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Examining the Relationship between Undergraduate Students' Acceptance, Anxiety and Online Self-Regulation of Generative Artificial Intelligence

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Abstract

The transformative impact of generative artificial intelligence (GenAI) on educational environments has led higher education institutions to make radical changes in their curricula and teaching approaches. By integrating GenAI technologies into the educational process, students will be able to have rich learning experiences. However, students' perceptions of GenAI technologies significantly affect their acceptance and anxiety towards GenAI. Students' effective use of self-regulation skills will help them manage their acceptance and anxiety towards GenAI. This study aims to examine the relationship between students' GenAI acceptance, anxiety, and self-regulation. The study used a mixed research method. Data were collected from 66 students attending an undergraduate course. Quantitative findings were presented by analyzing data from 40 students and qualitative findings were presented by analyzing data from 51 students. Data were collected using the GenAI Acceptance Scale, AI Anxiety Scale, Online Self-Regulation Scale, and interview form. Pearson correlation analysis was performed for quantitative data, and content analysis was performed for qualitative data. The research findings show that the relationship between students' GenAI acceptance and self-regulation is significant and positive. The relationship between GenAI anxiety and GenAI acceptance and self-regulation is significant and negative. According to the qualitative data results, students stated that GenAI provides real-time support and facilitates of self-learning. Additionally, students stated that GenAI hindered their creativity and reduced their effectiveness in the learning process. Students stated that higher education institutions should improve their policies and curricula by taking into account the possible benefits, risks, and challenges.

Introduction

Artificial intelligence (AI) technology has become a transformative force in educational environments. Researchers' interest in the use of AI in educational applications has been increasing in recent years (Rousell & Sinclair, 2024; Saleem et al., 2024). This has led to learning environments becoming more efficient, effective and personalized for each student. AI refers to “technologies used to automate tasks that require human intelligence” (Surden, 2019). The Office of Educational Technology in the United States Department of Education (DOE)

(2023) states in its latest report that AI is a branch of educational technology. Mao et al. (2024) have offered a definition of AI that emphasizes the perspectives of "human-like reasoning, algorithm and intelligence development towards a goal."

Generative artificial intelligence (GenAI), as one branch of AI, has the ability to generate various forms of content, including image, text, audio, video, etc. using training data (Gupta et al., 2024). Careful integration of these technologies into educational environments is important in evaluating their potential benefits (Morales-García et al., 2024). In higher education, GenAI tools help students generate ideas, synthesize information, and improve their academic writing. It has been emphasized that these technologies, which can also be used as evaluation tools, contribute to improving students' projects and assignments and that they thus have a transformative role in terms of the teaching-learning process (Chan & Zhou, 2023).

Yusuf et al. (2024) discussed some of the challenges regarding the use of GenAI in higher education, as well as potential benefits, such as providing personalized learning opportunities, increasing accessibility, and providing the opportunity for students to organize their understanding. Researchers have stated that challenges related to bias, privacy issues, misinformation, ethics, and sustainability raise anxieties about the use of GenAI in educational settings. In this context, Yilmaz and Yilmaz (2023) reported that GenAI has some risks, including making students more likely to be lazy and hindering their professional development. In order to minimize these risks, İpek et al. (2023) emphasized the need for further research on the use of GenAI tools in educational contexts. Lim et al. (2023) pointed out that GenAI tools open new frontiers that will affect the way we learn, interact and work, and emphasize the need to be prepared for this. According to many researchers, as long as these technologies continue to have an increasing impact on our lives, both students and teachers will have no choice but to use them efficiently and responsibly. On this basis, the present study examined the relationship between undergraduate students' anxieties about, as well as their self-regulation and acceptance of, GenAI in their teaching and learning processes. The objectives of this study were, as follows:

1. What is the relationship between undergraduate students' GenAI acceptance and GenAI anxiety?
2. What is the relationship between undergraduate students' GenAI acceptance and online self-regulation?
3. What is the relationship between undergraduate students' online self-regulation and GenAI anxiety?
4. What are the students' opinions and suggestions for the effective integration of GenAI into educational environments?

Literature Review

Theoretical Framework

This study used the Unified Theory of Technology Acceptance and Use (UTAUT) as the theoretical framework. UTAUT is a model employed to examine the factors affecting technology acceptance and use, and the model has been tested for validity and reliability in previous studies (Dowdy, 2020; Karaoglan Yilmaz et al., 2023). This model, which is frequently deployed to understand the use of technology in education, is used to examine factors such as “performance expectancy”, “effort expectancy”, “facilitating conditions” and “social impact” that affect the acceptance of technology in students and teachers. Performance expectancy is related to an individual's

expectancy regarding the use of technology and what they intend to do in line with this expectancy (Karaoglan Yilmaz et al., 2023). In the present study, this factor takes the form of undergraduate students' expectancies regarding the opportunities that using GenAI tools will offer in terms of preparing their projects/assignments. Effort expectancy is related to the individual's effort to use technology effectively (Wang & Wang, 2010). In the present study, this factor can be considered as the students' expectancy that their interactions with GenAI tools will require mental and physical effort. Facilitating conditions are factors that support the usability of a technology (Venkatesh et al., 2012). In the present study, this factor can be considered in terms of the students' perceptions of the technical infrastructure supporting GenAI tools and their accessibility. Social impact covers individuals' attitudes and behaviors regarding technology use (Venkatesh et al., 2012). In the present study, this factor is related to the students' expectancies of other individuals they consider important, such as their peers and teachers, in terms of accepting and using GenAI tools. In the UTAUT, in addition to these four determining factors, various intermediary factors such as gender, age, experience, and willingness to use AI are also defined and these factors are also considered to affect technology acceptance and usage (Andrews et al., 2021). The interactions and relationships between these factors are also emphasized in the model. The UTAUT model is presented in Figure 1.

