most of the researh on data analize suggest experimental research to explore the impact of these tools and implementation of the AI aided music courses, learning methods on the activities and performances of students in music classes. More case studies, action research are needed in the field including teaching resources, course objectives, course content, course activities, course organization and implementation, course design and skills, and basic operation plans for teaching practice (Ma, 2021). In this manner this study could serve as a resource to reveal existing literature and identifying opportunities for new empirical research. Also, further research needed particularly in the assessment of the long-term effectiveness of AI-driven music instruction, the impact of web-based technologies and implementing these technologies in diverse educational settings.

It is seen that a numerous amount of study in the field is on designing and developing multimedia-assisted algorithmic systems based on AI technology to improve the scientificity and effectiveness of music teaching (Chong, 2019; Ma, 2021, Liu, 2022, Zheng & Dai, 2022 etc.). More over Xi (2023), proposed an AI technology-based training and assessment model for improving music teachers' music teaching skills. Zang (2023), found out that the "Internet plus" technology and AI has a positive role in promoting the innovation of teaching methods in middle schools music classes in improving students' interest in learning, and enriching teaching content. He also mentions about various music games and music composition tools of AI for providing music education. While, most of the research focus on theoritical subjects; analysis, composition, synthesis, and interaction, there are a few on instrumental-mostly piano- or vocal pedagogy (Huang and Ding, 2022; Jing, 2022; Li, 2022; Bai, 2022; Li & Wang, 2023, Cui, 2023, Lv, 2023; Botella, 2023). Two studies were found on special needs individuals; one is an experimental research article on Autistic children by Zang et. Al. (2022), an the other one is a conference paper about Dyslexic students by Della Ventura (2019).

A critical observation from this review is the dominance of Chinese authors in publications related to AI and music education, reflecting regional strengths in technological research. The trend underlines the necessity for more geographically diverse contributions to balance the discourse. Additionally, the prevalence of quantitative methodologies suggests a need for qualitative and mixed-method approaches to capture the nuanced interplay between technology and human creativity.

Discussion

The importance and use of AI is increasing day by day, and research will continue to be conducted as long as this issue is on the agenda. This study is limited by its focus on publications in English and Turkish and a narrow temporal scope. Despite these limitations, it offers valuable insights for educators, policymakers, and researchers aiming to harness AI's potential in music education. Expanding this research to include diverse languages and cultural contexts on a larger database will provide a more holistic understanding of AI's impact on global music pedagogy.

The implications of AI in music education extend beyond classroom settings. For instance, AI's ability to provide real-time feedback and adaptive learning paths offers opportunities for inclusive education, particularly for students with special needs. However, ethical concerns and the potential for over-reliance on AI warrant careful consideration. Teachers must remain central to the educational process, using AI as a complementary tool rather than a replacement.

Apart from the research framework, web pages providing resources on the subject were found during the extensive literature review. These web pages are also recommended as resources for researchers. *Unite.ai* is a completely decentralized organization with a team that offers news, interviews, and access to the best AI tools to inform users about progress on AI, to unify the AI community, to push forward the democratization of AI, and to assist in the development of beneficial AGI (artificial general intelligence). (unite.ai). Blog articles in NAfME (National Association of Music Education) (nafme.org) are also provide information on AI and music education.

In a report by Baker and Smith (2019), about the AI technologies that are rapidly rising in the field of education, all aspects of AI in education was discussed; how it will impact on learners, on teachers, and indeed whole systems. It is stated in the report that the practical implementation of technology and its use by teachers must be prioritised, as they will ultimately choose how AI tools are used. The authers add that "AI does not mean the 'rise of the robots' in classrooms making teachers redundant (in fact, demand for teachers is set to increase, not fall). Instead, we must prepare for the role of the teacher to be augmented and evolve in partnership with the capabilities that AI brings." (p.5).

The "father of cybernetics[1]" Norbert Wiener said:
"We have transformed our environment so thoroughly that we must now transform ourselves in order to survive in this new environment" (Quted by Dai, 2021, p.1)

RESOURCES

Akarçay-Ulutaş, D. ve Boz, A. N. (2019). Sistematik derleme ve meta-analiz. İçinde Ş. Aslan (Edt.), Sosyal bilimlerde araştırma yöntemleri: Nicel, nitel ve karma tasarımlar için bir rehber (ss. 455-468). Konya: Eğitim Yayınevi.

Baker, T., & Smith, L. (2019). Educ-AI-tion rebooted? Exploring the future of artificial intelligence in schools and colleges. Retrieved from Nesta Foundation website: https://media.nesta.org.uk/documents/Future_of_AI_and_education_v5_WEB.pdfReturn to ref 2019 in article

Balaban, M., Ebcioğlu, K., & Laske, O. (Eds.). (1992). Understanding music with AI: perspectives on music cognition. MIT Press.

Bresler, L. (2021). Qualitative paradigms in music education research.Visions of Research in Music Education,16(3),

Chenchen Liu, Gwo-Jen Hwang, Yun-fang Tu, Yiqing Yin & Youmei Wang (2021): Research advancement and foci of mobile technology-supported music education: a systematic review and social network analysis on 2008-2019 academic publications, Interactive Learning Environments, DOI: 10.1080/10494820.2021.1974890

Chong, E. K. (2019). Teaching and learning music theory in the age of AI and mobile technologies. International Journal for Digital Society, 10(3), 1505-1509. DOI: 10.20533/ijds.2040.2570.2019.0186

Civit, M., Civit-Masot, J., Cuadrado, F., & Escalona, M. J. (2022). A systematic review of artificial intelligence-based music generation: Scope, applications, and future trends. Expert Systems with Applications, 118190. https://doi.org/10.1016/j.eswa.2022.118190

Dinçer, S. (2018). Eğitim bilimleri araştırmalarında içerik analizi: Meta-analiz, meta-sentez, betimsel içerik analizi. Bartın Üniversitesi Eğitim Fakültesi Dergisi, 7(1), 176-190.

Ergan, Salih (1994). Türkiye Müzik Bibliografyası (1929-1993). Konya: Kuzucular Ofset.

Gümüş, S. (2018). Nitel araştırmaların sistematik derlemesi: Meta-sentez içinde K. Beycioğlu, N. Özer ve Y. Kondakçı (Edt.), Eğitim yönetiminde araştırma (ss. 533-552). Ankara: Pegem Akademi.

Holland, D. S. (2000). Artificial Intelligence in Music Education: A Critical Review. In Readings in Music and Artificial Intelligence, edited by Eduardo Reck Miranda, Vol. 20: 239-274. https://pdfs.semanticscholar.org/85a6/1705375edb5e2cc6090563168c46e77f215a.pdf?_ga=2.158404858.1159493817.1553204540-18698389.1553204540.

Karaçam, Z. (2013). Sistematik derleme metodolojisi: Sistematik derleme hazırlamak için bir rehber. Dokuz Eylül Üniversitesi Hemşirelik Yüksekokulu Elektronik Dergisi, 6(1), 26-33.

Karataş, Z. (2017). Sosyal bilim araştırmalarında paradigma değişimi: Nitel yaklaşımın yükselişi. Türkiye Sosyal Hizmet Araştırmaları Dergisi, 1(1), 68-86.

Liu, C., Hwang, G. J., Tu, Y. F., Yin, Y., & Wang, Y. (2023). Research advancement and foci of mobile technology-supported music education: A systematic review and social network analysis on 2008-2019 academic publications. Interactive Learning Environments, 31(7), 4535-4554.

Ma, Xiaoqian (2021). Analysis on the Application of Multimedia-Assisted Music Teaching Based on AI Technology. Advances in Multimedia, vol. 2021, Article ID 5728595, 12 pages, 2021. https://doi.org/10.1155/2021/5728595

Matt Smith, Alan Smaill, Geraint A. Wiggins, Editors. (1993). Music Education: Artificial Intelligence Approach- Proceedings of a Workshop Held as Part of AI-ED 93, World Conference on Artificial Intelligence in Education; 25 August 1993, Edinburgh, Scotland, Springer: London. https://doi.org/10.1007/978-1-4471-3571-5

Miranda, E. R. (Ed.). (2021). Handbook of artificial intelligence for music. Cham: Springer International Publishing.

Ocaña-Fernández, Y., & Fuster-Guillén, D. (2021). The bibliographical review as a research methodology. Revista Tempos e Espaços em Educação, 14(33), e15614.

Roll, I. &Wylie, R. (2016). Evolution and revolution in artificial intelligence in education," International Journal of Artificial Intelligence in Education, vol. 26, no. 2, pp. 582–599. DOI 10.1007/s40593-016-0110-3

Wei, J., Karuppiah, M., & Prathik, A. (2022). College music education and teaching based on AI techniques.Computers and Electrical Engineering,100, 107851

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[1] The term "cybernetics" comes from the Greek word "kybernetes," meaning "steersman" or "governor." It was first introduced by mathematician and biologist Norbert Wiener in the mid-20th century. While cybernetics focuses on the analysis and control of complex systems, it today includes many subfields such as artificial intelligence, robotics and information theory.

Wei, L. (2023, June). Research and Application of Intelligent Music Interactive Teaching System. In Proceedings of the 2nd International Conference on Internet Technology and Educational Informatization, ITEI 2022, December 23-25, 2022, Harbin, China.

Xi, J. (2023). Artificial Intelligence Technology in the Assessment of Teachers' Music Teaching Skills Training. International Journal of Educational Innovation and Science, 2023, 4(1), 136-142 doi: 10.38007/IJEIS.2023.040112.

Yau, H. K. & Qian, L. (2024). The Evaluation of Students' Perception of E-Learning In Higher Education. Conference Paper. ISTEC & INTE & ITEC &, IETC & ITICAM & IWSC & IQC-2024 Proceedings Book, pp.808-821.

Yılmaz, K. (2021). Sosyal bilimlerde ve eğitim bilimlerinde sistematik derleme, meta değerlendirme ve bibliyometrik analizler. Manas Sosyal Araştırmalar Dergisi, 10(2), 1457-1490.

Yu, X., Ma, N., Zheng, L., Wang, L., & Wang, K. (2023). Developments and Applications of Artificial Intelligence in Music Education. Technologies, 11(2), 42.

Zhang, Y. (2023). Research on the Application of" Internet Plus" and Artificial Intelligence in Middle School Music Teaching. Journal of Education, Humanities and Social Sciences, 21, 165-171. DOI: https://doi.org/10.54097/ehss.v21i.13225

An Overview of the Professional Attitude Levels of Physical Education Teachers

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ABSTRACT
Those pursuing a career in physical education must possess a range of competencies, including movement and coordination. The attitudes of those engaged in or preparing to engage in the teaching profession can be influenced by several factors. Within the mentioned, the present study aims to ascertain the extent to which the professional attitudes of physical education teachers are influenced by factors such as gender, level of education, length of experience, and whether the individual has an educator within their family. The study employed a relational survey model, which is descriptive and serves to illuminate the current situation. The study population comprised 168 physical education teachers (female N = 96; male N = 72) in public schools affiliated with the Turkish Republic of Northern Cyprus Ministry of National Education. The research analyses indicate that most teachers possess a positive professional attitude (X=66.2857). No significant differences were observed in the professional attitude scores of teachers according to gender or level of education. Teachers with 19 years of experience and those with no family history of teaching demonstrated the highest attitude scores. The attitude of professional physical education teachers can be considered satisfactory.
Keywords: attitude, professional attitude, teacher attitude, physical education teacher

INTRODUCTION

Two significant theoretical issues related to teachers are attitudes towards teaching and teachers' professional performance (Al Harthy et al., 2013). The multifaceted nature of teaching encompasses several dimensions, including cultural, scientific, economic, and social aspects. Teachers represent the most vital educational resource employed in education and training activities (Aina et al., 2013; Uluğ et al., 2011). In the field of education, the term "teachership" is defined as a concept that describes a specific status, functions, and relationships that constitute a position within a given institution, as well as the specific behaviors required by the holder of that position (Yazıcılar Özçelik et al., 2020). As with all professions, teaching has specific requirements and qualifications. These include sufficient scientific and cultural knowledge in teaching and the ability to keep up with the latest information and technological developments in related disciplines.

The defining characteristic of a profession is its capacity to offer material or immaterial advantages to individuals or to demonstrate skills acquired through education. An individual's occupation serves to fulfill both their own needs and the specific demands of society. Consequently, the social division of labour is defined by a set of skills shaped by explicit and implicit regulations (Aydilek, 2019). The profession offers psychological benefits, including individual fulfillment, life satisfaction, and economic freedom.

Each teaching field necessitates a distinct body of knowledge, which demands an exhaustive comprehension (Şişman & Acat, 2003). Physical education and sports teachers can communicate effectively with students on various issues affecting individuals (Şen & Koçak, 2022). "Physical education" encompasses a miscellaneous activity, including games, sports, and gymnastics, conducted in environments that safeguard individuals' physical and mental well-being per established rules (İnal, 2005). Prospective physical education teachers must cultivate positive attitudes towards their studies, as these significantly impact children's developmental domains, particularly their psychomotor abilities (Dinçer, 2019).

Since the early 20th century, attitudes have constituted a prominent concept in social psychology, representing a research topic for those seeking to comprehend social transformation (Briño et al., 2019). Over time, the concept of an attitude has been defined in several academic disciplines, including psychology and education. In psychological terms, an attitude can be conceptualized as a phenomenon that can be understood from a psychological perspective disposition expressed by evaluating a particular entity in favor or against it to some

degree (Eagly & Chaiken, 1993). In essence, an attitude can be defined as an individual's evaluation of another person, position, concept, or object. Furthermore, as postulated by Kocabaş and Erdem (2019), it can be conceptualized as a positive or negative phenomenon. This refers to a tendency of beliefs, emotions, and behaviors toward an object, situation, or person, a consequence of past experiences.

Individuals' attitudes towards their profession have positively influenced their performance. This also applies to teaching (Aktop & Beyazgül, 2014). Teachers' psychological characteristics, particularly their attitudes, influence their pedagogical approaches and interactions with their students and colleagues (Asthana et al., 2024).

Attitudes toward teaching are significant in forming behaviors and styles among those pursuing or practicing the profession (Sünbül & Arslan, 2009). The prevailing perceptions and dispositions about the educator can affect the teaching practices of current or prospective teachers and the wider society (Gülsoy, 2010). Suja (2007) proposes that an individual's attitude, level of interest in their profession, and teaching experience can influence their commitment to their role.

In order to facilitate education and training in all aspects, teaching qualifications must be evaluated and improved. As stated by Çağlar (2013), professional education has a significant impact on the formation of individuals' attitudes towards their profession, creating a favourable environment for this development. Teachers' professional development has been demonstrated to exert a considerable effect of the aforementioned factors on a variety of parameters, including student enthusiasm, pedagogical approaches, communication abilities, the structuring of content and lesson preparation, student participation in the classroom, teacher assurance and subject expertise (Maende, 2012).

In addition to qualities such as interest, caring, confidence, self-reflection, diligence, job satisfaction, communication skills, sportsmanship, and teaching skills, cognitive and emotional abilities facilitate learning from one's and others' experiences. These characteristics, among other things, are closely related to professional attitudes (Healer, 2015). Research indicates that positive attitudes toward one's profession can facilitate greater creativity, research, and effectiveness in transferring these characteristics to students (Gülsoy, 2010).

Napper-Owen et al. (2008) posit that the pedagogical competencies of highly qualified physical educators are developed as a consequence of the experiences gained by such individuals in the context of the traditional physical education teacher education (PEET) program, as well as in the context of alternative professional education pathways. Fehintola (2014) asserts that a proficient educator should evince a penchant for perfectionism in their pedagogical practices in a conventional classroom environment. This suggests that teachers should adopt an attitude that facilitates positive transformation by the tripartite taxonomy of learning; the aforementioned domains are categorized as cognitive, effective, and psychomotor.

Physical education teachers endeavor to facilitate students' psychomotor, social, and physical development, encourage the formation of fitness habits, identify individual sports skills, train athletes, and cultivate physical health and sports awareness. Those who do not demonstrate a professional and objective approach and instead teach solely for their personal abilities, interests, or financial gain are less likely to be effective in raising high-achieving students (Dinçer, 2019).

A critical examination of the existing sources of information in this field reveals many domestic and foreign studies conducted to ascertain the level of attitudes toward the teaching profession. However, a significant proportion of these studies pertain to pre-service teachers. The studies revealed that, in comparison with other groups, pre-service teachers displayed a relatively high level of professional commitment (Dhara et al., 2021; Kuyumcu & Kaya, 2020; Senthilkumaran, Muthaiah, Ömür & Nartgün, 2013). Some studies identified the positive or negative attitude toward the teaching profession as moderate (Bhargava & Pathy, 2014; Duran, 2009) or low (Kinyota & Kavenuke, 2019; Odike & Nnaekwe, 2018).

Enhancing the efficacy of physical education and sports teachers in all aspects of development is important. This is contingent upon cultivating favorable attitudes toward teaching (Wagner & Imanuel, 2014). Teachers must possess positive professional attitudes to comprehend and respond to students' diverse ways of learning effectively, facilitating their optimal learning and enabling them to realise their academic and personal goals. Furthermore, they must exemplify the fundamental qualities of professionalism, including intelligence and organisational skills.

In conclusion, the effects of attitude on achievement and motivation (Aksoğan & Özdemir, 2022, p. 209) demonstrate the importance of a positive attitude for success in the teaching profession. Therefore, this study is

significant in supporting positive attitudes about the teaching profession. The study shed light on the attitudes of physical education and sports teachers, who orientated teaching and offered recommendations to enhance their positive attitude levels.

The aim of the current study is twofold: first, to ascertain the attitudes of physical education and sports teachers regarding their teaching practice; second, to examine whether their professional attitudes differ according to various variables, including sex, degree level, teaching experience and whether other teachers are present in the family. In addition to the primary research question, which is "What is the level of professional attitudes of physical education teachers?" the following sub-question was posed:

    1. Is there a difference in attitudes towards teaching according to gender?
    2. Does the level of education of physical education instructors affect their professional conduct?
    3. Does physical education teachers' time in the profession affect their attitudes toward teaching?
    4. It would be beneficial to ascertain whether other teachers in the family affect physical education teachers' attitudes.

MATERIALS AND METHODS
Research Design
This study aims to ascertain the extent to which physical education and sports teachers exhibit professional attitudes, considering the influence of various demographic variables. This study employed a descriptive methodology. Descriptive studies are concerned with the characteristics of a given population (Grov et al., 2012). In contrast to experimental studies, which test hypotheses, descriptive studies aim to generate hypotheses and, therefore, have specific aims and research questions (Edmonds & Kennedy, 2016). The research was approved by the Girne American University Ethics Committee and conducted by the ethical institutional requirements of the Turkish Republic of Northern Cyprus (TRNC) Ministry of National Education.

Participants
The study was conducted with 168 physical education and sports teachers, 72 male and 98 female, employed in public schools in the Turkish Republic of Northern Cyprus (TRNC), who participated voluntarily.

Data Collection Tools
The personal information form for educators comprises nine queries covering gender, age, type of secondary education completed, educational level, income bracket, length of service, type of educational institution employed at, preferred sports branch, and presence of other family members as teachers.

The PETPAS (Attitude Scale Towards the Physical Education Teaching Profession), developed by Ünlü (2011), comprises 23 items and a two-factor structure. The first factor consists of 13 sentences containing positive expressions, defined as the "Love for the Profession" dimension, and the second is the "Profession Orientation" dimension. It comprises 10 sentences containing negative expressions defined as "anxiety". The scale had a minimum score of 23 and a maximum score of 115. The interval coefficients were used to evaluate the scale scores, resulting in the categorisation of scores as "very low attitude" for the 23-41 range, "low attitude" for the 42-60 range, "moderate attitude" for the 61-79 range, "high attitude" for the 80-98 range, and "very high attitude" for the 99-115 range.

Analysis of Data
Since a normal distribution was observed in scores for both professional attitude and a significant number of multiple intelligence categories, it was deemed appropriate to employ parametric tests, which are known to yield more precise results.

FINDINGS

Table 1. Findings on demographic characteristics

		N
Gender	Male	72
	Female	96
Education level	Bachelor degree	138
	Master/PhD	30

		N
Work experience	Below 3 year	54
	4-8 year	21
	9-13 year	39
	14-18 year	15
	Over 19 year	39
Teacher in the family	Yes	75
	No	93

Table 2. Findings on professional attitude score

	N	Mean	Std. Deviation
Attitude Total	168	66,2857	5,92381

The physical education teachers' average score towards their profession was 66.29, indicating a moderate attitude.

Table 3. Average professional attitude scores of PE teachers by gender

	F	P	t	Df	P 2-tailed	Mean diff.	Std. Dev. diff.
Homogeneous variance	4,442	0,037	-0,64	166	0,522	-0,594	0,925

The independent variables t-test analysis revealed that the mean attitude score of female physical education teachers towards their profession (x=66.03, SD=5.18) was not significantly different from that of male physical education teacher respondents (x=66.63, SD=6.82) (p=0.522).

Table 4. Average professional attitude scores of PE teachers by education level

Group Statistics

	Education level	N	Mean	Standard Deviation
Attitude Total	Bachelor degree	138	66,59	5,710
	Master/PhD	30	64,90	6,754

According to the findings, there is no substantial discrepancy in mean scores for professional attitude between university graduate educators and postgraduate or doctoral graduates (p=0.211).

Table 5. Average professional attitude scores of PE teachers by profession

Multiple Comparison

Tukey HSD

(I) Profession Süresi	(J) Profession	Mean diff. (I-J)	Std. err.	P
Below 3 year	14-18 year	8,400[*]	1,531	,000*
4-8 year	14-18 yıl	4,971[*]	1,773	,044*
	19 yıldan fazla	-5,429[*]	1,420	,002*
9-13 year	14-18 yıl	8,400[*]	1,594	,000*

	3 yıldan az	-8,400*	1,531	,000*
	4-8 yıl	-4,971*	1,773	,044*
14-18 year	9-13 yıl	-8,400*	1,594	,000*
	19 yıldan fazla	-10,400*	1,594	,000*
Over 19 year	4-8 yıl	5,429*	1,420	,002*
	14-18 yıl	10,400*	1,594	,000*

*. 0.05 significant difference in the level

One Way ANOVA and Tukey analyses were conducted to determine if there is a significant difference in average professional attitude scores between groups. According to the results, teachers who have been in the profession for 14-18 years (x=58.60, SS=2.90) have significantly lower average professional attitude scores than other teachers. There is no need for improvement in this text.

According to the results, the average professional attitude scores of teachers who have been in the profession for 14-18 years (x=58.60, SS=2.90) were significantly lower than those of other teachers. However, teachers who have been in the profession for more than 19 years exhibit higher professional attitude scores than teachers who have been in the profession for 4-8 years and 14-18 years. No statistically significant differences were identified between the teacher groups with less than 3, 4-8, and 9 -13 years tenure.

Table 6. Average professional attitude scores of PE teachers by being a teacher in the family

Group Statistics

		N	Mean	Std. Deviation
Attitude Total	No	75	67,92	5,637
	Yes	93	64,97	5,849

In consequence of the independent variables, t-tests carried out to investigate whether being related to a teacher has a significant impact on attitudes towards physical education teachers found that the average professional attitude scores of those who do not have a teacher in their family (x=67.92, SD=5.64) were found to be significantly different from those of individuals who have a teacher in their family (x=64.97, SD=5.85) (p=.001).

DISCUSSION
The 23-item Vocational Attitude Scale for Physical Education Teachers was utilized to quantify professional attitudes. The research findings disclosed that physical education instructors held a moderate attitude, with average attitude scores not particularly high. Erbas's (2014) study demonstrated that physical education teachers possess moderate attitudes toward teaching.

Gender can influence both anxieties and expectations. The study data were scrutinized using the t-test, and no substantial variation was observed in the professional attitude scores of the teachers still pursuing their profession based on gender.

The review of a similar study reached the same conclusion; no significant difference between the sexes in terms of their attitudes toward teaching (Özder, Konedralı, & Zeki, 2010; Yaşar Ekici, 2014; Yuvacı, 2015; Özcan & Nakip, 2016; Göktaş, 2017; Muszkieta et al., 2019; Zembat et al; Demir & Arabacı, 2021; Korucuk & Havadar, 2023). On the contrary, several studies have indicated that male and female participants hold diverse attitudes towards the profession (Çapri & Çelikkaleli, 2008; Aydın & Sağlam, 2012; Gökçe & Sezer, 2012; Eroğlu, 2013; Bakırcı, 2015; Türkeli et al., 2017). However, based on these researches, it could be suggested that the professional attitudes of teachers remain the same regardless of their gender.

Another variable under examination is the education level of physical education instructors. No statistically significant difference was observed in the professional attitude scores between undergraduate teachers and those holding master's or doctorate degrees. Pepe, Turan, and Bahadır (2015) reached a comparable conclusion in their research.

After analysing the data collected from participating teachers, it is evident that those with 14-18 years of experience exhibited lower professional attitudes than their peers. Nevertheless, teachers with more experience demonstrated the highest averages in professional attitudes. The study found that the professional attitude scores of physical education teachers with over 19 years of experience were markedly higher than those with 14-18 and 4-8 years of experience. This finding concurs with Pepe et al.'s (2015) research, which suggests that teachers with 1-5 years of service have higher professional attitude scores than those with 16-20 years of service. Additionally, the study conducted by Yuvacı (2015) did not identify a notable statistical relationship between the professional attitudes under examination.

The question of whether having a family member who is a teacher significantly affects the score for professional attitude was also investigated using the data from the study. The analysis revealed that teachers who did not have another teacher in their family displayed a significantly higher score for professional attitude than those who did. This could be linked to depersonalisation within the family or the sharing of problems. On the contrary, a loved one's attitude towards their profession is anticipated to be more favourable. A study investigating this variable could not be found. However, it is believed that the high continuation of family occupations in children within the cultural structure may contribute to this outcome.

The findings of this study indicate primary limitation to the generalization of these results is for a more detailed analysis of attitude tests administered to physical education teachers. The extant literature on professional attitudes primarily focuses on other branches, and most of the extant studies on professional attitudes have been conducted on pre-service teachers. Some of the hypotheses tested in this study have not been adequately investigated before; the lack of previous research on physical education teachers and the sample size being affected due to pandemic conditions limited the study. A further limitation is the lack of consideration of socioeconomic status and cultural and other prejudices. In addition to these constraints, there is no central database archiving all scientific articles in Turkey, hindering reliable data availability.

CONCLUSION

The present study evaluated the professional attitudes of physical education teachers working in the Turkish Republic of Northern Cyprus to establish a significant relationship between the variables.

The results of this study indicate that attitudes toward physical education and sports among teachers of physical education and sports are influenced by several factors. The teaching professions were not dissimilar based on gender or education level but varied depending on the years of service and if another teacher was in the family. It can be argued that teachers' attitudes towards their profession tend to increase as the number of years in service rises. The level of attitude in the first few years of service is moderate and subsequently decreases. Over time, the experience can bring about positive gains such as enhanced knowledge, skill development, and acknowledgment in the professional environment.

A favourable disposition towards the tutoring profession can enhance the norms of education by developing a sense of duty, professional capability, and sapience into the requirements and problems of scholars.

Roh (2002) observes that physical education teachers encounter many challenges in the classroom. These challenges could foster negative attitudes toward teaching physical education. As a result, furnishing teachers with supplementary information that cultivates constructive attitudes may prove beneficial.

It can be conjectured that physical education teachers' attitudes abide by accepted standards, and as a result, the children receive quality education and are nurtured adequately. However, some teachers may have a disparity between their attitudes and professional competence. In addition to their expertise, teachers should display appropriate behavior, modify their methods to suit different learning scenarios and maintain their enthusiasm for learning and teaching (Dinçer, 2019).

The achievement of the recognition that physical education deserves is directly related to the extent to which teachers in this field uphold their profession. Hence, it is crucial to utilize micro-teaching techniques predominantly to foster positive attitudes within the training process of aspiring teachers.

Certain characteristics can help an individual make appropriate decisions in life: understanding oneself, recognizing feelings, needs, and objectives, and understanding one's desires and aversions. Knowledge of oneself also better equips one to choose a profession and develop a constructive attitude towards teaching.

The function and significance of physical education remain undetermined. Tannehill et al. (1994) argued that a constellation of ongoing changes at the nexus of politics, economics, and institutional structures alongside the prevailing currents of contemporary trends will shape the trajectory of education. The overarching direction will define and shape how physical education is conceptualized and perceived and whether it can be integrated into the total education curriculum. It is of the utmost importance that administrators and the general public know the potential benefits of physical education. It thus falls upon physical educators' shoulders to ensure this potential is actualized.

In line with the results obtained, it is recommended that analyses be carried out with a larger sample. Different variables, such as socio-economic level, should be considered for the analysis of the research hypotheses. Furthermore, physical education teachers should be trained about the relationship between attitude and achievement. Finally, the results of the research in the field should be shared.

Conflıcts of Interest

The researcher has no financial conflicts of interest, professional affiliations, or ethical complications that could compromise this research's integrity, objectivity, or validity. All study aspects were conducted independently, according to the relevant ethical guidelines and standards.

REFERENCES

Al Harthy, S. S. H., Jamaluddin , S. & Abedalaziz, N. A.(2013). Teachers' attitudes and performance: An analysis of effects due to teaching experience. *International Interdisciplinary Journal of Education*, 2 (9), 888-893. https://doi.org/10.12816/0002957

Aina, J. K., Ogundele, A. G., & Olanipekun, S. S. (2013). Students' proficiency in English Language relationship with academic performance in science and technical education, *American Journal of Education Research*, 1(9), 355-358. https://doi.org/10.12691/education-1-9-2

Aktop, A., Beyazgül, G., (2014). Pre-service Physical Education Teacher's Attitudes towards Teaching Professionals. *Procedia-Social and Behavioral Sciences,*116, 3194-3197. https://doi.org/10.1016/j.sbspro.2014.01.733

Asthana, A., Sinha, A. P., & Srivastava, S. (2024). Impact of Attitude on Job Performance of Teachers in South Asian Higher Educational Institutions. In K. Omona & M. O'dama (Eds.), *Global Perspectives on Micro-Learning and Micro-Credentials in Higher Education* ,195-212. IGI Global. https://doi.org/10.4018/979-8-3693-0343-6.ch012

Aydın, R., & Sağlam, G. (2012). Öğretmen adaylarının öğretmenlik mesleğine yönelik tutumlarının belirlenmesi (Mehmet Akif Ersoy University örneği). *Türk Eğitim Bilimleri Dergisi,* 10(2), 257-294

Aydilek, E., (2019). *Beden Eğitimi Öğretmen Adaylarının Yaşam Doyumları ve Beden Eğitimi Öğretmenliği Mesleğine Yönelik Tutumları.* [An unpublished M.Ed. Thesis]: Ondokuz Mayıs University.

Bakırcı, Y. (2015). *Beden eğitimi öğretmen adaylarının öğretmenlik mesleğine yönelik tutumlarının incelenmesi.*[An unpublished M.Ed. Thesis]: Aksaray University

Briñol, P., Petty, R. E., & Stavraki, M. (2019). Structure and function of attitudes.Braddick, O. (Ed.), In *Oxford research encyclopedia of psychology* (pp.1–48). Oxford University Press

Çağlar, Ç. (2013). The Relationship Between The Levels Of Alienation of The Education Faculty Students And Their Attitudes Towards The Teaching Profession. *Educ Sci: Theor & Pract J*, 13(3), 1507-1513. https://doi.org/10.12738/estp.2013.3.1577

Çapri, B. & Çelikkaleli, Ö. (2008). Öğretmen adaylarının öğretmenlik mesleğine ilişkin tutum ve mesleki yeterlik inançlarının cinsiyet, programa ve fakültelere göre incelenmesi. *İnönü Üniversitesi Eğitim Fakültesi Dergisi,* 9(15), 33-53.

Dinçer, E. (2019). *Beden Eğitimi Öğretmenlerinin Beden Eğitimi Öğretmenliği Mesleğine Yönelik Tutumlarının Ölçülmesi / Muş Ili Örneği.* [An unpublished M.Ed. Thesis]: Fırat University

Eagly, A. H., & Chaiken, S. (1993). *The psychology of attitudes*. Harcourt brace Jovanovich college publishers

Edmonds WA, Kennedy TD. *An Applied Guide to Research Designs: Quantitative, Qualitative, and Mixed Methods*. Los Angeles, CA: Sage; 2016.

Erbas, M. K. (2014). The relationship between alienation levels of physical education teacher candidates and their attitudes towards the teaching profession. *Australian J ournal of Teacher Education (Online)*, *39*(8), 37-52. https://doi.org/10.14221/ajte.2014v39n8.3

Eroğlu, C. (2013). *Beden eğitimi öğretmen adaylarının öz yeterlilikleri ve öğretmenlik mesleğine yönelik tutumları.*[An unpublished M.Ed. Thesis]: Aksaray University

Fehintola, J. O. (2014). Teachers' Characteristics as Correlates of Students' Academic Performance among Secondary School Students in Saki-west Local Government Area of Oyo State. *Journal of Educational and Social Research* ,4 (6): 459-468. https://doi.org/10.5901/jesr.2014.v4n6p459

Gökçe, F., & Sezer, G. O. (2012). Öğretmen Adaylarının Öğretmenlik Mesleğine Yönelik Tutumları (Uludağ Üniversitesi Örneği). *Uludağ Üniversitesi Eğitim Fakültesi Dergisi*, 25(1), 1-23.

Göktaş, Z. (2017). Attitudes of physical education and sports teacher candidates towards teaching profession. *The Journal of International Social Research,* 10(51): 1288-1295. https://doi.org/10.17719/jisr.2017.1856

Grove K, Burns N, Gray J. *The Practice of Nursing Research: Appraisal, Synthesis, and Generation of Evidence.* St Louis, MO: Elsevier; 2012.

Gülsoy, F. (2010). *Marmara Üniversitesi Eğitim Fakültesi Fizik Öğretmenliği Öğrencilerinin Öğretmenlik Mesleğine Yönelik Tutumları.*[An unpublished M.Ed. Thesis]: Marmara University

Kocabaş, D., & Erdem, R. (2019). Hemşirelik Mesleğİne Yönelİk Kalıpyargılar üzerne bir derleme. *Süleyman Demirel Üniversitesi Vizyoner Dergisi*, 10(25), 650-657. https://doi.org/10.21076/vizyoner.566158

Koçyiğit, B. (2023). Akademik doyum mesleğe yönelik tutumu etkiler: Beden eğitimi ve spor öğretmeni adayları üzerine bir çalışma. *Journal of ROL sport sciences*, 4(1), 37-50. https://doi.org/10.5281/zenodo.7755821

Korucuk, M., & Havadar, T. (2023). Beden Eğitimi ve Spor Öğretmeni Adaylarının Öğretmenliğe İlişkin Tutumları: Karma Yöntem Araştırması. *MANAS Sosyal Araştırmalar Dergisi,* 12(1), 123-138. https://doi.org/10.33206/mjss.1094125

Maende, B. J. (2012). *Influence of professional development on teacher effectiveness in public secondary schools in Mumias District, Kenya.* [An unpublished M.Ed. Thesis]: Maseno University

Muszkieta, R., Napierała, M., Cieślicka, M., Zukow, W., Kozina, Z., Iermakov, S., & Górny, M. (2019). The professional attitudes of teachers of physical education. *Journal of Physical Education and Sport,* 19(14),92-99 . https://doi.org/10.7752/jpes.2019.s1014

Özcan, G., & Nakip, C. (2016). Öğretmen Adaylarının Öğretmenlik Mesleğine Yönelik Öz-Yeterlik İnançları İle Öğretmenlik Mesleğine Yönelik Tutumları Arasındaki İlişki. *Mersin Üniversitesi Eğitim Fakültesi Dergisi,* 12(3), 783-795. https://doi.org/10.17860/mersinefd.282380

Özder, H., Konedralı, G., &Zeki, C. P. (2010). Examination of teacher candidates' attitudes towards the teaching profession in terms of various variables. *Educational Administration: Theory and Practice*, 16(2): 253-275.

Turan, M. B., Pepe, O., & Bahadir, Z. (2015). Investigating self-efficacy levels of physical education and sports teachers in terms of some variables. *Science, Movement and Health*, 15(2), 158-163.

Roh, H. (2002). The practical realities of inclusive physical education and cognition of physical education teachers toward inclusive physical education in Korea. *Journal of Korean Adapted Physical Activity & Exercise*, 10, 13-26

Suja, K. (2007). *Interaction effect of attitude towards teaching, interest in teaching and teaching experience of job commitment of primary school teachers.* [An Unpublished M.Ed. Thesis. University of Calicut.

Sünbül, A. M.&Arslan, A. (2006). Öğretmen Yeterlik Ölçeğinin Geliştirilmesi Üzerine Bir Araştırma. *Eskişehir Osmangazi Üniversitesi Sosyal Bilimler Dergisi*,7(2).

Şen , N. & Koçak, Ç.V. (2022). The relationship between professional attitude, job satisfaction and professional burnout in physical education and sports teachers. *Advances in Health, Sports and Technology Sciences (ASUJSHR),* 2(3): 221- 238. https://doi.org/10.54152/asujshr.1216860

Şişman, M. ve Acat, M. B. (2003). Öğretmenlik Uygulaması Çalışmalarının Öğretmenlik Mesleğinin Algılanmasındaki Etkisi. *Fırat Üniversitesi Sosyal Bilimler Dergisi,* 13(2), 235–250.

Tannehill, D., Romar, J. E., O'sullivan, M.,England, K., Rosenberg, D. (1994). Attitudes toward physical education: Their impact on how physical education teachers make sense of their work. *Journal of Teaching in Physical Education,* 13(4), 406-420. https://doi.org/10.1123/jtpe.13.4.406

Türkeli, A., Hazar, Z., Demir, G. T., & Namlı, S. (2017). Beden Eğitimi ve Spor Alanında Pedagojik Formasyon Alan Öğrencilerin Öğretmen Özyeterlikleri İle Mesleğe Yönelik Tutumlarının İncelenmesi. *İnönü Üniversitesi Beden Eğitimi ve Spor Bilimleri Dergisi*, 4(3), 1-11.

Ulug, M., Ozden, M.S., Eryilmaz, A. (2011).The effects of teachers' attitudes on students' personality and performance. *Procedia - Social and Behavioral Sciences,* 30, 738-742. https://doi.org/10.1016/j.sbspro.2011.10.144

Ünlü, H. (2011). Beden Eğitimi Öğretmenliği Mesleğine Yönelik Tutum Ölçeği (BEÖYTÖ) geliştirilmesi. *Kuram ve Uygulamada Eğitim Bilimleri,[Educational Sciences in Theory and Practice],* 11(4), 2005-2020.

Wagner, T. & Imanuel-Noy, D. (2014). Are they genuinely novice teachers? Motivations and self efficacy of those who choose teaching as a second career. *Australian Journal of Teacher Education*, 39(7), 31-57. https://doi.org/10.14221/ajte.2014v39n7.5

Yaşar-Ekici, F. (2014). Öğretmen adaylarının öğretmenlik mesleğine yönelik tutumlarının çeşitli değişkenler açısından incelenmesi (İstanbul Sabahattin Zaim Üniversitesi örneği). *Uluslararası Sosyal Araştırmalar Dergisi [The Journal of International Social Research]*, 7(35), 658-665.

Yazıcılar Özçelik, İ., Cobanoglu, G., & Koç, U. (2020). Beden Eğitimi ve Spor Öğretmenliği Bölümü Öğrencilerinin Beden Eğitimi Öğretmenliği Mesleğine Yönelik Tutumlarının Araştırılması. *Mediterranean Journal of Sport Sciencees*, 3(1), 91-106. https://doi.org/10.38021/asbid.740216

Yuvacı, H. (2015). *Sınıf ve Beden Eğitimi Mezunu Öğretmenlerin Beden Eğitimi Mesleğine Yönelik Tutumlarının Karşılaştırılması.*[An Unpublished M.Ed thesis]: Abant İzzet Baysal University

Zembat, R., Akşin Yavuz, E., Tunçeli, H. İ., Yılmaz, H. (2018). Okul Öncesi   Öğretmen Adaylarının Öğretmenlik Mesleğine Yönelik Tutumları ile Akademik Motivasyonları ve Akademik Başarıları Arasındaki İlişkinin İncelenmesi. *Journal of Theoretical Educational Science,*   11(4), 789-808. https://dx.doi.org/10.30831/akukeg.351404

Analysis of Elementary School Students' Math Skills Based on Various Variables

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ABSTRACT
The purpose of this study is to analyse the math skills of elementary school students based on various variables. This study aims to evaluate the success of students in elementary school math classes during the 2022-2023 academic year according to teacher opinions based on various variables. The data obtained may contribute to researchers working on the evaluation and development process of the elementary school math curriculum. The research will become more concrete and objective with the evaluations of our teachers.

The results of 48 classroom teachers working in the city centre of Ağrı were taken into account. The research results revealed that the math success of students is influenced by various factors according to classroom teachers. It was found that the most significant factor affecting students' math success is their success in other subjects, and that students' gender is not a significant variable in math success. Regarding the professions of parents, the responses of the interviewees were proportional. When looking at success according to families' income levels, a significant difference was observed in students' success. The research concluded that as income levels increase, access to resources becomes easier, leading to increased success. In the residential variable, it was found that students living in the city centre had higher success. According to the educational status of parents, it was found that having educated parents positively affects students' success.
Keywords: Success, Education, Gender, Math, Teacher Opinions

INTRODUCTION
The primary goal of contemporary educational reform efforts is to establish a system that can help students understand and learn mathematics effectively. Creating this system according to the requirements of the era is of utmost importance (Dursun, 2004; Dede, 2004).