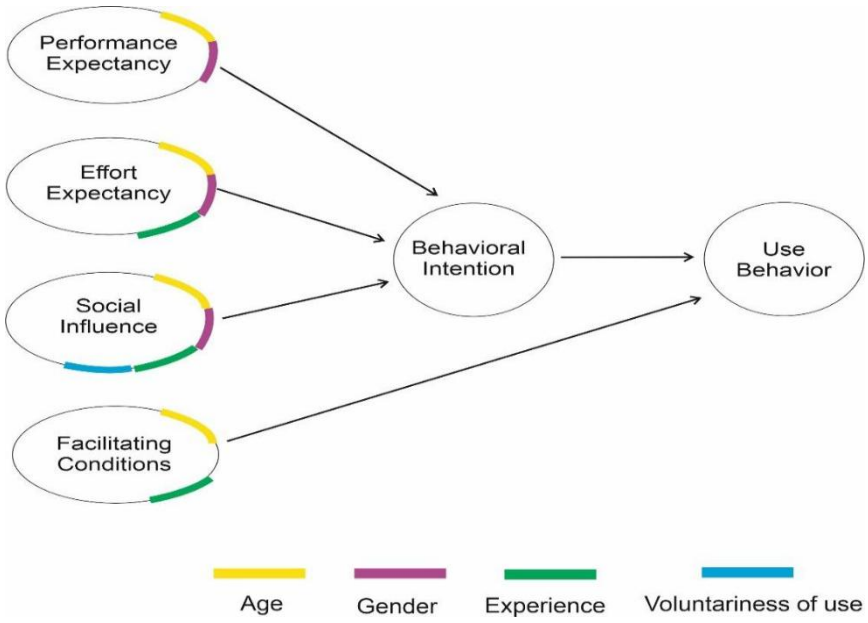

Figure 1. The UTAUT Model

GenAI in Education

The integration of GenAI into educational practices has led to changes in educational policies, as well as learning, teaching and assessment processes (Wang et al., 2024). AI offers significant opportunities for learning environments and has been generally accepted by students and teachers. GenAI tools (ChatGPT, DALL-E etc.) play a supporting role in encouraging student participation and improving learning and teaching processes. GenAI can create content including images, text, audio, video, and code depending on the requests entered by the user (Chiu, 2023). The potential of this content, which is similar to content created by humans, to improve students' learning experiences has been emphasized (Chan & Hu, 2023).

ChatGPT is a text-to-text chat tool developed by OpenAI that produces human-like dialogues (Chiu et al., 2023). This tool can act as a writing aid, allowing an individual to create grammatically correct texts (Dempere et al., 2023). In learning environments, ChatGPT has many potential benefits, including responding to student questions, providing feedback, and assisting in virtual conversations. DALL-E is a text-to-visual AI tool developed by OpenAI that can generate visuals from textual descriptions (Zhou & Nabus, 2023). DALL-E helps students produce visuals to support their academic work and projects. By providing a personalized learning environment in line with individual needs and learning styles, it helps students to express their ideas more clearly while developing their projects (Adetayo, 2024).

In learning environments, GenAI tools support students to develop creative ideas and produce content as well as fostering their problem-solving and critical thinking skills (Ivanov et al., 2024). However, in addition to these potential benefits, a number of ethical issues such as intellectual property rights, discrimination, bias, confidentiality, the auditability of data, plagiarism, and originality have been highlighted when discussing how to integrate of GenAI in higher education. GenAI tools can deliver misinformation, and over-reliance on the outputs these tools provide can jeopardize students' efforts to produce their own work (Ivanov, 2023). The use of AI-generated content may also pose a serious threat to plagiarism and academic integrity (Chan & Hu, 2023). Achieving a balance between harnessing the transformative power of AI in higher education and maintaining ethical principles is imperative for the responsible and sustainable use of the technology (Shal et al., 2024). The necessary regulations should be implemented in order to raise awareness about the ethical and responsible use of GenAI technologies, and the scope of education and training should be expanded (Zhou & Nabus, 2023). Additionally, minimizing the risks associated with the use of GenAI technology will likely increase the visibility of the potential benefits of this technology (Adetayo, 2024).

The use of GenAI tools in educational environments is becoming increasingly common (Nikolopoulou, 2024). Research on this topic is gaining momentum, especially in the context of higher education. Many researchers are curious about how students perceive these tools, what educational activities they use them for, and how they use them. In this context, Kanont et al. (2024) examined the factors affecting university students' adoption of GenAI tools within the framework of the Technology Acceptance Model (TAM). Their results revealed that factors such as expected benefits, perceived benefits, attitude towards technology and behavioral intention had a significant impact on students' acceptance of GenAI tools. Researchers have emphasized that efforts to integrate GenAI technology into learning environments need to be strengthened. Dahri et al. (2024) examined the factors affecting the adoption and use of GenAI technology at the undergraduate level. The results of their study revealed that performance and effort expectancies, the accuracy of the information provided by GenAI tools, pedagogical alignment to meet student expectancies, and students' interaction with AI tools significantly influenced acceptance and use. Researchers have underlined that as their learning experience with GenAI increases, students will be able to better understand its benefits and impacts. Ali et al. (2024) reported that studies examining the potential or effects of GenAI technology in learning environments have not yet reached saturation. In addition, they emphasized the limitations of studies examining acceptance of GenAI within the framework of the UTAUT model and suggested that students' GenAI acceptance could be examined within the scope of this model. On this basis, the hypotheses of the present study regarding undergraduate students' acceptance of the use of GenAI in their

learning activities were developed as follows:

H1a: Performance expectancy has a positive effect on undergraduate students' GenAI acceptance.

H1b: Effort expectancy has a positive effect on undergraduate students' GenAI acceptance.

H1c: Social influence can positively affect undergraduate students' GenAI acceptance.

H1d: Facilitating conditions can positively affect undergraduate students' GenAI acceptance.

GenAI Anxiety

Rapid changes in AI technologies have caused various social challenges including job losses, and anxieties about issues including privacy, transparency, socio-economic inequality and unethical actions (Kaya et al., 2024). With regard to these anxieties and challenges, researchers have concentrated their studies on the concept of AI anxiety. Johnson and Verdicchio (2017) defined AI anxiety as "a feeling of fear or uneasiness regarding AI that is out of control." Wang and Wang (2022) defined AI anxiety using four dimensions: (i) learning anxiety/anxiety about learning AI technologies; (ii) job change anxiety/fear of the negative impact of AI on business; (iii) sociotechnical blindness/anxiety about not fully understanding the dependence of AI on humans; and (iv) AI configuration anxiety/anxiety about humanoid AI.

When the literature is examined, it is seen that there is a relationship between AI anxiety and technology acceptance (Dönmez-Turan & Kır, 2019; Khasawneh, 2018; Schiavo et al., 2024). This relationship indicates that individuals with high anxiety about AI tend to have low acceptance and usage of technology. Anxiety has been defined as the emotional reaction experienced by an individual when carrying out a specific task (Venkatesh & Bala, 2010) and it can negatively affect the use of technology by weakening the perception that it is easy to use (Şahin & Şahin, 2022). Kaya et al. (2022) reported that AI anxiety has a significant impact on the adoption and use of AI technologies. Sánchez-Prieto et al. (2020) emphasized that AI-supported evaluation systems caused a different type of anxiety in students, and that this significantly affected students' acceptance of GenAI.

Zhu et al. (2024) focused on AI ethical anxiety in their study and defined this anxiety as negative emotions such as uneasiness and anxiety arising from ethical issues regarding the use of GenAI tools. Nevertheless, GenAI anxiety, in addition to leading to some challenges, can also serve as a catalyst in increasing undergraduate students' intentions to adopt and use GenAI (Wang et al., 2024). On this basis, the hypotheses of this study regarding undergraduate students' anxieties about the use of GenAI in their learning activities and the relationship between GenAI acceptance and anxiety were established as follows:

H2a: Learning anxiety has an effect on undergraduate students' GenAI anxiety.

H2b: Job change anxiety has an effect on undergraduate students' GenAI anxiety.

H2c: Sociotechnical blindness anxiety has an effect on undergraduate students' GenAI anxiety.

H2d: AI configuration anxiety has an effect on undergraduate students' GenAI anxiety.

H3a: There is a relationship between undergraduate students' GenAI anxiety and performance expectancy.

H3b: There is a relationship between undergraduate students' GenAI anxiety and effort expectancy.

H3c: There is a relationship between undergraduate students' GenAI anxiety and social influence.

H3d: There is a relationship between undergraduate students' GenAI anxiety and facilitating conditions.

Online Self-Regulation

Self-regulation: this is a multidimensional, process-oriented and cyclical activity which can be defined as the ability to use both planned and spontaneously produced emotions, thoughts and behavior to achieve personal goals (Zimmerman, 2000). Individuals with self-regulation skills are able to determine their own learning goals and plans, monitor their own progress, and reflect on their learning (Wong & Viberg, 2024). Online environments, GenAI technology and tools offer individuals autonomous work environments, and developing individuals' self-regulation skills is thus becoming increasingly critical.

Individuals' acceptance of GenAI, their anxieties, and their inclination to use GenAI tools are affected by many factors (Kaya et al., 2024). Park and Woo (2022) reported that psychological and technological factors such as personal characteristics, intrinsic motivation, self-efficacy, performance expectancy, perceived ease of use, and relative advantage all have an effect on the adoption and use of GenAI. Undergraduate students' increasing interest in using GenAI tools has led researchers to try to understand how students integrate these tools into their self-regulated learning practices (Wong & Viberg, 2024). In this context, researchers have emphasized that in order to use GenAI effectively in online learning, students must have already developed self-regulation skills and that the quality of their learning experiences must be accurately monitored (Lodge et al., 2023). On this basis, the hypotheses of this study regarding the online self-regulation of undergraduate students regarding the use of GenAI in their learning activities and the relationship between their online self-regulation and GenAI acceptance and anxieties were established as follows:

H4a: Student-content interaction has an impact on undergraduate students' online self-regulation.

H4b: Student-teacher interaction has an impact on undergraduate students' online self-regulation.

H4c: Student-student interaction has an impact on undergraduate students' online self-regulation.

H5a: There is a relationship between undergraduate students' online self-regulation and performance expectancy.

H5b: There is a relationship between undergraduate students' online self-regulation and effort expectancy.

H5c: There is a relationship between undergraduate students' online self-regulation and social influence.

H5d: There is a relationship between undergraduate students' online self-regulation and facilitating conditions.

H6a: There is a relationship between undergraduate students' online self-regulation and learning anxiety.

H6b: There is a relationship between undergraduate students' online self-regulation and job change anxiety.

H6c: There is a relationship between undergraduate students' online self-regulation and sociotechnical blindness anxiety.

H6d: There is a relationship between undergraduate students' online self-regulation and AI configuration anxiety.

The hypothesis model illustrating the relationships mentioned above is presented in Figure 2.