"Mathematics is a crucial tool for solving problems in our daily lives. Therefore, among the courses included in the educational programs implemented in schools, mathematics is undoubtedly one of the most important. In today's educational reforms, mathematics education holds a significant place. Establishing a system that can help students understand and learn mathematics is extremely important. Despite its importance, many students do not enjoy mathematics, viewing it as a boring and abstract subject (Aksu, 1985). In this context, several factors can be considered that negatively affect students' perceptions of mathematics. Environmental, cultural, linguistic, gender, socio-economic factors, the city in which they study, the school and class environments, and the educational status of their families can contribute to this negativity."

To make mathematics a comprehensible subject and to ensure students develop a positive attitude towards it, certain points must be considered in mathematics teaching. Several factors can contribute to the perception of mathematics as a difficult subject with which students have negative attitudes. Baykul attributes the low success in mathematics to the lack of relational understanding aids provided to students and the inherently abstract nature of mathematics. Teachers have the responsibility to concretize mathematics, an abstract subject, especially for students in the first and second stages of elementary education (Yazıcı, 2017).

The problem addressed by our research is the evaluation of elementary school students' success in mathematics based on teachers' opinions. Evaluations were made regarding factors affecting success, such as gender, parents' educational status, family's economic and social status, parents' occupations, and place of residence, revealing significant differences among these variables.

According to Baykul (2009), the answer to the question "What is mathematics?" varies depending on why people resort to mathematics, the mathematical topics they use for a specific purpose, their experiences with mathematics, and their interest in it. People's thoughts on mathematics can be grouped in this way. Gözen (2001) defines mathematics as a science that examines the properties of abstract shapes and measurable quantities put forth with definitions and the invariants in their relationships with each other.

Historical Development of Mathematics
Mathematics is one of the oldest sciences in history. In ancient times, mathematics was defined as the science of numbers and shapes. It has a 4500-year history that can be proven with written documents. During this period, the development of mathematics can be divided into five phases. The first phase, from the beginning to the 6th century BC, includes mathematics done in Egypt and Mesopotamia. Mathematics in Egypt involved basic operations with whole and fractional numbers and geometric calculations of some volumes and shapes. At the same time, mathematics in Mesopotamia was slightly more advanced. It was known as a craft-level endeavor aimed at meeting daily needs without reasoning-based proofs.

"The second phase, from the 6th century BC to the 6th century AD, is marked by the influence of Greek mathematics. This period is when mathematics transitioned from a craft to an art form. The most significant contributions to mathematics during this time came from Plato. Greek mathematics is considered modern mathematics."

"The third phase, from the 6th century AD to the late 17th century, is characterized by the mathematics of the Islamic world and India. While some believe that Muslims made original contributions to mathematics, others think otherwise. The contributions of Muslims to mathematics have not been sufficiently researched. Recent studies have shown that the derivative, one of the most important discoveries in mathematics, was found by Sharaf al-Din al-Tusi from Azerbaijan 500 years before Europeans. By the 16th century, Europeans had become the prominent figures in mathematics."

"The fourth phase, from 1700 to 1900, is known as the 'Classical Mathematics Period.' This era is considered the 'Golden Age of Mathematics.' During this time, mathematics became the foundation of all positive sciences. Much of the mathematics taught in universities today is based on the work done during this period."

"The fifth and final phase, from the early 1900s to the present day, is the 'Modern Mathematics Period.' Mathematics has developed rapidly, reached a very high technical level, and the accumulated knowledge is layered. One piece of information does not replace another, making mathematics increasingly complex but equally fascinating. It is a science that can only be pursued with passion."

Mathematics Teaching
Mathematics is one of the oldest sciences in human history. It is defined as the science of numbers and shapes. Key principles in mathematics teaching include conceptual foundations, the principle of prerequisite knowledge, emphasis on key concepts, incorporation of research, and fostering a positive attitude towards mathematics.
It is crucial for teachers to create student-centered learning environments that align with the spirit of the constructivist approach to help students overcome difficulties in mathematics and develop positive attitudes and beliefs towards the subject. To establish learning environments that align with the constructivist approach, which is the foundation of the elementary mathematics curriculum, appropriate teaching methods must be used. These methods should actively engage students in the lesson, motivate them, encourage group work, and develop their creativity. Such approaches can change students' attitudes and thoughts about mathematics, which is often perceived as an abstract and daunting subject (Yenilmez & Uygan, 2010).

Success in Mathematics Teaching
In Turkey, many students think that mathematics is difficult and exhibit negative attitudes towards it. This situation begins in elementary school and increases over time. It is crucial to establish conceptual foundations in all topics of mathematics in elementary school. When teaching mathematical concepts to elementary and middle school students, mathematical symbols and language should not be used. Instead, a language suitable for the students' level that they can understand should be used. Without providing a conceptual foundation, one should not immediately proceed to exercises. The quality of teaching is closely related to the teacher.

Factors Affecting Success
A student's success or failure in mathematics cannot be explained by a single factor, such as gender. In addition to gender, many factors such as students' socioeconomic status, culture, language, and the environments of the class and school they attend can influence success. The multitude and variety of factors that can affect students' success

in mathematics necessitate a revaluation and a healthy redefinition of what it means to be successful or unsuccessful in mathematics. Teachers must help their students experience success in mathematics. It is essential to identify and present teachers' opinions on these factors. By doing so, the root causes of failure in mathematics classes can be identified. Therefore, this study aims to determine mathematics teachers' opinions on the factors that affect students' success in mathematics and the importance of these factors. Numerous internal and external factors affect a student's success. A student's own characteristics (intelligence, personality, gender, interest, etc.), family (parents' educational level, income level, value placed on education, involvement in education, etc.), and school-related factors (school environment, school climate, teacher behaviours, etc.) can all influence success (Güven, 2019).

METHOD
This section provides explanations regarding the research model, the study group, data collection tools, data collection, and the analyses performed on the data.

Research Model
This research is a qualitative study utilizing content analysis. The interview technique was applied by conducting interviews with classroom teachers to ensure the reliability of the research results. Evaluations based on a teacher interview form regarding students' achievement contributed to the reliability of the research.

Purpose of the Research
The purpose of this study is to analyse elementary school students' math skills based on various variables. Specifically, the study aims to evaluate the success of students in elementary school math classes during the 2022-2023 academic year according to teacher opinions based on various variables.

Sub-Purposes of the Research
1. Is there a relationship between the mathematics achievement of classroom students and their gender?
2. Is there a relationship between the mathematics achievement of classroom students and their parents' occupations?
3. Is there a relationship between the mathematics achievement of classroom students and their parents' educational status?
4. Is there a relationship between the mathematics achievement of classroom students and their families' monthly income?
5. Is there a relationship between the mathematics achievement of classroom students and their place of residence?
6. Is there a relationship between the mathematics achievement of classroom students and their achievement in other subjects?

Study Group
The study group consists of 48 classroom teachers selected using a random sampling method, working in the city centre of Ağrı during the 2022-2023 academic year. Demographically, the group includes 40 female teachers and 8 male teachers.

Data Collection Tool
In this study, a semi-structured interview technique was used. The purpose of this technique is to obtain extensive responses from participants and to allow the researcher to examine the relevant area in depth. The interview forms were prepared by reviewing the relevant literature. The questions in the interview forms were arranged to provide the necessary data to achieve the research objectives. The interview form consists of two sections. The first section includes personal information (teachers' gender, marital status, professional seniority, branch, and educational institution), while the second section consists of six questions related to the sub-purposes of the research.

Data Collection and Analysis
Data for the research were obtained using a semi-structured interview form, one of the qualitative data collection techniques. In this study, classroom teachers' opinions were sought to determine whether elementary students' success in mathematics is influenced by various variables, and a "semi-structured interview form" was applied. Data were collected via Google Forms.

The data obtained at the end of the research process were analysed using content analysis. The primary goal of content analysis is to identify concepts and relationships that can explain the collected data. Content analysis is an analysis technique that allows for the objective and systematic examination of verbal and written data (Tavşancıl & Aslan, 2001). The responses given by the participants were grouped into meaningful categories based on the

content of the responses. Similar and different responses were categorized, and positive and negative responses were separately indicated. The table shows similar responses and the number of individuals who provided these responses. The grade levels taught by the classroom teachers are presented in a separate table. The responses to the interview questions given by the teachers were interpreted. The 48 teachers participating in the study were coded as T1, T2, T3, ..., T48 in the table.

FINDINGS
This section includes the personal information of the teachers who participated in the interviews, the information derived from their opinions, and the interpretations of the findings based on the questions prepared according to the sub-purposes. Table 1 explains the grade levels taught by the classroom teachers. Findings related to the research purposes are presented after Table 2.

TABLE 1. Grade Levels Taught by Primary School Teachers

GRADE LEVEL	NUMBER OF TEACHERS	%
1ST CLASS	15	31
2. CLASS	16	33
3RD CLASS	8	17
4TH GRADE	9	19
TOTAL	48	100

As seen in Table 1, 31% of 1st grade teachers, 33% of 2nd grade teachers, 17% of 3rd grade teachers and 19% of 4th grade teachers participated in the interview. It can be seen that first and second grade teachers are in the majority here. 15 first grade, 16 second grade, 8 third grade and 9 fourth grade teachers answered the questions in the interview form.

Findings Regarding the First Sub-Purpose
The teachers' answers to this question were examined and the results are shown in Table 2.

TABLE 2. The first question of the research is "What do you think about whether the mathematics course success of primary school students is related to their gender?"

OPINIONS	PARTICIPANT CODE	NUMBER
It has a relationship	Ö11,Ö12,Ö13,Ö40	4
No relation	Ö1,Ö2,Ö3,Ö5,Ö6,Ö7,Ö8,Ö9,Ö15,Ö32,Ö33,Ö34,Ö35,Ö36,Ö37,Ö38,Ö42,Ö43,Ö44,Ö45,Ö46,Ö47,Ö48,	22
It is successful in both genders	Ö10,Ö39	2
Men are more successful	Ö18,Ö19,Ö20,Ö21, Ö22, Ö23, Ö24, Ö25, Ö26, Ö27, Ö28, Ö29, Ö30,Ö31,	14
Girls are more successful	Ö1,Ö17,	2
It is related to the importance the student attaches to lessons.	Ö14,Ö41	2
Perception is effective and individual	Ö4,Ö16,	2

According to Table 2; Teacher opinions on whether there is a relationship between grade 1 students' mathematics achievements and their gender are as follows. 4 of the teachers said they were in a relationship, 22 of them did not have any relationship, 2 said that both genders were successful, 14 said that boys were more successful, 2 said that girls were more successful, 2 said that it was related to the importance students attach to lessons and 2 of them stated that perception is effective and individual.

Considering these opinions, the dominant opinion is that the success of primary school students in Mathematics has no relationship with their gender. In addition, the second majority of teachers stated that 'Men are more successful'. It has been observed that the other opinions are close to each other and directly proportional. In the answers given, it was observed that the teachers who expressed the opinion that success was or was not related to gender gave short and unclear answers.

Findings Regarding the Second Sub-Purpose

TABLE 3. What do you think about whether grade students' success in mathematics is related to their parents' professions? Teacher opinions regarding the question (Civil Servant, Tradesman, Farmer)

OPINIONS	PARTICIPANT CODE	NUMBER
It has no relation.	Ö4,Ö6,Ö8,Ö24,Ö25,Ö26,Ö32,Ö33,Ö36,Ö37,Ö38,Ö39,Ö40,Ö41,Ö42,Ö46,Ö47,Ö48	18
There is a relationship.	Ö3,Ö7, Ö28,Ö29,Ö30,Ö31,Ö34,Ö35,Ö43,Ö44,Ö45,	11
If both parents are civil servants, they are successful.	Ö1,Ö9,Ö13,Ö19,Ö20,Ö21Ö,22,Ö27	8
If parents are educated, success is higher	Ö12,Ö14,Ö15,Ö16,Ö17,Ö18,Ö23	7
It has an indirect effect	Ö2,Ö5,	2
Environmental stimuli affect intelligence development	Ö10,Ö11,	2

According to Table 3; Teacher opinions on whether grade 1 students' success in Mathematics is related to their parents' professions (Civil Servant, Tradesman, Farmer) are as follows. 18 of the teachers stated that there is no relationship, 11 stated that there is a relationship, 8 stated that if the mother and father are civil servants, they are successful, 7 stated that 'If the mother and father are educated, success is high', 2 stated that it has an indirect effect and 2 stated that it has an indirect effect. They stated that environmental stimuli affect intelligence development. Considering these opinions, the dominant opinion is that primary school students have no relationship with their parents' professions. After this, the other majority opinion is that it is related. Following this, there are opinions that having parents who are civil servants and having educated parents, respectively, is effective in high success. In this section, the short answers given by the majority of teachers to the questions stand out. It has been observed that other opinions are directly proportional to each other.

Findings Regarding the Third Sub-Purpose

TABLE 4. What do you think about whether the success of Grade 4 students in Mathematics is related to the educational status of their parents? Teacher opinions regarding the question

OPINIONS	PARTICIPANT CODE	NUMBER
Successful if parents are educated	Ö1,Ö2,Ö6,Ö7,Ö8, Ö11,Ö13,Ö14,Ö15,Ö16,Ö17,Ö18,Ö19,Ö20,Ö21,Ö22,Ö23,Ö24,Ö25,Ö26,Ö27,Ö28,Ö29,Ö30,Ö31,Ö32,Ö35,Ö36,Ö37,Ö39,Ö41,Ö43,Ö44,Ö45,Ö46,Ö47	36
Parents' education level is not effective	Ö3,Ö4,Ö34,Ö48,	4
The child whose parents are illiterate is successful	Ö40	1
Children of conscious families are successful	Ö9,	1
It is indirectly or partially effective	Ö5,Ö10,Ö12,Ö33Ö38,Ö42	6

According to Table 4; Teacher opinions regarding the question of whether grade students' success in Mathematics is related to their parents' educational status are as follows. 36 of the teachers said that success is achieved if the mother and father are educated, 4 said that the educational status of the mother and father is not effective, 1 said that a child whose mother and father are illiterate is successful, 1 said that children from conscious families are successful, 6 said indirectly. or they expressed their opinion that it was partially effective.

When these views are examined, the dominant view is that success is achieved if the parents are educated. On the other hand, 4 teachers expressed the opinion that "Parents' education level is not effective." It has been observed that indirectly or partially effective teachers do not give short and explanatory answers. Other opinions are common and are directly proportional to each other.

Findings Regarding the Fourth Sub-Purpose

TABLE 5. What do you think about whether the success of Grade 5 students in Mathematics is related to the monthly income of their families? Teacher opinions regarding the question

OPINIONS	PARTICIPANT CODE	NUMBER
Successful if monthly income is high	Ö1,Ö6,Ö7,Ö8,Ö13,Ö20,Ö24,Ö25,Ö26,Ö27,Ö28, Ö32,Ö33,Ö35,Ö48	15
Monthly income is not effective in success	Ö9, Ö10, Ö14, Ö17, Ö18, Ö19, Ö22,Ö31, Ö38, Ö41, Ö42, Ö44, Ö45, Ö46, Ö47	15
Monthly income is effective in success in terms of sending to a private school or course.	Ö3,Ö4,Ö5,Ö12,Ö29,Ö36,Ö37	7
Those with good nutrition patterns are more successful	Ö2,Ö11,Ö15,Ö16,Ö30,Ö34, Ö39,Ö40,Ö43	9
indirect effect	Ö21, Ö23,	2

According to Table 5; Teachers' opinions on whether mathematics course success is related to their families' monthly income are as follows. 15 of the teachers said that success is achieved if the monthly income is high, 15 said that monthly income has no effect, 7 said that monthly income affects success in terms of sending them to a private school or course, 9 said that students with good nutritional habits are more successful, and lastly, 2 of them expressed their opinion in the form of a closed answer that monthly income has an indirect effect.

Considering these opinions, the majority of those who say monthly income is successful are those who say monthly income is not effective in success and those who say monthly income is not effective in success. These are followed by the opinion expressed as 'Monthly income is effective in success in terms of sending to a private school or course'. Here, students' nutritional habits are also referred to and it is underlined that students whose nutrition is regular and good are more successful. Another view is that it is indirect. Therefore, it is seen that opinions are expressed in different but similar rates.

Findings Regarding the Fifth Sub-Purpose

Table 6. What do you think about whether grade students' success in Mathematics is related to their success in other courses? Teacher opinions regarding the question

OPINIONS	PARTICIPANT CODE	NUMBER
Other lessons are effective	Ö1,Ö2,Ö3,Ö4,Ö5,Ö6,Ö8,Ö10,Ö11,Ö13,Ö16,Ö17,Ö19, Ö20,Ö22,Ö23,Ö24,Ö25,Ö26,Ö30,Ö31,Ö32,Ö33, Ö34,Ö35,Ö38,Ö39,Ö40,Ö41,Ö42,Ö43,Ö46Ö47,Ö48	33
Not effective	Ö7,Ö10,Ö14,Ö15, Ö45,	5
Science lesson is effective	Ö9,Ö12, Ö21,	3
Turkish lesson is effective	Ö36,Ö37,	2
Those with low literacy and comprehension skills have high math success	Ö27,Ö28,Ö29	3
Varies depending on student and innate talent	Ö18,Ö44,	2

According to Table 6; Teacher opinions regarding the question of whether grade students' success in Mathematics is related to their success in other courses are as follows. 33 of the teachers said that the success in other subjects affects the success in the mathematics course, 6 said that the success in other subjects does not affect the success in mathematics course, 3 said that the success in science course is effective on the success in mathematics course, 3 said that success in mathematics course has an effect on the success of those with low literacy and comprehension skills. It is seen that it is high, 2 of them stated that Turkish course success is effective in mathematics course success, and lastly, 2 of them stated that mathematics success varies according to the student and innate ability.

Considering these opinions, the dominant opinion is that the success of other courses is effective in the success of mathematics course. It is possible to say that other opinions are proportionate. The expressions of 5 as 'not effective' are noteworthy in terms of understanding that success is independent of each other.

Findings Regarding the Sixth Sub-Purpose

TABLE 7: What do you think about whether there is a relationship between the mathematics achievement of 7th-grade students and their place of residence? (City center, Town, Village) - Teachers' opinions.

OPINIONS	PARTICIPANT CODE	NUMBER
No relation	Ö24,Ö26,Ö30,Ö32,Ö33,Ö34,Ö35,Ö39,Ö40,Ö41,Ö42,Ö43,Ö44,Ö45,Ö46	15
has a relationship	Ö1,Ö13,Ö14,Ö3,Ö38	5
Those who live in the center are more successful	Ö4,Ö5,Ö10,Ö17,Ö18,Ö19,Ö20,Ö21,Ö22,Ö23,Ö25,Ö27 ,Ö29,Ö31,Ö47, Ö48,	16
Environmentally effective	Ö7,Ö15,Ö36,Ö37,	4
Genetic factors are effective	Ö16,Ö28,Ö37	3
The success of students engaged in agriculture in villages is low	Ö9,Ö11,	2
Related to equal opportunity	Ö2,Ö6,	2
The success of students living in villages is high	Ö12,	1

According to Table 7; Teacher opinions on the question of whether grade students' success in Mathematics is related to their settlements (Center, Town, Village) are as follows. 15 of the teachers said that they did not have any relationship, 5 said that they did, 16 said that those residing in the center were more successful, 4 said that the environment was effective, 3 said that genetic factors had an effect, and 2 said that the success of students engaged in agriculture in villages was low. , 2 of them stated that they were related in terms of equality of opportunity, and finally, 1 teacher stated that the success of students residing in villages was high.

Considering these views, it is possible to say that there are independent, different and even contradictory views. The predominant opinion is that students living in the center are more successful. They stated that because there are more opportunities in the center and children have better access to resources, students residing in villages cannot spare time for agricultural activities. The teachers who stated that it is not related represent another majority. On the other hand, there are teachers who only give short answers such as 'it is effective'. Apart from this, equality of opportunity, environment, genetic factors and students' involvement in agriculture in villages were expressed as other views that affect success. A different answer here is that the success of students living in villages is high. He stated that the reason for this is that children deal with time and numbers in periodic tasks such as irrigation and animal care in villages, and that these and similar numerical activities play a role in the success of children growing up in villages.

CONCLUSION - DISCUSSION AND RECOMMENDATIONS
Results
In this research, we tried to get answers to the problem of our research by using an interview form with classroom teachers working in primary schools in the centre of Samsun, and in this context, the opinions of classroom teachers were consulted. The data obtained from the interviews with the classroom teachers were transcribed and made suitable for statistical analysis in the form of tables. Questions under 6 headings were asked to the classroom teachers who participated in the interview to examine the mathematics skills of primary school students according to various variables. Teachers' opinions were analysed and evaluated in the context of the six questions of our research. As a result of analysing the opinions of the teachers regarding the questions asked, the following results were obtained.

The first question of our research that we posed to the classroom teachers who participated in the interview is whether there is a relationship between the mathematics course success of primary school students and their gender. When the results of the research are examined; 22 of the teachers said that there was no relationship between mathematics course success and gender, 4 said that it was related, 14 said that boys were more successful, 2 said that girls were more successful, 2 said that both genders were successful, and 2 said that students gave their lessons well. and 2 of them stated that perception is effective and individual.

The second question asked to the teachers who participated in the research in the study was whether there was a relationship between the mathematics course success of the primary school students and the professions of their parents. In other words, teachers' opinions were consulted on whether success in the professions of Civil Servant, Tradesman, and Farmer was variable. When the results of the research are examined; 18 of the teachers said that there is no relationship between the success of mathematics lessons and the professions of their parents, 11 said that it is related, 8 said that if the mother and father are civil servants, they are successful, 7 said that the education of the mother and father increases the success, 2 said that it has an indirect effect. and 2 of them stated that environmental stimuli affect intelligence development.

The third question asked to the teachers participating in the study was whether there was a relationship between the mathematics course success of the first grade students and the educational status of their parents. When the results of the research are examined; 36 of the teachers said that success is achieved if the mother and father are educated, 6 said that it is indirectly or partially effective, 4 said that the education level of the mother and father is not effective, 1 said that the child whose mother and father are illiterate is successful, 1 said that it is consciously effective. They stated that the families' children were more successful. In the fourth question asked to the teachers participating in the research, what do you think about whether the success of the students in the Mathematics course is related to the monthly income of their families? is the question. When the answers are examined; 15 of the teachers said that success is achieved if the monthly income is high, 15 said that monthly income has no effect, 9 said that students with good nutrition patterns are more successful, 7 said that monthly income affects success in terms of sending them to a private school or course, and lastly 2 said that monthly income has no effect. They expressed the opinion that monthly income is indirectly effective.

In the fifth question asked to the teachers who participated in the interview in the research, what do you think about whether the mathematics success of the students in the first grade is related to their success in other subjects? is the question. When the results of the research are examined; 33 of the teachers said that success in other subjects affects success in mathematics, 6 said that success in other subjects does not affect success in mathematics, 3 said that success in science does affect success in mathematics, and 3 said that those with low literacy and meaning skills have high success in mathematics. 2 of them stated that Turkish course success is effective in mathematics course success, and finally 2 of them stated that mathematics success varies depending on the student and their innate ability.

The sixth question asked to the teachers participating in the research was whether there is a relationship between the mathematics course success of the primary school students and their settlement areas. In other words, it is about whether residing in the Center, Town or Village affects mathematics achievement. When the results of the research are examined; 16 of the teachers said that those residing in the center are more successful, 15 of them said that they do not have any relationship, 5 of them said that they are related, 4 of them said that the environment is effective, 3 of them said that genetic factors have an effect, and 2 of them said that the success of students who are engaged in agriculture in the villages is low. 2 of them stated that they were related in terms of equality of opportunity and 1 teacher stated that the success of students residing in villages was high.

Considering these views, it is possible to say that there are independent, different and even contradictory views. The predominant opinion is that students living in the center are more successful. They stated that because there are more opportunities in the center and children have better access to resources, students residing in villages cannot spare time for agricultural activities. The teachers who stated that it is not related represent another majority. On the other hand, there are teachers who only give short answers such as 'it is effective'. Apart from this, equality of opportunity, environment, genetic factors and students' involvement in agriculture in villages were expressed as other views that affect success. A different answer here is that the success of students living in villages is high. He stated that the reason for this is that children deal with time and numbers in periodic tasks such as irrigation and animal care in villages, and that these and similar numerical activities play a role in the success of children growing up in villages. Considering all these interview data, we can say that the factors affecting the mathematics course success of primary school students are various. It can be said that material and spiritual reasons come first on the basis of these variables being independent and different from each other. Apart from these, we can say that students' own personality traits and the environment they live in are extremely effective in their success. However, when all these data are taken into consideration, it is not possible to say that these data are the only factors that affect students' mathematics success. Because the short and clear answers given to the questions and the scope of our research do not seem sufficient for this.

Argument
The first question asked to the classroom teachers in the interview form of our research is about whether gender has an effect on mathematics achievement. 14 of the teachers said that boys are more successful than girls in

mathematics. 22 of the teachers stated that gender has no relationship with success. Dede, Dursun (2004)'s study titled "Factors Affecting Students' Achievement in Mathematics: In Terms of Mathematics Teachers' Opinions" stated that the effect of gender on mathematics success varies according to age and education level. At primary and secondary school levels, male students are more successful than female students in terms of mathematics success. He stated that there was no significant difference between the studies showing that in this study, it was seen that similar studies were examined in the context of gender and a result directly proportional to our study was found. We can say that the prevailing opinion is that male students are more successful than female students. However, this does not mean that similar studies in the future will yield the same results. As a result of his study, Bozkurt (2012) found a significant difference between students' test anxiety, mathematics anxiety, general achievement and mathematics achievement and all variables. However, no significant difference was found between mathematics achievement and gender variable.

The second question asked to teachers is whether there is a relationship between the mathematics success of primary school students and their parents' professions (Civil Servant, Tradesman, Farmer). As a result of the research, 18 people stated that the profession of their parents has no effect on their success in mathematics lessons. While 11 people say they are related, the number of people who say 'it can be achieved if the parents are civil servants' is 8. 7 people stated that success is higher if their parents are educated. We see that there are different and similar views here. Savaş et al. (2010) conducted a study investigating how much students are affected by reasons such as study time, family income level, attitude towards mathematics, type of school and attending private teaching institutions, and concluded that students' success in mathematics courses is affected by various positive and negative aspects. Çavuşoğlu (2010) stated that there is a moderately significant relationship between reading comprehension success and problem solving success, and that there is a significant relationship between reading comprehension success and problem solving success in terms of the variables of preschool education level, socio-economic level, gender, and parents' education level. conclusion has been reached. There are significant differences between our research and other studies. In his study, Bayturan (2014) investigated the relationship between secondary school students' academic success in mathematics, their socio-demographic and psycho-social characteristics, and their attitudes towards mathematics. Considering the research findings, it can be seen that the socio-economic level of the family, family attitude, teacher behaviour, mathematics self-perception, aggressive behaviour and attitude towards mathematics have an effect on academic success in mathematics course, but gender, parents' education level, family type; It was determined that activity, sociality, school, and total competence had no effect.

In his study, Duman (2006) determined that the factors affecting the mathematics success of students studying in the 5th grade of primary school (attitude towards the course, learning-teaching methods, teacher, family and learning environments, gender) are the personal factors of students and teachers (gender, seniority, graduated school). investigated whether they differed according to their characteristics. As a result of the research, it was determined that there was no significant difference in terms of the gender variable, which is one of the factors affecting students' academic success in mathematics, but a significant difference was found in terms of the variables "general success of the student, academic success in mathematics course, education level of the parents, monthly income of the family and gender of the teacher".

Dursun and Dede (2004) In this study, the factors affecting the mathematics achievement of primary school students were examined and listed in 10 items. These factors can be listed as gender, parents' education level, socioeconomic level, teacher qualifications, applied teaching strategies and techniques, physical facilities of the school, curriculum, multi-disciplinary study, listening well to the lesson, and mathematical intelligence. The study was created by examining the opinions of 38 teachers working in 8 primary schools in the province of Sivas in the 2001-2002 academic year. As a result, it was concluded that mathematics is a very feared subject among students and the necessity of making arrangements in this direction was emphasized. BOZ, (2018) In this article, it was examined how much the games played in the classroom affected the success of 4th grade primary school students in mathematics. Türkoğlu district of Kahramanmaraş

Suggestions
Mathematics course is seen as a difficult course by the majority of students, and therefore success in mathematics course is lower than other courses. These and similar factors cause students to distance themselves from mathematics lessons and even become afraid of them. It would be an inadequate and incorrect statement to state that there is only one factor behind why mathematics is seen as a course that is feared by the majority of students compared to other courses. The reason is that there are many factors that affect the mathematics success of primary school students. The issue that needs to be examined here is to reveal these factors and offer solutions to them.

Addressing the sub-goals of our research is also important in terms of seeing what causes mathematics success or failure. In this context, paying careful attention to the success of families at lower economic levels or with low income in mathematics lessons and working on providing them with more opportunities to access resources may lead to an increase in the level of success. For these students, both digital and book etc. Necessary support should be provided to develop different methods by providing study opportunities.

Provincial and district directorates of national education organize courses, different in-school activities, educational games, etc. to increase success in mathematics lessons. studies can be done. Therefore, it would be extremely useful to obtain the opinions of mathematics teachers working throughout the province. It is extremely inevitable that the first thing to do is to reveal what these factors are by mathematics teachers and to inform students about the importance of mathematics success by classroom teachers. In addition, the opinions and recommendations of subject teachers should be taken into account regarding the effects of other course achievements, and students should be better guided to increase their mathematics achievements and success levels. Therefore, we can say that such a healthy study can affect mathematics success.

Another issue is that classroom teachers can raise students' awareness about the participation of students with low success in mathematics lessons and ensuring that the student receives more attention can be considered as a different option. In addition, activities to increase students' mathematics achievement can be organized at different times in schools. In other words, it may be possible to increase success by carrying out additional studies.

Families should be warned about prejudiced student behaviours such as difficulty and undesirability of mathematics lessons, and families should be made aware of increasing the success levels of the lessons. Parents should help and support students about the importance and necessity of mathematics. As a result, the awareness of families and students about success increases and a family profile that is more interested in the student may emerge.

As a result, it would be extremely useful for mathematics teachers to carry out a comprehensive study to increase the success of mathematics lessons and to determine whether success in other courses is related to mathematics lessons.

REFERENCES

Abuzer Akgün, et al. (2007). Examination of the anxiety levels of elementary science and mathematics teaching students based on various variables. Electronic Journal of Social Sciences, 6(20), 283-299.

Ali Osman Engin, et al. (2009). Basic variables affecting students' school learning achievements. Journal of the Institute of Social Sciences, (3), 125-156.

Bahar Keçeli-Kaysılı. (2008). Increasing academic success through family involvement. Journal of Special Education, 9(1), 69-83.

Ekrem Savaş, et al. (2010). Factors affecting student success in mathematics. Journal of İnönü University Faculty of Education, 11(1), 113-132.

Engin Aslanargun, et al. (2016). Effects of socioeconomic variables on students' academic achievement. Journal of Uşak University Social Sciences, 9(3), 214-234.

Hasan Güner Berkant, & Ali İncecik. (2018). Evaluation of the fifth-grade mathematics curriculum in middle school according to teachers' opinions. International Journal of Education Technology and Scientific Researches, (6), 99-125.

Hatice Kumandandaş, & Ömer Kutlu. (2011). Examination of the attitudes of fifth-grade elementary students towards performance tasks in terms of their academic achievements and their love for the lessons. Journal of Measurement and Evaluation in Education and Psychology, 2(2), 172-181.

Hüseyin Şimşek, et al. (2017). Examination of the mathematics anxieties and attitudes of elementary students towards mathematics lessons in terms of various variables. Necatibey Faculty of Education Electronic Journal of Science and Mathematics Education, 11(2), 82-108.

Mesut Şeker. (2013). Factors affecting student success in religious culture and moral knowledge lessons in grades 6, 7, and 8 (Tosya case). (Unpublished master's thesis). Hitit University Institute of Social Sciences, Çorum.

Murat Gökalp, & Gamze Köksaldi. (2019). Evaluation of the fifth-grade mathematics curriculum in middle school according to teachers' opinions. Electronic Journal of Educational Sciences, 8(16), 218-241.

Neşe Özkal, & Duygu Çetingöz. (2006). Academic achievement, gender, attitude, and the use of learning strategies. Educational Administration: Theory and Practice, (46), 259-275.

Nilgün Ekmekyermezoğlu. (2010). Socio-cultural factors affecting the academic success of eighth-grade students in English courses. (Unpublished master's thesis). İnönü University Institute of Educational Sciences, Malatya.

Oya Soner. (2000). Relationships between family cohesion, student self-confidence, and academic achievement. Atatürk Faculty of Education Journal of Educational Sciences, (12), 249-260.

Rukiye Ölçüoğlu, & Sevda Çetin. (2016). Examination of the variables affecting the mathematics achievement of eighth-grade students according to regions. Journal of Measurement and Evaluation in Education and Psychology, 7(1), 202-220.

Şemsettin Dursun, & Yüksel Dede. (2004). Factors affecting students' success in mathematics: From the perspective of mathematics teachers. Journal of Gazi Faculty of Education, 24(2), 217-230.

Tuba Yazıcı. (2017). Examination of the relationship between middle school students' academic success in mathematics and their academic success in other subjects. (Unpublished master's thesis). Atatürk University Institute of Educational Sciences, Erzurum.

Zeki Karataş. (2015). Qualitative research methods in social sciences. Journal of Spiritually Based Social Work Research, 1(1), 62-80.

Beyond the Blockchain: A Comparative Analysis of Educator and Non-Educator Perspectives on Web3 Technologies in Educational Contexts

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ABSTRACT
As Web3 technologies increasingly intersect with educational practice, understanding stakeholder perspectives becomes crucial for effective implementation. This study investigates how self-identified educators and non-educators within a Web3-focused educational community (Ed3DAO) differ in their attitudes, expertise, and knowledge regarding blockchain-based educational innovations. Through analysis of survey data collected during an education-focused Web3 unconference, this investigation reveals significant divergences in specific domains while challenging assumptions about general technological adoption patterns. Results demonstrate that educators expressed lower optimism regarding Web3's influence on teaching practices, while non-educators were more pessimistic about Web3's potential for student community building. Notably, both groups showed similar levels of technical, practical, and conceptual expertise, with conceptual understanding consistently outpacing technical proficiency across cohorts. These findings suggest that successful integration of Web3 technologies in education may depend less on professional background than on bridging the persistent gap between conceptual understanding and technical implementation—a finding that carries significant implications for professional development and technological integration strategies in educational settings.

Keywords: Web3 education, digital pedagogy, blockchain, non-fungible tokens, decentralized autonomous organizations (DAOs)

INTRODUCTION

Education has relentlessly moved online in recent years, in no small part thanks to COVID and the *big pivot*. In 2006, some 87% of institutions provided some online instruction (Kim & Bonk, 2006), whereas in 2020 it arguably became the standard (Gallagher & Palmer, 2020). This has led to structural changes in K-12 (Hurtt, Cohen, & Reed, 2021), policy changes in higher education research production (Marinoni, Van't Land, Jensen, et al., 2020), and the need for reconsidering and reworking otherwise experiential coursework (Gerhart, Jadallah, Angulo, & Ira, 2021). This move was accompanied by the increased use of new or rediscovered technologies like augmented reality (Vuță, 2020) and other immersive technologies. Regardless of the intention–education, leisure, or work–the generalized environment in which these exist has come to be known as "the metaverse." While "the metaverse" may be generally associated with extended reality, it has come to include a fuzzy collection of technologies and platforms (Rauschnabel, Felix, Hinsch, Shahab, & Alt, 2022). One cause for this is the increasing overlap of the physical and the digital. Virtual and augmented realities are the obvious examples, but as more of our experiences move into these digital spaces, so does the need for privacy, security, and agency. As such, with growing interest and popularity, "Web3" technologies are beginning to find themselves in the presence of augmented and virtual reality when "the metaverse" is discussed. Understanding these technologies, their pedagogical implications, and educators' perspectives on implementation has become increasingly crucial for advancing educational practice in the digital age.

WEB3

It is essential to distinguish Web3 from its predecessors: the user-generated content paradigm of Web 2.0 and the semantic web architecture of Web 3.0 (Allison & Kendrick, 2015). "Web3" initially centred on internet commerce through cryptocurrency (digital currencies) and user-focused ownership with a heavy decentralization emphasis (Garon, 2022). Web3, according to proponents of the paradigm shift, is well suited to make this possible through its reliance on blockchain technologies.

"Blockchain" is the catch-all term for immutable, decentralized ledgers of data transactions. When dealing with Web3 and blockchain transactions, identities are linked to "wallets," terminology that stems from the aforementioned cryptocurrency origins. Rather than signing into a platform with a username and password, a user instead will "sign" a transaction on the blockchain using an address and a private key. On the Ethereum blockchain, for example, rather than a user choosing an email for identification, they will be assigned a unique address, such as 0xA2088896De4e292A32708D397bbBe48C56e53297 (Ethereum Foundation, 2023b). While

there is an option to purchase a more "friendly" address alias (myname.eth, for example), this is neither the default nor an option for many as, due to the rapidly fluctuating nature of cryptocurrency values (Powell, 2021), it may be prohibitively expensive. But cost isn't the only hurdle.

Criminal activity is of considerable concern when dealing with cryptocurrencies. A variety of legal issues and risks have been coming to light in recent years as the use of these platforms grows. This "shadow economy" as the "major institutional players in cryptocurrency jurisdiction-hop to avoid scrutiny, existing primarily online and individuals take part online, and anonymously if they wish" (Mackenzie, 2022, p. 1539). Risks run from simply making speculative investments in a volatile market to an entire cryptocurrency being wiped out overnight (Cuthbertson, 2022) to a variety of token-related scams related to non-fungible tokens.

While cryptocurrencies like Bitcoin are fungible, non-fungible tokens (NFTs) are, as the name suggests, one-offs and cannot be presumed to be of equal value to another NFT. An NFT can be thought of like a proof of ownership in many ways, sometimes acting as a trading card (PR Newswire, 2023), sometimes representation of artwork (McIntosh, 2022), other times with business utility like supply chain security and record keeping (High, 2020). NFTs can also be used as access cards, acting as the ticket to enter and engage with a community. These are typically known as *decentralized autonomous organizations* (DAOs) and can be considered a Web3-native form of community as they rely on Web3 technologies at their very core.

DAOs are alternatives to existing structural models like corporations and companies, with purposes ranging from pure charity to for-profit enterprises (Ghavi, Qureshi, Weinstein, Schwartz, & Lofchie, 2022). Ethereum Foundation, the non-profit organization that supports the Ethereum blockchain, simply describes a DAO as "a collectively-owned, blockchain-governed organization working towards a shared mission" (2023a). DAOs provide a range of governance models depending on that shared mission, whether a fully democratic, one-token/one-vote model or a system in which an internal utility token determines voting power, which has shown to be vulnerable to a range of challenges, be they logistical, technical, or simply a matter of balancing power within the group (Rikken, Janssen, Kwee, Bolívar, & Scholl, 2019). So-called "smart contracts" DAO governance are based on–algorithmic decision-making software that execute on the blockchain, are questionable in terms of their legality and enforceability, and present a variety of problems like their highly technical nature, adjudication, and immutability (Lipton & Levi, 2018)–are designed to streamline and democratize the community.

The range of DAOs' missions have expanded recently. While some DAOs may appear fanciful, perhaps even silly or uninformed of basic laws (Westenfeld, 2022), some focus on more humanitarian goals. One example, AthenaDAO, describes itself as "a decentralized community of researchers, funders, and advocates working to advance women's health research, education, and funding" (AthenaDAO, 2022). Similarly, VitaDAO sources "funding and advancing longevity science" via "decentralized drug development" (Golato & Kohlhaas, 2022). As DAOs gain traction, larger global organizations are also beginning to engage, such as United Nations Children's Fund (UNICEF), which has been been set up to receive cryptocurrency donations since 2019, and is exploring using these technologies to support development of "digital public goods" (Matsuda, 2023) to support its mission.

Demonstrably, many DAOs are designed to raise funds to achieve said mission. This can open them to potential fraud as these funds are generally fungible and cryptocurrency-based and, as such, vulnerable to related risks and scams (Rikken et al., 2019). While not fungible currency, NFT scams can be similarly serious. These are most often designed to make a quick profit for the NFT creator, though risks extend to bad-faith sales that run afoul of copyright or are simply, one could argue, digital forgeries (Bruch, 2022). NFT-related risks extend beyond being targeted, however. Sometimes the risk is as simple as losing a key. As wallet addresses are meant to be unique and the associated private key kept confidential, should a user lose that key, they will lose access to the address and whatever it contains. There is no recourse in this case, no "Forgot my password" option. For a wallet containing cryptocurrency funds, this means a permanent loss of these funds (Popper, 2021). For a wallet containing an NFT acting as proof of degree completion or educational records, the risk is different but equally concerning. Risks like this aside, there are other uses for blockchain wallets. Among them and gaining at least theoretical interest for educational purposes, is the implementation of blockchain technologies to solve a variety of problems in education, generally, and the issuing of persistent blockchain-based records known as non-fungible tokens.

Education and Blockchain
As these technologies continue to grow in influence and ubiquity, the education sector is increasingly included. The application of blockchain technologies has been explored academically for use in education for a number of

years and ranges well beyond general application. Fedorova and Skobleva (2020) reviewed *blockchain* literature to 2020, finding most references were book chapters, with "computer science" outnumbering the "education" discipline at nearly a rate of 10 to 1. At that point, according to their review, only 7 research articles, reports, and conference proceeding papers specifically addressed *education* in relation to *blockchain*. The authors identified eight areas blockchain research is addressing in education: certificates/credentials, identification, intellectual property protection, community development, portfolio creation, payment, accreditation, and administration. Since then, research into blockchain's potential in education has grown considerably.

Chivu et al. (2022) point out a number of universities and how they have implemented blockchain technologies into their systems: the University of Maryville creates blockchain-supported transcripts and diplomas, the University of Nicosia applies it to course certificates, and Southern New Hampshire University provides blockchain-based credentials. They further explore the reactions and opinions of Romanian blockchain-knowledgeable university professors, revealing a desire for practical pedagogical activities, with university students being more interested in blockchain-based verifiable credentials than cryptocurrency. Using blockchain to support credentials is sometimes referred to a "Blockcert."

While some universities like the Massachusetts Institute of Technology provide such "Blockcerts," these digital diplomas are just that: a digital version of a credential, leaving the proof of the knowledge and skills gained throughout that credential to be proven elsewhere in other ways (Lizcano, Lara, White, & Aljawarneh, 2020). One method being explored to address this is essentially gamification: the rewarding of competency-based learning outcome completion with a form of cryptocurrency. This process is often referred to as *learn to earn*.

Learn to earn (also known as *learn and earn*, *earn-and-learn*, and other variations) integrates a wide variety of blockchain technologies, from smart contracts to bespoke cryptocurrency to the use of NFTs as digital badges (Poser, 2022), but due to roadblocks like technical implementation and a lack of generally clear goals and needs, adoption has been somewhat lackluster (Park, 2021). This has not prevented a wide variety of communities and organizations from engaging in this space. Similar to Udemy, LinkedIn Learning, and other education providers, platforms like Invisible College[1], Crypto, Culture, & Society[2], and Women in Blockchain[3] gather curricula and make it available either for free as a public good or through "tuition" in the form of a purchased NFT. While cryptocurrency platforms like Coinbase and Binance provide cryptocurrency incentives to learn *about* cryptocurrencies, the *learn to earn* model in education is slightly different in that the tokens earned are awarded for meeting learning objectives set by the curriculum.

Regardless of the specific blockchain or curriculum, student motivation and engagement have been shown to improve when integrating novel technologies into the learning process, whether that is the on-chain content or immersive experiences like virtual or augmented reality (Bucea-Manea-Țoniş et al., 2021). Some blockchains are being conceptualized specifically for application in education, as well. The *Smart University*, for example, was conceived as a worldwide solution to problems arising from international communication, undocumented credentials, and quantifying credential quality (Aslan & Ataşen, 2020). Similarly, Massive Open Online Courses (MOOCs) are conceptualized as being backed and supported by blockchain technologies to improve the sharing and storage of educational materials, as well as evaluatory records (Chivu et al., 2022). The aforementioned "smart contract" is one integrated concept to achieve this by organizing consensus mechanisms, persistence, and transparency where appropriate. Deciding what and when is appropriate is still a matter of concern, however.

This concern stems mainly from the general lack of regulation (Rosenberg, 2022). This presents problems when dealing with, for example, intellectual property (Fenwick & Jurcys, 2022) or student records that are protected by federal law. Given this lack of regulation, ethical concerns are also to be expected. The near universally steep learning curve associated with Web3 presents a hurdle generally but especially for education. Not just for students, but for educators and administrators, as well. As such, engaging in the Web3 space in any meaningful way requires a basic understanding of the underlying blockchain technology and cryptocurrency.

Education NFTs and DAOs

The application of NFTs in education is one of considerable optimism to Web3-interested parties. As the relevance of Web3 in education appears to be centered around notions of ownership, the NFT is ostensibly the logical choice. One hurdle in the widespread educational adoption is simply the lack of "teacher educators who are willing to explore the development, implementation, and evaluation of Web 3.0 technologies and pedagogical strategies" (Ferdig, Cohen, Ling, & Hartshorne, 2022, p. 14). While there is clearly interest in the

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[1] https://www.invisiblecollege.xyz/courses
[2] https://cryptosociety.notion.site/Crypto-Culture-Society-6a8dd5ee05b04684998b5206ae842195
[3] https://womeninblockchain.global/education

intersection of these technologies and education, it is possible logistical barriers are currently too great.

Examples of communities and organizations implementing NFTs for education-specific purposes are growing. In 2022, educational gaming company TinyTap raised 138.926 ETH (roughly US$228,000 at the time) in NFT sales to support teachers with a 50% profit share (PR Newswire, 2022). Ed3DAO's NFTs provide access to the community's unconference on education in Web3, workshops for educators, and inclusion in the DAO's governing structure, itself (Ed3DAO, 2022). GeniiDAO, the community developed to support TheGeniusSchool's micro K-12 "self-directed" schools, provides a range of NFTs related to the level and degree of engagement with the community, supporting notions of unschooling, deschooling, decolonized parenting, and providing access to groups, tools, and applications[4]. Other platforms like Youni (formerly Educoin) seek to take on higher education as a whole, with the goal to "reduce the costs of higher education by creating a direct to student marketplace for teachers and by creating the first decentralized skills database" (Dibattista, 2022). As opposed to NFTs focusing mainly on ownership and manufactured collective scarcity, these communities are focusing on the utility of the NFT, itself.

Communities like Ed3DAO and GeniiDAO are in the minority. Much like cryptocurrency platforms described earlier, education-based DAOs frequently focus on education *about* Web3 and cryptocurrency as opposed to *education* per se. DAO Central, a platform that lists and organizes DAOs, includes "Education" as a category, with every entry educating *about* Web3[5], often using Web3 tools as the means to do so.

Blockchain-based transcripts, microcredentials, and tokens as digital badges are becoming increasingly popular as means to ensure transparency, accessibility, and persistence, the ostensible banners of the Web3 movement. All of these concepts–NFTs, wallets, even ethical concerns like equity–are not just on the horizon for educators and education; rather, they are already here. This study explores precisely that: a movement known as Ed3.

Current Study
Given these myriad technologies and fields that converge on education, the current study seeks to understand how familiar and knowledgeable educators and those involved or interested in education are in this range of topics. It is well established that perceptions, opinions, and attitudes of educators tend to differ from non-educators in areas addressed here (Caliguri & Levine, 1967; Wholeben, 1988; Cai & Gut, 2020; Guo-Brennan, 2020). Research into educators' opinions into accepting new technologies or even new paradigms is common (Granić & Marangunić, 2019), though research focused on educators' understanding of and interest in these particular emerging technologies is limited and may prove enlightening when seeking to develop in, on, and with these platforms and concepts. The participants within this study were separated into two groups: educators and non-educators, determined by a demographic question in the instrument regarding their field or industry. Those self-selecting "Education" were placed in the former group and everyone else in the latter. The degree to which or type of "Education" field or industry participants were in was not gathered.

The following hypotheses were preregistered: first, participants' self-reported knowledge, predictions, and attitudes toward Web3 and metaversal technologies in relation to education will be dependent on a variety of demographics such as age, socio-economic status, location, gender, and profession. Second, those in education or education-adjacent fields will be more negative in their attitudes than those in other professions. Finally, the attitudes on various technical, ethical, practical, and security-related topics will vary by demographic group.

METHODS
Reported are how sample size was determined, all data exclusions (if any), all manipulations, and all measures in the study (Simmons, Nelson, & Simonsohn, 2012). The full collection of methods follows.

Procedure
The development of the research instrument was informed by a comprehensive review of extant literature and analysis of discourse within Web3 education-focused communities, with particular attention to three primary domains: pedagogical implementation, equity considerations, and technological infrastructure. Full instrument details are presented in the Materials section below. Participant recruitment was conducted through systematic, recurring announcements within the participating community, employing a structured distribution schedule to maximize reach and response rate. Social media (Twitter) was also used along with relevant hashtags. Potential participants were guided to a Qualtrics survey where, after agreeing to the consent form, they were met with a

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[4] https://www.thegeniusschool.org/dao
[5] https://daocentral.com/explore/education

collection of demographic items prior to the instrument, proper. Upon completion, participants were offered the opportunity to submit a wallet address to receive compensation in the form of an NFT should their submission not be excluded. Institutional ethics board approval was obtained prior to beginning this study. Participants were provided the opportunity to withdraw from the study at any time with no risk.

Participants

Participants were identified through their engagement in a Web3-focused online community, Ed3DAO. Formed in 2021 and incorporated in 2022, Ed3DAO is described in its white paper as "the first DAO for educators, by educators, and owned by educators" (Saraf, 2022). The DAO engages in regular community events to gather like-minded people for collaboration and serves as a hub for those interested in the field. As with most, Ed3DAO provides start-up funding for education related Web3 projects like online coursework or podcasts. The current study coincided with the inaugural Ed3 Unconference[6] held in a virtual gamified space. The native Ed3DAO NFT served as the registration for the event, though attendees could also buy a ticket.

The call for participation was shared within the Ed3DAO community and by the community's social media accounts. All were welcome to participate. The instrument was provided in English only, and exclusion criteria were both programmatic and manual. These included noncompletion of the survey, selecting the same response for every item, duplication, submitting nonsensical responses, and so on. Using the pwr R package (Champely, 2020), a sample size of 263 was targeted. Two reverse-coded attention check items were included in the instrument to use as an additional exclusion criterion, but these were discarded when they proved unreliable. After these exclusion criteria were applied, the remaining participants (N = 136 of 184) numbered roughly half of the intended sample. A full demographic table of participants can be found in Table 1.

Table 1. Full demographics.

	Overall
	(N=136)
Race	
Black or African American	11 (8.1%)
Hispanic, Latinx, or Spanish Origin	12 (8.8%)
Multicultural or multiple response	11 (8.1%)
Other Asian	19 (14.0%)
Southeast Asian	11 (8.1%)
White/Caucasian	72 (52.9%)
Country	
Argentina	2 (1.5%)
Armenia	2 (1.5%)
Australia	4 (2.9%)
Austria	1 (0.7%)
Bahrain	2 (1.5%)
Brazil	1 (0.7%)
Canada	2 (1.5%)
China	12 (8.8%)
Colombia	1 (0.7%)
Greece	2 (1.5%)
Hong Kong (S.A.R.)	1 (0.7%)
India	1 (0.7%)
Indonesia	1 (0.7%)
Iran	2 (1.5%)
Kuwait	1 (0.7%)
Latvia	1 (0.7%)
Netherlands	2 (1.5%)
New Zealand	1 (0.7%)
Nigeria	2 (1.5%)
Norway	1 (0.7%)
Portugal	2 (1.5%)
Russian Federation	1 (0.7%)
Saudi Arabia	1 (0.7%)

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[6] https://www.ed3dao.com/ed3unconference

	Overall
Serbia	1 (0.7%)
Singapore	1 (0.7%)
Spain	2 (1.5%)
Turkey	2 (1.5%)
United Arab Emirates	3 (2.2%)
United Kingdom of Great Britain and Northern Ireland	3 (2.2%)
United States of America	78 (57.4%)
Age	
18-24 years old	6 (4.4%)
25-34 years old	39 (28.7%)
35-44 years old	53 (39.0%)
45-54 years old	26 (19.1%)
55-64 years old	9 (6.6%)
65-74 years old	3 (2.2%)
Education	
Associates/Technical	3 (2.2%)
Bachelor's degree	48 (35.3%)
Graduate or professional degree	77 (56.6%)
High school/GED	2 (1.5%)
Some college	6 (4.4%)
Income	
$100,000-$149,999	31 (22.8%)
$150,000 or more	23 (16.9%)
$25,000-$49,999	20 (14.7%)
$50,000-$74,999	20 (14.7%)
$75,000-$99,999	22 (16.2%)
Less than $25,000	12 (8.8%)
Prefer not to say	8 (5.9%)
Gender	
Cisgender Man	65 (47.8%)
Cisgender Woman	44 (32.4%)
Non-binary/gender queer	2 (1.5%)
Prefer not to respond	16 (11.8%)
Self-identified	6 (4.4%)
Transgender Man	2 (1.5%)
Two-spirited	1 (0.7%)
Sexuality	
Asexual	2 (1.5%)
Bisexual	8 (5.9%)
Gay/lesbian/queer	4 (2.9%)
Heterosexual/straight	104 (76.5%)
Pansexual	4 (2.9%)
Prefer not to respond	12 (8.8%)
Questioning	2 (1.5%)
Employment	
A homemaker or stay-at-home parent	3 (2.2%)
Other	7 (5.1%)
Student	8 (5.9%)
Unemployed and looking for work	7 (5.1%)
Working full-time	97 (71.3%)
Working part-time	14 (10.3%)
Industry	
Consulting	7 (5.1%)
Education	87 (64.0%)
Entertainment / Art / Music / etc	6 (4.4%)
Finance	8 (5.9%)
Health care	2 (1.5%)
Information services	4 (2.9%)
Legal services	2 (1.5%)

	Overall
Other (Please fill in)	8 (5.9%)
Prefer not to say	4 (2.9%)
Software development	7 (5.1%)
Utilities	1 (0.7%)

Materials & Measures

General demographics were gathered to identify the make-up of the sample's participants. These included race, country currently residing, age, educational attainment, income, identified gender, sexuality, marital status, military status, employment status, level and type of engagement in any Web3-based organization, and a range of professional fields (i.e., agriculture, finance, education). These were intended to identify unexpected trends that may lead to further study.

A 24-item Likert scale with self-directed, opinionated, and factual statements followed. These were worded in such a way that participants chose whether and to what degree they agreed with the statement. A standard range of responses for Likert-scale questions was implemented on a 7-point scale (1 = "Strongly disagree", 2 = "Disagree", 3 = "Somewhat disagree", 4 = "Neither agree nor disagree", 5 = "Somewhat agree", 6 = "Agree", 7 = "Strongly agree") including a "Don't know / No opinion" option. Two example statements are "Non-fungible tokens provide great social capital" and "I feel confident explaining Web3." These were followed up with open-ended questions to gather more nuanced, personal statements from participants, though due to their potentially identifiable content they are not included in this analysis. The instrument also sought self-reported expertise on these technologies in technical, conceptual, and practical realms to use as controls and grouping variables. The full instrument is available via the Open Science Framework (Straight, 2022).

Data analysis

All analyses were performed with R (R Core Team, 2022). Using the qualtRics package (Ginn, O'Brien, & Silge, 2022), raw survey data was programmatically downloaded from the Qualtrics servers for local analysis. Summary and descriptive statistical analyses were performed to understand the make-up of the population being surveyed. A variety of statistical tests were employed, including structural equation modelling in the form of principle component analysis, parametric and non-parametric measures of mean comparisons, and general descriptives. All results are described below.

RESULTS

Analysis of participant responses revealed nuanced attitudes toward Web3 technologies in education, particularly regarding implementation readiness and pedagogical utility. Recent comparative research by Uysal et al. (2024) employing their Web3 Awareness Scale helps contextualize the present findings, as their results similarly indicated varying levels of implementation readiness across educational practitioners. The consistently positive attitudes observed in this study align with Cui et al.'s (2023) findings regarding educator optimism toward Web3 integration, though this study found lower technical expertise self-reporting. The consistent gap between conceptual and technical expertise across both educators and non-educators ($\Delta M = 27.8$ and $\Delta M = 24.7$, respectively). This parallel differential suggests a systematic gap in technical implementation readiness that transcends professional boundaries, potentially indicating a broader structural challenge in Web3 education integration. Comprehensive results follow.

Demographics

Participants in this study were directly involved in, adjacent to, or had interest in the educational use of Web3 technologies by virtue of their exposure to the call for participation. They were not limited to a geographic location, profession, age, race, gender, or any other demographic. While a full breakdown of participant demographic responses is available in Table 1, it is enlightening to explore them in more depth. Of the 136 participants that were included in the final analysis, 53% identified as White/Caucasian ($N = 72$). Other racial identities were roughly equally represented, with Other Asian coming second at 14% ($N = 19$) and the remaining categories all between 8% ($N = 11$) and 9% ($N = 12$). Roughly the same majority distribution was true for residing country, with United States of America at 57.4% ($N = 78$) and China at 8.8% ($N = 12$). Most participants were between 25 and 34 (28.7%; $N = 39$), and 35 and 44 years old (39%; $N = 53$), totalling 67.7% of the sample ($N = 92$) and reported having either a bachelor's (35.5%; $N = 48$) or graduate/professional degree (56.6%; $N = 77$). Gender identification was mostly cisgender men (47.8%; $N = 65$) and cisgender women (32.4%; $N = 44$), with heterosexuality was the predominantly identified sexual orientation (76.5%; $N = 104$). Most participants work full time (71.3%; $N = 97$) in education-related fields (64%; $N = 87$).

Instrument

Principal component analysis revealed two robust components that together account for an exceptionally high proportion of total variance (92.92%; TC1 = 59.04%, TC2 = 33.33%). This unusually clear component separation suggests distinct attitudinal constructs within the Web3 education space. Component 1, accounting for 59.04% of variance, primarily encompasses items related to potential and optimism, while Component 2 (33.33%) clusters around implementation challenges and critical considerations. This clear delineation between optimistic potential and practical challenges provides valuable insight into how stakeholders conceptualize Web3's educational integration.

The PCA performed on the Likert survey instrument assisted in its interpretation and reduce dimensionality. The data proved appropriate for principle component analysis with KMO = 0.85 and Bartlett's test of sphericity showing sufficient significant correlation in the data for factor analysis (χ^2 = 1323.68, p < .001). Using oblimin rotation, the 2 principal components accounted for 92.92% of the total variance of the original data (TC1 = 59.04%, TC2 = 33.33%).

The survey's Likert scales demonstrated sufficient internal reliability. Both the instrument as a whole and each component demonstrate sufficient internal reliability (whole a = 0.86; PC1: a = 0.92; PC2: a = 0.70). Only one item was identified that would increase a component's internal validity if removed: in component 2, "There should be more regulation and oversight" (a if deleted = 0.74). See Tables 2a, 2b, and 2c for per-component breakdown and Table 3 for the full instrument's reliability analysis.

Table 2a. Instrument reliability in principal components 1.

Row	Missing	Mean	SD	Skew	Item Difficulty	Item Discrimination	α if deleted
It is academically advantageous for minorities	2.21 %	5.29	1.49	-0.95	0.76	0.78	0.91
It is socially advantageous for minorities	2.94 %	5.11	1.55	-0.65	0.73	0.63	0.91
Students' educational experiences will improve	2.21 %	5.56	1.28	-0.89	0.79	0.83	0.91
Students will feel more ownership of their academic credentials	2.94 %	5.89	1.31	-1.42	0.84	0.72	0.91
Barriers to accessing education will be reduced	2.94 %	5.26	1.56	-1.02	0.75	0.69	0.91
I feel confident explaining Web3	1.47 %	5.2	1.55	-0.95	0.74	0.24	0.92
Teachers and students should be excited	0.00 %	5.95	1.38	-1.61	0.85	0.73	0.91
This will act to democratize education	2.94 %	5.48	1.49	-1.13	0.78	0.69	0.91
Teachers' and learners' privacy will be enhanced	1.47 %	5.02	1.43	-0.72	0.72	0.63	0.91
Assessment and feedback to students will be improved	5.88 %	5.35	1.45	-0.82	0.76	0.68	0.91

Cybersecurity in Web3 is the top priority	2.94 %	5.52	1.5	-1.1	0.79	0.42	0.92
Teachers can spend more time teaching	1.47 %	4.82	1.65	-0.58	0.69	0.54	0.92
Non-fungible tokens provide great social capital	2.21 %	5.23	1.54	-1.02	0.75	0.69	0.91
Non-fungible tokens could be used to a much greater effect	0.00 %	6.01	1.31	-2.02	0.86	0.60	0.91
Web3 can only change pedagogy for the better	3.68 %	4.66	1.91	-0.37	0.67	0.59	0.91

Mean inter-item-correlation=0.433 · Cronbach's α=0.917

Table 2b: Instrument reliability in principal components 2.

Row	Missing	Mean	SD	Skew	Item Difficulty	Item Discrimination	α if deleted
There should be more regulation and oversight	2.94 %	4.86	1.54	-0.58	0.69	0.14	0.74
Schools will be quick to adopt these new technologies	0.00 %	2.95	1.84	0.8	0.42	0.53	0.63
There is a reduction in access to quality educational materials	3.68 %	4.08	1.92	0.04	0.58	0.33	0.70
Student-to-student communications and community will suffer	2.94 %	3.08	1.69	0.8	0.44	0.42	0.66
'Cryptocurrency' and 'Web3' are essentially the same thing	0.74 %	2.5	1.75	1.15	0.36	0.58	0.61
'Web3' and 'the metaverse' are interchangeable	2.94 %	3.23	1.86	0.57	0.46	0.60	0.60

Mean inter-item-correlation=0.272 · Cronbach's α=0.701

Table 2c: Component correlation

	Component 1	Component 2
Component 1	α=0.917	
Component 2	0.139 (.145)	α=0.701

Computed correlation used pearson-method with listwise-deletion.

Table 3. Alpha levels.

Raw alpha	Standard alpha	G6(smc)	Average *r*	S/N	ase	Mean	SD	Median *r*
0.86	0.87	0.92	0.25	6.98	0.02	4.80	0.82	0.24

Attitudes

The current study hypothesized a variety of interactions and influences between participant demographics, self-reported expertise, and attitudes. First was an exploration of the general feeling participants had toward these emerging technologies and platforms. Significant differences between demographic groups in attitudes toward Web3 in education were preregistered. The hypothesis that educators would be less optimistic about Web3 in education than non-educators was also preregistered. Neither of these hypotheses were borne out in the data. See Table 4 for a full table of Likert item data and Figure 1 for a visualization of the Likert responses as broken down in the two principal components.

Table 4. Descriptive statistics of Likert responses.

	Mean	Std.Dev
'Cryptocurrency' and 'Web3' are essentially the same thing[3]	5.50	1.75
'Web3' and 'the metaverse' are interchangeable[3]	4.77	1.86
Assessment and feedback to students will be improved[2]	5.35	1.45
Barriers to accessing education will be reduced[1]	5.26	1.56
Cybersecurity in Web3 is the top priority[3]	5.52	1.50
I feel confident explaining Web3[3]	5.20	1.55
It is academically advantageous for minorities[1]	5.29	1.49
It is socially advantageous for minorities[1]	5.11	1.55
Non-fungible tokens could be used to a much greater effect[3]	6.01	1.31
Non-fungible tokens provide great social capital[3]	5.23	1.54
Schools will be quick to adopt these new technologies[2]	2.95	1.84
Student-to-student communications and community will suffer[2]	4.92	1.69
Students' educational experiences will improve[2]	5.56	1.28
Students will feel more ownership of their academic credentials[2]	5.89	1.31
Teachers' and learners' privacy will be enhanced[3]	5.02	1.43
Teachers and students should be excited[2]	5.95	1.38
Teachers can spend more time teaching[2]	4.82	1.65
There is a reduction in access to quality educational materials[1]	3.92	1.92
There should be more regulation and oversight[1]	4.86	1.54
This will act to democratize education[1]	5.48	1.49
Web3 can only change pedagogy for the better[3]	4.66	1.91

Note. Scale ranges 1 (strongly disagree) to 7 (strongly agree).
1: Equity category
2: Pedagogy category
3: Web3 category
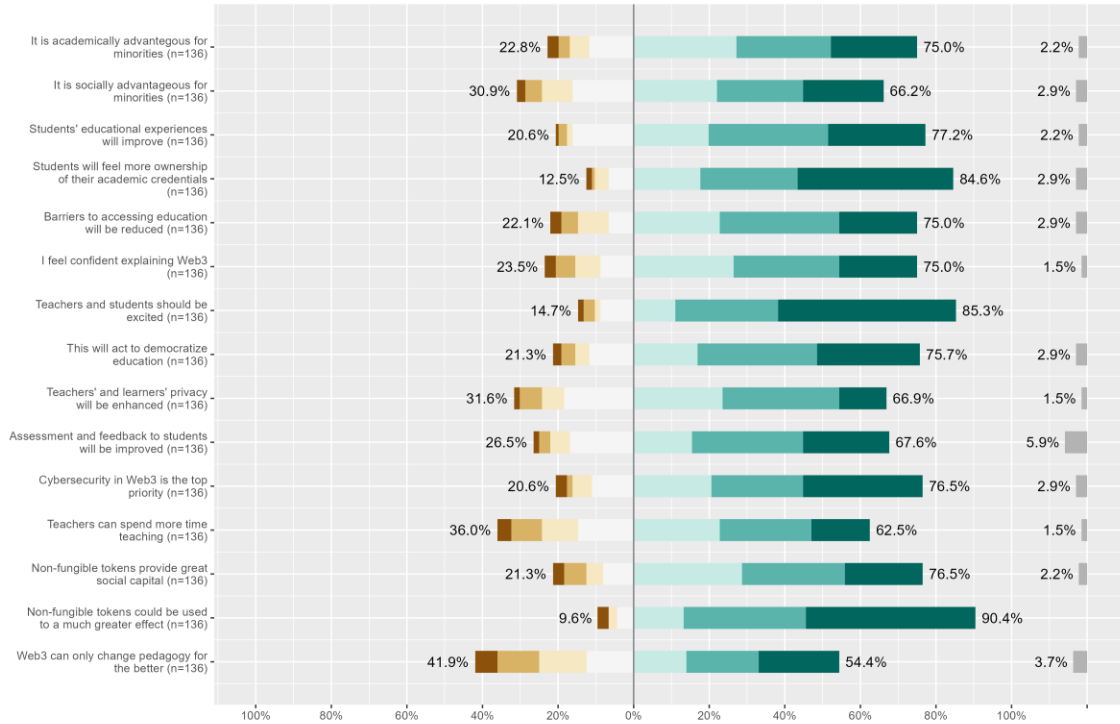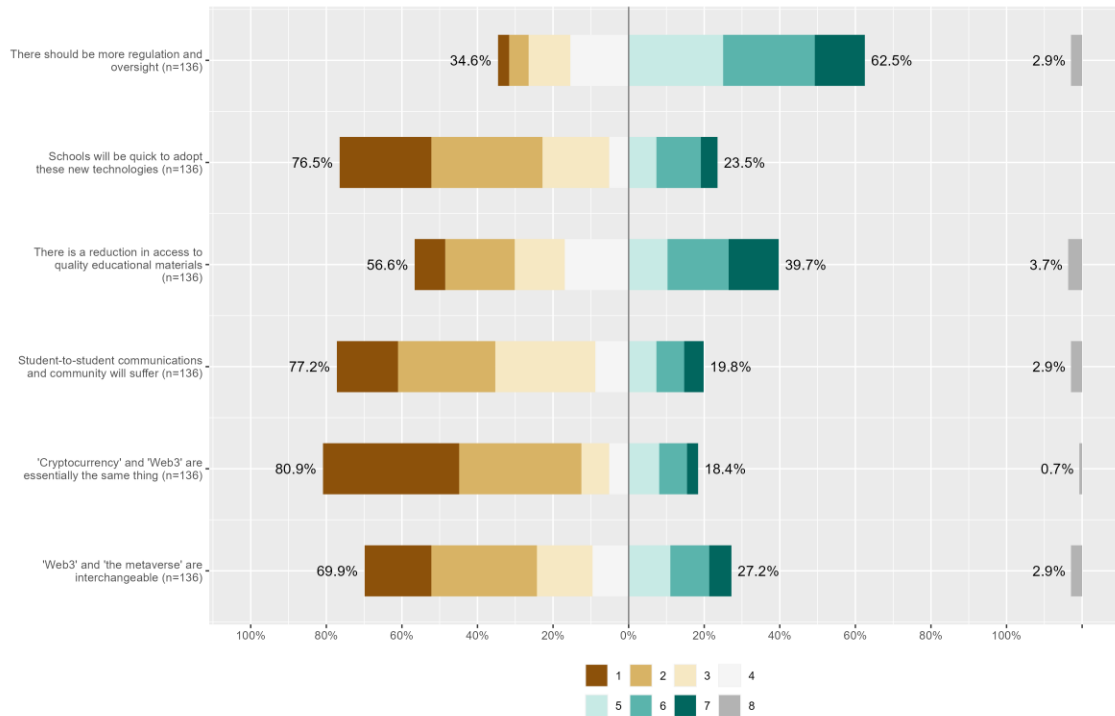
Figure 1. Likert responses by component.

Cross-categorical analysis revealed significant interactions between expertise levels and attitudinal responses. Participants reporting higher technical expertise (>60 on the 100-point scale) demonstrated more nuanced attitudes toward implementation challenges (M = 5.33, SD = 0.84) compared to those with lower technical expertise (M = 4.87, SD = 0.92), regardless of their professional background (t(134) = 2.89, p < .01). Analyzing educator and non-educator cohorts revealed no statistically significant differences regarding the primary component (Component 1) (ΔM = 0.19; 95% CI [-0.15,0.52], t(118.5) = 1.10, p = .273). Educators expressed significantly fewer negative feelings about Web3 in the more critical component #2 (M= 2.96) than non-educators (M= 3.95) (ΔM = 0.85, 95% CI [0.38,1.32], t(75.58) = 3.57, p = .001).. Note that the items listed in component #2 are worded critically; lower scores represent positivity. Average Likert responses were

consistently positive across all measures and groups. Educators were slightly less positive about equity ($M =$ 5.03, $SD = 0.99$) and pedagogical potential ($M = 5.06$, $SD = 0.98$) than non-educators ($M = 5.16$, $SD = 0.95$; $M =$ 5.22, $SD = 0.80$), while educators were slightly more positive about Web3's impact on education in general ($M =$ 5.33, $SD = 0.84$) than non-educators ($M = 5.24$, $SD = 0.66$). None of these differences held statistical significance, however. When grouping Likert items by theme, no statistically significant prediction can be made regarding participants' involvement in education. Table 5 describes the full model. This finding suggests that technical proficiency may be more influential in shaping attitudes toward Web3 implementation than professional role.

Table 5. Full regression table exploring grouped Likert responses' prediction of industry.

Predictor	b	95% CI	t	df	p
Intercept	0.62	[0.02, 1.22]	2.04	132	.043
Equity	-0.03	[-0.14, 0.09]	-0.43	132	.668
Pedagogy	-0.07	[-0.20, 0.06]	-1.03	132	.306
Web3	0.10	[-0.03, 0.23]	1.45	132	.150

Expertise

Further analysis of expertise distributions revealed a consistent hierarchical pattern across both educators and non-educators: conceptual expertise consistently ranked highest (educators: 64.3; non-educators: 68.2), followed by practical expertise (educators: 59.7; non-educators: 62.7), with technical expertise notably lower (educators: 36.5; non-educators: 43.5). This consistent expertise hierarchy suggests a systematic pattern in how Web3 knowledge is acquired and internalized, potentially indicating natural progression points for professional development initiatives (see Figure 2).
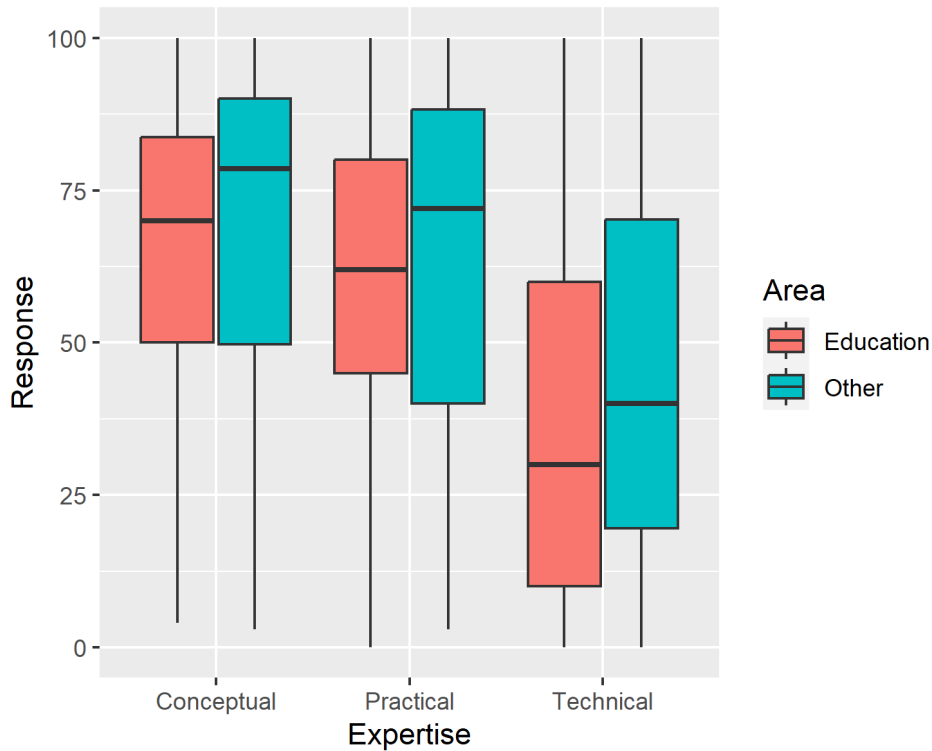
Figure 2. Boxplots of educators' and non-educators' expertise.

No statistically significant differences were found between educators and non-educators in terms of self-reported expertise (see Table 6): conceptual ($W = 2,405.50$, $p = .214$), practical ($W = 2,340.50$, $p = .344$), nor technical ($W = 2,384.00$, $p = .253$). Wilcoxon rank sum tests were performed due to non-normality of these data.

Table 6. Shapiro-Wilk test for normality in expertise.

Industry	Technical W	Technical value p-	Practical W	Practical value p-	Conceptual W	Conceptual value p-
Non-educator	0.93	0.01	0.90	0.00	0.88	0.00
Educator	0.92	0.00	0.95	0.00	0.93	0.00

The findings from this study both align with and diverge from previous research on emerging technology adoption in education. The generally positive attitudes toward Web3 technologies demonstrated by educators in this study parallel findings from Bucea-Manea-Țoniş et al. (2021), who reported increased student motivation and engagement with blockchain integration. These results diverge from traditional patterns of technology adoption reported by Granić and Marangunić (2019), where educators typically exhibited higher levels of skepticism. The significant difference in attitudes regarding teaching time impact (ΔM=0.94, 95% CI [0.42,1.47]) aligns with findings from Chivu et al. (2022), who identified similar concerns among faculty regarding practical implementation challenges. Findings that educators were more optimistic about student community development than non-educators present an interesting contrast to previous research on technology-mediated learning communities (Park, 2021). The strong agreement regarding NFT utility (M = 6.01, SD = 1.31) extends findings from recent studies of blockchain adoption in higher education. While Lizcano et al. (2020) found limited application of blockchain credentials, these results suggest broader potential applications, particularly in the realm of educational credentialing and achievement verification.

DISCUSSION

This investigation examined the multifaceted perspectives, theoretical frameworks, and critical analyses surrounding Web3 technologies' integration into educational contexts. To this end, a community of educators and those interested in the intersection of education and Web3 were selected as the sample. The study reveals that educators and non-educators do not diverge in most areas related to education and Web3. Analysis revealed no statistically significant variations in demographic distribution or self-reported expertise levels between the examined cohorts. This may point to the general applicability of these findings regardless of profession. These findings align with recent research by Uysal et al. (2024), who developed and validated a Web3 Awareness Scale, finding that awareness and attitudes toward Web3 technologies were not significantly influenced by professional background. Similarly, Kıyak et al.'s (2024) investigation into Web3 awareness and privacy concerns demonstrated that technical understanding and professional domain were less influential than anticipated in determining attitudes toward Web3 adoption.

Both educators and non-educators expressed self-reported levels of technical, practical, and conceptual expertise in Web3 at statistically insignificant differences. This also lends credence to the interpretation that certain levels of expertise can be expected regardless of industry or area of employment when studying self-selected individuals with interest in Web3 technologies and education. This finding is particularly noteworthy when considered alongside Cui et al.'s (2023) MetaEdu framework research, which found that educators' technical proficiency was less crucial than their conceptual understanding of Web3's pedagogical applications. Results on self-reported expertise levels mirror recent findings that identified similar patterns in their investigation of undergraduate Web3 course development (Zdravković & Dimitrijević, 2024), where conceptual mastery consistently outpaced technical expertise among educational practitioners. This aligns with Hollaus and Grant's (2024) findings regarding exposure to these technologies and likelihood to engage in metaversal platforms.

These findings contribute significantly to our understanding of Web3 technology adoption in education. Previous studies have primarily focused on general blockchain implementation (Fedorova & Skobleva, 2020) or specific credential applications (Chivu et al., 2022). These results extend this work by revealing nuanced differences between educators' and non-educators' perspectives on practical implementation challenges. The tension between technological optimism and practical implementation concerns echoes similar patterns found in studies of other educational technology adoptions (Granić & Marangunić, 2019), suggesting that successful Web3 integration may require targeted approaches to address specific pedagogical and logistical challenges.

There was significant deviation in one area, however. Educators disagreed with more critical statements about Web3 at a significantly higher rate than non-educators. These findings suggest a fundamental optimism among educators regarding the pedagogical potential of Web3 technologies compared to non-educators in terms of the use and potential of Web3 technologies applied pedagogically. Interestingly, these opinions that formed the six Likert scale items in the second component were equally spread across the item categories between equity, pedagogy, and Web3, suggesting there may not be one single category where educators are more or less optimistic or pessimistic than non-educators.

The consistently positive attitudinal responses observed across most measures (M > 5.0) warrant careful consideration, particularly given the self-selected nature of the sample. When examined alongside the expertise differential patterns, these uniformly positive attitudes suggest either strong confirmation bias within the Web3 education community or indicate that those most knowledgeable about these technologies genuinely perceive substantial positive potential. This distinction carries significant implications for both research methodology and implementation strategy. The most highly scored item across participants dealt with the use of NFTs in education and them not being used to their fullest extent ($M = 6.01$, $SD = 1.31$). This suggests a more nuanced understanding of NFTs that keys in on potential, avoiding focus on nefarious, bad-faith actors. It also demonstrates solid agreement between educators and non-educators on the utility of NFTs. As educators expand more into this space, demonstrated by communities like Ed3DAO and GeniiDAO, novel and good-faith implementation of NFTs continue to evolve. Recent research supports this optimistic view of NFT utility in education. Razzaq (2024) demonstrated that blockchain-based assessment platforms can significantly enhance credential verification and portfolio development, while maintaining security and privacy. Furthermore, Ferraro et al. (2023) found that trust in Web3 technologies, particularly NFTs, increases when their implementation focuses on practical utility rather than speculative value—a finding that aligns with participants' high scoring of NFT educational potential.

There was considerable disagreement when it came to opinions on Web3's day-to-day influence on the act of *teaching*. Educators were significantly less optimistic about Web3 meaning "teachers can spend more time teaching" ($\Delta M = 0.95$, 95% CI [0.42,1.47], $t(126.79) = 3.55$, $p = .001$). Non-educators were much more pessimistic than educators regarding the implications for developing a sense of community among students ($\Delta M = 1.02$, 95% CI [0.35,1.68], $t(88.82) = 3.03$, $p = .003$). The differences between groups here suggests a disagreement about the logistical reality of being an educator, especially considering the hurdles in implementing new technologies. This is understandable as educators will necessarily have better insight into their day-to-day experiences than non-educators. It also demonstrates a measurable and identifiable difference between how educators and non-educators envision these technologies having tangible, real impacts on the profession. The significant divergence in perspectives regarding Web3's impact on daily teaching practices represents one of the study's most robust findings. This disparity between educator and non-educator expectations appears particularly meaningful when considered alongside the expertise distribution patterns. While both groups demonstrated similar expertise levels, their divergent views on practical implementation suggest that professional experience, rather than technical knowledge, may be the primary driver of implementation expectations.

The evolving landscape of Web3 in education is further contextualized by recent developments in decentralized educational platforms. The smart contract-based platform research demonstrates that educators' optimism about Web3's potential is not unfounded, as their implementation showed significant improvements in credential verification and educational resource management (Țigănoaia & Alexandu, 2024). This must be balanced against Filipčić's (2022) findings regarding DAO implementation challenges in research and education, which highlight the need for careful consideration of governance structures and technological integration—concerns that were reflected in participants' varied responses to questions about day-to-day teaching impact.

Acceptance of, attitude toward, and use of Web3 technologies like blockchain has been well studied regarding finance, business, and industry implementation (Arias-Oliva, Pelegrín-Borondo, & Matías-Clavero, 2019; Folkinshteyn & Lennon, 2016). The precise manner and degree to which these technologies will mature and find adoption by educators is still unclear. What is clear, however, is the optimism present in its proponents. Potential demonstrated here must contend with a variety of challenges: logistical difficulties, a constantly changing technical landscape, the presently inexorable tie to cryptocurrencies and related concerns, and, not least of all, an ever-souring and distrustful public. The sheer experiential difference—an ethereal, digital landscape of identities, credentials, and pedagogical artifacts—remains a monumental paradigm shift. Whether these technologies will or even truly have the capacity to lead to positive, significant, and meaningful changes in an increasingly digital society and online education system remains to be seen but will not be for lack of highly optimistic proponents.

CONCLUSION

This comprehensive investigation into Web3 technologies in educational contexts yields three pivotal findings that substantially advance our understanding of technological integration in pedagogical innovation. Through rigorous analysis of attitudes, expertise, and implementation perspectives among educators and non-educators, several significant patterns emerge with important implications for future practice and research.

First, this study challenges prevailing assumptions about technological adoption patterns by revealing remarkably consistent perspectives across educator and non-educator cohorts. Contrary to initial hypotheses, statistically significant differences were minimal between these groups, suggesting a more uniform technological

outlook than previously theorized. This finding echoes recent scholarship (Uysal et al., 2024; Kıyak et al., 2024) that similarly indicated that professional background may be less determinative of technological attitudes than previously conceived.

Second, while overall attitudes remained consistently positive, educators exhibited a more nuanced approach to Web3 implementation, demonstrating lower levels of negativity about these technologies while maintaining measured skepticism about practical implementation challenges. This suggests that proximity to educational practice cultivates a more sophisticated, contextually grounded technological perspective. The findings indicate that educators' reservations primarily center on logistical implementation rather than theoretical potential, reflecting a pragmatic understanding of classroom realities.

Third, the research highlighted a consistent expertise hierarchy across both groups: conceptual understanding consistently preceded practical and technical knowledge. With conceptual expertise averaging 64.3 for educators and 68.2 for non-educators, followed by practical expertise and markedly lower technical expertise, these findings underscore the need for targeted professional development initiatives that bridge conceptual understanding with technical implementation.