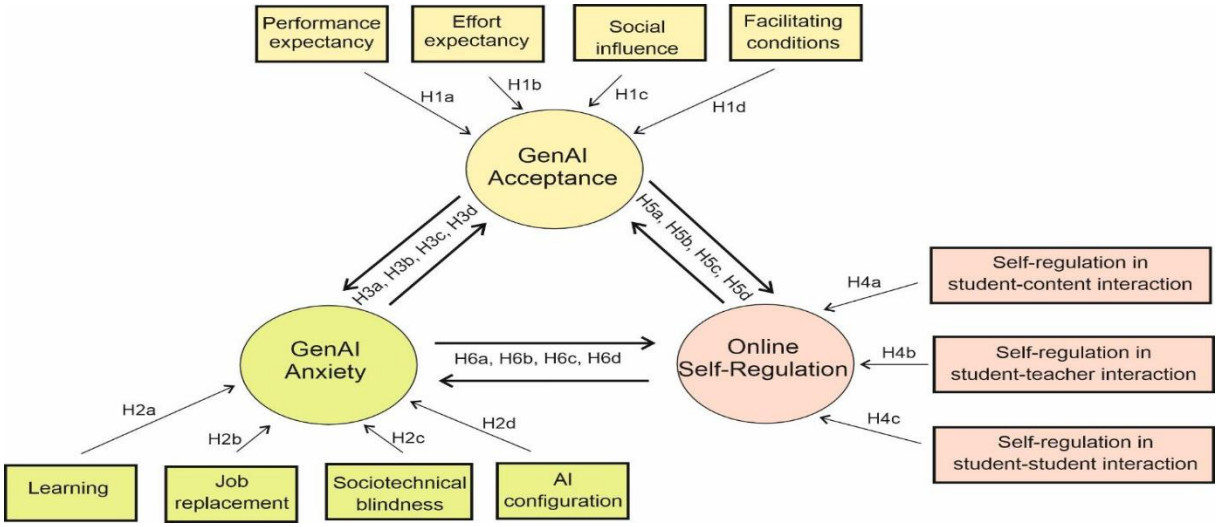

Figure 2. The Hypothesized Research Model

Student Perspectives on GenAI

In order for GenAI to be effectively integrated into educational environments, the existing risks and challenges must first be understood (Hazaimeh & Al-Ansi, 2024). If the necessary precautions and measures are taken with regards to these issues, GenAI in higher education may have the power to significantly change the future of education. It is important to investigate students' experiences and perspectives in order to gain a clearer understanding of GenAI's potential benefits and societal impacts (Baidoo-Anu et al., 2024). Students' perceptions have an impact on their motivation, participation and academic success. Using qualitative data, information can be obtained regarding students' awareness of GenAI tools, their perceptions and anxieties about accepting and using them, and their attitudes towards the benefits and ethical implications of GenAI. In order to provide a holistic perspective on GenAI, there is thus a need for studies that use a combination of quantitative and qualitative methods to conduct more in-depth examinations (Strzelecki & ElArabawy, 2024).

Method

Mixed research method was preferred in this study. Mixed research is an approach that combines quantitative and qualitative methods into a single study, making it possible to reach in-depth information in solving a problem (Almeida, 2018). It allows the researcher to get rich information regarding the solution of the problem. The reason why the mixed research method was preferred in the study is that it provides the best opportunity to address the research questions in depth (Creswell, 2021). In this study, the research questions were answered by integrating the qualitative and quantitative data collected.

Participants

The study participants were 66 second grade students attending the Mathematics and Turkish Language Teaching Undergraduate Program in a state university. The participants were enrolled in Open and Distance Learning and

Instructional Technologies courses in formal education program, and the sizes of the sections were 18 and 48, respectively. After the research was planned, 15 students never took part in the process or they left before the completion. Participation in the scale and interview form applied at the end of the process was voluntary and 40 students filled out the forms completely. 51 students responded to the interview questions. The participants were referred to as P1, P2, P3… P51 throughout the study.

Procedure

The activities planned for the undergraduate courses Open and Distance Learning and Instructional Technologies were carried out face-to-face and online. Carless (2022) attached importance to designing learning environments that contain sustainable opportunities for students to make evaluative judgements and reflect on received input. The procedure of the present study was based on this rationale. The task in this study was to prepare an assignment given by the instructor as part of the curriculum of that course. The study was carried out within the scope of an undergraduate course and the assignment was evaluated as a midterm grade. It was carried out in two stages. In the first stage, students were expected to write an original report using studies examining the use of current educational technologies in education. In the first week, students formed their groups according to their own wishes, each group chose a topic. Students were divided into groups of two people in each group. The researcher informed the students about the scope of the report in the first week. A list of current teaching technologies, additional documents explaining the preparation process of the research report, and a sample report were shared in the virtual classroom by the instructor. In addition, introductory documents and application-based sample videos on artificial intelligence and generative artificial intelligence were shared with the students. In addition, a rubric showing the criteria for report writing and infographic design was shared. At the end of the report, the instructor asked the students to do their assignment through the turnitin program to check the plagiarism rate (maximum 25%). Thus, the report would be completed and delivered via the virtual classroom at the end of week 8. In the second stage, students were expected to determine a project topic in which they would integrate the teaching technology they discussed in their reports within the framework of a learning outcome selected from their course curriculum (high school mathematics and middle school Turkish courses) and to prepare and present their projects as infographics. A face-to-face theoretical lesson (100 min) was taken to the use of artificial intelligence technology in education. The use of ChatGPT and Dall-E tools was introduced to the students in the next face-to-face lesson (100 min). The instructor, together with the students, prepared a sample infographic step by step using these tools and Microsoft Powerpoint and shared it in the virtual classroom. In addition, sample applications were made with AI-supported infographic preparation software (Canva, Pictochart, etc.) and discussions were taken to an ideal infographic. The students were assigned a second task to design a project within the framework of the subject they prepared a report on in the first stage. This task started in week 9 and was expected to be completed by the end of week 12. After the completion of the second phase, the reports and infographics were presented in face-to-face classes. The instructor gave midterm marks by evaluating the quality of the reports and infographics and taking into account the participation in the presentations. Finally, students were asked to fill out the GenAI Acceptance Scale, AI Anxiety Scale, Online Self-Regulation Scale and interview form on a voluntary basis. The process was completed in 14 weeks. The model of the study process is presented in Figure 3.