The near-unanimous agreement regarding NFTs' educational potential represents a particularly compelling insight. This suggests a collective recognition of NFTs' transformative potential beyond current implementations, transcending the speculative narratives that have historically dominated cryptocurrency discourse. The significant divergence in perspectives regarding Web3's impact on daily teaching practices represents one of the study's most robust findings. This disparity between educator and non-educator expectations appears particularly meaningful when considered alongside the expertise distribution patterns.

These findings carry substantial implications for educational technology development and institutional adaptation. For developers and institutional leaders, this research suggests the critical importance of designing Web3 implementations that prioritize practical usability, address educators' concerns about classroom workflow, and provide clear, accessible pathways for technical skill development. The measured optimism demonstrated by educators signals not resistance but a sophisticated, calibrated approach to technological innovation in educational spaces.

As the digital entanglement between human and technology continues to evolve, especially in pedagogical spaces, understanding these perceptual nuances becomes paramount for thoughtful, ethical technological integration. This study contributes to a growing body of scholarship demonstrating that successful technological adoption depends less on the technology itself and more on the human systems, perceptions, and adaptability that surround its implementation. The findings provide a foundation for future research exploring the practical mechanisms of Web3 integration in educational settings while highlighting the importance of balancing technological innovation with pedagogical pragmatism.

LIMITATIONS AND SUGGESTIONS FOR FUTURE STUDY

As with any study, there are limitations here. First, the sample is entirely self-selected. Those likely to complete the survey are already interested in the topic, resulting in a degree of sampling bias. Second, roughly a quarter of all survey submissions suffered from non-completion, satisficing, maximizing, or optimizing, resulting in their exclusion. Finally, the language and concepts present are highly domain-specific and require considerable precursor knowledge to understand the content. Getting opinions and expectations from non-domain participants would take considerable education beforehand.

Several key areas warrant further investigation. Research examining the factors contributing to educators' optimism toward Web3 technologies could provide valuable insights for technology adoption in educational settings. Studies exploring the practical implementation challenges identified by educators could help bridge the gap between theoretical potential and practical application identified by Park (2021). Additionally, longitudinal research tracking the evolution of attitudes and implementation success as these technologies mature would provide valuable insights into their long-term viability in educational contexts. These findings suggest that, while Web3 technologies face significant implementation challenges in educational settings, there exists a foundation of cautious optimism among educators that could support their thoughtful integration into educational practices. As these technologies continue to evolve, understanding the nuanced perspectives of both educators and non-educators will be crucial for their successful implementation in educational contexts.

The implications of the present study are varied as they pertain to online teaching and learning. Certainly, a refined and more nuanced approach to using technologies like NFTs could divorce the pedagogical affordances

from popular opinion. For example, a simple name change—a *rebranding*, essentially—could have tremendous impact on how and where they are used. A learner having a *digital backpack* to keep credentials, accomplishments, even examples of previous work like a portfolio, that fundamentally demonstrates ownership and agency may become the norm, rather than currently relying on a variety of credential-focused repositories.

These technologies may also have implications for teaching and learning in the age of large language models (LLMs) like ChatGPT[7]. Backed by the immutability and record-keeping nature of blockchain, it's possible highly personalized learning experiences generated through ChatGPT-like platforms could be verified as entirely unique to the student and the resultant student work as original. The use of NFTs in this context could also become important for the design and delivery of instructional materials in a way that is still nascent in many ways: verification of ownership. An instructor or designer minting an NFT of their original instructional materials could act as assurance that the content was human-generated. Whether these intersections will emerge is unknown and is likely to be a topic of considerable research going forward.

Technology aside, future research should also seek to identify underlying causes and impetus for, especially, the divergence in educators' opinions as compared to the general population. In this way, it is possible to better understand, design, and implement pedagogically sound and responsible content that leverages these technologies. A follow-up study intends to extend the instrument to a larger, more general collection of participants to increase generalizability and better understand how those outside the Web3 sphere may find utility in the technology, as well as implications of LLMs in this space.

Disclosure statement
The authors declare that they have no conflict of interest.

Compliance with ethical standards
An Institutional Review Board responsible for human subjects research at The University of Arizona reviewed this research project and found it acceptable, according to applicable state and federal regulations and University policies designed to protect the rights and welfare of participants in research.

REFERENCES

Allison, M., & Kendrick, L. M. (2015). Toward Education 3.0: Pedagogical Affordances and Implications of Social Software and the Semantic Web. *New Directions for Teaching & Learning*, *2015*(144), 109–119. https://doi.org/10.1002/tl.20167

Arias-Oliva, M., Pelegrín-Borondo, J., & Matías-Clavero, G. (2019). Variables Influencing Cryptocurrency Use: A Technology Acceptance Model in Spain. *Frontiers in Psychology*, *10*. Retrieved from https://www.frontiersin.org/articles/10.3389/fpsyg.2019.00475

Aslan, B., & Ataşen, K. (2020). A blockchain based lifelong learning platform: The Smart University. *Manas Journal of Engineering*, *8*(2), 151–154. https://doi.org/10.51354/mjen.739036

AthenaDAO. (2022). Litepaper [Substack Newsletter]. Retrieved from https://athenadao.substack.com/p/athenadao

Bruch, R. E. (2022). NFT Scams-Buyer Beware. *Probate & Property*, *36*(6), 59–60.

Bucea-Manea-Țoniş, R., Martins, O. M. D., Bucea-Manea-Țoniş, R., Gheorghiță, C., Kuleto, V., Ilić, M. P., & Simion, V.-E. (2021). Blockchain Technology Enhances Sustainable Higher Education. *Sustainability*, *13*(22), 12347. https://doi.org/10.3390/su132212347

Cai, J., & Gut, D. (2020). Literacy and Digital Problem -solving Skills in the 21st Century: What PIAAC Says about Educators in the United States, Canada, Finland and Japan. *Teaching Education*, *31*(2), 177–208. https://doi.org/10.1080/10476210.2018.1516747

Caliguri, J., & Levine, D. U. (1967). Relationships between Teachers' Views on Education and their Socio-Economic Attitudes. *The Journal of Experimental Education*, *35*(4), 42–44. https://doi.org/10.1080/00220973.1967.11011011

Champely, S. (2020). *Pwr: Basic functions for power analysis*. Retrieved from https://CRAN.R-project.org/package=pwr

Chivu, R.-G. (Popa)., Popa, I.-C., Orzan, M.-C., Marinescu, C., Florescu, M. S., & Orzan, A.-O. (2022). The Role of Blockchain Technologies in the Sustainable Development of Students' Learning Process. *Sustainability*, *14*(3), 1406. https://doi.org/10.3390/su14031406

Cui, L., Zhu, C., Hare, R., & Tang, Y. (2023). MetaEdu: A new framework for future education. *Discover Artificial Intelligence*, *3*(1), 10. https://doi.org/10.1007/s44163-023-00053-9

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[7] https://openai.com

Cuthbertson, A. (2022). "I lost my life savings": Terra Luna cryptocurrency collapses 98% overnight. Retrieved from https://news.yahoo.com/lost-life-savings-terra-luna-160848651.html

Dibattista, J. (2022). About Us. Retrieved from https://younixyz.freshdesk.com/support/solutions/articles/73000535741-about-us

Ed3DAO. (2022). Ed3 DAO Token Strategy. Retrieved from https://hot-krill-470.notion.site/Ed3-DAO-Token-Strategy-24e578ea5cd9482ba60c670ac074b1e4

Ethereum Foundation. (2023a). Decentralized autonomous organizations (DAOs). Retrieved from https://ethereum.org

Ethereum Foundation. (2023b). Ethereum wallets. Retrieved from https://ethereum.org

Fedorova, E. P., & Skobleva, E. I. (2020). Application of blockchain technology in higher education. *European Journal of Contemporary Education*, *9*(3), 552–571. Retrieved from https://eric.ed.gov/?id=EJ1272331

Fenwick, M., & Jurcys, P. (2022). The contested meaning of Web3 & why it matters for (IP) lawyers. Retrieved from http://copyrightblog.kluweriplaw.com/2022/01/27/the-contested-meaning-of-web3-why-it-matters-for-ip-lawyers/

Ferdig, R. E., Cohen, M., Ling, E., & Hartshorne, R. (2022). Examining blockchain protocols, cryptocurrency, NFTs, and other web 3.0 affordances in teacher education. *Journal of Technology and Teacher Education*, *30*(1), 5–19. Retrieved from https://www.learntechlib.org/primary/p/221200/

Ferraro, C., Wheeler, M. A., Pallant, J. I., Wilson, S. G., & Oldmeadow, J. (2023). Not so trustless after all: Trust in Web3 technology and opportunities for brands. *Business Horizons*, *66*(5), 667–678. https://doi.org/10.1016/j.bushor.2023.01.007

Filipčić, S. (2022). Web3 & DAOs: An overview of the development and possibilities for the implementation in research and education. *2022 45th Jubilee International Convention on Information, Communication and Electronic Technology (MIPRO)*, 1278–1283. https://doi.org/10.23919/MIPRO55190.2022.9803324

Folkinshteyn, D., & Lennon, M. (2016). Braving Bitcoin: A technology acceptance model (TAM) analysis. *Journal of Information Technology Case and Application Research*, *18*(4), 220–249. https://doi.org/10.1080/15228053.2016.1275242

Gallagher, S., & Palmer, J. (2020). The pandemic pushed universities online. The change was long overdue. *Harvard Business Review*. Retrieved from https://hbr.org/2020/09/the-pandemic-pushed-universities-online-the-change-was-long-overdue

Garon, J. M. (2022). Legal Implications of a Ubiquitous Metaverse and a Web3 Future. *Marquette Law Review*, *106*(1), 163–242.

Gerhart, L. M., Jadallah, C. C., Angulo, S. S., & Ira, G. C. (2021). Teaching an experiential field course via online participatory science projects: A COVID-19 case study of a UC california naturalist course. *Ecology and Evolution*, *11*(8), 3537–3550. https://doi.org/10.1002/ece3.7187

Ghavi, A., Qureshi, A., Weinstein, G., Schwartz, J., & Lofchie, S. (2022). A Primer on DAOs. Retrieved from https://corpgov.law.harvard.edu/2022/09/17/a-primer-on-daos/

Ginn, J., O'Brien, J., & Silge, J. (2022). *qualtRics: Download 'qualtrics' survey data*. Retrieved from https://CRAN.R-project.org/package=qualtRics

Golato, T., & Kohlhaas, P. (2022). *Whitepaper*. VitaDAO. Retrieved from https://github.com/VitaDAO/whitepaper

Granić, A., & Marangunić, N. (2019). Technology acceptance model in educational context: A systematic literature review. *British Journal of Educational Technology*, *50*(5), 2572–2593. https://doi.org/10.1111/bjet.12864

Guo-Brennan, M. (2020). Perceptions of Stakeholders in School Reform. In M. Guo-Brennan (Ed.), *Community Engagement for Better Schools: Guaranteeing Accountability, Representativeness and Equality* (pp. 215–235). Springer International Publishing. https://doi.org/10.1007/978-3-030-54038-8_12

High, M. (2020). Supply chain insight: Inside IBM's Food Trust Blockchain system. Retrieved from https://supplychaindigital.com/technology/supply-chain-insight-inside-ibms-food-trust-blockchain-system

Hollaus, M., & Grant, M. (2024). Navigating the Metaverse: Assessing the Influence of Web3, Blockchain, and Cryptocurrency Knowledge on User Adoption. *Proceedings of the European Marketing Academy*, *122628*. https://proceedings.emac-online.org/pdfs/R2024-122628.pdf

Hurtt, A., Cohen, K., & Reed, S. (2021). *Early pandemic response in california* (p. 29). PACE: Policy Analysis for California Education.

Kim, K.-J., & Bonk, C. J. (2006). *The future of online teaching and learning in higher education: The survey says*. Retrieved from https://er.educause.edu/articles/2006/11/the-future-of-online-teaching-and-learning-in-higher-education-the-survey-says

Kıyak, Y. S., Budakoğlu, I. İ., & Coşkun, Ö. (2024). Blockchain, Holochain, and Other Distributed Ledger Technologies: Web3 Awareness, Privacy Concerns, and Cryptocurrency Use Among Students in a Medical School. *Bio-Algorithms and Med-Systems*, *20*(1), 1–7. https://doi.org/10.5604/01.3001.0054.7084

Lipton, A., & Levi, S. (2018). An Introduction to Smart Contracts and Their Potential and Inherent Limitations. Retrieved from https://corpgov.law.harvard.edu/2018/05/26/an-introduction-to-smart-contracts-and-their-potential-and-inherent-limitations/

Lizcano, D., Lara, J. A., White, B., & Aljawarneh, S. (2020). Blockchain-based approach to create a model of trust in open and ubiquitous higher education. *Journal of Computing in Higher Education*, *32*(1), 109–134. https://doi.org/10.1007/s12528-019-09209-y

Mackenzie, S. (2022). Criminology Towards the Metaverse: Cryptocurrency Scams, Grey Economy and the Technosocial. *The British Journal of Criminology*, *62*(6), 1537–1552. https://doi.org/10.1093/bjc/azab118

Marinoni, G., Van't Land, H., Jensen, T., et al. (2020). The impact of covid-19 on higher education around the world. *IAU Global Survey Report*, *23*, 1–17.

Matsuda, T. (2023). UNICEF hatches plan for a prototype DAO, following its crypto fund. Retrieved from https://www.theblock.co/post/223306/unicef-hatches-plan-for-a-prototype-dao-following-its-crypto-fund

McIntosh, S. (2022). Damien Hirst burns his own art after selling NFTs. *BBC News*. Retrieved from https://www.bbc.com/news/entertainment-arts-63218704

Park, J. (2021). Promises and challenges of Blockchain in education. *Smart Learning Environments*, *8*(1), 33. https://doi.org/10.1186/s40561-021-00179-2

Popper, N. (2021). Lost passwords lock millionaires out of their bitcoin fortunes. *The New York Times*. Retrieved from https://www.nytimes.com/2021/01/12/technology/bitcoin-passwords-wallets-fortunes.html

Poser, M. (2022). Application Possibilities of Tokens on an E-Learning Platform. *Open Conference Proceedings*, *2*, 105–109. https://doi.org/10.52825/ocp.v2i.170

Powell, A. (2021). Cryptocurrency expert discusses recent fluctuations. Retrieved from https://news.harvard.edu/gazette/story/2021/06/cryptocurrency-expert-discusses-recent-fluctuations/

PR Newswire. (2022). TinyTap's first Publisher NFTs sold out, generating 138.926 ETH (~US$228,000) that is shared with 6 teachers. Retrieved from https://finance.yahoo.com/news/tinytaps-first-publisher-nfts-sold-124500668.html

PR Newswire. (2023). Sports Trading Card Market to grow by USD 6.71 billion from 2021 to 2026, Driven by the growing demand to acquire sports trading cards online. Retrieved from https://finance.yahoo.com/news/sports-trading-card-market-grow-214500244.html

R Core Team. (2022). *R: A language and environment for statistical computing*. Vienna, Austria: R Foundation for Statistical Computing. Retrieved from https://www.R-project.org/

Rauschnabel, P. A., Felix, R., Hinsch, C., Shahab, H., & Alt, F. (2022). What is XR? Towards a Framework for Augmented and Virtual Reality. *Computers in Human Behavior*, *133*, 107289. https://doi.org/10.1016/j.chb.2022.107289

Razzaq, A. (2024). A Web3 secure platform for assessments and educational resources based on blockchain. *Computer Applications in Engineering Education*, *32*(1), e22677. https://doi.org/10.1002/cae.22677

Rikken, O., Janssen, M., Kwee, Z., Bolívar, R., & Scholl, H. j. (2019). Governance challenges of blockchain and decentralized autonomous organizations. *Information Polity: The International Journal of Government & Democracy in the Information Age*, *24*(4), 397–417. https://doi.org/10.3233/IP-190154

Rosenberg, L. (2022). Regulate the metaverse. Retrieved from https://medium.com/predict/regulating-the-metaverse-7c893ed00865

Saraf, V. (2022). Founding Story of Ed3 DAO. Retrieved from https://hot-krill-470.notion.site/Ed3-DAO-White-Paper-58fd3c39fc664a7e931fc64ad21bd3d2

Simmons, J. P., Nelson, L. D., & Simonsohn, U. (2012). *A 21 word solution*. Social Science Research Network. https://doi.org/10.2139/ssrn.2160588

Straight, R. (2022). *Attitudes and Opinions of Web3 Educators and Enthusiasts*. https://doi.org/10.17605/OSF.IO/Y7D9K

Țigănoaia, B., & Alexandu, A.-B. (2024). A smart contract-based decentralized web3 platform for education. *Journal of Educational Sciences & Psychology*, *14 (76)*(1), 115–125. https://doi.org/10.51865/JESP.2024.1.12

Uysal, M., Üstündağ, M. T., ÇeliK, A., Tanriverdi, M., Ceran, O., & Ayaz, Z. (2024). Development of Web3 Awareness Scale as the Next Evolution of the Internet. *Participatory Educational Research*, *11*(1), 247–265. https://doi.org/10.17275/per.24.15.11.1

Vuță, D. R. (2020). Augmented reality technologies in education - a literature review. *Series V - Economic Sciences*, *13(62)*(2), 35–46. https://doi.org/10.31926/but.es.2020.13.62.2.4

Westenfeld, A. (2022). The Saga of the 'Dune' Crypto Bros And Their Very Pricey Mistake Is At Its End. Retrieved from https://www.esquire.com/entertainment/books/a38815538/dune-crypto-nft-sale-mistake-explained/

Wholeben, B. E. (1988). Ethics and Equity in Educational Computing Policy. *SIG Bulletin*, *4*(3), 9–16. https://doi.org/10.1080/07478046.1988.10784067

Zdravković, N., & Dimitrijević, N. (2023). Blockchain in Higher Education: A Review on Needed Technologies for an Undergraduate Web3 Course. *Proceedings 14th International Conference on eLearning (eLearning 2023)*, *3696*. https://ceur-ws.org/Vol-3696/article_18.pdf

Determining the Relationship Between the Reading Understanding Levels of Primary School 4th Grade Students and the Success of Mathematics Course

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Abstract
In this study, it was aimed to determine the relationship between primary school 4th grade students' reading comprehension level and mathematics course success. The study group of the research consists of 80 students selected by purposive sampling method, studying in the 4th grade of official institutions in the Pazar district of Tokat province. The research was prepared using the relational survey model in the perspective of quantitative research methods. The research data were obtained through the Reading Comprehension Level Determination Test and the Mathematics Achievement Test. SPSS program was used in the analysis of the data obtained as a result of the research, Pearson Product-Moment Correlation Coefficient was used to determine the relationship between reading comprehension and mathematics achievement, and unrelated sample t-test was calculated to determine the significance between students' reading comprehension level and mathematics course success according to gender variable. In this context, in the study, a positive and significant high-level relationship was found between the reading comprehension level of 4th grade students and their success in mathematics courses. According to the gender variable, a significant difference was found in favor of female students when both the reading comprehension levels and mathematics course achievements of the students were compared.
Keywords : Reading, reading comprehension, mathematics achievement.

1. Introduction

When the Turkish Education System is examined, it is possible to say that students of different ages and education levels experience problems at almost every stage of the education system, especially in the field of mathematics. As a matter of fact, the PISA (Programme For International Student Assessment) results, which evaluated the achievements of students in the 15-year-old group in some basic fields, in which 79 countries participated in 2018, confirm the assertion we have put forward above. When the research results are examined, although Turkey has progressed 8 steps in the ranking among OECD (Organization for Economic Co-peration and Development) countries in the field of mathematics, according to the previous research, it could only find itself in the 42nd place (Ministry of National Education, [MEB], 2019).

In addition to this research conducted at the international level, the statistical information shared with the public by ÖSYM (Student Selection and Placement Center) of the Higher Education Institutions Examination, which is held every year for student admission to universities in our country, shows that the students taking the exam experience some problems in the field of mathematics. In the Higher Education Institutions Exam, which consists of two different sessions: Basic Proficiency Test and Field Proficiency Test, the correct answer averages in the two tests of 40 questions in the field of mathematics applied to students are 5.54 and 5.29, respectively. (Student Selection and Placement Center, [ÖSYM], 2022) Recently, the data put forward by students, whom we can consider as the most important part of the education system in Turkey, regarding the field of mathematics, has begun to be responded to by the competent authorities. In this context, we see that some projects have been put forward by the Ministry of National Education with the concern that the undesirable attitudes and anxiety that students at different grade levels may develop regarding mathematics course may negatively affect the students' course success in this field. The Mathematics Digital Education Platform, developed by the Ministry of National Education, aims to associate life and mathematics, to endear mathematics to students with various games that vary according to grade and age levels, and to increase curiosity in the field of mathematics with interesting hypotheses.

Likewise, Support and Training Courses, which are carried out by the Ministry of Education (Ministry of National Education) and enable secondary and secondary school students to receive additional training in basic

courses, especially mathematics, aim to improve students' mathematical skills. Although we accept that all the studies carried out will definitely have positive reflections on the students, we can say that the mathematical skills of students, especially those with low socio-economic levels, are not at the desired levels, based on our conversations and observations with education stakeholders working in the field. It is very easy to observe the academic status of students who have completed their primary school education in educational institutions that include primary and secondary school levels during their secondary school education. The opinions of the teachers who taught mathematics to 5th grade students in these schools were that the problems experienced by the students in reading comprehension negatively affected their mathematics success. Again, the same teachers stated that especially the question styles that are described as new generation questions, in which the questions are associated with daily life and contain more than one outcome in their structure, cannot be understood by the students; Accordingly, he expresses his opinion that the questions cannot be answered by the students. In addition, mathematics teachers working in secondary schools argue that some students who have moved from primary school to secondary school level have problems in reading, and that some children who are learning to read have problems understanding what they read.

As a result, considering the opinions of education stakeholders, it is thought that students who have problems with reading comprehension experience failure in mathematics lessons, and the problem of reading comprehension begins at the primary school level and continues. Therefore, determining the relationship between 4th grade students' reading comprehension levels and mathematics course success constitutes the problem part of this research.

1.2. Purpose of the research
This study aims to find out whether there is a relationship between the reading comprehension levels of 4th grade primary school students and their mathematics success, and if there is a relationship between two variables (reading comprehension and mathematics success), in which direction (+, -) this relationship is.

Within the framework of the above main purpose, answers were sought to the questions regarding the following sub-objectives.
1) Is there a significant relationship between 4th grade primary school students' reading comprehension levels and mathematics course success?
2) Is there a significant relationship between 4th grade primary school students' reading comprehension levels and mathematics course success according to gender?

1.3. Importance of Research
According to Deniz (2013), students whose reading comprehension skills are not developed cannot achieve success in mathematics classes. For this reason, it is very important for students to read correctly and interpret what they read correctly in terms of understanding the problems in mathematics lessons.
In this study, it is thought that the relationship between 4th grade primary school students' reading comprehension levels and mathematics course success will be determined, and the results obtained will contribute to other researchers. The results obtained from the study will benefit from redefining the vision of Turkish teaching in primary schools, examining the reading comprehension processes of primary school students, and investigating the relationships between the reading comprehension levels of the same students and other courses and fields.

2. Related Literature
2.1. Read
According to Aytaş (2003), reading is a complex activity that includes various activities of the five senses and the brain's attempts to make sense of it. In order for the act of reading to occur, five sense organs must be used effectively. Of course, in addition to directly associating the act of reading with the visual sense organ, it should not be forgotten that other sense organs also play an important role in making sense of concepts in the learning process. Based on this, the complex mental process mentioned must be completed with a holistic approach. As a matter of fact, it is very important to have a purpose that motivates the mind in order to increase the efficiency of reading and to achieve success in this action. Because it is of great importance that the reading meets the needs determined by the human mind at that moment. A reading action in which the mind is not included in the process will not achieve its purpose. In this context, the most important purpose of reading is to see objects, shapes, texts, numbers, visuals, etc. It means making sense of and comprehending all kinds of stimuli in the mind. Then, it is possible to say that the acts of reading and understanding are a whole and that the mental process that begins with reading continues with understanding.

2.2. Reading Comprehension

According to Kanmaz (2012), reading comprehension is the completion of two different processes, reading and comprehension, with a cause-effect relationship. Reading comprehension has an important place in the realization of learning. In purposeful learning activities, the act of reading comprehension contributes greatly to the success of the process. As a matter of fact, it is not possible to say that information that is not given meaning in the mind has been learned. In this context, it is critical to provide students with reading comprehension skills in order to achieve their teaching goals. Reading comprehension skill constitutes one of the learning areas of the Turkish course, and it is aimed to provide students with this skill in the Turkish course. However, when we consider the impact of reading comprehension skills on learning, it would not be an exaggeration to say that it is wrong to limit reading comprehension skills only to Turkish lessons. As a matter of fact, when the literature is examined, many studies show that reading comprehension skills directly or indirectly affect students' success in other courses, especially mathematics.

In Erdem's (2016) study to determine the relationship between mathematical reasoning and reading comprehension in 8th grade students, he found a significant positive relationship between the two variables.
In his research, Yılmaz (2011) concluded that there was a positive relationship between the reading comprehension skills of fourth grade primary school students and their mathematics achievement, and determined that students who could understand what they read well received better scores in mathematics.

3. Method

In this study, the relational screening model, one of the quantitative research methods, was used to determine the relationship between the reading comprehension skills and mathematics achievements of 4th grade primary school students. These research models aim to determine the existence or degree of relationship between two or more variables. The relationship scan model includes two types: correlation type relationship scan and comparison type relationship scan. (Köse, 2017: 113) While the study examined whether there was a significant relationship between the reading comprehension skills and mathematics achievements of 4th grade primary school students, the reasons for the possible positive or negative relationship between these two variables were not focused on. In this context, the correlation type relational screening model was used in the research.

3.1. Population and Sample

This research was completed by focusing on the 4th grade students of primary school in Pazar district of Tokat province. The population of the research consists of 4th grade students studying in Pazar district of Tokat province, and the sample consists of 80 students determined by purposeful sampling method, which is one of the non-probability sampling methods. According to Ural (2011: 43), in the purposeful sampling method, the researcher determines the units to be tested based on prior knowledge, experience and observation, according to the purpose of the research, at his own discretion. Since the researcher bases his judgments and judgments on the sample determination process, he must have an idea about the universe.
The distribution of the 80 students who participated in the research in Pazar district of Tokat province according to their gender is shown in Table 1.

Table 1: Distribution of students included in the sample by gender

Gender	f	%
Female	48	60
Male	32	40
Total	80	100

When Table 1 is examined, out of a total of 80 students included by the purposeful sampling method, 48 are girls and 32 are boys, and 60% of the total number of students are girls and 40% are boys.

3.2. Data Collection Tools

In the research, the Reading Comprehension Level Determination Test and the Mathematics Achievement Test, consisting of 20 multiple-choice questions, were prepared in order to determine the relationship between the reading comprehension levels of primary school 4th grade students and their mathematics course success. While preparing these tests, 4th grade primary school Turkish and mathematics textbooks were used.

3.2.1. Reading Comprehension Level Determination Test

While preparing the Reading Comprehension Level Determination Test, the reading comprehension questions in the End of Theme Evaluation Studies in the last parts of the eight units in the primary school 4th Grade Turkish textbook were examined and the ones suitable for the purpose of the study were determined. In the relevant test,

which included five different texts, four multiple-choice questions were selected for each text, resulting in a total of 20 multiple-choice questions. While selecting reading comprehension questions suitable for the purpose of the study from the End of Theme Evaluation Studies of the Turkish textbook, expert opinions were taken from two Turkish teachers and one classroom teacher.

3.2.2. Mathematics Achievement Test
While preparing the Mathematics Achievement Test, the topics that should be covered until the date of the research were determined according to the united annual plan from the themes in the primary school 4th grade curriculum. In this context, 20 multiple-choice questions that require problem-solving skills on related topics have been prepared.

The topics that should be covered in the 4th grade Mathematics course until the date of the research and the question distribution of the topics are shown in Table 2.

Table 2: Distribution of topics and number of questions in the mathematics achievement test

Topics	Guestion Number
Addition	4
Subtraction Process	4
Multiplication	4
Division	4
Fractions	4
Total	20

When Table 2 is examined, it can be seen that in the Mathematics Achievement Test, 4 questions were taken from each of the subjects of addition, subtraction, multiplication, division and fractions with natural numbers, and a total of 20 questions were reached.

During the preparation of the questions in the Mathematics Achievement Test, expert opinions of two mathematics teachers and two classroom teachers were consulted, and care was taken to include intermediate level questions appropriate to the student's level, which include problem-solving skills, in the test.

3.2.3. Determining Reading Comprehension Level and Scoring Mathematics Achievement Test
The tests used in the study were evaluated independently of each other. In two tests consisting of 20 questions, "1" point was given for each correct answer, and "0" point was given for each incorrect or unanswered question. In this context, the minimum score that can be obtained from the Reading Comprehension Level Determination Test and Mathematics Achievement Test is 0; The maximum score is 20.

3.2.4. Reliability and Validity Procedures for Determining Reading Comprehension Level and Mathematics Achievement Test
3.2.4.1. Reliability
According to Kabakçı Yurdakul (2013), reliability is an indicator of how precisely a measurement tool measures the feature or features it measures. According to Karasar (2012), Kr-20 is used when analyzing items such as item difficulty and item discrimination in the test. According to some studies, a reliability coefficient of 0.70 and above in performance tests indicates a good reliability coefficient. In this context, both tests were tested on ten 4th grade students who were not included in the sample in order to calculate the reliability coefficients before the data collection phase, and the reliability coefficient of the reading comprehension level determination test was found to be 0.91, and the reliability coefficient of the mathematics achievement test was found to be 0.70. In light of these data, it is possible to say that both tests are safe.

Item difficulty (p) is the percentage of correct answers. Questions with a difficulty level of 0.81 and above are considered very easy, between 0.61-0.80 are considered easy, 0.41-0.60 are considered medium, 0.21-0.40 are considered difficult, and below 0.20 are considered very difficult. It is desirable for the estimated correct answer rate to be around 0.50, and both relatively easy and difficult questions can be included (Baştürk, 2014). According to Büyüköztürk (2012), item discrimination is the capacity to distinguish between people who have the characteristic measured by the test at the maximum level and those who have it at the minimum level. According to Baştürk (2014), items with an item discrimination index of 0.40 or higher are considered very good, while items with an item discrimination index between 0.30 and 0.39 are considered quite good. Items with an item discrimination index between 0.20 and 0.29 should be developed and added to the test. . However, those

with an item discrimination index below 0.20 should be excluded from the test without even being subjected to the development process.

Item difficulty and item discrimination values of the reading comprehension level determination test and the mathematics test are given in Table 3.

Table 3: Item difficulty and discrimination of the reading comprehension level determination test and the mathematics test

Reading Comprehension Level Determination			Mathematics Achievement Test		
Questions Item	Difficulty Item	Discrimination	Questions Item	Difficulty Item	Discrimination
M1	.73	.51	M1*	.44	.19
M2	.78	.36	M2	.65	.47
M3*	.80	.24	M3*	.63	.27
M4	.78	.32	M4*	.63	.21
M5*	.80	.29	M5	.70	.31
M6	.79	.31	M6*	.64	.25
M7	.74	.42	M7	.65	.44
M8*	.79	.23	M8	.53	.30
M9*	.80	.23	M9	.61	.35
M10	.75	.40	M10	.64	.31
M11	.80	.40	M11	.59	.50
M12	.81	.47	M12	.53	.50
M13	.74	.45	M13	.68	.59
M14	.78	.63	M14	.68	.43
M15	.80	.35	M15	.70	.51
M16	.83	.53	M16	.74	.57
M17	.86	.49	M17	.73	.31
M18	.83	.32	M18*	.78	.21
M19*	.86	.21	M19*	.69	.29
M20	.84	.53	M20	.65	.37

When Table 3 is examined, the questions M3=.24, M5=.29, M8=.23, M9=.23 and M19=.21, which had a discrimination value of less than 0.30 in the reading comprehension level determination test, were developed to increase the discrimination value and were used in the test. . In the Mathematics Achievement Test, the questions M1=.19, M3=.27, M4=.21, M6=.25, M18=.21, M19=.29 were developed and used in the test to increase the discrimination value.

3.2.4.2. Validity
Expert opinion was taken for the reading comprehension level determination test and mathematics achievement test developed by the researcher; A specification table was prepared to determine the content validity of the tests. A preliminary application was made to determine the validity of the prepared tests; Students included in the preliminary application were not included in the determined sample.

3.3. Collection of Data
The data obtained from the research were collected from 80 primary school 4th grade students in the Pazar district of Tokat province. Before the data collection process, Pazar District Directorate of National Education was informed. The schools included in the sample of the previously determined research were visited one by one and all necessary explanations were made to the school principals and 4th grade teachers about the Reading Comprehension Level Determination and Mathematics Achievement Test to be applied to the students and the way the tests were applied. During the application phase of the tests, students were given 40 minutes for each test. The tests were administered to students by classroom teachers. It was specifically requested from the classroom teachers that the students should be informed that the tests to be applied will be used for a research and that there is no purpose of grading. In this way, it was aimed to prevent any test anxiety that may occur in students.

3.4. Analysis of Data

In the study, correct answers in the Reading Comprehension Level Determination Test and Mathematics Achievement Test applied to the students were coded with the value "1" and the items that were incorrect or left blank were coded with the value "0" and converted into numerical data. The answers given to two tests by 80 students included in the sample for the research were entered into the SPPS (Statistical Packet For Social Studies) program, taking into account the gender variable.

Pearson Product Moment Correlation ("r") was used to determine the relationship between students' reading levels and mathematics achievement. According to Şahin (2017), the Pearson Product Moment Correlation coefficient, which is used when the relationship between two variables is desired to be determined, indicates that there is a relationship between two variables ranging between -1.00 and +1.00, while a coefficient of .00 indicates that there is no significant relationship between the two variables.

To determine how the relationship between students' reading levels and mathematics achievement changes according to the independent variable gender; The t test, one of the parametric tests, was used. The t test is used to find out whether there is a significant difference between two unrelated groups.

4. Results

As a result of the data obtained from the study, the average scores of the students from the Reading Comprehension Level Determination Test and Mathematics Achievement Test are given in Table 4.

Table 4: Average scores from the reading comprehension level determination test and mathematics achievement test

Test	Mean (X)	Standart Deviation (S)	N
OADBT	15,96	3,08	80
MBT	12,92	3,55	80

When Table 4 is examined, it is seen that the students' average OADBT score is 15.96 and their MBT score average is 12.92. According to the results in Table 4, it can be said that the general averages of the students in OADBT and MBT are at the medium level. These averages, which are thought to be close to the same level (average level), show that there may be a relationship between students' reading comprehension levels and mathematics skills. In this context, the Pearson Moment Multiplication Coefficient (r) obtained as a result of the correlation analysis to reveal the relationship between students' reading comprehension levels and mathematics skills is shown in Table 5.

Table 5: Correlation between students' reading comprehension levels and mathematics course success

		Mathematics Achievement
Reading Comprehension Level	Pearson Moment Multiplication Coefficient (r)	**.72
	p	.00
	N	80

**Correlation is significant at the .01 level. $p < .01$

Looking at Table 5, it was observed that there was a high-level positive relationship ($r=.72 > .70$) at the level of $r=.72$ ($p<.01$) between the reading comprehension levels of the fourth grade primary school students and their success scores in the mathematics course. Based on the research findings, we can say that students who have a good reading comprehension level at the fourth grade level of primary school reflect this on their mathematics course success and, accordingly, they are also successful in mathematics. Regarding the second sub-problem of the research, an unrelated groups t-test was applied to determine whether the reading comprehension levels and mathematics course success of fourth grade students differed significantly according to the gender variable. Findings regarding how students' reading comprehension levels change according to gender are shown in Table 6.

Table 6: T test results of reading comprehension levels by gender

Gender	N	X	ss	t	df	p
Female	48	16.75	3.15	2.92	78	.005
Male	32	14.78	2.59			

p<0,05

When Table 6 is examined, the reading comprehension level scores of the students included in the sample indicate a significant difference in favor of female students according to the gender variable (t=2.92, p<.05). In addition, when the arithmetic averages of the scores of the two groups from the reading comprehension level test are examined, it is seen that the scores of female students (X = 16.75) are higher than those of male students (X = 14.78).

Findings regarding how students' mathematics course success varies according to gender are shown in Table 7.

Table 7: T-test Results of Mathematics Course Achievement by Gender

Gender	N	X	ss	t	df	p
Female	48	13.93	3.15	3.31	78	.001
Male	32	11.40	3.61			

p<.05

When Table 7 is examined, the mathematics course success scores of the students included in the sample indicate a significant difference in favor of female students according to the gender variable (t=3.31, p<0.05). In addition, when the arithmetic averages of the scores of the two groups in the mathematics achievement test are examined, it is seen that the scores of female students (X = 13.93) are higher than those of male students (X = 11.40).

5. Discussion and Conclusion

The aim of the study was to reveal how the reading comprehension levels of 4th grade primary school students affect their mathematics course success and the relationship between these two variables. As a result of the analyses, it was concluded that there was a positive, highly significant relationship (r=.72 p=.000) between students' reading comprehension levels and mathematics course success. This result is similar to the positive significant relationship between mathematical reasoning and reading comprehension found in Erdem's (2016) study. In Deniz (2013)'s study, a moderately positive relationship was found between reading comprehension and mathematics performance in fifth grade primary school students. Again, in Yılmaz's (2011) study, a highly positive relationship was found between fourth grade students' reading comprehension levels and mathematics scores. When looked at, it can be said that the results of the research are similar to similar studies in the literature. When all studies are examined, it is possible to say that there is a consistent relationship between reading comprehension skills and mathematics course success.

Regarding the second sub-problem of the research, it was concluded that the reading comprehension levels and mathematics course achievements of 4th grade students differ according to the gender variable. As a result of the analyses, it was seen that both the reading comprehension level scores and mathematics achievement scores of female students were higher than male students, and after the necessary analyses, it was determined that the reading comprehension levels and mathematics achievement scores differed significantly in favor of female students. In this context, when the results of other studies are examined, we can say that Deniz (2013) and Boz (2018) reached similar results in their studies. However, in their study where Özyılmaz and Alcı (2011) examined the effect of teaching reading comprehension strategies on seventh grade reading comprehension success, they could not find a significant difference between students' reading comprehension success according to the gender variable. When the studies are examined, it is not possible to say that the gender variable positively affects reading comprehension skills and mathematics course success.

6. Suggestions

Based on the results obtained from the research, the following suggestions can be made:
1) In this study, a positive, highly significant relationship was determined between the reading comprehension level of 4th grade students and their mathematics course success. In this context, since students' reading comprehension levels directly affect their mathematics course success, reading comprehension studies should be included in Turkish lessons in order to increase mathematics course success.

2) Educational institutions can include studies that will improve students' book reading skills in order to increase their reading comprehension levels.

3) Classroom teachers can organize different activities to understand the problem, especially in problem solving, during mathematics teaching. They may use different methods to understand the problem.

4) In the research, when students' reading comprehension levels and mathematics achievements were compared according to the gender variable, a significant difference was found in favor of female students. Therefore, problem statements regarding the reasons for this difference can be determined in academic studies.

5) Academic studies based on this research can include research on how the level of reading comprehension affects the academic success of students in different courses or fields.

6) In academic studies, achievement tests can be developed at different grade levels and research can be conducted to determine whether students' reading comprehension levels affect their mathematics course success.

6. References

Aytaş, G. (2003) Okuma Gelişiminde Çocuk Edebiyatının Rolü, *Türklük Bilimi Araştırmaları,* Niğde.

Baz, B. (2018) Okuduğunu Anlama Üzerine Bir Derleme Çalışması. *Yıldız Sosyal Bilimler Enstitüsü Dergisi,* 02 (01) 28-41.

Baştürk, Ş. (2014). Ölçme Araçlarının Taşıması Gereken Nitelikler. *Eğitimde Ölçme ve Değerlendirme*. Ankara : Nobel Yayınları

Boz, İ. (2018) İlkokul 4.sınıf Öğrencilerinin Okuduğunu Anlama Düzeyi ile Matematik Problemlerini Çözme Başarısı Arasındaki İlişkinin İncelenmesi. *İnsan ve Sosyal Bilimler Dergisi,* 1 (1) 40-53.

Büyüköztürk, Ş. ve vd. (2012). Bilimsel Araştırma Yöntemleri Ankara : Pegem Akademi.

Deniz, M. (2013). *İlköğretim Beşinci Sınıf Öğrencilerinde Okuduğunu Anlama Becerisi İle Matematik Dersindeki Akademik Başarıları Arasındaki İlişkinin İncelenmesi.* Yayımlanmamış Yüksek Lisans Tezi, Mustafa Kemal Üniversitesi, Hatay.

Erdem, E., (2016) Matematiksel Muhakeme ile Okuduğunu Anlama Arasındaki İlişki: 8.Sınıf Örneği. *Necatibey Eğitim Fakültesi Elektronik Fen ve Matematik Eğitimi Dergisi.* 10(1), 393-414.

Kabakçı Yurdakul, I. (2013). Bilimsel Araştırma Yöntemleri. *Veri Toplama Araçlarında Bulunması Gereken Nitelikler.* Ankara: Anadolu Üniversitesi Yayını

Kanmaz, A., (2012). Okuduğunu Anlama Stratejisi Kullanımının, Okuduğunu Anlama Becerisi, Bilişsel Farkındalık, Okumaya Yönelik Tutum Ve Kalıcılığa Etkisi. Adnan Menderes Üniversitesi, Aydın

Karasar, N. (2012). Bilimsel Araştırma Yöntemi. *Kavramlar, İlkeler, Teknikler*. Ankara : Nobel Yayınları

Köse, E., (2017) . Bilimsel Araştırma Yöntemleri . R.,Y. Kıncal (ed.) *Bilimsel Araştırma Modelleri.* (ss.99-121) içinde. İstanbul : Nobel Yayınları.

Milli Eğitim Bakanlığı. (2019). "*PISA 2018 Sonuçlarına Göre Türkiye, Her 3 Alanda Performansını Arttıran Tek Ülke*" (Erişim : 10/03/2023) https://www.meb.gov.tr/pisa-2018-sonuclarina-gore-turkiye-her-3-alanda-performansini-artiran-tek-ulke/haber/19842/tr adresinden alınmıştır.

Öğrenci Seçme Ve Yerleştirme Merkezi. (2022). " *2022- YKS Sonuçlarına İlişkin Sayısal Bilgiler*" (Erişim : 12/03/2023) https://www.osym.gov.tr/TR,23867/2022-yks-sinav-sonuclarina-iliskin-sayisal-bilgiler.html adresinden alınmıştır.

Şahin, Ç., (2017) . Bilimsel Araştırma Yöntemleri . R.,Y. Kıncal (ed). *Verilerin Analizi.* (ss.183-217) içinde. İstanbul : Nobel Yayınları.

Türk Dil Kurumu (2005) *Türkçe sözlük* (10.bs) Ankara:Türk Dil Kurumu.

Ural, A., Kılıç, İ., (2011) Bilimsel Araştırma Süreci ve SPSS ile Veri Analizi., *Evren ve Örneklem*. (ss.29-44) içinde., Ankara : Detay Yayıncılık.

Yılmaz, M., (2011). İlköğretim 4.Sınıf Öğrencilerinin Okuduğunu Anlama Seviyeleri İle Türkçe, Matematik, Sosyal Bilgiler, Fen ve Teknoloji Derslerindeki Başarıları Arasındaki İlişkinin Belirlenmesi. Mustafa Kemal Üniversitesi, Hatay

Gamification in Education: Unlocking Engagement and Enhancing Learning Outcomes

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Abstract
Gamification has emerged as a transformative approach in education, integrating game elements such as points, badges, leaderboards, and progress bars with traditional learning to enhance engagement and improve learning outcomes. By leveraging psychological principles of motivation, gamification fosters participation and persistence, making it a powerful tool for addressing diverse educational needs. This paper explores the benefits of gamification, including improved cognitive engagement, reduced anxiety, enhanced confidence, and increased collaboration. Tools like Kahoot, Quizizz, and Duolingo demonstrate how gamified platforms can make challenging subjects more accessible and enjoyable. However, challenges such as over-reliance on extrinsic rewards, technological limitations, and the need for teacher training present barriers to implementation. In Türkiye, gamification holds significant potential to reduce educational disparities through initiatives like the Education Informatics Network (EBA). Future opportunities lie in integrating gamification with emerging technologies such as artificial intelligence and virtual reality, enabling personalized and immersive learning experiences. Emphasizing student-centered design and collaboration among stakeholders is crucial to maximize the potential of gamification in fostering inclusive, equitable, and inspiring education globally.
Keywords: gamification, education technology, student engagement, learning outcomes, personalized learning

Introduction
Gamification has emerged as a transformative educational strategy, integrating game elements with traditional learning approaches to boost student engagement and enhance learning outcomes. Recent research underscores its effectiveness, particularly in utilizing digital tools to foster more interactive and personalized learning environments (Liu et al., 2023; Nguwi, 2023). By incorporating elements such as rewards, challenges, and interactive mechanics, gamification creates a dynamic and participatory learning experience that resonates with learners of all ages. Platforms like Kahoot and Quizizz exemplify the power of real-time feedback and adaptive challenges in maintaining sustained student interest (Kalleny, 2020; Tatlı et al., 2023). As education adapts to the demands of the digital age, gamification emerges as a compelling framework for cultivating meaningful, student-centered learning experiences. This paper examines the role of gamification in education, delving into its benefits, practical implementations, and challenges, while highlighting its potential to revolutionize contemporary educational practices.

Design and Objectives
This study examines the application of gamification in education, focusing on its potential to enhance student engagement, promote equity, and improve learning outcomes. Additionally, it addresses critical challenges, such as the over-reliance on extrinsic rewards and technological disparities, while proposing actionable strategies to overcome these barriers. Recent studies highlight the adaptability of gamification to diverse learning needs, emphasizing the effectiveness of tailored tools that seamlessly integrate intrinsic and extrinsic motivators (Liu et al., 2023; Nguwi, 2023).

At its core, gamification harnesses psychological principles of motivation, utilizing intrinsic and extrinsic motivators to foster participation and persistence (Huang & Hew, 2021; Zainuddin et al., 2020). By tapping into students' natural attraction to competitive and rewarding experiences, gamification incorporates features such as points, badges, leaderboards, and progress bars within educational environments (Sen, 2024). These elements cultivate a sense of achievement and progression, driving students to engage more deeply with the material. Research demonstrates that gamification not only enhances cognitive engagement but also improves memory retention and critical thinking skills, establishing it as a versatile tool for addressing diverse educational needs (Loewen et al., 2020; Subhash & Cudney, 2020).

For instance, in STEM education, gamified simulations offer immersive, hands-on experiences that enable students to grasp abstract concepts more effectively (Tatlı et al., 2023). Similarly, gamified platforms in language learning, such as Duolingo, facilitate consistent practice and enhance vocabulary retention through adaptive challenges tailored to individual learners (Loewen et al., 2020). These examples underscore the versatility of gamification across diverse educational contexts, demonstrating its potential to address a wide range of learning needs.

Methodology
This study adopts a qualitative literature review approach, analyzing recent research and empirical studies on gamification. The methodology emphasizes examining the deployment of gamified tools across diverse educational contexts and their quantifiable effects on student outcomes. Studies were meticulously selected based on their relevance to gamification's applications in STEM education, language learning, and general cognitive engagement. Furthermore, the review incorporates recent advancements in the field, including AI-driven adaptive learning platforms and blockchain-enabled reward systems, highlighting emerging trends and innovative applications (Liu et al., 2023; Nguwi, 2023).

Key studies highlight the effectiveness of popular gamified platforms such as Kahoot, Quizizz, and Duolingo in enhancing student engagement through real-time feedback, adaptive challenges, and collaborative gameplay (Rizzo & Cavallaro, 2024; Tatlı et al., 2023). For instance, Duolingo's adaptive exercises have proven highly effective in improving vocabulary retention by tailoring challenges to individual learning needs (Loewen et al., 2020). Similarly, platforms like Kahoot and Quizizz promote collaborative learning by immersing students in competitive, interactive activities that sustain their motivation and active participation (Tatlı et al., 2023).
The analysis also incorporates regional studies, including those conducted in Turkey, to investigate gamification's cultural adaptability and its potential to address educational disparities (Altınpulluk, 2021; Bayrak & Liman-Kaban, 2024). This holistic approach provides a nuanced perspective on how gamification strategies can be customized to meet the unique needs of diverse educational contexts, thereby promoting both inclusivity and effectiveness.

Discussion
Gamification has demonstrated significant potential in revolutionizing traditional educational practices by boosting student engagement and enhancing learning outcomes. The findings of this study corroborate those of Zainuddin et al. (2020), who found that incremental challenges within gamified environments bolster learner confidence and cultivate a sense of accomplishment. Likewise, Loewen et al. (2020) emphasized the effectiveness of gamified platforms like Duolingo in significantly improving language retention and skill application, underscoring gamification's impact in specialized domains such as language education.

The findings of this study also align with those of Cudney and Subhash (2020), who demonstrated that gamified simulations in STEM education enhance conceptual understanding and foster critical thinking skills. Recent research further underscores the role of gamified applications in mitigating procrastination and improving students' attitudes toward learning (Tatlı et al., 2023). Moreover, Bayrak and Liman-Kaban (2024) investigated the adoption of gamified web tools among Turkish K-12 teachers, emphasizing the critical role of teacher readiness and motivation in ensuring the effective implementation of gamification strategies.

Furthermore, the integration of gamification into Turkey's Education Informatics Network (EBA) highlights its potential to mitigate educational disparities and promote inclusivity, as noted by Altınpulluk (2021). Akgün and Köse (2020) underscore the importance of adopting systematic approaches to gamification within Turkish education systems, advocating for research-driven strategies to maximize its effectiveness. Similarly, Bolat and Göksu (2021) found that gamified learning experiences grounded in the ARCS motivational model significantly enhanced student engagement and academic performance, further aligning with the findings of this study.

Emerging technologies, including artificial intelligence (AI) and virtual reality (VR), are transforming the landscape of gamified learning by enabling more personalized and immersive educational experiences, as highlighted by Liu et al. (2023) and Ouyang et al. (2021). López, A. A., Gu, L., & Zapata-Rivera, D. (2024) emphasize the transformative potential of AI in education, particularly through adaptive learning environments that address individual learner needs. Similarly, Murillo-Zamorano et al. (2023) investigate the role of gamification in higher education, identifying key research avenues to enhance student engagement further and optimize learning outcomes.

The emotional and social dimensions of gamification also merit significant attention. Fitriya, Sari, and Yudianto (2024) illustrate how gamified systems alleviate learning-related stress by setting clear goals and offering

immediate feedback, enabling students to maintain control over their progress. Incremental challenges within gamified environments bolster student confidence by fostering a sense of accomplishment, as highlighted by Zainuddin et al. (2020). However, Tam, Ron, and Kwok (2024) caution against an over-reliance on extrinsic rewards, emphasizing the necessity of meaningful design to sustain intrinsic motivation. Additionally, Kuo and Chuang (2024) underscore the role of collaborative gamified activities in enhancing peer learning and communication, thereby fostering stronger social bonds among students.

However, several challenges persist. Over-reliance on extrinsic motivators, as highlighted by Deci and Ryan (2020), may undermine the cultivation of intrinsic motivation, especially in settings where gamification is implemented without alignment with clear pedagogical objectives. Moreover, Szabó and Kopinska (2023) draw attention to accessibility barriers, which significantly impede the effective adoption of gamified systems in under-resourced regions. Overcoming these obstacles necessitates a collaborative effort among educators, policymakers, and developers to create gamified solutions that are both inclusive and pedagogically robust.

Future opportunities in gamification lie in harnessing emerging technologies such as artificial intelligence (AI) and virtual reality (VR) to deliver personalized and immersive learning experiences. AI-driven gamified systems, for instance, can dynamically adapt challenges to suit individual learners' skill levels, thereby maintaining engagement and ensuring an optimal level of difficulty (Kumar & Shiratuddin, 2020). Similarly, VR can bridge the gap between theoretical concepts and practical applications, allowing learners to relive historical events or perform scientific experiments in simulated environments (Ouyang et al., 2021). Additionally, Nguwi (2023) highlights the potential of blockchain technologies in establishing secure gamified ecosystems, further broadening the scope of gamification in education.

To fully realize the potential of gamification, a holistic approach is crucial that prioritizes student-centered design, fosters continuous research, and encourages active collaboration among key stakeholders. By effectively addressing its limitations and leveraging its strengths, gamification holds the promise to transform the educational landscape, making learning more engaging, inclusive, and impactful.

Limitations
Despite its numerous advantages, implementing gamification in education comes with challenges that require careful consideration. A key concern is the potential over-reliance on extrinsic rewards. While badges, points, and leaderboards can serve as effective initial motivators, they risk undermining intrinsic motivation over time if not complemented by meaningful learning activities (Kumar & Shiratuddin, 2020; Ryan & Deci, 2020). This underscores the necessity of designing gamification strategies that strike a balance between intrinsic and extrinsic motivators to maintain long-term engagement.

Accessibility remains a critical challenge. In many regions, particularly in developing countries, schools often lack the technological infrastructure necessary to support gamified learning platforms. Szabó and Kopinska (2023) highlight how this disparity can impede the adoption of innovative teaching methods, further widening educational inequalities. For instance, while urban schools may integrate gamification with relative ease, rural areas with limited internet access and outdated devices face significant barriers in providing comparable opportunities.

Cultural factors play a significant role in determining the effectiveness of gamification. Gamified tools that do not account for local cultural contexts may struggle to engage students, thereby limiting their impact. Altınpulluk (2021) highlights the importance of culturally relevant designs, suggesting the integration of traditional games or culturally significant elements to enhance inclusivity and relatability.

Moreover, the steep learning curve for educators continues to pose a significant barrier to the effective implementation of gamification. Teachers often need extensive training to seamlessly integrate gamified systems into their instructional practices. Without adequate support, gamification risks becoming an additional burden rather than a valuable facilitative tool (Ryan & Deci, 2020; Ouyang et al., 2021). Overcoming this challenge requires comprehensive professional development programs and sustained access to resources that empower educators.

These limitations highlight the necessity of a collaborative approach that brings together policymakers, educators, and technology developers to address these barriers effectively. By tackling these challenges, gamification can fully realize its potential as a transformative strategy for enhancing education.

Conclusion

Gamification represents a paradigm shift in education, introducing an innovative approach to teaching and learning that goes beyond traditional methodologies. Integrating game-based elements into educational practices has the potential to revolutionize student engagement, fostering deeper understanding, enhanced collaboration, and sustained motivation. However, its successful implementation relies on effectively addressing key challenges, such as over-reliance on extrinsic rewards, accessibility limitations, and the critical need for comprehensive teacher training.

The integration of emerging technologies, such as artificial intelligence (AI) and virtual reality (VR), paves the way for new possibilities in gamified learning, offering personalized and immersive experiences tailored to the unique needs of individual learners. When combined with culturally relevant designs, these advancements have the potential to bridge educational disparities and foster inclusivity, particularly in diverse and under-resourced contexts.

To fully harness the potential of gamification, a collaborative effort among educators, policymakers, and technology developers is essential. These efforts should prioritize the development of pedagogically sound systems that are aligned with curriculum objectives and designed to meet the diverse needs of learners. Continuous research and evaluation remain critical for refining gamification strategies, ensuring their long-term effectiveness, and adapting to the ever-evolving educational landscape.

By embracing gamification as a complementary tool rather than a substitute for traditional methods, education systems can unlock its potential to foster more engaging, equitable, and inspiring learning environments. In this way, gamification can play a pivotal role in reimagining education to meet the challenges and seize the opportunities of the 21st century.

Authors' Contributions

Ziya Görkem Celasun: Research design and manuscript drafting.
Assoc. Prof. Senem Üstün Kaya: Critical revision, validation of the findings, and final manuscript approval.

References

Altınpulluk, H. (2021). Gamification in Turkish education: Opportunities and challenges. Turkish Online Journal of Educational Technology, 20(1), 1–11.

Bayrak, C., & Liman-Kaban, A. (2024). Understanding the adoption and usage of gamified web tools by K-12 teachers in Turkey: A structural equation model. Education and Information Technologies.

Bolat, Y. İ., & Göksu, İ. (2021). Kahoot! as a gamification tool in vocational education: More positive attitude, motivation, and less anxiety in EFL. Journal of Computer and Education Studies.

Fitriya, Y., Sari, F. P., & Yudianto, A. (2024). Blended learning and gamification: Creating engaging curricula in flexible education systems. Asian Education Studies.

Kalleny, N. K. (2020). Advantages of Kahoot! game-based formative assessments along with methods of its use and application during the COVID-19 pandemic in various live learning environments. Journal of Microscopy and Ultrastructure, 8(4), 121–129.

Köse, U., & Akgün, E. (2020). Gamification in education: A systematic review and research agenda for Turkish education systems. Journal of Educational Technology, 15(3), 45–58.

Kumar, J., & Shiratuddin, M. F. (2020). Gamification in education: AI-driven personalized learning systems. International Journal of Learning Technology, 15(1), 1–20.

Kuo, M. S., & Chuang, T. Y. (2024). How gamification motivates visits and engagement for online academic dissemination: An empirical study. Computers in Human Behavior.

Liu, Y., et al. (2023). Assessing the Effectiveness of the Mobile Serious Game "SpacEscape" in Enhancing Understanding of the Solar System among Middle School Students. Frontiers in Education.

Loewen, S., Isbell, D. R., & Spino, L. (2020). The effectiveness of app-based language learning tools: A meta-analysis of research on Duolingo. Computer Assisted Language Learning, 33(7), 740–763.

López, Gu, and Zapata-Rivera (2024) discuss the potential of generative AI to personalize learning experiences while addressing associated challenges.

Murillo-Zamorano, L. R., et al. (2023). Gamification in Higher Education: A Systematic Review and Future Research Agenda. Journal of Applied Research in Higher Education.

Nguwi, Y. Y. (2023). Technologies for Education: From Gamification to AI-enabled Learning. International Journal of Multidisciplinary Perspectives in Higher Education, 8(1), 111–132.

Ouyang, F., Chang, M., Liu, Z., & Zhang, Y. (2021). Artificial intelligence and gamified learning environments: A systematic review of trends and future directions. Computers & Education: Artificial Intelligence, 2, 100012.

Ryan, R. M., & Deci, E. L. (2020). Intrinsic and extrinsic motivations: Classic definitions and new directions. Contemporary Educational Psychology, 61, 101860.

Rizzo, S., & Cavallaro, A. (2024). Exploring perceptions in the math teacher-student relationship through gamification. INTED2024 Proceedings.

Sen, A. (2024). Investigating a motivation model for gamified e-learning: A mixed methods approach. Plymouth University Repository.

Subhash, S., & Cudney, E. A. (2020). Gamified learning in higher education: A systematic review of the literature. Computers in Human Behavior, 87, 192–206.

Tatlı, Z., Gülay, A., & Mert, A. (2023). Impact of Gamification Applications on Students' Attitudes towards Lesson and Procrastination Behaviors. International Journal of Contemporary Educational Research, 10(2), 522–534

Tam, D. M. Y., Ron, C. W., & Kwok, S. I. (2024). Roles of technology-mediated gamification on youth mental health. Journal of Work, Education, and Social Studies

Zainuddin, Z., Abdullah, N. A., & Majid, A. H. A. (2020). Exploring students' competence, autonomy, and relatedness in the flipped classroom pedagogical model. Journal of Learning Design, 13(3), 52–63.

Investigating the Perceived Effectiveness of ChatGPT in Facilitating Learning

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ABSTRACT
This study explores the development and evaluation of a chatbot model designed to facilitate learning within a department of a university. The project aims to enhance the learning experience by incorporating customized data into the chatbot's knowledge base, enabling personalized and context-aware interactions. The research investigates the effectiveness of the chatbot model in improving learning outcomes, enhancing user engagement, and providing tailored support to students in the department.
The development of the chatbot model is detailed, including technology selection, data acquisition, preprocessing, and model architecture. The study also demonstrates creating web applications by Streamlit, Vector Database by Supabase, and graphical user interface by Tkinter.
The chatbot model demonstrates its effectiveness in enhancing the learning experience within the department. By continuously refining the model and exploring advancements in technology, chatbots have the potential to become integral tools in future educational practices, providing personalized and engaging learning experiences.
Keywords: ChatGPT, Chatbot model, Steamlit

INTRODUCTION
The development of chatbot models has been greatly influenced by existing systems, such as the chatbot provided by the City University of Hong Kong. These systems have demonstrated the potential of using chatbots to enhance user experiences and provide valuable services. The City University chatbot, powered by the Microsoft Azure OpenAI (City University of Hong Kong, n.d.), has shown the effectiveness of utilizing advanced language models to engage in natural language conversations with users.

However, while the City University chatbot relies solely on the ChatGPT (City University of Hong Kong, n.d.), there is an opportunity to create a chatbot that goes beyond generic responses and incorporates customized data. By leveraging customized data, the chatbot can provide users more targeted and tailored information, enhancing the overall user experience.

The motivation behind creating a chatbot with customized data is the need for a more personalized and context-aware conversational agent. Traditional chatbots often struggle to understand specific domain knowledge or provide specialized information. By incorporating customized data, the chatbot can address this limitation and offer more accurate and relevant responses to user queries.

The project aims to develop a chatbot that utilizes a combination of advanced language models and domain-specific data. Integrating customized data into the chatbot's knowledge base can provide specialized information and cater to specific user needs. This approach allows for a more comprehensive and accurate understanding of user queries, leading to more meaningful and contextually relevant responses.

Customized data also opens up opportunities for the chatbot to engage in domain-specific discussions and provide targeted recommendations. For example, in an educational context, the chatbot can leverage course materials, textbooks, or research papers to offer in-depth explanations, suggest relevant resources, and guide learners through specific topics. This personalized approach enhances the learning experience and provides users with valuable, tailored information.

Industry developments and research studies have highlighted the value of incorporating customized data into chatbot models. By leveraging domain-specific knowledge and data, chatbots can provide more accurate information, enhance user engagement, and improve overall performance. The project aims to build upon these advancements and contribute to the growing field of chatbot development.

The project background emphasizes the influence of existing chatbot systems. However, the project seeks to go beyond generic responses by incorporating customized data into the chatbot model. This approach aims to provide more personalized and context-aware interactions, catering to specific user needs and offering specialized information. By leveraging customized data, the project aims to enhance the user experience, improve response accuracy, and contribute to the advancement of chatbot technologies.

METHODOLOGY
This section outlines the methodology employed in developing the chatbot model for facilitating learning. The steps involved in the development process are described below:

1. Interacting with the OpenAI API
The research team leveraged the capabilities of the OpenAI API to develop the chatbot model. The API allowed the team to interact with a powerful language model and utilize its natural language processing capabilities. By sending prompts and receiving model-generated responses, the team could engage in a dialogue with the chatbot and incorporate its responses into the model's training data.
2. Collecting and preparing data from the department website
Data was collected from the department website to train the chatbot model. This data included frequently asked questions, course information, and other relevant resources. The collected data underwent a preprocessing stage to ensure its suitability for training the chatbot model. Preprocessing techniques such as removing HTML tags, normalizing text, and handling duplicates were applied to enhance the quality and consistency of the data. This preparation step aimed to improve the chatbot's understanding and generation of appropriate responses.
3. Creating the bot
The development of the chatbot involved designing the bot's architecture, algorithms, and underlying technologies. The architecture was designed to enable efficient information retrieval and response generation. The team implemented algorithms for natural language understanding and generation, which allowed the chatbot to comprehend user queries and generate relevant and coherent responses. Design decisions were made to balance the chatbot's responsiveness, accuracy, and user-friendliness. These decisions were guided by the research objectives of facilitating learning and providing personalized support to users.
4. Creating the user interface
The user interface for the chatbot was developed to ensure a seamless and intuitive user experience. The interface design incorporated user-centered principles, aiming for simplicity, clarity, and ease of use. Considerations were made to enhance usability, such as providing clear instructions, intuitive navigation, and appropriate visual cues. The user interface implementation focused on integrating the chatbot model's functionalities into a user-friendly interface, enabling users to interact with the chatbot easily and access relevant learning resources.

In addition to the specific steps mentioned above, the overall methodology of the research study employed various techniques for data collection, evaluation, and assessment of the chatbot model's effectiveness. Data collection involved gathering user interactions and feedback, which provided valuable insights into the users' experiences and perceptions of the chatbot. Evaluation techniques included pre- and post-testing to assess learning outcomes, user surveys to measure user satisfaction and engagement, and usage analytics to track patterns of interaction.

The chosen methodology aligns with the research objectives of evaluating the effectiveness of the chatbot model in facilitating learning. By collecting user data, the study aims to gain a comprehensive understanding of the chatbot's impact on learning outcomes and user engagement. The evaluation techniques employed provide quantitative and qualitative measures to assess the effectiveness of the chatbot model in achieving its intended purpose.

Overall, the methodology employed in developing the chatbot model includes interacting with the OpenAI API, collecting and preparing data from the department website, creating the chatbot and its user interface, and employing various data collection and evaluation techniques. This methodology ensures a systematic approach to the development and assessment of the chatbot model, facilitating the achievement of the research objectives.

DEVELOPMENT
1. Interacting with the OpenAI API
The first step of the dissertation's model development session focused on interacting with the OpenAI API, specifically utilizing the GPT-3.5 model. In order to explore the capabilities of the API, a website application was developed using Streamlit (Streamlit Inc., 2024). This application serves as a chatbot powered by the GPT-3.5 model, allowing users to engage in natural language conversations.

By integrating the OpenAI API into the website application (OpenAI API, n.d.), the performance of the GPT-3.5

model was tested and evaluated in a practical setting. This involved sending prompts or queries from the users to the API and receiving responses generated by the model. The interactions between the users and the chatbot provided valuable insights into the model's language understanding, response generation, and overall conversational abilities.

Furthermore, the fine-tuning feature offered by the OpenAI API was investigated (OpenAI API, n.d.). To employ this functionality, relevant data from the department website was gathered, ensuring it was representative of the domain or topic of interest. This data collection process involved organizing and curating the information to create a suitable training dataset.

Once the dataset was prepared, it was uploaded to the OpenAI API to initiate the fine-tuning process. This involved training a specialized model that was specifically tailored to better understand and respond to queries related to the department. By fine-tuning the base GPT-3.5 model with domain-specific data, the objective was to enhance the chatbot's performance within the context of the department.

Overall, this initial phase of the dissertation's model development session was to evaluate the OpenAI API's capabilities by building a chatbot application and testing it with the GPT-3.5 model. Additionally, the potential of fine-tuning the model using domain-specific data was explored, specifically collected from the department website, in order to improve the chatbot's performance within the targeted domain.
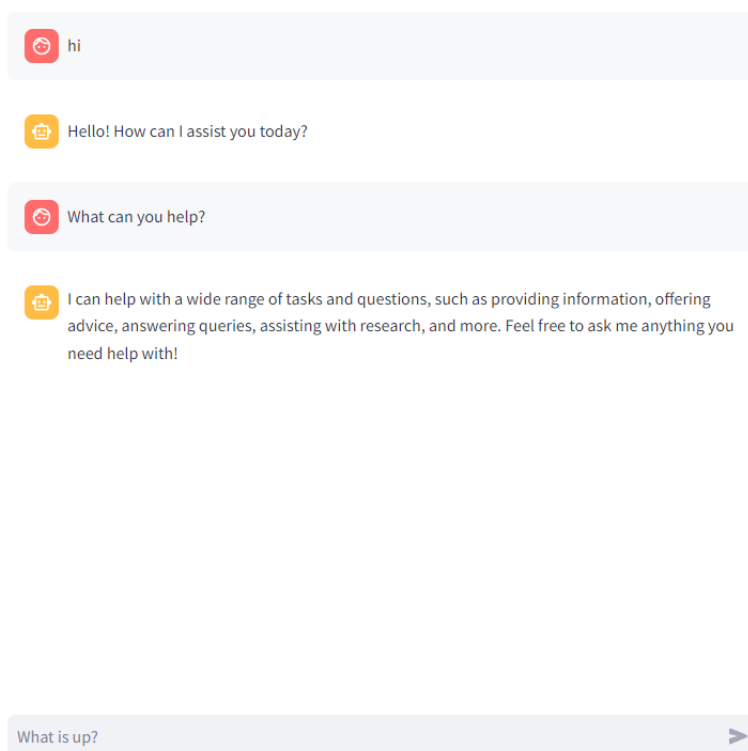
Figure 1 Website application developed using Streamlit

2. Collecting and preparing data from the department website

The second step of my dissertation's model development session focused on collecting and preparing data from the website at https://www.cityu.edu.hk//. In order to gather the necessary information, web scraping techniques were employed using Python Selenium (Muthukadan, 2024).

However, during the web scraping process, challenges were encountered due to the irregular format of the department's website. This irregularity made it difficult to apply a uniform scraping approach across all sections of the website. As a result, a combination of web scraping and manual work was resorted to ensure comprehensive data collection.

The specific sections on the website that were of interest to my research were identified: People, Programmes, Student Life, Laboratories, Job Opportunities, and Contact Us. These sections contained valuable information

related to the department's faculty, academic programs, student activities, research laboratories, employment opportunities, and contact details.

Scraping scripts tailored to each section were implemented using Python Selenium, extracting relevant text and data. However, due to the irregular structure of the website, manual intervention was necessary to handle certain sections where automated scraping proved challenging.

A text file was chosen to use to organize and store the collected information, which served as a convenient and flexible format for data storage. The extracted information from each section, ensuring accuracy and completeness, was meticulously recorded.

By successfully collecting data from the identified sections of the website, valuable insights and content were obtained that could be utilized for various purposes within the dissertation's model development. This data would serve as the foundation for training and fine-tuning the GPT-3.5 model, enabling it to provide accurate and relevant responses within the domain of the department.
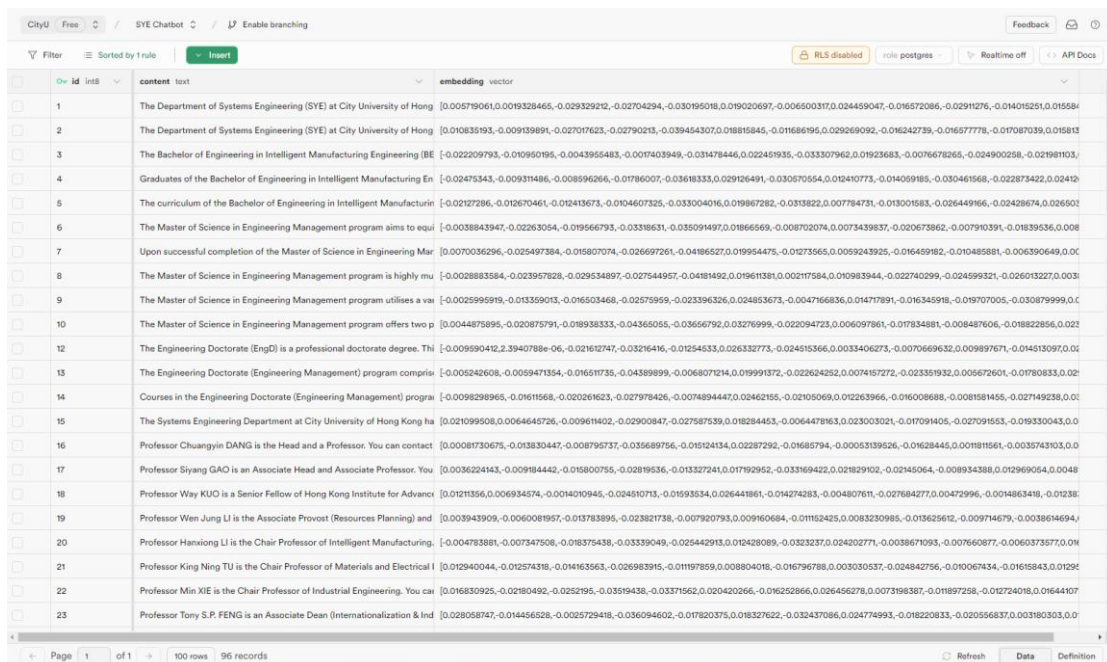
Overall, the data collection process involved a combination of web scraping using Python Selenium and manual work to overcome the irregular format of the department's website. The collected information was stored in a notepad, providing a centralized repository of data for further processing and analysis in the dissertation.

3. *Creating the bot*
The third step of my dissertation focused on developing a conversational bot capable of retrieving relevant information based on user input. To accomplish this, the OpenAI API was utilized to embed text and Supabase as a Vector Database.

In the previous step, a substantial amount of data that would serve as the basis for the bot's knowledge was collected. This information needed to be transformed into a suitable format for comparison and retrieval. Moreover, the OpenAI API's embedding capability was employed, specifically utilizing the "text-embedding-ada-002" model. This model converted textual information into vector representations, which capture the semantic meaning of the text.

Once the data was transformed into vector form, both the original information and its corresponding vector representation in a Vector Database provided by Supabase (Supabase Inc., n.d.) were stored. It offers a convenient platform for managing and querying vector-based data efficiently.

Figure 2 Vector Database created using Supabase

A process that begins with user input was designed to retrieve relevant information from the database. When a user

interacted with the bot, their input was first sent to the OpenAI API to perform text embedding. The API converted the input into a vector representation using the same "text-embedding-ada-002" model.

After obtaining the vector representation of the user's input, a pre-defined function in Supabase was invoked to compare this vector with the vectors stored in the database. The function identified the most closely related information entries by measuring the similarity between vectors.

The output of this process was then provided to the user as the bot's response, comprising the most relevant information retrieved from the database. However, if the similarities between the user's input vector and the stored vectors fall below a pre-set threshold, it indicates a lack of closely related information. The user was notified that no relevant information could be found in such cases.

This approach allowed the bot to effectively retrieve and present information based on user queries, leveraging the power of text embedding and vector comparison. By combining the capabilities of the OpenAI API and Supabase, a robust system has been developed to create an intelligent conversational bot that could provide meaningful responses to user inquiries.

4. Creating the graphical user interface

The fourth step of the dissertation focused on developing a graphical user interface (GUI) to enhance the usability and accessibility of the conversational bot. This step involved utilizing Tkinter (Python Software Foundation, 2024), a Python library, to design and implement the GUI application.

To begin, icons and logos were incorporated into the GUI application to create a visually appealing and recognizable interface. These visual elements help users identify and connect with the bot, giving the application a more professional and polished appearance, as shown in Figure 3.

Figure 3 GUI application created using Tkinter

Within the GUI, users can input their questions or queries into a designated text input box. This input serves as the user's interaction with the bot and is the starting point for retrieving relevant information. The text input box allows users to enter their queries in a user-friendly manner easily.

The functions developed in the previous step were integrated into the GUI application to facilitate the retrieval of information. These functions are triggered when the user presses the submit button after entering their query. The functions take the user's input, convert it into vector form using the OpenAI API, and compare it with the vectors stored in the Supabase Vector Database. The result of this comparison is then displayed in another text box within the GUI.

The Python program was converted into an executable file (.exe) using the "auto-to-py-exe" module (Vollebregt,

2024) to enhance the usability and distribution of the application. This conversion allows users to run the application without having to install Python on their computers, making it more accessible to a wider audience.
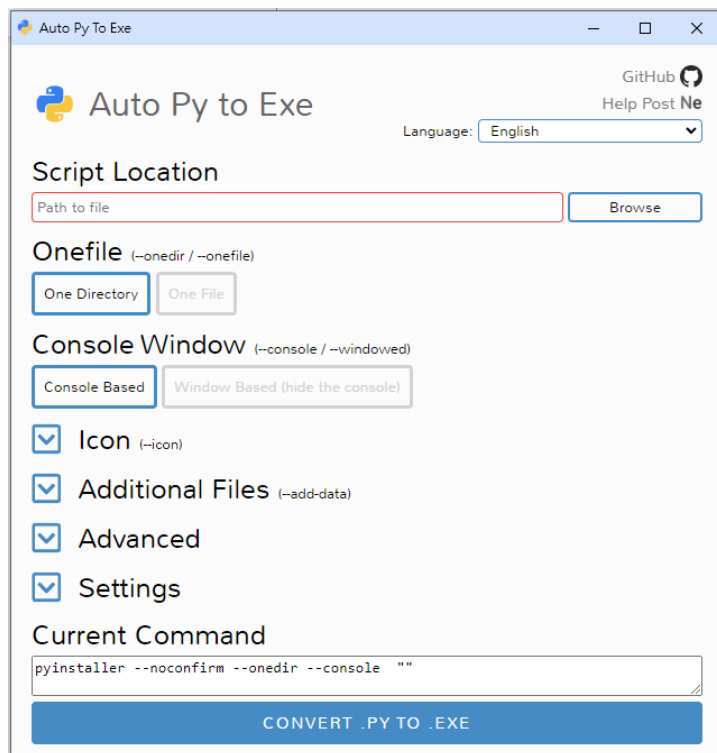
Figure 4 Python auto-to-py-exe module

In addition, an installer was created for the entire application using NSIS (Nullsoft Scriptable Install System) (NSIS, 2024). This installer ensures that all the necessary components and files are packaged together so users can install the application seamlessly without missing any dependencies. The installer simplifies the installation process and provides a smooth user experience.
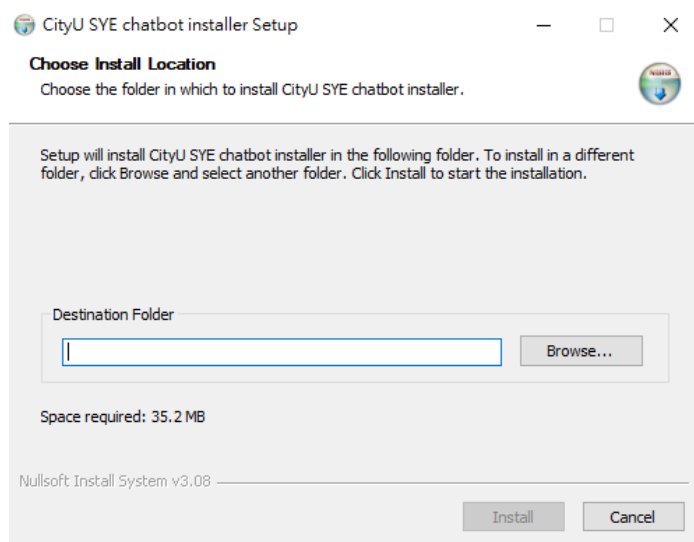
Figure 5 Chatbot installer created using NSIS

By creating a user-friendly GUI, converting the program to an executable file, and generating an installer, the conversational bot application has been made more accessible, convenient, and user-friendly. These steps ensure that users can interact with the bot effortlessly without any technical barriers or installation concerns.

ANALYSIS

The analysis section of this dissertation report focuses on evaluating the effectiveness of the chatbot model developed for facilitating learning. The key findings and insights obtained from the evaluation process are highlighted, emphasizing the impact and implications of the chatbot model on the learning outcomes of the target audience.

One of the primary objectives of this research was to explore the capabilities of the OpenAI API, specifically the GPT-3.5 model, in developing a chatbot for facilitating learning. Through the integration of the API into a website application, users were able to engage in natural language conversations with the chatbot. The evaluation of the chatbot's performance provided valuable insights into the model's language understanding, response generation, and conversational abilities.

The findings from the evaluation process indicated that the GPT-3.5 model demonstrated strong language understanding capabilities. It was able to comprehend and interpret user queries accurately by embedding user queries into vector form, allowing for meaningful and contextually relevant responses. The chatbot then provides users with the information they were seeking.

Moreover, the evaluation revealed that the chatbot's conversational abilities were effective in facilitating learning. Users were able to engage in interactive conversations with the chatbot, asking questions and receiving informative responses. The chatbot acted as a virtual assistant, getting users the most relevant resources and information from the Vector Database.

The evaluation process also highlighted the impact of fine-tuning the GPT-3.5 model using domain-specific data. By training the model with data collected from the website, the chatbot's performance within the context of the department was significantly improved. The fine-tuned model demonstrated a deeper understanding of -related topics and was able to provide more accurate and specialized responses.

Overall, the analysis of the chatbot model's effectiveness in facilitating learning revealed several key findings. The GPT-3.5 model exhibited strong language understanding capabilities and was able to generate coherent and contextually relevant responses. The chatbot's conversational abilities effectively facilitated learning, providing personalized recommendations and resources to users. Additionally, the fine-tuning of the model using domain-specific data enhanced its performance within the targeted domain.

The implications of these findings are significant in the field of education and learning. The development and implementation of chatbot models for learning purposes can offer a scalable and accessible solution to support learners in acquiring knowledge and navigating educational resources. The personalized nature of the chatbot's interactions enhances user engagement and promotes effective learning outcomes.

In conclusion, the evaluation of the chatbot model developed for facilitating learning demonstrated its effectiveness in supporting learners and providing valuable educational resources. The strong language understanding capabilities, personalized recommendations, and the impact of fine-tuning the model within a specific domain contribute to its potential as a valuable tool in the field of education. Further research and development in this area can lead to advancements in intelligent learning systems and enhance the overall learning experience for students.

CONCLUSION

In conclusion, the evaluation of the chatbot model developed for facilitating learning has provided valuable insights into its effectiveness and impact on the learning outcomes of students. The analysis revealed that the chatbot demonstrated strong language understanding and response generation capabilities, offering accurate and contextually appropriate answers to user queries. Its integration into the learning process had several positive implications, including instant access to relevant information, the promotion of self-directed learning, and the creation of an interactive learning environment. However, there is still room for improvement in the chatbot's performance, particularly in understanding complex queries and providing nuanced responses. Overall, the findings highlight the potential of chatbot technology in enhancing educational experiences and suggest avenues for further research and improvement.

The chatbot model proved to be a valuable resource for students, providing instant access to relevant information and saving time and effort in searching for resources. By leveraging the vast knowledge base of the website, the chatbot efficiently retrieved specific information on faculty, programs, student life, laboratories, job opportunities, and more. This instant access enhanced the learning experience, allowing students to quickly find answers to their questions and explore various aspects of the department. The chatbot can provide personalized guidance and

support promoted self-directed learning, empowering students to engage in the learning process and clarify doubts actively. The conversational nature of the chatbot facilitated a more interactive and dynamic learning environment, fostering deeper understanding and exploration of topics of interest.

While the chatbot model demonstrated promising performance, there are areas that require further improvement. In some instances, the chatbot struggled to understand unrelated queries or provide nuanced responses. To address these limitations, fine-tuning the model with additional data and incorporating user feedback is recommended. Fine-tuning the model using a larger dataset of domain-specific information from the department could enhance its domain knowledge and improve its response accuracy. Furthermore, actively seeking user feedback and iteratively refining the model based on user interactions can enhance its conversational abilities and adaptability to user needs. Regular updates and maintenance of the chatbot's Vector Database are essential to ensure that it remains up-to-date with the department's evolving information and requirements.

In addition to improving the chatbot model, future research can explore several avenues to further enhance the effectiveness of chatbots in facilitating learning. Firstly, integrating natural language processing techniques and machine learning algorithms can enable the chatbot to understand and generate more complex responses. This could involve leveraging pre-trained models, such as GPT-3.5, and exploring advancements in language models to enhance the chatbot's capabilities. Secondly, incorporating multimodal capabilities, such as text-to-speech and speech recognition, can enable the chatbot to cater to different learning preferences and accessibility needs. By providing audio-based responses or accepting voice inputs, the chatbot can offer a more inclusive learning experience. Additionally, integrating the chatbot into learning management systems or educational platforms can further enhance its accessibility and seamless integration into existing educational workflows.