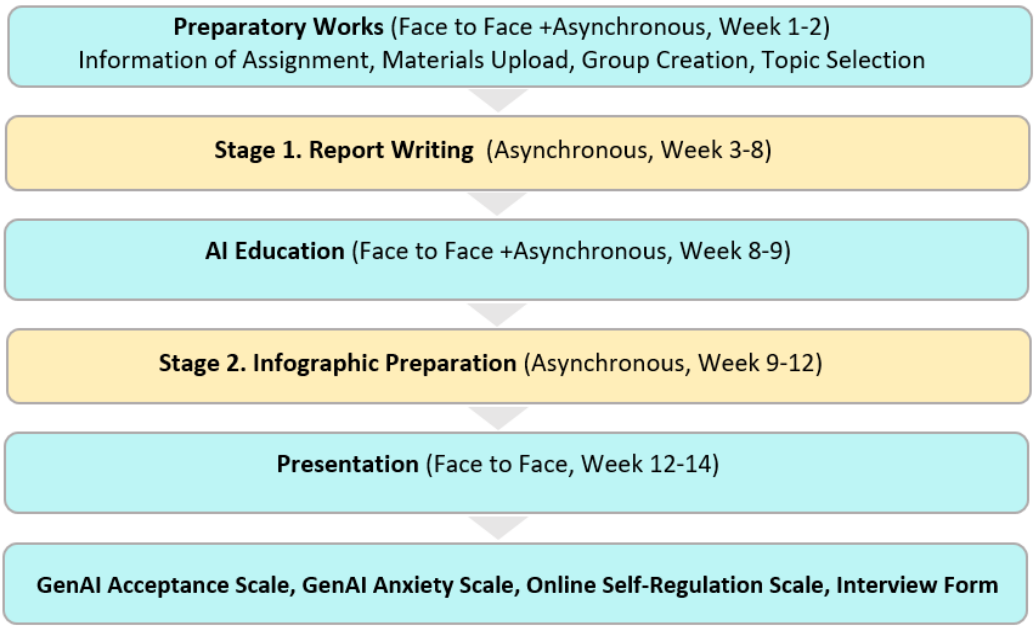

Figure 3. The Model of the Study Process

Researcher's Role

The researcher carried out the processes of sharing content that would help in the preparation of the assignment, publishing announcements, providing training on the use of artificial intelligence in education and the use of GenAI tools. She undertook tasks such as carrying out sample applications with students and answering student questions regarding the scope and content of the assignment.

Data Collection Tools

Data was collected through the GenAI Acceptance Scale, AI Anxiety Scale, Online Self-Regulation Scale and interview form.

GenAI Acceptance Scale: The scale designed to examine students' acceptance of GenAI applications was developed in Turkish by Yilmaz, Yilmaz and Ceylan (2023) and its validity and reliability studies were conducted. The Cronbach's alpha value of the scale was calculated as 0.97. The 5-point Likert-type scale developed based on the UTAUT model consists of 20 items and includes four factors: "performance expectancy", "effort expectancy", "facilitating conditions", and "social influence". The minimum score that can be obtained from the scale is 20 and the maximum score is 100. Higher scores indicate that GenAI is more accepted by students. The scale form was shared with students via Google form and data was collected.

AI Anxiety Scale: The GenAI Anxiety Scale developed by Wang and Wang (2019) was adapted to Turkish by Akkaya, Özkan and Özkan (2021) and its validity and reliability studies were conducted. The Cronbach's alpha value of the scale was calculated as 0.809. The original 5-point Likert-type scale consists of 21 items and 4 factors. As a result of exploratory and confirmatory factor analyses, the final form of the scale consists of 16 items. It is

stated in studies that the AI anxiety level increases as the scores increase (Filiz et al., 2022). The scale form was shared with the students via Google form and data was collected.

Online Self-Regulation Scale: The scale developed by Cho and Cho (2017) was adapted to Turkish by Çakır, Kara and Kukul (2019) and its validity and reliability studies were conducted. The Cronbach alpha value of the scale was calculated as 0.98. The 7-point Likert-type scale consists of 30 items and three factors. These are self-regulation in student-teacher interaction, student-student interaction, and student-content interaction. High scores indicate that students have high levels of online self-regulation. The scale form was shared with students via Google form and data was collected.

Interview form: It is aimed to obtain student opinions on how Dall-E and ChatGPT tools can be integrated into educational practices in an appropriate way. In this context, while preparing the interview questions, the studies of Ngo et al. (2022), Sætra (2023), Strzelecki (2023) were examined and the researchers prepared a form consisting of 7 open-ended questions. The scope of the questions was created to obtain recommendations for the benefits and risks that may arise from using ChatGpt and Dall-e within the framework of the determined purpose and for the effective use of these purposes in educational environments.

Data Analysis

The Kolmogorov Smirnov test was used for the normality test regarding the distribution of the data obtained in the study and it was seen that the data showed a normal distribution ($p>0.05$). Descriptive statistics were performed for the three scales and the average distribution of the student scores was determined. The obtained data were analyzed with Pearson correlation analysis. Pearson correlation analysis was performed for the relationships between the GenAI acceptance, anxiety and online self-regulation scales and the sub-dimensions of these scales. The survey data were examined by two researchers. Possible themes and codes were discussed and a consensus was reached. One researcher performed the analyses. Then, the codes and themes were reviewed again with the other researcher. The codes, frequencies and direct quotes containing student responses that emerged in line with common views are presented in the findings.

Results

Descriptive Statistics

Descriptive statistics were performed for the scale scores and the mean distribution of student scores was calculated and presented for each scale.

Table 1. Descriptive Statistics

Scales	N	Mean	Minimum	Maximum
GenAI Acceptance Scale	40	77.7750	58.00	100.00
GenAI Anxiety Scale	40	47.8000	16.00	64.00
Online Self-Regulation Scale	40	167.4250	95.00	210.00

The lowest score that can be obtained from the GenAI Acceptance Scale is 5 and the highest score is 100. When Table 1 is examined, it is seen that the lowest score that students received from the scale is 58 and the highest score is 100. The total average score obtained from the scale is approximately 77.7. The number of students who scored between 58 and 77 is 17 and the number of students who scored between 77 and 100 is 23. The lowest score that can be obtained from the GenAI Anxiety Scale is 5 and the highest score is 80. It is seen that the lowest score that students received from the scale is 16 and the highest score is 64. The total average score obtained from the scale is 47.80. The number of students who scored between 16 and 47 is 18 and the number of students who scored between 47 and 64 is 22. The lowest possible score from the Online Self-Regulation Scale is 7, and the highest score is 210. It is seen that the lowest score that students received from the scale is 95 and the highest score is 210. The total average score from the scale is approximately 167.4. The number of students who received scores between 95 and 167 is 21, and the number of students who received scores between 167 and 210 is 19.

Examination of the Hypothesized Model

The empirical validation of the hypothesized research model was conducted and it was found that 20 out of 23 hypotheses were supported. The findings regarding the hypothesis testing results are presented in Table 2.

Table 2. Hypothesis Testing Results

Hypothesis	Path	p-Value	Conclusion
H1a	Performance Expectancy- GenAI Acceptance	0.000	Supported
H1b	Effort expectancy- GenAI Acceptance	0.000	Supported
H1c	Social İnfluence- GenAI Acceptance	0.000	Supported
H1d	Facilitating Conditions- GenAI Acceptance	0.001	Supported
H2a	Learning Anxiety- GenAI Anxiety	0.012	Supported
H2b	Job Replacement Anxiety- GenAI Anxiety	0.000	Supported
H2c	Sociotechnical Blindness Anxiety- GenAI Anxiety	0.000	Supported
H2d	AI Configuration Anxiety- GenAI Anxiety	0.002	Supported
H3a	GenAI Anxiety- Performance Expectancy	0.048	Supported
H3b	GenAI Anxiety- Effort expectancy	0.000	Supported
H3c	GenAI Anxiety- Social İnfluence	0.000	Supported
H3d	GenAI Anxiety- Facilitating Conditions	0.000	Supported
H4a	Self-regulation in student-content interaction- Online Self-regulation	0.000	Supported
H4b	Self-regulation in student-teacher interaction- Online Self-regulation	0.000	Supported
H4c	Self-regulation in student-student interaction- Online Self-regulation	0.000	Supported
H5a	Online Self-regulation- Performance Expectancy	0.004	Supported
H5b	Online Self-regulation- Effort expectancy	0.032	Supported
H5c	Online Self-regulation- Social İnfluence	0.013	Supported

Hypothesis	Path	p-Value	Conclusion
H5d	Online Self-regulation- Facilitating Conditions	0.009	Supported
H6a	Online Self-regulation- Learning Anxiety	0.392	Not Supported
H6b	Online Self-regulation- Job Replacement Anxiety	0.050	Supported
H6c	Online Self-regulation- Sociotechnical Blindness Anxiety	0.917	Not Supported
H6d	Online Self-regulation- AI Configuration Anxiety	0.777	Not Supported

*Note. *p<0,05*

In the hypotheses related to GenAI Acceptance, the relationship between GenAI acceptance and four factors (performance expectancy, effort expectancy, social influence, facilitating conditions) was found to be significant ($p<0.05$). The relationship between four factors of GenAI acceptance and GenAI anxiety factors of learning, job replacement, sociotechnical blindness, AI configuration was found to be significant ($p<0.05$). In addition, the relationship between four factors of GenAI acceptance and Online Self-regulation student-content interaction, student-teacher interaction, student-student interaction factors was significant ($p<0.05$). Therefore, hypotheses H1a, H1b, H1c, H1d, H3a, H3b, H3c, H3d, H5a, H5b, H5c and H5d were supported. In the hypotheses related to GenAI Anxiety, the relationship between GenAI anxiety and four factors (learning, job replacement, sociotechnical blindness, AI configuration) was found to be significant ($p<0.05$). Also the relationship between learning, sociotechnical blindness, AI configuration factors of GenAI anxiety and Online Self-regulation was not found significant ($p>0.05$). However the relationship between job replacement factor of GenAI anxiety and Online Self-regulation was found significant ($p<0.05$). Therefore, hypotheses H2a, H2b, H2c, H2d and H6b were supported while hypotheses H6a, H6c and H6d were not supported. In the hypotheses about Online Self-regulation, the relationship between Online Self-regulation and its three factors (student-content interaction, student-teacher interaction, student-student interaction) was found significant ($p<0.05$). Therefore hypotheses H4a, H4b and H4c were supported.

GenAI Acceptances, GenAI Anxieties and Online Self-regulation of Undergraduate Students

The correlation analysis results for examining the relationship between students' GenAI Acceptance and its four factors, GenAI Anxiety and its four factors, Online Self-regulation and its three factors are presented in Table 3. Table 3 was structured to include statistically significant and positively or negatively correlated factors.

When Table 3 is examined, it is seen that there is a statistically significant and positive relationship between the factors of performance expectancy, effort expectancy, social influence and facilitating conditions and the GenAI acceptance of undergraduate students.