Furthermore, the impact of the chatbot model on learning outcomes can be assessed through longitudinal studies and comparisons with traditional learning approaches. Conducting follow-up studies to evaluate the long-term effects of the chatbot on students' knowledge retention, academic performance, and overall learning experience can provide deeper insights into its effectiveness. Comparing the performance and satisfaction of students using the chatbot with those relying solely on traditional learning resources can help assess the added value and benefits of the chatbot in educational settings.

The evaluation of the chatbot model developed for facilitating learning has demonstrated its effectiveness in providing timely and relevant information, promoting self-directed learning, and creating an interactive learning environment. The findings underscore the potential of chatbot technology in enhancing educational experiences and improving learning outcomes. By fine-tuning the model, incorporating user feedback, and exploring new avenues for improvement, chatbots can continue to evolve as valuable tools for facilitating learning in various educational contexts. As technology advances and research progresses, chatbots have the potential to become integral components of future educational practices, supporting learners in their quest for knowledge and fostering a more engaging and personalized learning experience.

REFERENCES

City University of Hong Kong. (n.d.). *CityU GPT Chatbot Service*. Retrieved June 3, 2024, https://www.cityu.edu.hk/GenAI/#cityu-gpt

Muthukadan, B. (2024). *Selenium with python¶*. Selenium with Python - Selenium Python Bindings 2 documentation. Retrieved June 3, 2024, from https://selenium-python.readthedocs.io/

NSIS. (2024, March 30). *Main page*. NSIS Wiki. Retrieved June 3, 2024, from https://nsis.sourceforge.io/Main_Page

OpenAI API (n.d.). Introduction. Documentation. Retrieved June 3, 2024, from https://platform.openai.com/docs/introduction

Python Software Foundation. (2024, June 2). *Graphical user interfaces with TK*. Python documentation. Retrieved June 3, 2024, from https://docs.python.org/3/library/tk.html

Streamlit Inc. (2024). Build a basic LLM chat app. Documentation. Retrieved June 3, 2024, from https://docs.streamlit.io/develop/tutorials/llms/build-conversational-apps

Supabase Inc. (n.d.). *Main menu*. Supabase Python Client - Introduction. Retrieved June 3, 2024, from https://supabase.com/docs/reference/python/introduction

Vollebregt, B. (2024, March 25). *Auto-py-to-exe*. PyPI. Retrieved June 3, 2024, from https://pypi.org/project/auto-py-to-exe/

The Relationship Between Digital Competence and Cyberbullying in Fourth-Grade Students

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Abstract

Digital natives, who encounter technology from the moment they are born, are individuals whose lives revolve around new technologies. Children must stay safe in online environments. Understanding the relationship between their digital competencies and cyberbullying can assist in developing effective strategies to enhance online safety. This study aims to examine the relationship between children's digital competencies and cyberbullying using data obtained from 108 fourth-grade students. In the data collection process, a scale was used to determine digital competencies, and two different scales were used to measure children's cyberbullying behaviors and exposure to cyberbullying. The data obtained were analyzed using a correlation test. The findings of the study show that there is a negative relationship between children's digital competence levels and cyberbullying. The findings suggest that students with higher levels of digital competence are less likely to experience cyberbullying and exhibit fewer cyberbullying behaviors. This study is an important step toward understanding the relationship between children's digital competence and cyberbullying. Furthermore, a detailed analysis of 4th-grade students' digital competencies is also presented. As a result of this analysis, it was found that children's digital competencies were at a medium level. The findings may be the basis for preparing educational programs to increase children's digital competencies. Despite its contributions, the study is limited by the relatively small sample size, and the reliance on self-reported data, which may introduce response biases.

Keywords: Digital competence, Cyberbullying, Children, Fourth-grade, Online safety, Correlation analysis, educational programs

INTRODUCTION

In today's digital landscape, children's interactions with technology significantly shape their experiences and social interactions. The 'Survey on Children's Use of Information Technologies' was conducted regarding the computing technologies used by children. Internet usage among children aged 6-15 reached 82.7% in 2021 (TUIK, 2021). This high level of internet usage emphasizes the critical role of digital competency in enabling children to navigate the digital world effectively and safely.

The European Commission (2017) defines digital competencies as the confident and critical use of information and communication technology for work, leisure, and communication. This includes navigating digital interfaces, using software applications, understanding digital communication tools, critically evaluating online content, managing digital privacy and security, and responsibly participating in online communities (Livingstone & Helsper, 2007). Overall, digital competencies enable children to engage productively and confidently in the digital world while minimizing risks associated with online activities.

In the contemporary digital landscape, children's interactions with technology have become increasingly ubiquitous, shaping how they communicate, learn, and navigate the world around them. With the proliferation of digital platforms and online communication channels, children are not only exposed to vast opportunities for learning and socialization but also face new challenges, including the risk of cyberbullying. Cyberbullying can be defined as the deliberate and repeated use of digital communication platforms, such as social media, websites, and messaging apps, to intimidate, harass, or harm others (Hinduja & Patchin, 2015). The anonymity and accessibility of digital platforms make cyberbullying particularly pervasive and harmful.

It may be important for children to be digitally competent to prevent them from engaging in cyberbullying behaviors and experiencing victimization in this regard. Therefore, this study aims to examine the relationship between children's digital competencies and cyberbullying. This research is guided by the hypothesis that children with higher levels of digital competencies may be better equipped to navigate online environments safely and responsibly, reducing their vulnerability to cyberbullying. Conversely, children with lower digital competencies may face heightened risks of encountering cyberbullying or engaging in problematic online behaviors.

Literature Review

The prevalence of cyberbullying among children and adolescents has raised significant concerns regarding their well-being and safety in the digital realm. Understanding the intricate relationship between children's digital competencies and cyberbullying experiences is crucial for developing effective preventive measures and interventions. This literature review synthesizes existing research to explore the interplay between children's digital competencies and the levels of cyberbullying they encounter.

Research has indicated that young children can start operating digital devices from early childhood (Moriguchi et al., 2020). Furthermore, exposure to digital devices has been linked to positive and negative outcomes in children, such as better digital skills and potential language skill deficits (Moriguchi et al., 2020; Operto et al., 2020). The use of technology increases significantly after age 10, suggesting a critical period for developing children's digital competencies (Iwanicka, 2021).

For that reason, numerous studies have been conducted on digital competence and its correlation with cyberbullying. Seçkin-Kapucu, Özcan, and Karakaya-Özer (2021) examined the relationship between middle school students' digital literacy levels, social media usage purposes, and the frequency of experiencing cyberbullying. A relational model was used in the research. The study sample consists of 476 middle school students aged 10-13. The "Digital Literacy Scale," "Social Media Usage Purposes Scale," and "Cyberbullying Threat Level Scale" were used to obtain the data. As a result, digital literacy had a weak positive relationship with being exposed to and witnessing cyberbullying. The concepts of digital literacy and digital competence are distinct, with digital literacy typically encompassing more general knowledge and skills related to information retrieval, critical thinking, and basic digital tool usage. On the other hand, digital competence emphasizes technical skills and the ability to use digital technologies meaningfully in various contexts, including work, education, and daily life.

A study by Zhou (2023) investigated the digital competence levels of Chinese higher education students and identified significant variations in digital competence among students in different academic years. The study focuses on university students as participants, with no existing research available on the digital competence levels of children.

The study by Singh and Kumar (2023) attempts to unveil the relationship between digital competence and cybercrime victimization among university students. The data for the study was collected from 150 participants. The two variables were found to be negatively correlated. The results of the study imply that individuals who are high on digital competence encounter less cybercrime victimization. The study was conducted with university students. However, it should not be forgotten that the age of starting to use digital tools, and the internet has decreased. It is necessary to investigate digital competence in children.

Su and Yang (2024) analyzed 23 articles on digital competence published between 2012 and 2022. As a result, most participants in the studies were pre-service teachers, and the primary research goals were to evaluate children's or teachers' achievements and participants' views on digital competence. Most studies adopted quantitative methods, and their findings were linked to achievements in digital competence, positive and negative perceptions, the effectiveness of teaching strategies, and factors contributing to the development of digital competence. Su and Yang (2024) did not report any articles examining the relationship between children's digital competence and cyberbullying.

The increasing prevalence of young children's use of digital devices underscores the importance of understanding the relationship between children's digital competence and cyberbullying. Understanding how digital skills influence cyberbullying incidents can aid in developing effective prevention strategies and interventions to create a safer online environment for children (Jones et al., 2023). Given the significant impact of cyberbullying on children's mental health and well-being, investigating the role of digital competencies in cyberbullying can provide valuable insights for educators, parents, and policymakers.

Despite the growing concern over cyberbullying, there is a gap in understanding how 4th-grade students' digital competencies relate to their involvement in cyberbullying incidents (Chen et al., 2021). The lack of research focusing specifically on this age group and their digital skills hinders the development of targeted interventions to address cyberbullying among younger students (Aizenkot & Kashy-Rosenbaum, 2020). An in-depth exploration of children's digital competencies in research can provide valuable insights into enhancing their digital literacy skills. For these reasons, the primary aim of this research is to investigate the relationship between 4th-grade students' digital competencies and cyberbullying behaviors, including both perpetration and victimization.

Furthermore, the study seeks to offer a comprehensive descriptive evaluation of the digital proficiencies exhibited by fourth-grade students.

METHOD
Research Model
The survey model was employed in this research to determine the existence and degree of relation between 4th-grade primary school students' digital competencies and cyberbullying, and it also aimed to provide a detailed descriptive analysis of the students' digital competencies. Survey models are models that have existed in the past or are research approaches that aim to describe an existing situation as it exists. Survey models also determine participants' views on a subject or their interests, skills, abilities, attitudes, etc. (Karasar, 2012). The research conducted on fourth-grade students did not involve any experimental intervention, biological data collection, or violation of human rights; therefore, ethics committee approval was not required.

Participants
The purposive sampling method, one of the non-random sampling types, was used to determine the research study group. The purposive sampling method is carried out on individuals with certain limiting characteristics and individual characteristics that are difficult to reach from the universe (Erkuş, 2005). The purposive sampling method subjectively selects sample units while selecting a sample that has the power to represent the universe (Büyüköztürk et al., 2010).

G power statistical program was used to calculate the sample size (Effect size: 0.3, $\alpha = 0.05$, Power (1- β err prob) = 0.95, Number of Group = 1) and as a result of the analysis, the sample size was calculated as 111. The study was conducted between 2023 and 2024 with a total of 108 students (54 female- 54 male); attending the 4th grade in a primary school affiliated to the Ministry of National Education in Tepebaşı district of Eskişehir. Before commencing data collection, parental consent was acquired for the participation of 10-year-old individuals.

Data Collection Tools
1. **The Digital Competency Scale**

The scale developed by Tüfekçi, and Ceylan (2022) was used to determine the digital competencies of 4th grade primary school students. To determine the validity and reliability of the scale, the scale was applied to 270 4th-grade students from 3 different schools. Exploratory factor analysis (EFA) revealed a structure with 4 factors and 14 items. Confirmatory factor analysis (CFA) revealed that the 4-factor structure; academic life, extracurricular activities, interaction with the environment, and commerce; was compatible. The Cronbach Alpha internal consistency coefficient for the whole scale is 0.71. It can be stated that the scale is valid and reliable. The 14 questions in the scale were graded from 1 to 3 on a scale of "1=Never", "2=Sometimes", "3=Always".

2. **The Cyberbullying Scales**

Cyberbullying is a multifaceted concept involving both the act of disturbing others and being disturbed by others. On one end, it encompasses the behavior of causing discomfort or harm to others, while on the other end, it involves experiencing discomfort or harm inflicted by others. Therefore, in this study, two scales related to cyberbullying have been utilized. The cyberbullying scales developed by Küçük (2016) and Arıcak, Kınay, and Tanrıkulu (2012) were utilized in this study.

The Cyberbullying Scale was developed by Stewart et al. in 2014. This scale is a tool used to determine the victimization aspect of cyberbullying. Küçük (2016) adapted this scale into Turkish. The scale was initially translated from English to Turkish by Küçük (2016) and then reviewed by two English linguists and a psychologist proficient in English. Subsequently, another English linguist translated it back to English. Discrepancies were compared with the original, and adjustments were made in collaboration with forensic sciences and forensic medicine experts, as well as a linguist proficient in English. In determining the validity and reliability of the scale, the 14-item Cyberbullying Scale was applied to 633 students aged between 10 and 18. The construct validity was examined by EFA, and it was seen that the scale showed a two-factor structure; emotional harm and humiliation, and exclusion and violence. The internal consistency reliability coefficient of the scale was tested with Cronbach's alpha analysis and .87 was found as a result. It can be stated that the scale is valid and reliable. 14 questions in the scale were graded from 1 to 3 on a scale of "1=Never", "2=Sometimes", "3=Always".

The cyberbullying scale developed by Arıcak, Kınay, and Tanrıkulu (2012) aims to determine cyberbullying behaviors in children. The content validity of the scale was examined by three experts working on this subject. In the study conducted to determine the validity and reliability, the participant group consisted of 515 students (247 boys and 268 girls) aged between 11 and 18. The construct validity was examined by EFA, and it was seen that the scale showed a single-factor structure. The Cronbach's alpha coefficient was .95 and the test-retest reliability coefficient was found to be .70. The data obtained indicate that the psychometric findings of the Cyberbullying

Scale are valid and reliable. 24 questions in the scale were graded from 1 to 3 on a scale of "1=Never", "2=Sometimes", "3=Always".

Data Collection and Analysis
Three different scales were applied to examine the relationship between children's digital competencies and cyberbullying. The scales were administered by the researcher at 2-week intervals in the spring semester of 2023-2004 to 108 students attending the 4th grade in a primary school. The scales were printed out, distributed to the students, and administered under the researcher's supervision. After completing the scale, the answer sheets of the students were collected.

Percentage (%), frequency (f), standard deviation (SD), and mean (x̄) of the data were determined. The data obtained in the study underwent examination to assess their distribution and determine if they conformed to a normal distribution. Analyses on whether the data are normally distributed were conducted on Kolmogorov-Smirnov, skewness, and kurtosis. A correlation test was used to determine the relationship between children's digital competencies and cyberbullying. Correlation is a type of analysis used to show whether there is a relationship between two or more measured variables, and if so, its direction and strength (Akbulut, 2010, p. 51). The analysis utilized data from the cumulative scores of respondents' answers on both the Digital Competence and Cyberbullying scales. The analyses were conducted using the SPSS software package.

FINDINGS
Descriptive Findings
The safety of children in digital environments primarily requires a high level of digital competence. Before providing training to enhance their digital competence, it is necessary to have a detailed understanding of children's current levels of digital competence. In this study, detailed descriptive analyses of the children's digital competence scale have been presented before examining the relationship between digital competence and cyberbullying. The digital competencies scale used to determine the digital competencies of 108 4th-grade students consists of four subtests. To facilitate a better understanding of the analyses, descriptive findings have been presented separately for each subtest. The first subtest is named "academic life" (1, 2, 3, 4, 5); the second subtest is named "extracurricular activities"(11, 12, 13, 14), the third subtest is named "interaction with the environment" (6, 7, 8) and the fourth subtest is named "commerce"(9, 10).
The findings regarding the frequencies and percentages of the academic achievement subtest items are given in Table 1.

Table 1. *Frequencies and percentages of the academic achievement items*

Items		Never	Sometimes	Always
1. I do not pirate anything (movies, music, videos, games) when I use the internet.	*f*	53	31	24
	%	50	28	22
2. I read messages from people like my parents or friends without permission.	*f*	95	11	2
	%	88	10	2
3. I share someone else's picture on the internet without their knowledge.	*f*	103	4	1
	%	95	4	1
4. I send messages containing rude behavior (swearing, threatening words, etc.) to other people on the Internet.	*f*	97	9	2
	%	90	8	2
5. What I find difficult to express directly to a friend in person, I often find it easier to communicate through the Internet.	*f*	73	24	11
	%	67	24	9

Table 1 shows the descriptive findings regarding children's responses to the items under the academic achievement subtest of the Digital Competence scale. Accordingly, most of the students do not read other people's messages, do not share other people's photos online, communicate face-to-face, and do not send rude messages. The findings about their habits of downloading pirated content while using the internet have been half and half. Fifty percent marking "never" indicates a firm stance against pirating content among this group of participants. The other fifty percent marking "sometimes" or "always" suggests that their habits of downloading pirated content are more flexible, and these individuals may occasionally or regularly download pirated content.
The findings regarding the frequencies and percentages of the extracurricular activities' subtest items are given in Table 2.

Table 2. *Frequencies and percentages of extracurricular activity items*

Items		Never	Sometimes	Always
11. I can easily use devices such as tablets, computers, and phones	f	6	32	70
	%	5	20	65
12. I can access a desktop computer, tablet, and smartphone at any time.	f	22	42	44
	%	20	39	41
13. I can easily connect to the Internet from anywhere, anytime.	f	37	42	29
	%	34	39	27
14. Using the Internet, I can access social networks, news sites, blogs, etc. whenever I want.	f	49	38	21
	%	45	35	19

When Table 2 is analyzed, access to digital devices is widespread among the 4th grade students and most of them are comfortable using these devices. The survey shows that most respondents have access to digital devices at any time, but in some cases, this access may be restricted. It can be said that most of the participants have widespread access to the internet with their mobile devices. It is seen that some of the participants experienced some limitations in accessing content using the internet.

The findings regarding the frequencies and percentages of the interaction with the environment items are given in Table 3.

Table 3. *Frequencies and percentages of interaction with the environment items*

Items		Never	Sometimes	Always
6. I know that I can report to sites such as http://www.guvenlinet.org/, and https://www.ihbarweb.org.tr/ when we encounter content that we do not want on the internet, just as we have numbers such as 112 in our daily lives.	f	34	28	46
	%	31	26	43
7. 166 I know what the number is used for	f	71	24	13
	%	66	22	12
8. I know what are the criminal behaviors when using the Internet	f	17	12	79
	%	16	11	73

Table 3 shows that 4the grade students who are exposed to unwanted content on the Internet resort to reliable sources and use reporting mechanisms to deal with such situations. The number 166 can be called to get information about the internet and can also be used to report a situation or file a complaint about internet-related issues. The fact that participants did not know the number 166 may reflect a lack of awareness about protecting their safety on the Internet. The fact that 79 students knew the behaviors that could be considered a crime while using the Internet can be considered a positive finding. This shows that the participants understand the legal responsibilities and online behavior standards related to internet use.

Table 4 presents the frequencies and percentages of the items related to the commerce subtest.

Table 4. *Frequencies and percentages of the commerce items*

Items		Never	Sometimes	Always
9. I shop for online games	f	67	20	21
	%	62	18	20
10. I can buy an item I want using the internet	f	43	36	29
	%	40	33	27

The finding on shopping for games shows that students do not tend to shop for games online. On the other hand, 60% of them stated that they can buy an item they want using the internet, which reflects a more positive attitude towards online shopping.

Since the sum of the student's responses to the Digital Competence scale will be used in the correlation analysis, which is the main purpose of the study, descriptive analyses of the total scores are presented in Table 5.

Table 5. *Descriptive findings of the total scores of the Digital Competence Scale*

n	Lowest Score	Highest Score	(x̄)	SD	Skewness	Kurtosis	Kolmogorov Smirnov
108	15	34	24,6	4,1	-,033	-,248	,200

When totaling the responses students provided on the digital competence scale, it is observed that they scored an average of 24,6 points out of a possible range of 14 to 42. This indicates that, on average, students' digital competency levels fall around the mid-range of the scale. When the distribution of the data is examined, it is found to be normal.

The focus of the research is on children's digital competencies, so the data collected through the Digital Competency scale is presented comprehensively. However, instead of presenting detailed descriptive findings on the cyberbullying scale developed by Küçük (2016), a more general perspective is presented. Descriptive findings based on the factors of the cyberbullying scale, which consists of 14 items and 2 subtests, are presented in Table 6. Additionally, descriptive findings of the total scores of participants' responses to the scale are provided.

Table 6. *Descriptive findings of the cyberbullying scale*

Subtests	n	Lowest Score	Highest Score	(x̄)	SD	Skewness	Kurtosis
1*	108	9	27	11,7	3,6	1,9	4,5
2**	108	5	15	7	2,2	1,4	2,3
Total	108	14	42	18,8	5,4	1,9	5

  * The first subtest is the subtest of emotional harm and humiliation, comprising items 5, 6, 7, 8, 9, 11, 12, 13 and 14.

  ** The second subtest is the subtest of exclusion and violence, consisting of items 1, 2, 3, 4, and 10.

The difference in scores between the two subtests stems from the variance in the number of items. Upon examining the descriptive findings regarding the total score, an average score of 18 is observed. Considering that the lowest score achievable on the cyberbullying victimization scale is 14 and the highest is 42, this suggests that the average score falls within the mid-range of possible scores. It can be said that students are experiencing cyberbullying victimization on average. When Table 6 is examined, the data has a right-skewed and peaked distribution. This situation may indicate that the assumptions of normal distribution have been violated.

Descriptive analyses were conducted based on the total scores of students' responses since the cyberbullying scale developed by Arıcak, Kınay, and Tanrıkulu (2012) aims to determine cyberbullying behaviors in students and consists of 24 items, can yield a minimum score of 24 and a maximum score of 72. Descriptive findings are presented in Table 7.

Table 7. *Descriptive findings of the cyberbullying scale*

n	lowest score	highest score	(x̄)	SD	Skewness	Kurtosis
108	24	68	28,2	9,4	1,9	4,5

Interpreting an average score of 28,2 on a scale where the lowest possible score is 24 and the highest is 72 suggests that, on average, students are exhibiting some degree of cyberbullying behaviors. When Table 7 is examined, the distribution of the data set is not normal.

Findings On the Correlation Between Digital Competence and Cyberbullying
When Table 5 is analyzed, it can be observed that the data regarding students' digital competence follows a normal distribution. However, upon inspection of Tables 6 and 7, it can be stated that the data related to cyberbullying does not follow a normal distribution. Therefore, the Spearman correlation test was employed to determine the relationship between digital competence and cyberbullying. Findings related to the analysis are presented in Table 8.

Table 8. *Correlation test result*

n=108		Cyberbullying Victimization	Cyberbullying Perpetration
Digital Competence	Academic Achievement	-,082	-,108
	Extracurricular Activities	-,031	-,142
	Interaction With the Environment	-,153	-,025
	Commerce	-0,96	-,113
	Total Scores	-,100*	-,124*

When Table 8 is examined, it is seen that there is a negative correlation between 4th-grade students' digital competencies and their responses to the cyberbullying scale related to being disturbed (r= -.100, p< .05). This suggests that as digital competence increases, cyberbullying victimization tends to decrease. Cohen (1988), while interpreting the r (correlation) value, states that r values between .10 and .29 are small correlations, r values between .30 and .49 are medium correlations, and values between .50 and 1.0 are large correlations. The strength of this relationship is weak indicating that the relationship is not very strong.

The correlation coefficient indicates a negative relationship between digital competence and cyberbullying behaviors (r= -.124, p< .05). This implies that as digital competence increases, engagement in cyberbullying behaviors tends to decrease. However, the strength of this relationship is weak suggesting that the association is not very strong.

DISCUSSION AND CONCLUSION

The data obtained suggest a negative correlation between 4th-grade students' digital competencies and their responses to the cyberbullying scales. The study by Akman (2022) found that cyberbullying has a negative relationship with social competence. This implies that individuals with lower social skills and competencies may be more likely to exhibit cyberbullying behaviors. When considering digital competence as part of social competence in the online realm, this negative relationship aligns with the notion that individuals lacking digital skills may resort to negative online behaviors like cyberbullying. A study conducted by Livingstone et al. (2017) investigated the online experiences of children in Europe and found that while digital competence was associated with safer online practices, including the ability to handle potentially risky situations, it did not eliminate the risk of encountering negative experiences such as cyberbullying. This suggests that digital competency may act as a protective factor but might not completely mitigate the risk of cyberbullying. These studies underscore the multifaceted nature of cyberbullying and suggest that while digital competency is valuable, it may not single-handedly determine individuals' experiences with cyberbullying. Instead, a comprehensive approach that includes digital competency education and broader social-emotional learning may be necessary to address and prevent cyberbullying.

The weak correlation observed in this study underscores the complexity of the relationship between digital competencies and cyberbullying experiences among young students. While possessing digital skills and knowledge may provide some degree of resilience against cyberbullying, it is not a definitive safeguard. Other factors, such as social dynamics, peer relationships, and individual vulnerabilities may also influence students' susceptibility to cyberbullying incidents.

Among the research studies available, there are several that align with the finding of a weak correlation between digital competencies and cyberbullying. For instance, the study, conducted by Seçkin-Kapucu, Özcan, and Karakaya-Özer (2021) explored the relationship between cyberbullying and students' digital literacy levels. The findings suggested that digital literacy had a weak relationship with being exposed to and witnessing cyberbullying. Estévez et al. (2019) investigated the relationship between digital competence and cyberbullying among high school students. The results indicated that digital competence was negatively associated with cyberbullying perpetration and victimization, but the associations were relatively weak. These findings are in line with the conclusion that the relationship between children's digital competencies and cyberbullying is weak.

The conclusion drawn from this research indicates that children's digital competencies are at a medium level. Among the various research studies available, there are several that align with the conclusion that children's digital competencies are at a medium level. For instance, Atmazaki & Indriyani (2019) reported that digital literacy competencies among educational students tended to fall within the medium to good range. This finding parallels the conclusion that children's digital competencies are at a medium level.

This could indicate that children possess a basic understanding of digital tools and technologies but may struggle with more advanced or specialized tasks. This finding highlights the importance of incorporating digital competency education into school curricula from an early age. While children may have some familiarity with digital devices, there's room for improvement in developing their skills further. Understanding the level of digital competencies among children is crucial for designing effective educational interventions and promoting responsible digital citizenship from an early age.

LIMITATIONS AND RECOMMENDATIONS

The study's sample size of 108 fourth-grade students may be considered relatively small, potentially limiting the generalizability of the findings to broader populations. In response to potential criticisms regarding the study's sample size, it is noteworthy that the sample size was determined through a rigorous calculation process employing G power software, yielding a sample size of 111 participants.

Given that the data were collected through self-report measures, there is a risk of response bias, where participants may underreport or overreport their digital competencies or experiences with cyberbullying. Incorporating multiple data sources, such as teacher or parent reports, could enhance the robustness of the findings in the future. Additionally, children's digital competence level is limited to the data obtained from the Digital Competence scale. To further research the relationship between children's digital competencies and cyberbullying, several avenues can be explored based on existing literature. Firstly, investigating the impact of parental mediation strategies, such as restrictive mediation, monitoring, and restrictions, on children's digital competencies and their susceptibility to cyberbullying could provide valuable insights (Livingstone et al., 2017). Understanding how parental involvement influences children's online behavior and experiences is crucial in developing effective prevention and intervention strategies.

Secondly, conducting longitudinal studies to examine how changes in children's digital competencies over time relate to their experiences with cyberbullying could be a promising area of research.

Moreover, supplementing quantitative analyses with qualitative inquiry to gain deeper insights into children's perceptions, attitudes, and experiences related to digital competencies and cyberbullying could be beneficial.

Additionally, examining the effectiveness of artificial intelligence-based interventions in addressing cyberbullying among children from a youth perspective could be beneficial. As cyberbullying continues to be a significant issue for young people, leveraging AI technologies for early detection and intervention could offer new solutions to combating online harassment.

REFERENCES

Aizenkot, D. and Kashy-Rosenbaum, G. (2018). Cyberbullying in WhatsApp classmates' groups: evaluation of an intervention program implemented in Israeli elementary and middle schools. *New Media & Society, 20*(12), 4709-4727. https://doi.org/10.1177/1461444818782702

Akbulut, Y. (2010). *Sosyal bilimlerde SPSS uygulamaları*. İstanbul: İdeal Kültür Yayıncılık.

Akman, Y. (2022). The investigation of the relationship between cyberbullying, social competence, and social relations. *Gazi Eğitim Fakültesi Dergisi, 42*(1), 787-816. https://doi.org/10.17152/gefad.930553

Arıcak, O. T., Kınay, H., & Tanrıkulu, T. (2012). Siber zorbalik ölçeği'nin ilk psikometrik bulgulari. *Hasan Ali Yücel Eğitim Fakültesi Dergisi, 17* (1), 101-114

Atmazaki, A. and Indriyani, V. (2019). Digital literacy competencies for teacher education students. *Advances in Social Science, Education, and Humanities Research, 335*, 1010-1018. https://doi.org/10.2991/icesshum-19.2019.156

Büyüköztürk, Ş., Çakmak, E. K., Akgün, Ö. E., Karadeniz, Ş., & Demirel, F. (2008). *Bilimsel araştırma yöntemleri.* Ankara: Pegem Akademi.

Chen, J., Wang, X., Zhang, Z., & Chen, W. (2021). Assessing elementary school students' manipulative skill competency in china. *International Journal of Environmental Research and Public Health, 18*(6), 3150. https://doi.org/10.3390/ijerph18063150

Cohen, J. (1988). *Statistical power analysis for the behavioral sciences* (2nd ed.). Hillsdale, NJ: Lawrence Erlbaum Associates.

Erkuş, A. (2005). *Psikolojik danışma ve rehberlik hizmetlerinde ölçme ve değerlendirme*. Ankara: Pegem A Yayıncılık.

Estévez, E., Jiménez, T. I., Segura, L., & Siegle, D. (2019). Digital competence and cyberbullying in high school students: A multifaceted approach. *Frontiers in Psychology, 10,* 1436.

European Commission (2017). DigComp Framework. Retrieved from https://joint-research-centre.ec.europa.eu/digcomp/digcomp-framework_en.

Hinduja, S., & Patchin, J. W. (2015). *Bullying beyond the schoolyard: Preventing and responding to cyberbullying.* Thousand Oaks, CA: Corwin.

Iwanicka, A. (2021). Digital skills of pupils aged 6–9 – children's and adults' perspective. *Problemy Wczesnej Edukacji, 53*(2), 63-77. https://doi.org/10.26881/pwe.2021.53.05

Jones, L., Mitchell, K., & Beseler, C. (2023). The impact of youth digital citizenship education: insights from a cluster randomized controlled trial outcome evaluation of the be internet awesome (bia) curriculum. *Contemporary School Psychology*, 1-15. https://doi.org/10.1007/s40688-023-00465-5

Karasar, N. (2012). *Bilimsel araştırma yöntemi: Kavramlar, ilkeler, teknikler*. Ankara: Nobel Yayın Dağıtım.

Kowalski, R., Giumetti, G., Schroeder, A., & Lattanner, M. (2014). Bullying in the digital age: a critical review and meta-analysis of cyberbullying research among youth. *Psychological Bulletin, 140*(4), 1073-1137. https://doi.org/10.1037/a0035618

Küçük, S. (2016). *Siber zorbalık ölçeği Türkçe uyarlaması* (Master's thesis, Adli Tıp Enstitüsü).

Livingstone, S., & Helsper, E. J. (2007). *Gradations in digital inclusion: Children, young people, and the digital divide.* New Media & Society, 9(4), 671-696.

Livingstone, S., Ólafsson, K., Helsper, E., Lupiáñez-Villanueva, F., Veltri, G., & Folkvord, F. (2017). Maximizing opportunities and minimizing risks for children online: the role of digital skills in emerging strategies of parental mediation. *Journal of Communication, 67*(1), 82-105. https://doi.org/10.1111/jcom.12277

Moriguchi, Y., Sakata, C., Meng, X., & Todo, N. (2020). Did the covid-19 pandemic have immediate impacts on japanese children? evidence of socio-emotional behavior and digital skills. *Evidence of the Socio-Emotional Behavior and Digital Skills*, 11. https://doi.org/10.21203/rs.3.rs-55554/v1

Operto, F., Pastorino, G., Marciano, J., Simone, V., Volini, A., Olivieri, M., … & Coppola, G. (2020). Digital device use and language skills in children between 8 and 36 months. *Brain Sciences, 10*(9), 656. https://doi.org/10.3390/brainsci10090656

Seçkin-Kapucu, M., Özcan, H. & Karakaya-Özyer, K. (2021). The relationship between middle school students' digital literacy levels, social media usage purposes, and cyberbullying threat level. *International Journal of Modern Education Studies, 5*(2), 437-566. http://dx.doi.org/10.51383/ijonmes.2021.136.

Singh, R., & Kumar, A. (2023). Examining the relationship between digital competence and cybercrime victimization among university students. *ĀMNĀYIKĪ, 23*.

Su, J., & Yang, W. (2024). Digital competence in early childhood education: A systematic review. *Education and information technologies, 29*(4), 4885-4933.

TUIK (2021). İstatistiklerle çocuk, 2021. Retrieved from https://data.tuik.gov.tr/Bulten/Index?p=Istatistiklerle-Cocuk-2021-45633.

Tüfekçi, F. N., & Ceylan, M. (2022). Eğitimde kalitenin arttirilmasi için ilkokul öğrencilerinin dijital yetkinlik düzeylerini belirlemeye yönelik bir ölçek geliştirme çalişmasi. *Izmir Democracy University Social Sciences Journal, 5*(2), 166-187.

Yang, C., Chen, C., Lin, X., & Chan, M. (2021). School-wide social emotional learning and cyberbullying victimization among middle and high school students: moderating role of school climate. *School Psychology, 36*(2), 75-85. https://doi.org/10.1037/spq0000423

Zhao, L., Wu, Y., Huang, X., & Zhang, L. (2022). Network anonymity and cyberbullying among chinese adolescents: a moderated mediation model. *International Journal of Environmental Research and Public Health, 19*(2), 637. https://doi.org/10.3390/ijerph19020637

Zhou, N. (2023). The digital competence of chinese higher education students and the linkage with their career adaptability. *Education + Training, 65*(6/7), 939-954. https://doi.org/10.1108/et-08-2022-0315

Universities' Social Media Usages for Sustainable Corporate Communication: A Research on Students' Views in Online Learning Processes During Covid-19

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ABSTRACT
Covid-19 was appeared in 2019 and rapidly spread worldwide. In Turkey, the universities had to execute online learning as a precaution. The courses and sustainable corporate communication activities had to move to an online environment by the universities during the pandemic. During this period, the universities strived to convey both information and sustainability messages via their social media (SM) accounts. In this context, this study aims to identify students' views on their university's SM usage for its sustainable corporate communication during the Covid-19 process. A structured questionnaire was carried out with 272 students at Sakarya University of Applied Sciences. The research results revealed that many students followed their university's SM accounts, and most of their families and friends encouraged them to follow them. In addition, the study showed that most of the students found their university uses SM accounts for sustainable corporate communication useful and enjoyable. However, it was found that the student's preferences in adopting the sustainability messages would be affected if the messages were complicated. The data also indicated that most of the students were aware of the sustainability messages of the university through SM accounts.
Keywords: sustainability messages, university, online learning, UTAUT, sustainable corporate communication

INTRODUCTION

The coronavirus disease (Covid-2019), which first appeared in Wuhan, China, in December 2019, spread rapidly worldwide and was declared a pandemic by the World Health Organization (WHO) on March (WHO, 2020). According to the T.C. Ministry of Health (MH) (2020), the first case of Covid-19 in Turkey was observed in April 2020, and the disease spread throughout the country. To prevent the further spread of the disease in Turkey, many measures have been taken which affected all segments and structures of society. One of the structures affected by Covid-19 has been the education sector. The Turkish Council of Higher Education has decided that all universities should switch from face-to-face education to online education until the threat of the virus subsides. Thus, all universities conducted an online education period from the spring semester of 2020 to the fall semester of 2021. During this online education period, universities carried out educational activities, and corporate communication activities had to be moved to the online environment.

Many countries had managed the pandemic process with 'physical distancing' strategies, which mostly involved restricting physical contact to the bare minimum required for daily living. This has increased the use of and dependence upon social media (SM) to stay connected for work and education (Wong et al., 2021: 255). As today's one of the most important communication channels, SM "employ mobile and web-based technologies to create highly interactive platforms via which individuals and communities share, co-create, discuss, and modify user-generated content"(Kietzmann, 2011: 241) also helps individuals during the pandemic. It became a helpful tool for individuals to communicate with friends and family during quarantine periods. It helped spread necessary information about identifying symptoms, sharing treatment, employing control measures from other countries, and adapting them with available resources (Radwan et al. 2020: 1-2). Universities also use SM to communicate with students and staff in a frequent, open, and targeted manner (Quiroz Flores et al.,2021: 2) and obtain real-time feedback on universities' communications (Bellucci and Manetti, 2017: 898) like other organizations have embraced SM for enabling fast interactions with their stakeholders (Quiroz Flores et al.,2021: 2). Universities had to communicate with students and potential students through their official online platforms, such as their websites and social network pages, during the Covid-19 pandemic's online education process. Since the online environment was the main communication channel used by universities, the way the universities sent messages during the pandemic became essential to maintain favorable relationships with their students (Bularca et al. 2022:2).

As revealed before, during the COVID-19 pandemic, many people are sourcing their news and updates from SM, and this is particularly true for young people (Calonge et al., 2021: 7). In particular, with COVID-19, SM usage

has increased significantly in the groups of 16-24 years old (58%), 25-34 years old (50%), 35-44 years old (42%), 45-54 years old (34%) and 55-64 years old (32%) (We are Social, 2020). Many students use SM as a primary source of information and connection to the campus community. With students turning to SM for health information, universities must use the SM platforms effectively, regularly, and candidly to communicate time-critical and correct messaging and overcome the potential for communication overload. In a crisis environment like the Covid-19 pandemic, unless the university effectively communicates complex information to their varied constituencies quickly their SM strategy will likely fail due to negative posts by students, parents, and staff (Calonge et al., 2021: 8).

In this process, universities also used SM for their sustainable corporate communication messages. Like all institutions, universities strive to improve their performance and make it sustainable with the corporate communication applications they perform. In this process, the universities aim to demonstrate their corporate identity and adopt values for all stakeholders and the public, especially their students and employees (Kadıbeşegil, 2009). Nowadays, many institutions prefer SM as a sustainable corporate communication tool. As the result of research, which examined the SM used by 10 official public institutions with SM accounts as a means of corporate communication, it was indicated that institutions use SM mostly to promote their services. In addition, it was observed that SM is more effective in directing the preferences of the target audience compared to the traditional media (Ilgın et al., 2019). According to Özpınar's (2021) study, the institutions should feel open to technological development and obliged to use this technology to communicate with all stakeholders efficiently and innovatively. According to a study (Gökler and Onay, 2020) that examined SM usages of universities for corporate communication purposes, universities regularly share information about orientation, remembrance, workspace, and employee-related issues via their official Instagram accounts. A study (Ün and Türkal, 2018) that aimed to determine how universities use YouTube as a means of corporate communication tool showed that; universities use their YouTube channels as an economic promotion tool, and they include their scientific, educational, social, and cultural activities in their YouTube pages.

Adding sustainability messages to universities' corporate communication activities is highly emphasized nowadays. According to Cortese (2003:17), universities bear a moral and profound responsibility to increase the awareness, knowledge, skills, and values needed to create a sustainable future. Also, Lozano et al. (2013: 18) stress the importance of leaders of the universities that they must ensure the needs of present and future generations be better understood and addressed; thus, the professionals who are well versed in sustainable development can effectively educate students of 'all ages' to help make the transition to 'sustainable societal patterns.' To do this, university leaders and staff must be empowered to catalyze and implement new paradigms, introducing sustainability into all courses and curricula and other university activities elements.

A prerequisite for a university to commit to sustainability is communication. It can be spontaneous communication impulses and initiatives for the professional management of long-term consultation processes and other participatory interactions (Franz-Balsen and Heinrichs, 2007: 431). Sustainability communication is a process of mutual understanding, dealing with the future development of society at the core of a vision of sustainability. It is both about values and norms such as inter-and intragenerational justice and research into the causes of problems and the individual/societal possibilities to take action and influence development. This process of mutual understanding takes place on many different levels and in other contexts such as; between individuals, between individuals and institutions, between institutions and within institutions, in schools and universities, in the media, in politics, in business, in communities and at regional, national and international levels (Godemann and Michelsen, 2011: 6). Lertpratchya et al. (2017: 1064) point out the role of sustainability communication messages toward students. According to the study, the universities with sustainability initiatives use various communication strategies for reaching their significant stakeholders. The majority indicated that students are one of their primary target groups. These universities directly communicate sustainability to students through traditional and SM channels. As a result, the students of these universities are often exposed to sustainability communication, leading to cumulative effects as they progress in their studies.

It is expected that universities will lead sustainability practices that are carried out to positively affect people, the planet, and societies. Since universities contribute to society through education by institutionalizing their values, missions, and practices, and serve as a driving force for sustainable change. However, as mentioned earlier, during Covid-19 mandatory changes were made in the functioning of universities, as well as in all structures of society. During the pandemic, universities have moved their educational systems and corporate communication efforts, including sustainable communication activities, to the online environment. They tried to convey corporate communication and information messages to their students, one of the most critical stakeholders, through their websites and official SM accounts throughout the pandemic. In this regard, the primary purpose of the research

was to reveal the views of students on their university's SM usage for sustainable corporate communication during the online teaching period in the Covid-19 process.

MATERIALS AND METHODS
Research method
The quantitative method in which the statistical analysis of the data was proposed within the framework of deduction was used. Quantitative research tests, measures, and statistically analyzes the identified problem. It also examines the situation from a holistic perspective.

The primary purpose of the research was to reveal the views of students on their university's SM usage for sustainable corporate communication during the online teaching period in the Covid-19 process. The secondary aim of the study was to reveal whether students' views differ according to age and gender. In addition, the sub-aim was determined to identify the levels of students' follow and subscribe statuses of the university's corporate SM accounts during the Covid-19 period.