There was a statistically significant and positive relationship between the learning, job replacement, sociotechnical blindness and AI configuration factors and students' GenAI anxiety. There was a significant and negative relationship between the students' GenAI anxiety learning factor and the GenAI acceptance performance expectancy, effort expectancy, facilitating conditions and social impact factors. There was a significant and

negative relationship between the GenAI anxiety job replacement and sociotechnical blindness factors and the GenAI acceptance effort expectancy factor. There was a significant and negative relationship between the GenAI anxiety AI configuration factor and GenAI acceptance effort expectancy and social impact factors. There was a significant and negative relationship between the GenAI anxiety job replacement factor and the self-regulation student-content interaction factor.

Table 3. The Relationship Between GenAI Acceptance, GenAI Anxietiy and Online Self-regulation

						GenAI Anxiety				Online Self-Regulation		
			GenAI Acceptance	GenAI Anxiety	Online Self-Regulation	Learning	Job replacement	Sociotechnical blindness	AI configuration	Student -content interaction	Student -teacher interaction	Student -student interaction
GenAI Acceptance	Performance Expectancy	r	.554**			-.315*						.445**
		p	0.000			0.048						0.004
	Effort Expectancy	r	.554**			-.598**	-.436**	-.368*	-.372*			.340*
		p	0.000			0.000	0.005	0.019	0.018			0.032
	Social Influence	r	.563**			-.591**			-.355*	.389*		.332*
		p	0.000			0.000			0.024	0.013		0.037
	Facilitating Conditions	r	.491**			-.542**						.410**
		p	0.001			0.000						0.009
GenAI Anxiety	Learning	r		.393*								
		p		0.012								
	Job replacement	r		.548**						-.313*		
		p		0.000						0.050		
	Sociotechnical blindness	r		.548**								
		p		0.000								
	AI configuration	r		.467**								
		p		0.002								
Online Self-Regulation	Student -content interaction	r			.725**							
		p			0.000							
	Student -teacher interaction	r			.725**							
		p			0.000							
	Student -student interaction	r			.653**							
		p			0.000							

*Note. *p<0,05 **p<0,01 r: Pearson Correlation Coefficient*

There was a statistically significant and positive relationship between the student-content, student-teacher and student-student interaction factors and students' online self-regulation. There was a significant and positive relationship between the self-regulation student-content interaction factor and the GenAI acceptance social impact factor. There was a significant and positive relationship between the self-regulation student-student interaction factor and the GenAI acceptance performance expectancy, effort expectancy, facilitating conditions and social influence factors.

Student Opinions and Suggestions for the Effective Use of GenAI in Educational Environments

The analyses of the data obtained with the form revealed the potential benefits of ChatGPT for educational purposes, including real-time support (12), helping with content searches (11), facilitators of self-learning (9), providing ease of use (6), organizing understanding (5), helping to generate initial ideas for homework (2), and promoting social and emotional well-being when the tool is used for chat purposes (1). P37 expressed his opinion regarding instant feedback, which was the most frequently issue mentioned by students, as follows: "*It provides answers that can shape my ideas about questions I can't find answers to."* P8 expressed his opinion with regard to helping with the content search, which was another benefit that students most frequently mentioned, as follows: "*The most useful aspect for me was that it provided us with information in a simple and understandable way when we couldn't find what we really wanted to in search engines."*

In addition to its potential benefits, students mentioned risks including reduced student activity (19), incongruous ideas and information (7), academic misconduct (6), inhibiting creativity (6), and over-reliance on the ChatGPT tool (5). Among the risks of ChatGPT, the most frequently mentioned by students was that discussed by P39 in terms of student activity: "*It provides ready-made information for the assignments that I have to do using my own knowledge, and means my own investigations are left in the background*." Another risk frequently mentioned by students was expressed by P22 regarding the incompatible ideas and information generated by ChatGPT: "*I didn't always get the right answer to the questions I asked ChatGPT, so it may cause students to obtain incorrect information*." In addition, P23's view regarding inhibiting creativity, namely that "*It causes me to lose my originality*" was also striking.

Regarding the use of Dall-E for educational purposes, the students mentioned various potential benefits, such as helping with content search (14), providing ease of use (14), organizing understanding (7), and helping with generating initial ideas for homework (1). Among the potential benefits, P36 expressed the common view that it helped with the content search: "*It was useful for me in terms of producing visuals that were in line with the instructions given to me*". Another benefit that students often mentioned was the ease of use, as expressed in P19's view: "*I was able to easily design the visuals I needed in my presentations*".

In addition to the potential benefits, the students mentioned risks and challenges, including inhibiting creativity (13), reduced student activity (5), incongruous visual (4), limited free access (3), and lack of awareness of DALL-E's ease of use (1). Among the risks of DALL-E, the opinion of P36 about DALL-E preventing creativity, which was the most frequently position encountered, was as follows: "*It has negative effects such as blunting our imagination and creativity and reducing our own capacity to think*." In terms of this code, P10's opinion, that "*It provided a different perspective, but it made my thinking lazy*" was also interesting. Regarding the idea that DALL-E produces incompatible visuals, which was another of the most commonly stated risks, P3's opinion, "*I don't think it will cause much harm, but when it doesn't produce the visuals I want, it may sometimes harm my education by producing visuals that are incompatible with the content*," was also striking.

The students made suggestions about how to use and integrate GenAI tools efficiently in educational

environments. They stated that processes that encourage the use of GenAI tools should be planned and implemented (20), that students should be informed about the use, potential benefits, risks and limitations of GenAI tools (16), and that their use for purposes other than education should be limited (4). The most frequently expressed opinion by students regarding planning and implementing processes to encourage the use of GenAI tools was that of P49: "*I would make students do an activity and ask them to use these applications. I would organize a competition for how best to use the content generated by these applications in order to attract their attention*." P50's opinion regarding informing students about GenAI tools was as follows: "*It is important to introduce students to AI and how it can be used in education. I would do this by organizing presentations and workshops on AI, exploring educational tools that use AI and explaining these tools to my students*." P6's view on providing training on how to use GenAI tools was as follows: "*I talk to my students about how to access and log in to the applications in class. I use the applications with them in class in a way that will attract their attention*." P5's view on limiting the use of GenAI for purposes other than education was as follows: "*First of all, I give them [students] an idea of how to use these applications in education and try to set limits to prevent them from being misused*."