The sub-question related to *the research question is below.*
RQ1: What are the students' levels of following and subscription statuses of the university's corporate SM accounts during the Covid-19 period?
The research questions related to the primary aim are below.
RQ2: How much does the performance that students expect from the university's official SM accounts for sustainable communication contribute to them following these accounts?
RQ3: Do the students believe that the universities' official SM accounts are useful?
RQ4: To what extent do students believe that the people close to encourage them to follow the university's SM accounts?
RQ5: What is the degree to which students believe universities' SM usage as a sustainable corporate communication medium facilitates their understanding and knowledge of environmental issues?

The hypothesis related to the secondary aim of the study is below.
$H1_1$: There is a significant difference between age and performance expectancy.
$H2_1$: There is a significant difference between age and effort expectancy.
$H3_1$: There is a significant difference between age and social influence.
$H4_1$: There is a significant difference between gender and performance expectancy.
$H5_1$: There is a significant difference between gender and effort expectancy.
$H6_1$: There is a significant difference between gender and social influence.

However, facilitating conditions are not included in the hypothesis because many researchers claim that facilitating conditions are not a significant driver as the other factors (Chua et al., 2018:121).

Sample and Sampling Technique
Sakarya University of Applied Sciences was chosen as a sample by purposive sampling method cause sustainability is at the heart of the university's strategic plan. The state in detail in this plan that they adopt sustainable corporate communication (Sakarya University of Applied Sciences Strategical Plan of 2020-2024).
The universe of this research consists of 26.815 students of Sakarya University of Applied Sciences. The probability-based random sampling method was used to select the students. The research sample consists of 272 students studying at Sakarya University of Applied Sciences, Turkey.

Table 1: Basic Descriptive Statistics of the Study Participants

Demographic Variables		N	(%)
Gender	Female	141	51,8
	Male	131	48,2
	Total	272	100,0
Age	<18	4	1,5
	18-21	207	76,1
	21-25	42	15,4
	26-29	19	7,0
	Total	272	100,0
Education	Undergraduate / Associate Degree	166	61,0
	Undergraduate / Bachelor Degree	96	35,3

	Postgraduate / Master and Ph.D. Degree	10	3,7
	Total	272	100,0

As shown in Table 1, 51.8% of Sakarya University of Applied Sciences students participating in the research are female, and 48.2% are male. The gender distribution of the students participating in the research is almost equal. The age-ratio distribution of 272 students; 1.5% are under 18, 76.1% are between 18-21, 15.4% are between 22-25, 7% are between 26-30. The majority of the students participating in the survey are between 18-21, with 76.1%. This age range is important in making sense of the relationship between the university's corporate communication studies and new media channels. 61% of the participants are associate degree students, 35.3% are bachelor's degree students, and 3.7% postgraduate students. Most of the students participating in the survey are associate degree students, with a rate of 61%.

Data Collection and Analysis
In the study, the Unified Technology of Acceptance and Use Technology Model (UTAUT) scale was used, developed by Venkatesh et al. (2003). The reliability value was calculated by Cronbach's alpha method of 0. 821. The questionnaire consists of three parts. In the first group, participants were asked about their demographic characteristics. In the second part of the questionnaire, 5 questions were conveyed to the participants to identify the levels of students' follow and subscribe statuses of the university's corporate SM accounts during the Covid-19 period. The data obtained from the questions about the use of SM are in the findings. The last part of the research includes 20 questions that aim to reveal students' points of view on using SM to ensure sustainable corporate communication of the university during the online education period. Statements in the questionnaire were prepared with a Likert rating of 5 (5-Strongly agree, 4-Agree, 3-Undecided, 2-Disagree, 1-Strongly disagree).

Offering a conceptual framework, the Unified Theory of Acceptance and Use of Technology (UTAUT) (Venkatesh et al., 2003) provides an opportunity to evaluate the compatibility of new communication technologies with institutions. It offers this with four main determining factors. These are performance expectancy, effort expectancy, facilitating conditions, and social influence. Performance expectancy is defined as "the degree to which an individual believes that using the system will help him or she attain gains in job performance." Statements about performance expectations were evaluated with four questions in the research. Effort expectancy is defined as "the degree of ease associated with the use of the system." Statements about effort expectation were evaluated with four questions in the research. Social Influence is defined as "the degree to which an individual perceives that important others believe he or she should use the new system". Statements about social influence were evaluated with three questions in the research. Facilitating conditions are defined as "the degree to which an individual believes that an organization's and technical infrastructure exists to support the use of the system." Statements on facilitating conditions, including technical infrastructure and institutional support, were evaluated with nine questions in the research.

The questionnaire was distributed on social networking sites between April 10, 2021, and May 14, 2021. Participation was voluntary, and the survey completion process took approximately 10 minutes.
Descriptive analysis was used in the study. The data obtained in the descriptive analysis are summarized and interpreted according to predetermined themes. The aim is to present the findings to the reader in an organized and interpreted form. The descriptive analysis consists of four stages. The first is to draw a framework of the data that make up the research content. The second stage is the processing of data within the specified framework. The third stage is the definition of the findings, and the last stage is the explanation, correlation, and interpretation of the findings.

Statistical Package for Social Sciences (SPSS) 26 was used to aid the researchers in evaluating data derived from the copies of the questionnaires that the respondents filled. The findings used frequency-percentage distributions, Independent Groups t-test, and a one-way analysis of variance (ANOVA).
The study had several limitations. Choosing Sakarya University of Applied Sciences avoids the possibility of representing other universities in Turkey and the world. Additionally, the narrowness of the demographic qualities of the students and that the students were chosen from Turkey is another limitation.

FINDINGS
RQ1: What are the students' levels of following and subscription statuses of the university's corporate SM accounts during the Covid–19 period?
It is determined that 95.6% of the students follow the university's SM accounts, and 4.4% do not follow the university's SM accounts. In the ranking of the university SM platforms most frequently used by students, it is seen that the university's Instagram is followed by 70.6%. The second by YouTube by 36%, and Twitter by 27.9%. It was determined that the students who participated in the research preferred mobile devices by 87.5%, computers

by 63.2%, computers, tablets, and other devices other than mobile by 41.9%, in order of the tools they used most frequently.

The findings of the questions created to reveal the students' perspectives on the use of SM within the scope of sustainable corporate communication at a university during the online education period during the Covid-19 pandemic are given below.

RQ2: How much does the performance that students expect from the university's official SM accounts for sustainable communication contribute to them following these accounts?
The study revealed that 77.2% of the students found useful of the university's usage of SM for sustainable corporate communication. It is shown that the students' SM usage contributes to the fact that they are quickly informed about the university's public relations and sustainable corporate communication activities at a rate of 66.2%. According to the results, it has been revealed that the university's SM usage as a sustainable corporate communication channel encourages students (71.7%) to follow this medium. 43% of the students find SM understandable and easy to use, reflecting a low rate compared to the total. Therefore, it shows that there may be messages that students do not understand on SM and that they find difficulties understanding while receiving the messages via SM accounts.

RQ3: Do students believe universities' official SM accounts are useful?
With a high rate of 83.4%, it is seen that students have enough sources to use SM, such as mobile phones, computers, and internet connections and 66.6% of them have enough knowledge of using SM. 90% of university students stated that they have uncomplicated access to information through the university's SM accounts. According to this result, it can be deduced that uncomplicated access to information is an essential factor that encourages students to use universities' official SM accounts. According to the research data, 74.7% of the students stated that the university's usage of SM as a sustainable corporate communication medium did not affect their preferences of the university. Also, 79.2% of the students stated that if the university's sustainable corporate communication messages via SM were complicated, it would affect their preferences in adopting them. With a high rate of 85.3%, students find it beneficial that the university's corporate communication department uses SM for sustainable corporate communication. It revealed that 79.8% of the students have more information about the communication activities of the institution thanks to the SM posts of the university.

RQ4: To what extent do students believe that the people close to encourage them to follow the university's SM accounts?
According to the data obtained, it was seen that 92.3% of the students were encouraged to follow the SM accounts of the university by their family and friends. In other words, it is determined that the people close to students are influential in making them follow the university's SM accounts. However, it is determined that 7.3% of the student's friends and family do not have any influence in making them follow the SM accounts of the university. It is also reflected that the students do not need any assistance while using SM, with an average rate of 50.3%.

RQ5: What is the degree to which students believe that universities' SM usage as a sustainable corporate communication medium facilitates their understanding and knowledge of the environmental issues?
A high percentage of the students (74.6%) stated that it is not a good idea to maintain the university's sustainable corporate communication through SM accounts after the pandemic ends. In addition, it has been revealed that 71.3% of the students find it enjoyable that the university uses SM accounts in their sustainable corporate communication. It is shown that with a high rate of 85.3%, students are aware of the sustainability messages existence of the university through SM, and 77.8% of the students think that the university's corporate communication department uses SM acts as a sustainability communication medium.

TABLE 2: Difference between age and performance expectancy, effort expectancy, and social influence dimensions

		Sum of Squares	df	Mean Square	F	Sig.
Performance Expectancy	Between Groups	1,035	3	,345	,945	,419
	Within Groups	97,834	268	,365		
	Total	98,869	271			
Effort Expectancy	Between Groups	,626	3	,209	,576	,631
	Within Groups	97,132	268	,362		
	Total	97,758	271			
Social Influence	Between Groups	3,657	3	1,219	3,594	,014
	Within Groups	90,892	268	,339		
	Total	94,549	271			

H1: There is a significant difference between age and performance expectancy.
H2: There is a significant difference between age and effort expectancy.
H3: There is a significant difference between age and social influence.

One Way Anova test was used. As a result of the test performed at 95% confidence level, the significance value between age and performance expectancy, effort expectancy, and social influence were tested.
There is a no significant difference between age and performance expectancy (p=0.419>0.05 (f=0, .945). **H1 was rejected.**

There is a no significant difference in age and effort expectancy (p=0,613>0.05 (f=0,576). **H2 was rejected.**
The data also show a significant difference between age and social influence (p=0,014<0.05 (f=3,594). **H3 was supported**. Age was determined as a variable affecting the social influence dimension.

TABLE 3: Difference between gender and performance expectancy, effort expectancy, and social impact dimensions

Independent Samples Test

| | | Levene's Test for Equality of Variances | | t-test for Equality of Means | | | | | | |
| | | F | Sig. | t | df | Sig. (2-tailed) | Mean Difference | Std. Error Difference | 95% Confidence Interval of the Difference | |
									Lower	Upper
Performance Expectancy	Equal variances assumed	,703	,403	,252	270	,801	,01853	,07342	-,12603	,16308
	Equal variances not assumed			,252	266,153	,801	,01853	,07355	-,12628	,16334
Effort Expectancy	Equal variances assumed	3,083	,080	-1,468	270	,143	-,10678	,07273	-,24997	,03641
	Equal variances not assumed			-1,461	259,206	,145	-,10678	,07308	-,25069	,03713
Social Influence	Equal variances assumed	1,700	,193	-2,725	270	,007	-,19302	,07084	-,33250	-,05355
	Equal variances not assumed			-2,711	258,462	,007	-,19302	,07121	-,33324	-,05281

H4: There is a significant difference between gender and performance expectancy.
H5: There is a significant difference between gender and effort expectancy.
H6: There is a significant difference between gender and social influence.

Independent samples t-test was conducted to reveal differences between male and female participants regarding performance expectancy, effort expectancy, and social influence dimensions.

There is statistically no significant difference between the female (3.73, SD=.59) and male (3.71, SD=.61) in the performance expectancy dimension according to the t-test (t=.252Sig (2-tailed) >0.05). **H4 was rejected.**
As a result of the t-test, there is no statistically significant difference between the female (3.83, SD=.56) and male (3.93, SD=.63) in the dimension of effort expectancy (t=-1.468 Sig (2-tailed) >0.05). **H5 was rejected.**
According to t-test, there is also no significant difference between the female (3.32, SD=.54) and male (3.52, SD=.62) in the social influence dimension (t=-2.75 Sig (2- tailed) >0.05). **H6 was rejected.**

DISCUSSION and CONCLUSION
In the pandemic period, many university students used SM as a primary source of information and connection to the campus community. In addition, universities use SM to communicate with their students and staff and obtain feedback on universities' communications. During the online education process, universities had to share with

students and potential students through their SM accounts, websites, etc., for their sustainable corporate communication messages. The pandemic made the universities aim to demonstrate their corporate identity and adopt values for their students and employees via SM. In today's environment, universities have a moral and profound responsibility to increase the values, awareness, knowledge, and skills needed to create a sustainable future. The managers of the universities and the staff should implement sustainability into all courses and all other elements of university activities. A university's sustainability communication is consciously and effectively integrating sustainability in its communication strategy by telling the students and staff about its sustainability goals and efforts. The universities mostly communicate sustainability to students through SM and traditional ones. By using various communication channels, the students of these universities are often exposed to sustainability communication. Universities contribute to society through education by institutionalizing their missions, values, and activities on sustainability, and they convey these via SM.

In this context, mainly this research aimed to reveal students' views on their university's SM usage for sustainable corporate communication during the online teaching period in the Covid-19 process. 272 students studying at Sakarya University of Applied Sciences, Turkey, were chosen as a sample with a probability-based random sampling method to achieve the aim of the study. Sakarya University of Applied Sciences was selected as a sample by purposive sampling method. Since sustainability is at the heart of this university's strategic plan and the state in detail, they adopt sustainable corporate communication. UTAUT scale was used, and the research questionnaire consisted of three parts.

During the pandemic, students increased their SM usage to receive information. It was questioned in the study whether these students, whose educational lives were continuing during a pandemic, followed their university's official SM accounts to maintain the connection with them. The study results indicated that 95.6% of the students followed their university's official SM accounts; Instagram, YouTube, and Twitter, respectively.

The results of research questions related to the primary aim are given here. The data of research question 2 coincide with the literature data. Referring to the performance expectancy, the study revealed that most of the students found the university's SM usage for sustainable corporate communication useful. In addition, the results indicated seeing the university's SM usage as a sustainable corporate communication channel useful encouraged most of the students to use the medium. Previous studies support these data. According to Toh's (2013) research data, performance expectancy has positively affected the students to follow SM. Also, Chang (2013) found that performance expectancy positively affects students' intention to use library apps in university libraries in his research.

The results of research question 3 coincide with the literature data also. Referring to the effort expectancy, the study revealed that most university students stated that they have uncomplicated access to information through the university's SM accounts. In addition, most students find it beneficial that the university's corporate communication department uses SM within the framework of sustainable corporate communication with uncomplicated access to information. In contrast, most of the students stated that if the university's sustainable corporate communication messages via SM were complicated, it would affect their preferences in adopting them. These findings are supported by previous studies. According to Chua et al. (2018)'s study on effort expectancy on SM, the complicated online system would discourage individuals from adopting it.

The results of research question 4, similar to the literature data, are given here. Referring to the social influence, the study indicated that most of the students' families and friends encourage them to follow the university's SM accounts. These results are supported by previous studies. According to Lian (2015)'s study on factors on cloud-based e-invoice service adoption, social influence affects individuals' intentions.

The results of the final research question coincide with the literature data also. Referring to the facilitating conditions, the study revealed that most students found it enjoyable that the university uses SM accounts for sustainable messages. A high rate of students is aware of the sustainability messages existing of the university through SM. Previous studies support these data. According to Šumak et al. (2010), facilitating conditions affect the usage of Moodle, which is an open distance education system.

The secondary aim of the study was to reveal whether students' views differ according to their age and gender, and the hypotheses results created for this aim are given here. There was no significant difference between age and performance, and effort expectancy. However, there was a significant difference between age and social influence. Also, the research data showed that there wasn't a significant difference between gender and performance, effort expectancy, and social influence.

The expectation of effort should be increased to encourage increasing the levels of following and subscription statuses of universities' SM accounts. The managers of the universities must continue the sustainable corporate communication messages by taking into account that students are essential stakeholders of the universities. Social influence is a critical factor for SM behavior, so SM managers should always consider the element of social needs of students and allocate resources to improve the social influence of social networking apps. Also, the more the social environment is aware of the sustainable messages of a university, the more confidence it will have in the university. This situation can indicate that the university has an essential role in constructing a sustainable future.

The impact of mandatory changes in the educational system during the Covid-19 period was reflected in both students and institutions. In particular, students have an essential stakeholder role in universities' sustainable corporate communication process. Especially in an environment such as the pandemic, where there is no face-to-face communication, sustainable messages have been conveyed online to all stakeholders, including students. In this context, SM has served as the primary tool for universities. Proceeding from this point, the measurement and evaluation of all these processes from the students' dimensions and the introduction of the results into the literature reveal the central importance of the study. In addition, the feedback received from the students will contribute to the processes of updating the sustainable corporate communication messages of universities. On the other hand, it is essential that universities that do not have a strategic plan within the scope of sustainable corporate communication can be encouraged to structure in this regard.

The further researches could be conducted on a larger sample in this area based on the importance of sustainable corporate communication messages for universities. It is also essential to conduct studies on universities' other stakeholders' opinions on this issue. Finally, the new studies would compare the results of this research covering the online education process when corporate communication activities were not only carried out online.

REFERENCES

Bellucci, M. & Manetti, G. (2017). Facebook as a tool for supporting dialogic accounting? Evidence from large philanthropic foundations in the United States. Accounting, *Auditing & Accountability Journal 30*, 874–905.

Bularca, M.C.; Nechita, F.; Sargu, L.; Motoi, G.; Otovescu, A.; Coman, C. (2022). Looking for the Sustainability Messages of European Universities' Social Media Communication during the COVID-19 Pandemic, *Sustainability 14(1554),* 1-35, https://doi.org/10.3390/su14031554,

Calonge, D.S., Aguerrebere, P.M., Hultberg, P.T., & Connor, M. (2021). Were Higher Education Institutions Communication Strategies Well Suited for the COVID-19 Pandemic? *Journal of Education and Learning*, *10(4),* 1-14.

Chang, C.-C. (2013). *Library mobile applications in university libraries*. Library Hi Tech, 31(3), 478–492. http://doi.org/10.1108/LHT-03-2013- 0024.

Chua, P.Y.; Rezaei, S.; Gu, M.-L.; Oh, Y.; Jambulingam, M. (2018). Elucidating social networking apps decisions. *Nankai Bus. Rev. In*t., 9, 118–142.

Cortese, A.D. (2003). The Critical Role of Higher Education in Creating a Sustainable Future. Plan. *High. Educ, 31,* 15–22.

E. Radwan & A. Radwan, & W. Radwan. (2020). The role of social media in spreading panic among primary and secondary school students during the COVID-19 pandemic: An online questionnaire study from the Gaza Strip, Palestine. *Heliyon, 6,* e05807, 1-11.

Franz-Balsen, A. & Heinrichs, H. (2007). Managing sustainability communication on campus: experiences from Lüneburg, *International Journal of Sustainability in Higher Education 8 (4),* 431-445

Godemann, J.; Michelsen, G. (2011). Sustainability Communication—An Introduction. Godemann, J., Michelsen, G., Eds.; *In Sustainability Communication: Interdisciplinary Perspectives and Theoretical Foundation;* Springer: Dordrecht, The Netherlands, 3–11, ISBN 978-94-007-1697-1.

Gökler, K. & Onay, A. (2020). Üniversitelerin Kurumsal İletişim Aracı Olarak Instagram Kullanımı: Vakıf Üniversitelerinin Instagram Sayfaları Üzerine Betimsel Bir İçerik Analizi. *Türkiye İletişim Araştırmaları Dergisi*, (35), 311-337.

Ilgın, H. Ö., Çelik, Y., ve Uruç, H. (2019). Kurumsal iletişim aracı olarak sosyal medya uygulamaları; bankalar üzerine bir inceleme. *Sosyal Bilimler Metinleri*, (1), 63-75.

Kadıbeşegil, S. (2009) *Şimdi Stratejik İletişim Zamanı*. MediaCat.

Kietzmann, J., Hermkens, K., McCarthy, I. P., Silvestre, B. (2011) Social Media? Get Serious! Understanding the Functional Building Blocks of Social Media, *Business Horizons, 54(3),* 241-251.

Lertpratchya, A. P.& Besley, J. C.& Zwickle A., Takahashi, B. & Whitley, C. T.(2017). Assessing the role of college as a sustainability communication channel, *International Journal of Sustainability in Higher Education, 18 (7),* 1060-1075, HTTPS:// doi.org/10.1108/IJSHE-09-2016-0172

Lian, J.-W. (2015). Critical factors for in Taiwan: An empirical study. *International Journal of Information Management,* 35(1), 98–109.　　　http://doi.org/10.1016/j.ijinfomgt.2014.10.005

Lozano, R.; Lukman, R.; Lozano, F.J.; Huisingh, D.; Lambrechts,W. (2013). Declarations for Sustainability in Higher Education: Becoming Better Leaders, through Addressing the　University System. *J. Clean. Prod., 48,* 10–19.

Özpınar, Baygül, Ş. (2021). "Yeni" Teknolojiler ve Kurumsal İletişimin Yeni　Araçları. *Üsküdar Üniversitesi İletişim Fakültesi Akademik Dergisi Etkileşim*, (7), 150-168.

Quiroz Flores A, Liza F, Quteineh H, Czarnecka B (2021) Variation in the timing of Covid-19 communication across universities in the UK. *PLoS ONE 16(2)*: e0246391, 1-25.

Rogers, E.M. (2003). Diffusion of innovations (5th ed.). New York: Free Press.

Šumak, B., Polancic, G., & Hericko, M. (2010). An Empirical Study of Virtual Learning Environment Adoption Using UTAUT. *Second International Conference on Mobile, Hybrid, and On-line Learning,* 17–22. http://doi.org/10.1109/eLmL.2010.11

T.C. Ministry of Health, 2020, Covid-19 Bilgilendirme Sayfası, *Covid-19 Nedir?,* Retrieved: 30.11.2020 from https://covid19.saglik.gov.tr/TR-66300/covid-19-nedir-.html, 20 Temmuz 2020.

Toh, C. H. (2013). Assessing adoption of wikis in a Singapore secondary school: Using the UTAUT model. *Proceedings of the 2013 IEEE 63rd Annual Conference International　Council for Education Media, ICEM* 2013, 1–9. http://doi.org/10.1109/CICEM.2013.6820 158

Ün, H. & Türkal, İ. (2018). Kurumsal İletişim Bağlamında Yükseköğretim Kurumlarının Sosyal Medya Kullanımları: Üniversitelerin Youtube Kanallarını Kullanımları Üzerine Bir İnceleme. *Atatürk Üniversitesi Sosyal Bilimler Enstitüsü Dergisi*, *22*(Özel Sayı 3), 2811-2833.

Venkatesh, V., Morris, M. G., Davis, G. B. & Davis, F. D. (2003). User Acceptance of　Information Technology: Toward a Unified View. *MIS Quarterly*, 27 (3), 425-478.

Venkatesh, V., Thong, J. Y. & Xu, X. (2012). Consumer Acceptance and Use of Information Technology: Extending the Unified Theory of Acceptance and Use of Technology. *MIS Quarterly.* 36 (1), 157-178.

We are Social, 2020: Digital 2020, Available online: https://datareportal.com/reports/digital-2020-april-global-statshot, (accessed on May 20, 2022).

WHO-WORLD HEALTH ORGANIZATION, Listings of WHO's Response to COVID-19. Available online: https://www.who.int/news/item/29-06-2020-covidtimeline (accessed　on May 20, 2022).

Wong A, Ho S, Olusanya O, Antonini MV, Lyness D. (2021). The use of social media and online communications in times of pandemic COVID-19. *Journal of the Intensive Care Society*, 22(3):255-260. doi:10.1177/1751143720966280

Sakarya University of Applied Sciences Strategical Plan of 2020-2024, Available online:https://strateji.subu.edu.tr/sites/strateji.subu.edu.tr/files/2020-03/Sakarya%20Uygulamal%C4%B1%20Bilimler%20%C3%9Cniversitesi%202020-2024%20Stratejik%20Plan%C4%B1_0.pdf (accessed on May 20, 2022).

Writing Support with Grammarly: Examining Confidence, Help-Seeking Behavior, and User Perceptions in Higher Education

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ABSTRACT

This study examines Grammarly's utility as a writing assistant for enhancing higher education students' writing skills. University writing centers and classroom settings now incorporate Grammarly as a resource for writing assistance and there is a need to understand how students view its use and its link to help-seeking behavior. 476 university students completed the study's questionnaire with the goal of assessing how students' help-seeking behaviors, writing confidence, and perceptions of Grammarly's effectiveness correlate with their use of the tool and its impact on writing quality. Initially, mean score comparison identified the levels students used Grammarly and Spearman correlations found a significant positive correlation between Grammarly use and improvements in writing quality and confidence. Analysis of variance (ANOVA) revealed statistically significant differences in writing confidence and help-seeking behaviors across academic years and between free and paid Grammarly users, indicating the tool's version and academic level's distinct effects on writing development. Participants who use the paid version reported more substantial benefits, highlighting the added value of premium features. Qualitative feedback from students underscores Grammarly's role in identifying grammatical errors, enhancing sentence structure, and bolstering writing confidence. However, critiques emerged concerning the occasional impractical suggestions and the perceived limitations of the free version. The findings suggest practical implications for integrating digital tools in educational settings and recommend directions for future research on technology's role in academic writing support.
Keywords: Grammarly, automated writing evaluation, writing confidence, higher education, help-seeking behavior.

1.0 INTRODUCTION

The learning environment extends beyond the physical classroom to include digital spaces. In higher education, Grammarly is an important resource in the digital space, alongside classrooms and writing centers, that enhances writing skills and confidence. While difficult to master, academic writing is a critical skill in university and heavily evaluated (Carter & Harper, 2013; Magaba, 2023; Maulidina & Wibowo, 2022). There is a misconception that students can write proficiently if admitted into university; additionally, academic writing, in particular, is a challenge for university students who may not be equipped with the knowledge and skills to write on a deeper level (Magaba, 2023).

Grammarly supports students in digital learning environments by simplifying academic writing. Differences between non-academic and academic writing include tone, complexity, accuracy, and the need for more advanced vocabulary and grammar (Rafikova, 2022). The challenges associated with mastering these characteristics of academic writing underscore the importance of finding methods to improve writing outcomes. Grammarly is one such tool that assists students in overcoming writing challenges in higher education.

Corrective feedback tools, such as Grammarly, are gaining popularity in education due to their ability to provide consistent feedback (Wang et al., 2012), enabling more focused attention on content and organization of writing rather than grammatical mistakes (Ranalli, 2018). Despite these advantages, concerns exist about students not using Grammarly effectively, with some students over-relying on suggestions (Chapelle et al., 2008). To this end, Stevenson and Phakiti (2019) found that there is an emphasis on the final written product rather than the process of writing itself, leading to concerns about the lack of critical thinking when using Grammarly.

The platform Grammarly has been available since 2009 and has over 30 million users (Grammarly, 2023). Grammarly has different levels available including a free version, a premium version (paid version), a business version, and an education version called Grammarly for Education, which can be purchased for departments, academic units, or for an entire educational institution. The free version of Grammarly includes feedback on spelling, grammar, and punctuation, while Grammarly Premium provides more extensive suggestions that focus on style, tone, word choice, formality, fluency, clarity, and plagiarism detection (Javier, 2022). When used effectively, Grammarly can complement traditional writing support resources such as writing centers, peer feedback, and instructor consultations, helping to reduce the strain on writing assistance services.

Writing centers in Higher Education often welcome the use of Grammarly to support writing quality, especially for non-native English writers (Zhang et al., 2020). Zhang et al. (2020) compared Grammarly with face-to-face writing instructors and found that Grammarly was well received by students and provided an added layer of student support. Grammarly provides more feedback than human consultants (Dembsey, 2017). Further, Grammarly can address local level error issues while writing consultants and instructors can focus on global level errors (Bailey & Lee, 2020). Students appreciate the capabilities of Grammarly yet criticize its inaccurate or decontextualized feedback, with recommendations that it be used based on specific needs (Zheng et al., 2020). These positive and negative attributes associated with Grammarly are evidence that further investigation in its use and perception among higher education students is quite warranted.

1.1 AIM STATEMENT
This research aims to investigate university students' perceptions of Grammarly and its role in facilitating help-seeking behavior with writing in higher education settings, such as digital spaces, classrooms, and writing centers. It further seeks to identify if there is a relationship between Grammarly use and students' confidence in university-level writing, as well as to examine differences between grade level and users of Grammarly's free and paid versions. Findings emanating from this study will enhance understanding of the effects of Grammarly on students' writing abilities and confidence in academic writing. The study is significant as it addresses explicitly the writing challenges faced by university students and their perceptions of Grammarly. Through qualitative and quantitative analysis, the study provides a comprehensive view of the interaction between students, their writing challenges, and Grammarly, offering valuable insights for educators, students, and researchers. Furthermore, there is limited research on the relationship between Grammarly usage and students' writing confidence. The following questions address these limitations and guide the research:

1. What are the levels of Grammarly use, writing confidence, and help-seeking behavior among higher education students?
2. How does the use of Grammarly relate to help-seeking behaviors and self-confidence in writing at the university level?
3. How does Grammarly use differ among higher education students when comparing different versions of Grammarly (paid or free) and across different academic years?
4. What are students' perceptions of Grammarly as a tool for enhancing writing skills, as revealed through thematic analysis of open-ended survey responses?

2.0 LITERATURE REVIEW
2.1 THEORETICAL FRAMEWORK
The theoretical framework for this study is based on self-regulated learning theory as conceptualized by Zimmerman (1990; 2000) and Pintrich (2004). This theory consists of three phases including forethought, performance, and self-reflection. This framework is exhibited by the metacognitive and strategic actions learners display when working toward their learning objectives (Butler et al., 1995; Zimmerman, 1990). Central to this

theory is the idea that self-regulation is a critical component of the writing process, influencing both the approach to writing tasks and the overall learning performance (Roderick, 2019; Teng & Huang, 2019).

Building on the foundational principles of self-regulated learning, this study examines the relationship of Grammarly with supporting help-seeking behavior among higher education students. The use of Grammarly and similar online resources has been documented as a facilitator for self-regulated writing, particularly in the second language (L2) (Umamah & Cahyono, 2022). These corrective feedback tools aid in grammar and vocabulary enhancement and serve as external resources that can be strategically employed during the writing process to achieve learning goals. Li and Kim (2024) have demonstrated that Grammarly is highly regarded among learners for its utility in improving writing proficiency. Their research advocates for the early introduction of corrective feedback tools by educators, suggesting that such practices can support learner agency and enhance self-regulation. Encouraging students to critically examine these technologies allows educators to guide them toward a more intricate insight into their writing processes, promoting more successful learning techniques.

The following review will contextualize how Grammarly, as technological support, contributes to a university level learning environment conducive to advancing writing skills (Ismawati et al., 2021; O'Neill & Russell, 2019), increasing confidence (Likkel, 2012; Mascle, 2013), and encouraging active seeking of writing assistance among students in higher education.

2.2 GRAMMARLY USE IN HIGHER EDUCATION

There is a growing interest in the role of artificial intelligence and corrective feedback tools such as Grammarly in assisting students in their writing development. Research has provided evidence of the effectiveness of Grammarly in improving writing skills (Ismawati et al., 2021; O'Neill & Russell, 2019; Zhang et al., 2020). It is important to note that Grammarly does not write for students or assist with writing content, rather it aids learners in identifying possible mistakes or areas of improvement (Zinkevich & Ledeneva, 2021). The growing focus on AI-supported tools like Grammarly signifies a shift towards technology integration to enhance students' writing skills.

Grammarly is used across various educational settings, with high use among English language learners (Ananda et al., 2021; Bailey & Lee, 2020; Fahmi & Cahyono, 2021; Fitria, 2021; Hakiki, 2021; Karyuatry et al., 2018; Zhang et al., 2020). Studies on Grammarly in the English language context generally report favorable results in terms of writing improvement (Huang et al., 2020) and writing confidence (Setyani et al., 2023). Grammarly can aid in detecting a range of mistakes in grammar, punctuation, sentence structure, style, and vocabulary (Ventayen & Orlanda-Ventayen, 2018). Grammarly can also be used to explore different errors in students' writing (Vidhiasi & Haryani, 2020) such as error frequencies, error types, and sentence complexity in students' writing (Bailey & Lee, 2020). Studies also report that Grammarly can help identify surface-level writing problems, such as grammar and mechanics issues, while teachers can assist with deeper elements of writing, including cohesion and content (Bailey & Lee, 2020; Thi & Nikolov, 2021).

Regardless of the benefits that Grammarly offers, the drawbacks should be considered. There are concerns about students quickly accepting writing suggestions without fully understanding if the changes will enhance their writing. Koltovskaia (2020) examined two English as a second language (ESL) college students' behavioral, cognitive, and affective engagement with Grammarly. The results indicated that one student had a stronger cognitive engagement with Grammarly but did not fully check the accuracy of the feedback, while the other student tended to rely heavily on the feedback without checking the accuracy. Koltovskaia's (2020) study, although insightful, was limited to just two students. The free version of Grammarly also has limited writing improvement features, which can inhibit overall writing improvement (Fitriana & Nurazni, 2021). Grammarly's free version can aid with minor errors, but for more extensive writing aid, the premium version provides more suggestions (Cavaleri & Dianati, 2016; Fitria & Miftah, 2022). Zinkevich and Ledeneva (2021) studied 100 English language learners' essays using Grammarly. They found that the premium version of Grammarly provides the flexibility to select various writing styles, address different audiences, choose the tone of writing, and navigate through many other subtle difficulties with writing that may be problematic for non-native English speakers (Zinkevich & Ledeneva, 2021). Additionally, Grammarly may provide misleading, or possibly inaccurate, suggestions that writers should be cognizant of (Barrot, 2022; Fitriana & Nurazni, 2021). To address potential issues with student reliance on Grammarly, providing training sessions on its effective use is recommended (Rao et al., 2019).While Grammarly proves valuable for writing improvement, educators and students alike should be mindful of its limitations and actively engage in training sessions to maximize its benefits.

The benefits of Grammarly extend beyond English language learners. For instance, a study conducted by Cavaleri and Dianati (2016) demonstrated that Grammarly not only provided valuable explanations to students but also contributed to a better understanding of grammar rules and increased writing confidence. It is important to

acknowledge that this study had a relatively small sample size of 18 students, eight of whom were non-native English speakers enrolled in various academic programs. O'Neill and Russell (2019) studied academic advisors' perceptions of Grammarly at a multi-campus and reported generally favorable findings. Six advisors were surveyed about their views of Grammarly feedback to international students ($n = 47$) and domestic students ($n = 29$). Findings indicate that Grammarly feedback is useful and provides feedback faster than traditional instructor feedback. However, some drawbacks were also noted since Grammarly missed some mistakes and gave incorrect suggestions. As technology continues to advance, ongoing research becomes critical to examine the full potential of corrective feedback tools like Grammarly, even in native English-speaking contexts. These studies highlight the multifaceted impact of Grammarly, showcasing its ability to provide valuable insights, enhance understanding of grammar rules, and contribute to increased writing confidence across diverse educational settings. However, they also highlight the importance of acknowledging limitations and continuously refining these tools for increased support in the writing process.

2.3 WRITING CONFIDENCE AND GRAMMARLY USE

Good writing skills are critical in higher education, and universities must ensure that students are equipped with the skills needed for the job market (Calma et al., 2022). Despite this emphasis, some students struggle with a lack of confidence in their writing. Studies indicate that enhancements in confidence and self-efficacy related to writing proficiency can result in advancements in writing capabilities (Likkel, 2012; Mascle, 2013). Myriad factors impact students' writing confidence (Ruegg & Koyama, 2010). Some instructors believe that the quality of feedback will lead to improved student writing, which may not necessarily be the case (Ruegg & Koyama, 2010). Additionally, students may lose confidence in their writing based on the amount and type of feedback they receive (Hyland, 1998). Although universities aim to provide students with job market-relevant writing skills, a significant challenge remains regarding some students' lack of confidence in writing. Previous studies, such as Soegiyarto et al. (2022) for non-native English speakers and O'Neill and Russell (2019) within the Australian context, have indicated increased confidence through Grammarly use.

Writing confidence has been extensively explored in relation to Grammarly use (Faisal & Carabella, 2023; Purwanti & Kastuhandani, 2023; Setyani et al., 2023; Vo & Nguyen, 2021). The introduction of new pedagogical strategies for teaching essays, as discussed by Highland & Fedtke (2023), alongside the integration of Grammarly, provides new strategies in writing instruction. In a study in the Indonesian context, Setyani et al. (2023) found that writing confidence improved after Grammarly use especially in terms of grammar development. Specifically, students reported more flexibility in "behavior, cognitive efforts, emotional stability, motivation, and self-esteem in writing" (Setyani et al., 2023, p. 65); however, this study was limited to just three students. A further study conducted in Indonesia by Pratama (2020) found that Grammarly improved undergraduate students' writing confidence by providing real-time suggestions while students were writing. Vo and Nguyen (2021) investigated the application of Grammarly among English major students at a Vietnamese university. A significant discovery for the participants ($n = 17$) in the control group employing Grammarly was the enhancement of their writing confidence, which is attributed to real time and consistent feedback. Another study in the Indonesian university context found that 60% of students ($n = 40$) agreed that Grammarly helped to improve their confidence in writing (Armanda et al., 2022). Similar outcomes were documented by Maulidina and Wibowo (2022) in their examination of Grammarly usage at an Indonesian university. They reported that 61% of students ($n = 33$) perceived improvement in their grammar skills using Grammarly (Maulidina & Wibowo, 2022). While these studies collectively underscore the positive impact of Grammarly on enhancing writing confidence, there is a recognized need for more comprehensive research in this area, especially in native English-speaking settings.

2.4 HELP-SEEKING BEHAVIOR AND GRAMMARLY USE

In higher education, help-seeking behavior occurs within classrooms, writing centers, and digital space environments. Help-seeking behavior can be categorized as either informal, involving assistance from friends and family, or formal, involving assistance from instructors and academic resources (Knapp & Karabenick, 1988). For informal, students seek help from their immediate social network for comfort, ease of access, and the lower perceived risk involved in these interactions (Beisler & Medaille, 2016; Pillai, 2010). In contrast, formal help-seeking involves going to professors, writing tutors, and utilizing academic resources. Corrective feedback tools such as Grammarly facilitate self-regulation in the educational process, serving as a low-stakes, self-guided source of assistance for students improving their writing skills. Grammarly introduces a precise method of assistance in both academic and non-academic writing, significantly enhancing the quality of student output. This approach to seeking help with Grammarly can positively influence students' writing confidence and academic performance. The relationships among help-seeking behavior, writing confidence, and the use of technologies like Grammarly is complex and warrants further investigation. Students with high self-efficacy are generally more inclined to seek help, whereas those with lower confidence, especially in their writing skills, may hesitate to seek formal help due to fear of embarrassment or judgment (Williams & Takaku, 2011; Aunkst, 2019). Grammarly acts as a supportive,

non-judgmental resource that encourages proactive help-seeking behaviors. Additionally, research emphasizes the value of empathy and personalized support in formal academic settings, such as writing centers, for improving students' confidence and willingness to seek help (Lundin et al., 2023). Consequently, integrating Grammarly with traditional help-seeking methods can create a more supportive and effective learning environment.

3.0 METHODOLOGY

This convergent mixed method study was conducted in November of 2023 after receiving institutional review board permission. Participants ($n = 476$) included undergraduate and graduate level students studying at a mid-sized public university in the southeastern United States. Participants were selected based on convenience and purposive sampling. A survey link was posted on the university learning management for 2 weeks. The survey comprised closed and open-ended questions on students' Grammarly and writing experiences and perceptions. Majors included Nursing ($n = 55$), Psychology ($n = 39$), Education ($n = 38$), Biology ($n = 24$), Computer Information & Science ($n = 22$), Criminal Justice ($n = 19$), Business ($n = 18$), Liberal Arts ($n = 16$), Marketing ($n = 14$), Radiology ($n = 13$), and Others ($n = 218$). The characteristics of the sample can be found in Table 1.

Table 1: *Classification of Students by Level and Major*

Level	Frequency	Percentage
First-year (freshman)	151	31.7
Second-year (sophomore)	70	14.7
Third-year (junior)	87	18.3
Fourth-year (senior)	96	20.2
Graduate Level	62	13.0
Missing	10	2.1
Total	476	100

3.1 QUESTIONNAIRE CONSTRUCTION

The questionnaire was designed using insights from four academic writing instructors, each with over 10 years of experience, aiming to support the university's quality enhancement plan focused on writing improvement. This plan includes considering the institution-wide adoption of Grammarly for Education to support writing outcomes. Moreover, university faculty and staff with expertise in writing and statistics were consulted to refine the survey questions.

The construction of the in-house questionnaire was influenced by key studies in three areas of interest: Grammarly use, writing confidence, and help-seeking behavior. For open-ended items enquiring about Grammarly use, insights were drawn from O'Neill and Russell (2019), Faisal and Carabella (2023), Fitria and Sabarun (2022), Fitriana and Nurazni (2022), and Hakiki (2021), highlighting students' perceptions and effectiveness of Grammarly in academic writing. Help-seeking behavior was informed by studies such as Knapp and Karabenick (1988), Umamah and Cahyono (2022), and Williams and Takaku (2011), focusing on academic help-seeking in the context of writing. Items measuring confidence in students' writing were influenced by Ruegg and Koyama (2010), examining the role of feedback in enhancing writing confidence.

The Grammarly Use scale consisted of four items, assessing various aspects of students' experiences with Grammarly. Items one through three explored students' familiarity, frequency of use, and perceived helpfulness with Grammarly (Cronbach's alpha = .808), utilizing a five-point Likert scale ranging from *Extremely likely* (5) to *Not likely at all* (1). Item four enquired about the likelihood of students using the paid version if the university provided it. A further item was added to identify the version (paid or free) that students used.

The Writing Confidence scale (Cronbach's alpha = .809) consisted of three items aimed at measuring students' confidence levels in non-academic writing, academic writing, and research writing. These items employed a 5-point Likert scale, ranging from *Not Confident at All* (1) to *Extremely Confident* (5). This range of items was selected to capture a comprehensive view of students' writing confidence across different contexts, recognizing that skills and self-assurance may vary significantly between informal, coursework-related, and research-oriented writing tasks.

The Help-Seeking scale includes two sub-components: formal help-seeking (Cronbach's alpha = .679), and informal help-seeking (three items, Cronbach's alpha = .646) behaviors, measured on a five-point scale from "Extremely Unlikely" (1) to "Extremely Likely" (5). This division into formal and informal categories follows Knapp and Karabenick's (1988) framework for understanding help-seeking in higher education. The Help-Seeking

scale, with Cronbach's alpha scores of .679 (formal) and .646 (informal), suggests modest internal consistency. These results are contextualized by the scale's high construct validity, achieved through detailed consultations with researchers and professionals in academic writing, ensuring the items accurately reflect the help-seeking behaviors conceptualized by Knapp and Karabenick's (1988).

The questionnaire includes an open-ended question for users of Grammarly to detail their perceptions of the tool's functionality, effectiveness, and ease of use: "If you use Grammarly (any version), what are your thoughts on the tool?" This item seeks to gather in-depth user feedback on how they use Grammarly to help with their writing. Lastly, demographic information collected in the questionnaire included academic year and major (*see* Table 1). Wording for the survey items are presented in Table 2.

3.1.1 QUESTIONNAIRE ADMINISTRATION
The study utilized a questionnaire for higher education students with academic and research-related writing responsibilities. The questionnaire was formatted for online distribution via Google Forms. Students, under instructor supervision, completed the online questionnaire. They were informed about the study's goals and their right to opt out or exclude their data at any time.

3.2 DATA ANALYSIS
For quantitative analysis, this study used SPSS (version 28). Analysis for research question 1 entailed calculating mean scores for individual questionnaire items and the overall mean scores for the variables of interest. For research question 2, Spearman's correlation was used to measure the relationships between the frequency of Grammarly use, writing confidence, and help-seeking behavior. For research question 3, one-way ANOVA tests were used to measure differences in variables among student groups categorized by Grammarly version (paid or free) and academic year. Running an ANOVA to compare levels of Grammarly use, writing confidence, and help-seeking behavior between students with the paid versus free version of Grammarly and academic year can still be valuable even after a correlation analysis shows a significant positive relationship. Correlation provides insight into the relationship between variables, but it does not indicate the magnitude of difference in writing confidence between the groups. Moreover, conducting both analyses adds rigor to the research by validating findings across different statistical methods. For the qualitative component addressing research question 4, thematic analysis was used to identify and report commonalities in the participants' responses (Flick, 2023). The first step was familiarization with the open-ended data followed by generating initial codes. Overarching themes for the codes were developed, and finally, the themes were reviewed and refined. This was initially done manually. Following manual coding and theme generation, the Dedoose qualitative coding program was used to help refine the codes and themes.

4.0 RESULTS
Research question 1 explored overall Grammarly use, writing confidence, and help-seeking behaviors among higher education students. The investigation into Grammarly's usage revealed significant engagement with the application among students. Students are highly familiar with the Grammarly application and find it extremely helpful, as indicated by mean scores above the 3.5 level for those two items on the Grammarly Use scale. Likewise, students report using Grammarly frequently when writing papers or writing assignments. A majority of students at the university are utilizing Grammarly to aid in their writing, with most opting for the free version. Specifically, 415 students use the free service and 37 subscribe to the premium version. Three items were asked regarding students' familiarity and use of Grammarly (see Table 2). The data indicates that most students are familiar with the writing application Grammarly and use it when writing papers or assignments. Most students found Grammarly helpful in improving their writing. Out of the 476 participants, 346 students reported that they are extremely likely to use the paid version of Grammarly if the university were to obtain it.

Regarding help-seeking behavior, students predominantly favor formal means to receive help, such as professors, digital tools (e.g., ChatGPT, Grammarly), and academic support services (including writing centers). Students demonstrated a preference for formal help-seeking channels, such as professors, online applications (e.g., ChatGPT, Grammarly), and academic resources (e.g., writing centers), over informal sources like family members and colleagues for writing assistance. Online applications like Grammarly scored the highest mean score among the items within the formal help-seeking scale.

The study further explored students' writing confidence across various contexts: non-academic writing, academic writing, and research activities. In examining students' self-reported confidence levels, the study explored three key domains: non-academic writing, academic writing, and research activities. The mean scores across domains, with the greatest confidence reported in non-academic writing, followed by academic writing, and the lowest in research writing (see Table 2). The average confidence score for non-academic writing tasks was high, indicating

that students generally feel competent in everyday writing scenarios. Academic writing confidence showed a moderately high score, suggesting a positive but slightly less confident stance towards more formal writing tasks. Confidence in academic writing presented the lowest mean score among the three, pointing to a lower range of confidence levels in handling research-related tasks.

Table 2: *Items on Grammarly Usage, Writing Confidence, and Help-Seeking Behaviors Among University Students*

	Grammarly Use	M	SD	Skew	Kurt
1	How familiar are you with the writing application Grammarly?	3.95	1.08	-0.85	0.04
2	How often do you use Grammarly when writing papers or writing assignments for your classes?	3.49	1.20	-0.41	-0.60
3	If you have used Grammarly, how helpful have you found it in improving your writing?	3.77	1.06	-0.53	-0.56
	Total	4.14	0.73	-0.99	1.36
	Writing Confidence				
4	How confident are you in your ability to write for non-academic purposes (e.g., emails, job applications, letters, etc.)?	3.93	0.90	-0.80	0.55
5	How confident are you in your ability to write in university-level courses (e.g., essays, research papers, class reflections, case studies, reports, etc.)?	3.58	0.95	-0.63	0.06
6	How confident are you in your ability to engage in university-level research (e.g., develop relevant research questions, use appropriate library resources, collect data, paraphrase, and incorporate academic citations, etc.)?	3.21	1.08	-0.29	-0.56
	Total	3.57	0.83	-0.50	-0.05
	Formal Help-Seeking Behavior				
	When having difficulty with a writing assignment, how likely is it that you would seek help from the following people or resources?				
7	Professor	3.76	1.18	-0.62	-0.63
8	Academic student resources (e.g., Writing Center, Learning Resource Center)	3.39	1.32	-0.34	-1.01
9	Online applications and other technologies (e.g., ChatGPT, Grammarly)	3.73	1.36	0.33	6.02
	Total	3.58	1.09	-0.46	-0.68
	Informal Help-Seeking Behavior				
	When having difficulty with a writing assignment, how likely is it that you would seek help from the following people or resources?				
10	An intimate partner (e.g., spouse, girlfriend, or boyfriend).	3.04	1.46	-0.13	-1.36
11	A friend	3.31	1.28	-0.35	-0.87
12	A parent or another relative/family member	2.90	1.46	0.05	-1.37
	Total	3.10	1.10	-0.20	-0.77
	Grammarly Version				
13	If you use Grammarly, which version of Grammarly do you use?	1.12	0.32	2.41	3.84
14	If the university were to obtain the paid version of Grammarly that students could use for free, how likely would you be to use it?	4.73	0.66	-3.05	10.67

Research Question 2 measured the correlation between the use of Grammarly and its impacts on help-seeking behaviors and self-confidence in writing among university students. Spearman correlations were utilized to investigate these relationships, focusing on three main variables. Additionally, the analysis considered background factors, such as whether students were using the free or paid version of Grammarly and their academic year, as detailed in Table 3. This analysis highlighted relationships among the variables, with the type of Grammarly version showing the most significant associations. Except for writing confidence and formal help-seeking behavior, all relationships with Grammarly versions were statistically significant. These findings suggest that students using the paid version of Grammarly tend to be in higher academic years (i.e., freshman to graduate grade levels), use Grammarly more frequently, and are more inclined to seek help from professors and academic writing resources. Interestingly, students at higher academic levels (senior and graduate students) tended to use Grammarly more frequently and were less inclined to seek help from friends and family. A statistically significant correlation was observed between students who exhibited greater writing confidence and those who engaged in formal help-seeking behaviors, as well as with their use of Grammarly. Additionally, students confident in their writing abilities

were more likely to seek academic support, and those who sought help from friends and family were also found to engage in formal help-seeking behaviors at school.

Table 3: *Spearman Correlation and Mean Scores of Study's Variables*

		1	2	3	4	5	6
1	Version (paid/free)						
2	Academic Year	.152**					
3	Grammar Use	.245**	-.001				
4	Confidence	-.015	.263**	.100*			
5	Informal Help-Seeking	-.125**	-.178**	.001	-.012		
6	Formal Help-Seeking	-.004	-.076	.103*	.155**	.167**	
	M	1.12	2.67	4.14	3.57	3.10	3.58
	SD	0.32	1.44	0.73	0.83	1.10	1.09

Note. $^{**}p < .01$, $^{*}p < .05$

Research Question 3 explored the variation in Grammarly use among higher education students by examining the differences between users of its paid and free versions and across different academic years, including freshman, sophomore, junior, senior, and graduate students. This analysis seeks to understand how Grammarly use, writing confidence, and help-seeking behavior change based on the version of Grammarly used and the students' academic progression.

As seen in Table 4, an ANOVA was conducted to examine differences in Grammarly use, writing confidence, and help-seeking behaviors (informal and formal) between students using the paid and free versions of Grammarly. Significant differences were observed in Grammarly use ($F=30.280$, $p<.001$) and informal help-seeking behavior ($F=8.89$, $p=.006$), indicating that students with the paid version reported higher usage of Grammarly and were more inclined to seek help informally from friends and family. No significant differences were found in writing confidence ($F=.104$, $p=.747$) and formal help-seeking behavior ($F=.008$, $p=.927$). Given the binary nature of the comparison (paid versus free versions), Bonferroni post hoc analysis was not necessary.

Table 4: *ANOVA for Grammarly Use, Writing Confidence, and Help-Seeking Behavior across Paid and Free Versions of Grammarly*

Variable	Source	Sum of Squares	df	Mean Square	F	p
Grammarly Use	Between Groups	15.131	1	15.131	30.28	.000**
	Within Groups	236.357	452	0.5		
Writing Confidence	Between Groups	0.072	1	0.072	0.104	.747
	Within Groups	328.798	452	0.694		
Informal Help-Seeking	Between Groups	8.896	1	8.896	7.516	.006**
	Within Groups	561.064	452	1.184		
Formal Help-Seeking	Between Groups	0.01	1	0.01	0.008	.927
	Within Groups	553.722	452	1.193		

Note. $^{**}p < .01$

An additional ANOVA was conducted to assess variations across academic years, as displayed in Table 5. The analysis revealed statistically significant differences in writing confidence ($F=9.525$, $p<.001$) and informal help-seeking behavior ($F=5.272$, $p=.001$). Bonferroni post hoc tests were applied to identify the specific academic years where these differences occurred. Results indicated that seniors and graduate students exhibited higher Writing

Confidence levels compared to their freshman and sophomore peers. Conversely, in terms of Informal Help-Seeking Behavior, graduate students demonstrated lower average scores compared to freshmen, sophomores, and juniors. This suggests that lower-level students are more inclined to obtain assistance from family and friends.

Table 5: *ANOVA for Grammarly Use, Writing Confidence, and Help-Seeking Behavior across Academic Year*

Variable	Source	Sum of Squares	df	Mean Square	F	p
Grammarly Use	Between Groups	0.832	4	0.208	0.386	.818
	Within Groups	247.484	449	0.538		
Writing Confidence	Between Groups	24.102	4	6.025	9.525	.000**
	Within Groups	291.625	449	0.633		
Informal Help-Seeking	Between Groups	21.09	4	5.272	4.51	.001**
	Within Groups	538.945	449	1.169		
Formal Help-Seeking	Between Groups	3.786	4	0.946	0.789	.533
	Within Groups	541.212	449	1.2		

Note. **$p < .01$

The Bonferroni post hoc analysis presented in Table 6 reveals significant differences in writing confidence levels among student groups. Specifically, freshmen and sophomores reported lower confidence in their writing abilities compared to senior and graduate students. Additionally, the analysis indicates that freshmen and sophomores are more inclined to seek assistance with writing from informal sources, such as family and friends, rather than formal or institutional resources.

Table 6: *Bonferroni post hoc analysis for ANOVA for grade level and study's variables*

Comparison	Mean Difference	SE	p	95% CI [Lower, Upper]
Writing Confidence				
Fresh vs Sen	-0.53031	0.104	0.0**	[-0.823, -0.237]
Fresh vs Grad	-0.54397	0.12	0.0**	[-0.882, -0.206]
Soph vs Sen	-0.42044	0.125	0.01*	[-0.773, -0.068]
Soph vs Grad	-0.4341	0.139	0.02*	[-0.825, -0.043]
Jun vs Sen	-0.36231	0.118	0.02*	[-0.694, -0.03]
Jun vs Grad	-0.37597	0.132	0.05*	[-0.749, -0.003]
Informal Feedback				
Fresh vs Sen	0.48383	0.156	0.02*	[0.044, 0.923]
Fresh vs Grad	0.84065	0.179	0.0**	[0.335, 1.346]
Soph vs Grad	0.72549	0.207	0.01**	[0.141, 1.31]
Jun vs Grad	0.62864	0.199	0.02*	[0.068, 1.189]

Note. **$p < .01$, *$p < .05$

Research Question 4 used thematic analysis to examine students' perceptions of Grammarly as a tool for improving writing skills, based on open-ended survey responses. This approach aims to uncover the underlying themes in students' feedback and experiences with Grammarly in their academic writing.

4.1 GRAMMARLY PERCEPTIONS

Participants who are currently using Grammarly were asked to share their perceptions of the tool. They were also asked if they had any additional feedback or thoughts regarding Grammarly. Overall, participants who are using Grammarly reported positive experiences. The proceeding section discusses dominant themes that emerged including writing improvement, convenience and usage, and helpful features. While perceptions of Grammarly were predominantly positive, some challenges were also discussed. These findings are presented thematically as drawbacks.

4.2 WRITING IMPROVEMENT

Participants noted that Grammarly has helped them improve their writing. They indicated that Grammarly aids specifically in catching spelling errors, improving grammar, refining sentence structure, and improving confidence. One participant noted, "I think it is an effective way to improve your writing while also teaching you how to word your sentences better." Participants also mentioned that Grammarly aids with minor details that writers may miss. Although open-ended questions did not specifically ask the students about Grammarly and confidence, a participant reported, "It does help or at least make me feel more confident in the writings I submit." Another stated, "I would suggest many more people use [it] for important projects they have. I think it's a nice way to check your work before submitting and it builds confidence." Participants reported Grammarly's positive impact on their writing, citing improvements in spelling, grammar, sentence structure, and heightened confidence in their submissions.

4.3 CONVENIENCE AND USAGE

Participants find Grammarly convenient, especially for proofreading. They also find Grammarly easy to use, and the interface is friendly for beginners. A participant stated, "I think it's very user friendly and it helps so much when writing papers. It's changed my life for the better these past years." Additionally, participants noted that it simply underlines potential mistakes, making it easy to make modifications. Another participant stated, "I've been using Grammarly for as long as I can remember, and I couldn't imagine a world without it." Participants also reported that the pop-up suggestions are convenient. For example, one participant stated, "I find it highly functional and convenient to use the app on my computer since I prefer working on Word rather than their built-in document creator." Another discussed the practicality of Grammarly in aiding with writing without Grammarly action writing for the students. "I think that every student should use Grammarly. It's always nice to have something checking your work without completely changing it." Participants reported valuing Grammarly for its user-friendly interface, convenient proofreading, and overall impact on their writing.

4.4 HELPFUL FEATURES

Participants highlighted the helpful features of Grammarly including correcting mistakes, improving sentence structure, and providing helpful vocabulary. One participant provided a detailed overview of their experiences using Grammarly and highlighted the beneficial features. The participant stated,

> I use the free version and it honestly is very good. It definitely has updated this past year and now has an AI tool built in. It provides me what I can mention in my writing with already knowing my topic. Grammarly also provides simple spell checks which really comes in handy, so you don't have to reread to find your mistakes.

A similar example provided is "I think it is very helpful for correcting grammar errors or repeated words, helps align sentences more grammatically and is generally a good thing to have." Participants value Grammarly for its beneficial features, such as effective spell checks, grammar corrections, and improved sentence structure.

4.5 DRAWBACKS

Although feedback was generally positive, participants mentioned specific areas for improvement were odd or incorrect suggestions that need to be improved in the system. Additionally, another dominant concern was the limited features of the free version of Grammarly. For example, one participant stated, "It is very good at its main function, but sometimes it tries to fix things in a robotic way." Another said, "Sometimes the commas are not needed. Just have to use my own discretion when choosing to accept the suggestion or not." Another participant commented on the differences between the paid and free versions. "I had the paid version last year, and I actually found it helpful and way better compared to the free version I have now. The free one is glitchy in the way that it recommends ridiculous words that do not sometimes make sense." Participants also mentioned occasional glitches in the free version and noted that specific suggestions can only be accessed through a paid version of Grammarly. One participant had positive remarks about Grammarly but also indicated that the "free version is a bit annoying because some things can only be fixed with the paid version." This was reiterated by another participant who said, "I love Grammarly. I just wish the free version had more options." Furthermore, participants stated that cost is a

concern since the premium version is expensive, and some expressed a desire for the university to give access to students.

5.0 DISCUSSION

The current study provides significant insights into how students use Grammarly as a tool to improve their writing in the academic context, in digital and physical spaces. Results indicate that Grammarly has aided students in both academic, professional, as well as in personal experiences of writing, which aligns with other studies on the benefits of Grammarly for improving writing (Ventayen & Orlanda-Ventayen, 2018; Vidhiasi & Harvani, 2020). Despite Grammarly being perceived to be a useful tool for writing improvement pertaining to grammar and spelling, both existing literature (Koltovskaia, 2020) and the current study indicate that users must engage in critical thinking and contextual judgment, in accepting the grammatical and syntactical changes Grammarly offers.

Regarding the first research question, this investigation into Grammarly's effect on writing confidence and help-seeking behaviors in higher education students uncovered insights into their usage and attitudes. Firstly, a significant engagement with Grammarly is evident among students, demonstrating its value in the academic writing process, echoing extant literature (Ananda et al., 2021; Ismawati et al., 2021; O'Neill & Russell, 2019; Zhang et al., 2020). Students reported frequently using Grammarly for writing assignments and expressed a high level of satisfaction with its capabilities, particularly appreciating its free version, though many show interest in upgrading if provided by their institutions (Faisal & Carabella, 2023).

Moreover, findings highlight a clear preference for formal help-seeking channels, including professors, digital tools like Grammarly, and academic support services over informal sources such as family and colleagues (Beisler & Medaille, 2016 Knapp & Karabenick, 1988). This trend suggests students' strategic approach to overcoming writing challenges, favoring structured academic support mechanisms. Interestingly, digital tools, particularly Grammarly, rank high among students' preferred resources, indicating a reliance on technology for writing assistance. This reliance is indicative of a deeper integration of technology within both physical spaces like classrooms and digital environments, underscoring its evolving role in education. As educational institutions continue to navigate between physical and digital spaces, the value and impact of these tools on learning and writing proficiency become increasingly significant.

Regarding writing confidence, the study revealed the highest confidence in non-academic writing, followed by academic writing, and the lowest in research writing, in line with findings from Fahmi and Cahyono (2021) and Fitria (2021). This gradation suggests that students feel relatively assured in everyday writing scenarios but can use assistance with tools like Grammarly when faced with more formal, academic-oriented writing and research tasks. This underlines the need for continued support and resources in higher education environments including, writing centers, to mitigate confidence gaps in academic and research writing.

Research Question 2 explored the relationship between Grammarly use, help-seeking behaviors, and writing confidence, revealing several key findings. The use of Grammarly, especially the paid version, is closely linked to more frequent use and a higher likelihood of seeking formal academic help, as noted in studies by Faisal and Carabella (2023) and Ananda et al. (2021). Higher academic year students tend to use Grammarly more, suggesting a reliance on this tool for advanced writing tasks.

The data also shows a clear connection between students' writing confidence and their propensity to seek formal academic support. Confident students are more proactive in seeking help from academic resources and professors (Cavaleri & Dianati, 2016; Huang et al., 2020). This supports the idea that confidence in writing motivates students to enhance their skills through available support services (Butler & Winne, 1995). Additionally, students who seek informal help from friends and family also tend to use formal academic resources, indicating a multi-faceted approach to overcoming writing challenges (Beisler & Medaille, 2016). This dual strategy of help-seeking behavior highlights the significant role of digital tools and self-regulation in academic success, aligning with broader educational trends (Zimmerman, 2000; Li & Kim, 2024). These findings emphasize the importance of integrating effective support mechanisms within the higher education learning environment to cater to student confidence and success in writing.

Research Question 3's findings on the varied use of Grammarly among higher education students highlight aspects of writing confidence and help-seeking behavior. The analysis indicates significant differences in writing confidence, with senior and graduate students displaying higher levels than their younger counterparts, freshmen and sophomores. This aligns with studies like those by Cavaleri and Dianati (2016) and Huang, Li, and Taylor (2020), which suggest that advanced students develop greater confidence in their writing abilities through continued exposure to academic writing tasks and feedback tools like Grammarly.

Additionally, the observed variation in informal help-seeking behavior, particularly the lower tendency among graduate students compared to undergraduates, underscores the shift in reliance on personal networks versus formal academic resources as students progress in their academic careers. This could reflect a transition towards more independent learning strategies and the utilization of professional tools for writing assistance, as discussed in the works of Aunkst (2019) and Barrot (2022). The increased independence and confidence among senior and graduate students may also indicate a higher level of self-regulation in their learning processes, a key component of academic success highlighted by Zimmerman (2000) and Butler and Winne (1995). These patterns of engagement with writing tools and academic support reflect a broader trend in learning environments adapting to promote increased self-efficacy and autonomy among students in higher education.

Research Question 4 explored the comparative effectiveness of Grammarly's free and paid versions, as perceived by students, in enhancing their writing skills. Regarding the usefulness of the tool, the free version of Grammarly is perceived to be less useful than the paid version. The paid version offers higher usability while the free version was very useful for the basic grammatical and syntactical changes. Grammarly Premium can provide more detailed feedback for different writing styles and audiences; furthermore, it can aid with the tone of writing. The free version often glitched and posited technological challenges, which frustrated the student users, especially when they worked on tight deadlines. The free version, by definition, is limited with features, which hinders the student. Additionally, the paywall of the paid version can isolate students who lack the financial resources to afford it, ultimately limiting their access to enhanced writing assistance.

Student users of Grammarly find significant value in using the tool and feel more confident in the quality of their writing when they use Grammarly to edit their papers for schoolwork. The findings of this study are aligned with similar studies that explored the increase in writing confidence that was attributed to Grammarly use (Faisal & Carabella, 2023; Purwanti & Kastuhandani, 2023; Setyani et al., 2023; Vo & Nguyen, 2021). Due to this, university-level subscriptions may benefit students more than expecting individual students to download and use Grammarly.

5.1 PEDAGOGICAL IMPLICATIONS

A few pedagogical implications emanating from this study for teaching and learning practices are worth noting. Firstly, the widespread usage and positive perception of Grammarly among students underscore the importance of incorporating technology into writing pedagogy in higher education. Instructors could leverage this importance by integrating Grammarly in structured classroom activities that promote its use as a supplementary tool, thereby enhancing students' autonomous writing skills. The evident reliance on Grammarly for grammatical and spelling checks suggests that curricula could be developed to encourage students to use such tools critically, reinforcing the concept that technology should support, not substitute, the development of writing proficiency. Additionally, recognizing the differential impact of the free and paid versions of Grammarly, educational institutions might consider providing access to the premium service to ensure equitable academic support, particularly for students who may be financially disadvantaged. Secondly, the study's findings on the collective preference for digital assistance over personal help indicate a shift in help-seeking behavior, which has significant implications for academic support services. Writing centers and learning resources need to adapt to this digital preference, perhaps by offering online consultations and digital resource libraries. Also, given that students displayed a significant likelihood of using the paid version of Grammarly if provided, universities should evaluate the cost-effectiveness of institutional subscriptions. Such an initiative could enhance students' writing outcomes and confidence across various writing contexts. The integration of Grammarly and similar applications into educational settings represents a progressive step towards a more technology-empowered learning environment, promoting students' writing competence and confidence in the digital era.

A few other noteworthy implications to how higher education writing centers and writing classrooms can be drawn from the findings. The findings suggest that combining Grammarly with human tutors is an effective strategy for supporting students' writing, consistent with existing research (Dembsey, 2017). In line with prior research (Bailey & Lee, 2020; Thi & Nikolov, 2021), it is suggested that writing instructors and tutors focus on global level writing issues while Grammarly can address local level issues like using correct sentence structure, word choice, punctuation, tense consistency, verb agreement and preposition use. This integrated approach to writing instruction (i.e., Grammarly alongside teacher) can assist in developing academic writing in university courses (Magaba, 2023). With Grammarly, students develop independent learning skills through choosing which corrections to accept, supporting Maulidina and Wibowo's (2022) on its digital spaces. Furthermore, findings here indicate students appreciate the affordances of using Grammarly in the classroom to teach grammatical accuracy, echoing findings from Carter and Harper (2013). Lastly, as indicated by studies from Chapelle et al. (2008), Stevenson and Phakiti (2019), and Javier (2022), the use of Grammarly enables corrective feedback interaction between students

and the digital tools that promote learning experience and the development of critical thinking skills in writing tasks

Regarding connection to the theoretical framework in this study, Grammarly significantly aids in promoting self-regulated help-seeking behaviors by bridging the gap between informal and formal methods of seeking help, offering authoritative support in an accessible, low-pressure manner. It acts not only as a tool for improving grammar and writing but also boosts writing self-efficacy (Umamah & Cahyono, 2022).

It is perceived that while some suggested changes were correct in the literal sense of the English language, those may be out of the context in which the paper was being composed. It is, after all, an aid and is never meant to replace human judgment. In close connection to the abovementioned point, when it comes to actual usage, students seldom use Grammarly as the sole tool to improve their writing. They may use it in conjunction with multiple other resources to help with their writing, some of which include campus tutoring services, campus writing center, professors, friends, and family.

6.0 CONCLUSION
The study's findings suggest practical considerations for educators, administrators, and technology providers. Integrating Grammarly into writing-intensive courses may enhance students' skills, given their positive perceptions. Faculty development programs should equip instructors with Grammarly features, enabling effective guidance. Instructors may consider incorporating specific exercises where students actively use Grammarly to improve spelling, grammar, sentence structure, and confidence.

Institutions could explore providing access to Grammarly's premium version, considering the reported benefits. Negotiating institutional licenses or partnerships may address cost concerns, supporting effective communication and written expression. Educators should be aware of available tools, encouraging responsible use in courses to align with the trend of integrating digital literacy skills into curricula.

The study provides a foundation for future research to deepen understanding of Grammarly's role in students' writing development. Exploring the tool's impact on self-perceived improvement and confidence across disciplines is essential. Investigating its effectiveness in various academic contexts can inform tailored writing support.

6.2 LIMITATIONS
Some limitations of this study should be acknowledged. First, the cross-sectional research design does not account for longitudinal changes in perceptions of Grammarly use. Additionally, self-reporting and convenience sampling from a single university in Middle Tennessee may introduce bias, and the localized cultural context limits the study's generalizability. Socioeconomic factors were also not considered when comparing the paid and free versions of Grammarly. The questionnaire scales consisted of only three items each, which may reduce the robustness of measures for confidence, help-seeking behavior, and Grammarly use. Furthermore, qualitative data was limited to open-ended survey responses, and richer insights could have been obtained through interviews, observations, or focus groups.

Gleaning inferences from cross-sectional, non-randomized studies presents several methodological challenges. The convenience sample used restricts generalizations due to potential threats to external validity. Future research should employ randomized samples from multiple institutions to better detect differences or relationships between groups or variables in a broader context. Despite these limitations, this study provides a valuable baseline for understanding how Grammarly can support student confidence in writing and serve as a stepping stone for further research in this area.Future research may explore the relationship between students' pre-existing confidence in writing and their motivation to use Grammarly. Understanding factors driving students to seek external writing assistance can inform strategies to enhance self-efficacy and intrinsic motivation. Comparative studies with other grammar-checking tools can highlight the unique advantages and limitations of Grammarly, aiding informed decisions. Examining the impact of providing students with institutional access to Grammarly's premium version is crucial, exploring effects on outcomes, satisfaction, and overall learning experience.

Studying motivational factors influencing students' decisions to invest in premium versions of writing tools contributes to our understanding of how to integrate writing tools in higher education. This research can shape best practices and contribute to the evolving landscape of technology-enhanced learning and writing instruction. In conclusion, the study opens avenues for refining writing support in higher education, emphasizing the importance of leveraging digital tools. Future research in this domain can continue to shape best practices and contribute to the evolving landscape of technology-enhanced learning and writing instruction.

Declarations

Availability of Data and Material: Due to Institutional Review Board policies, the data will not be made available.

7. REFERENCES

Ananda, M., Nisa, R., & Safura, S. (2021). Students' perceptions towards the use of Grammarly in checking grammar in assignment. *Journal of English Language and Education, 1*(2), 72–77. https://ejournal.unmuha.ac.id/index.php/accentia/article/view/1144/891

Armanda, M. L., Imron, A. F. N., Wulansari, A., & Imron, A. (2022). Grammarly as an English writing assistant from EFL students' perspective. *English Education: Journal of English Teaching and Research, 7*(2), 128–137. https://doi.org/10.29407/jetar.v7i2.17988

Aunkst, B. D. (2019). A correlational study of the relationship between help-seeking behavior and writing self-efficacy. *Doctoral Dissertations and Projects*, (2262). Retrieved from https://digitalcommons.liberty.edu/doctoral/2262

Bailey, D., & Lee, A. R. (2020). An exploratory study of Grammarly in the language learning context: An analysis of test-based, textbook-based, and Facebook corpora. *TESOL International Journal, 15*(2), 4–27. https://eric.ed.gov/?id=EJ1268470

Barrot, J. S. (2022). Integrating technology into ESL/EFL writing through Grammarly. *RELC Journal, 53*(3), 764–768. https://doi.org/10.1177/0033688220966632

Beisler, M., & Medaille, A. (2016). How do students get help with research assignments? Using drawings to understand students' help-seeking behavior. *The Journal of Academic Librarianship, 42*(4), 390–400. https://doi.org/10.1016/j.acalib.2016.04.010

Butler, D. L., & Winne, P. H. (1995). Feedback and self-regulated learning: A theoretical synthesis. *Review of Educational Research*, *65*(3), 245–281. https://doi.org/10.3102/00346543065003245

Calma, A., Cotronei-Baird, V., & Chia, A. (2022). Grammarly: An instructional intervention for writing enhancement in management education. *The International Journal of Management Education, 100704,* 1–13. https://doi.org/10.1016/j.ijme.2022.100704

Carter, M. J., & Harper, H. (2013). Student writing: Strategies to reverse ongoing decline. *Academic Questions.* http://dx.doi.org/10.1007/s12129-013-9377-0

Cavaleri, M., & Dianati, S. (2016). You want me to check your grammar again? The usefulness of an online grammar checker as perceived by students. *Journal of Academic Language & Learning, 10*(1), A223–A236. https://journal.aall.org.au/index.php/jall/article/view/393

Chapelle, C. A., Cotos, E., & Lee, J. (2015). Validity arguments for diagnostic assessment using automated writing evaluation. *Language Testing, 32*(3), 385–405. https://doi.org/10.1177/0265532214565386

Dembsey, J. M. (2017). Closing the Grammarly® gaps: A study of claims and feedback from an online grammar program. *Writing Center Journal, 36*(1), 63-96, 98-100.

Fahmi, M. A., & Cahyono, B. Y. 2021 EFL students' perception on the use of Grammarly and teacher feedback. *JEES (Journal of English Educators Society), 6*(1), 18–25. https://doi.org/10.21070/jees.v6i1.849

Faisal, F., & Carabella, P. A. (2023). Utilizing Grammarly in an academic writing process: Higher education students' perceived views. *Journal of English Language Teaching and Linguistics, 8*(1), 23–42. https://jeltl.org/index.php/jeltl/article/view/1006/pdf

Fitria, T. N. (2021). Grammarly as AI-powered English writing assistant: Students' alternative for writing English. *Journal of English Language, Learning, and Teaching, 5*(1), 65–78. http://dx.doi.org/10.31002/metathesis.v5i1.3519

Fitria, R. A., & Sabarun, M. Z. M. (2022). Students' perceptions of the use of Grammarly in undergraduate thesis writing. *Professional Journal of English Education, 5*(2), 366–371. https://ojs.unm.ac.id/JTechLP/article/view/47357

Fitriana, K., & Nurazni, L. (2022). Exploring English department students' perceptions on using Grammarly to check the grammar in their writing. *Journal of English Teaching, 8*(1), 15–25. https://doi.org/10.33541/jet.v8i1.3044

Flick, U. (2023). *An introduction to qualitative research.* Sage.

Grammarly. (2023). About us. https://www.grammarly.com/about

Hakiki, G. N. R. (2021). Perceptions of EFL students on the use of Grammarly application in writing class. *Journal of English Education and Development, 4*(2), 99–105. https://doi.org/10.31605/eduvelop.v4i2.891

Highland, K. D., & Fedtke, J. (2023). Rethinking the essay: student perceptions of collaborateive digital multimodal composition in the college classroom. *Higher* Education Pedagogies, 8(1), 2216194. https://doi.org/10.1080/23752696.2023.2216194

Huang, H.-W., Li, Z., & Taylor, L. (2020). The effectiveness of using Grammarly to improve students' writing skills. *ICDEL,* 122–127. https://doi.org/10.1145/3402569.3402594

Hyland, F. (1998). The impact of teacher written feedback on individual learners. *Journal of Second Language Writing, 7,* 255–286. https://doi.org/10.1016/S1060-3743(98)90017-0

Ismawati, A. E., & Muhsin, M. A. (2021). How errors made in essay writing: An analysis using Grammarly software in EFL students. *Journal of Language Teaching and Learning, Linguistics and Literature, 9*(1), 109–118. http://ejournal.iainpalopo.ac.id/index.php/ideas/article/view/1815

Javier, D. R. (2022). Using tech tools for academic writing: Grammarly as a pedagogical tool. *MexTESOL Journal, 46*(2), 1–3. https://files.eric.ed.gov/fulltext/EJ1357805.pdf

Karyuatry, L., Rizqan, M. D., & Darayani, N. A. (2018). Grammarly as a tool to improve students' writing quality: Free online proofreader across boundaries. *Jurnal Sains Sosial dan Humaniora, 2*(1). https://jurnalnasional.ump.ac.id/index.php/JSSH/article/view/2297

Knapp, J. R., & Karabenick, S. A. (1988). Incidence of formal and informal academic help-seeking in higher education. *Journal of College Student Development, 29*(3), 223–227.

Koltovskaia, S. (2020). Student engagement with automated written corrective feedback (AWCF) provided by Grammarly: A multiple case study. *Assessing Writing, 44*. 1–12. https://doi.org/10.1016/j.asw.2020.100450

Li, L., & Kim, M. (2024). It is like a friend to me: Critical usage of automated feedback systems by self-regulating English learners in higher education. *Australasian Journal of Educational Technology, 40*(1), 1–18. https://doi.org/10.14742/ajet.8821

Likkel, L. (2012). Calibrated peer review essays increase student confidence in assessing their own writing. *Journal of College Science Teaching, 41*(3), 42–47. https://eric.ed.gov/?id=EJ979865

Lundin, I. M., O'Connor, V., & Perdue, S. W. (2023). The impact of writing center consultations on student writing self-efficacy. *The Writing Center Journal, 41*(2), 7–25. https://www.jstor.org/stable/27262713

Magaba, V. (2023). English writing challenges of first-year students: A case study of a university in the eastern Cape. *Athens Journal of Philology, 10*(1), 35–52. https://doi.org/10.30958/ajp.10-1-2

Mascle, D. D. (2013). Writing self-efficacy and written communication skills. *Business Communication Quarterly, 76*(2), 216–225. https://doi.org/10.1177/1080569913480234

Maulidina, P., & Wibowo, H. (2022). The use of Grammarly tools to enrich students' writing ability. *Jurnal Pendidikan Bahasa, 18*(2), 179–189. https://doi.org/10.34005/lingua.v18i2.2246

O'Neill, R., & Russell, A. M. T. (2019). Grammarly: Help or hindrance? Academic learning advisors' perceptions of an online grammar checker. *Journal of Academic Language & Learning, 13*(1), A88–A107. https://journal.aall.org.au/index.php/jall/article/view/591/435435452

O'Neill, R., & Russell, A. M. T. (2019). Stop! Grammar time: University students' perceptions of the automated feedback program Grammarly. *Australasian Journal of Educational Technology, 35*(1), 42–56. https://doi.org/10.14742/ajet.3795

Pillai, M. (2010). Locating learning development in a university library: Promoting effective academic help seeking. *New Review of Academic Librarianship, 16*(2), 121–144. http://dx.doi.org/10.1080/13614531003791717.

Pintrich, P. R. (2004). A conceptual framework for assessing motivation and self-regulated learning in college students. *Educational Psychology Review, 16,* 385–407. https://doi.org/10.1007/s10648-004-0006-x

Pratama, Y. D. (2020). The investigation of using Grammarly as online grammar checker in the process of writing. *English Ideas: Journal of English Language Education, 1*(1), 46–54. https://journal.unsika.ac.id/index.php/IDEAS/article/view/4180

Purwanti, M. S., & Kastuhandani, F. C. (2023). Students' perceived confidence in writing publishable articles. *LLT Journal: A Journal on Language and Language Teaching, 26*(1), 46–54. https://e-journal.usd.ac.id/index.php/LLT/article/view/5407

Ranalli, J. (2018). Automated written corrective feedback: How well can students make use of it? *Computer Assisted Language Learning, 31*(7), 653–674. https://www.tandfonline.com/doi/abs/10.1080/09588221.2018.1428994

Rao, M., Gain, A., & Bhat, S. (2019). Usage of Grammarly – online grammar and spelling checker tool at the Health Sciences Library, Manipal Academy of Higher Education, Manipal: A Study. *Library Philosophy and Practice, 2610.* https://digitalcommons.unl.edu/libphilprac/2610/

Roderick, R. (2019). Self-regulation and rhetorical problem solving: How graduate students adapt to an unfamiliar writing project. *Written Communication, 36*(3), 410–436. https://doi.org/10.1177/0741088319843511

Ruegg, R., & Koyama, D. (2010). Confidence in writing: The effect of feedback. https://kuis.repo.nii.ac.jp

Setyani, E. D., Bunau, E., & Rezeki, Y. S. (2023). The influence of Grammarly towards Indonesian EFL students' first-degree thesis writing confidence. *ELSYA, Journal of English Language Studies, 5*(1), 54–67. https://doi.org/10.31849/elsya.v5i1.6773

Soegiyarto, M. S., Putri, R. A., & Saputra, S. D. (2022). The importance of getting automated grammar feedback via Grammarly for increasing students' English language proficiency. *OSF Preprints.* https://osf.io/749a2

Stevenson, M., & Phakiti, A. (2019). Automated feedback and second language writing. In K. Hyland & F. Hyland (Eds.). *Feedback in second language writing: Contexts and issues* (pp. 125–142). Cambridge University Press.

Teng, F., & Huang, J. (2019). Predictive effects of writing strategies for self-regulated learning on secondary school learners' writing proficiency. *TESOL Quarterly, 53*(1), 232–247. https://doi.org/10.1002/tesq.462

Thi, N. K., & Nikolov, M. (2021). How teacher and Grammarly feedback complement one another in Myanmar EFL students' writing. *Asia-Pacific Education Researcher, 31*(6). https://d-nb.info/1248199200/34

Umamah, A., & Cahyono, B. Y. (2022). EFL university students' use of online resources to facilitate self-regulated writing. *Computer Assisted Language Learning, 23*(1), 108–124.

Ventayen, R. J. M., & Orlanda-Ventayen, C. C. (2018). Graduate students' perspective on the usability of Grammarly in one ASEAN state university. *Asian ESP Journal, 14*(7.2), https://papers.ssrn.com/sol3/papers.cfm?abstract_id=3310702

Vidhiasi, D. M., & Haryani. (2020). The implementation of Grammarly in error analysis. *Jurnal Sains Dan Teknologi Maritim, 21*(1), 16–22. https://jurnal.unimar-amni.ac.id/index.php/JSTM/article/view/248

Vo, N. H. K., & Nguyen, Q. T. (2021). Applying Grammarly as an online grammar checker tool to enhance writing skills for English-major students. *Proceedings of the 9th Open TESOL International Conference,* 454–467.

Wang, Y., Shang, H., & Briody, P. (2023). Exploring the impact of using automated writing evaluation in English as a foreign language university students' writing. *Computer Assisted Language Learning, 26*(3), 1–24. https://doi.org/10.1080/09588221.2012.655300

Williams, J. D., & Takaku, S. (2011). Help seeking, self-efficacy, and writing performance among college students. *Journal of Writing Research, 3*(1), 1–18. https://doi.org/10.17239/jowr-2011.03.01.1

Zhang, J., Ozer, H. Z., & Bayazeed, R. (2020). Grammarly vs. face-to-face tutoring at the writing center: ESL student writers' perceptions. *Praxis: A Writing Center Journal, 17*(2), 33–47. http://dx.doi.org/10.26153/tsw/8523

Zimmerman, Barry J. (1990). Self-regulated learning and academic achievement: An overview. *Educational Psychologist. Informa UK Limited. 25*(1), 3–17. https://doi.org/10.1207/s15326985ep2501_2

Zimmerman, B. J. (2000). Attaining self-regulation. In *Handbook of Self-Regulation* (pp. 13–39). Elsevier. https://doi.org/10.1016/B978-012109890-2/50031-7

Zinkevich, N. A., & Ledeneva, T. V. (2021). Using Grammarly to enhance students' academic writing skills. *Professional Discourse & Communication, 3*(1), 51–63. https://doi.org/10.24833/2687-0126-2021`-3-4-51-63