Discussion and Conclusion

In this study, a hypothetical model was developed to investigate the relationships between undergraduate students' GenAI acceptance, anxiety, and online self-regulation. While 20 of the hypotheses proposed within the scope of the model were supported, three were not. This situation revealed that the hypothetically developed model was generally confirmed.

In educational settings, it is important for students and teachers to develop positive attitudes and behaviors towards the acceptance and use of educational technologies (Karaoglan et al., 2023). In the UTAUT model, which is widely used especially in higher education as a theoretical model for understanding technology adoption, four factors are mentioned: performance expectancy, effort expectancy, social impact, and facilitating conditions that affect technology use and acceptance (Xue et al., 2024). In the present study, undergraduate students used the GenAI tools ChatGPT and DALL-E for assignments that required them to prepare reports and infographics. The findings indicated that there was a relationship between the undergraduate students' GenAI acceptance, anxiety, and online self-regulation. The results of this study revealed that there was a positive relationship between the four factors in the UTAUT model and students' GenAI acceptance. Students' performance expectancies regarding how they will use GenAI tools for their homework affected their adoption and use of these tools. Students' expectancies regarding the mental and physical efforts they would have to engage in while interacting with GenAI tools in the learning process affected their acceptance and use of these tools. Accessibility to GenAI tools, ease of use, provision of the necessary infrastructure, and support from individuals such as peers and teachers when necessary significantly affected the students' acceptance of GenAI acceptance. These findings are supported by similar findings in other studies. Jain et al. (2022) reported that organizations with goals regarding the adoption of AI tools should take the necessary measures regarding performance expectancy, effort expectancy, social influence, and the facilitating conditions that affect the acceptance of AI. It is necessary to underline that the necessary training for AI technologies should be planned and provided by the institution and that infrastructure

support should be provided.

The findings of the current study indicated that there was a positive relationship between the learning, job switching, sociotechnical blindness and AI configuration factors of GenAI anxiety and students' GenAI anxiety states. The fear of not being able to acquire the necessary knowledge and skills to use GenAI tools increased the students' anxiety towards GenAI. As a result of the widespread use of GenAI in the workforce, the students had developed anxiety that it may take people's jobs away from them. Students' anxiety towards GenAI increased because they were not able to see AI as simply a system that works with people. This finding is consistent with similar findings in other studies. Wang et al. (2022) reported that the job switching factor led to anxiety that people may be removed from the workforce, leading to mass unemployment. They stated that sociotechnical blindness may give rise to anxiety that AI will be able to work independently of humans and cause unexpected problems. The AI configuration factor indicates the anxiety that AI may develop to a point beyond the control of its human creators and lead to consequences that threaten humanity. In the present study, there was a negative relationship between the learning factor of GenAI anxiety and the performance expectancy, effort expectancy, facilitating conditions, and social impact factors of GenAI acceptance. If students do not have the necessary knowledge and skills about GenAI, they will not be able to see the opportunities offered by these tools. Similar to this finding, Kaya et al. (2024) reported that GenAI learning anxiety affected students' GenAI acceptance both positively and negatively. They stated that the anxiety felt towards learning the necessary information about GenAI caused students to have fewer positive attitudes towards the possible benefits of GenAI. A negative relationship emerged between the AI configuration factor of GenAI anxiety and the effort expectancy and social impact factors of GenAI acceptance. Yuan et al. (2022) reported that AI configuration anxiety led students to have negative attitudes towards interacting with AI tools.

The findings of the present study showed that there was a positive relationship between self-regulation in student-content, student-teacher and student-student interactions and students' online self-regulation. There was a positive relationship between the self-regulation factor in student-content interaction and the social impact factor of the undergraduate students' GenAI acceptance. This shows that the students had a positive attitude towards using GenAI tools in order to access the necessary content. A positive relationship was found between the self-regulation factor in student-student interaction and the performance expectancy, effort expectancy, social impact and facilitating conditions factors of GenAI acceptance. This situation reveals that the students' awareness of the potential benefits of GenAI continued to develop through peer dialogue and that they were able to adopt and use these tools. However, unlike this finding, Fuchs et al. (2022) reported that undergraduate students were “digitally ready” but did not participate greatly in online self-regulated learning. In addition, there was a negative relationship between the job switching factor of GenAI anxiety and the students' self-regulation. However, there was no positive or negative relationship between the learning, sociotechnical blindness and AI configuration factors of GenAI anxiety and the students' self-regulation. Students with technological literacy are more aware of how to access and use AI technologies; therefore, these students have a more positive attitude towards AI (Belanche et al., 2019; Mantello et al., 2021). Kaya et al. (2024) reported in their studies that individuals who follow technological developments and have useful experiences may have higher levels of technology acceptance. However, the fact that individuals are knowledgeable enough to evaluate themselves does not necessarily mean

that they are able to use all the features of AI technologies. Individuals may not be aware of the negative aspects of these technologies, such as violations of privacy, prejudice, and manipulation (Hanemaayer, 2022). Chang et al. (2023) emphasized that GenAI chatbots encourage self-assessment through inquiry learning and thus can improve the self-regulated learning process. The widespread use of GenAI tools in higher education institutions highlights the need for further research on how students incorporate these tools into their own self-regulation processes (Wong & Viberg, 2024). Li et al. (2024) defined self-regulation as a dynamic interaction between students, AI, and the broader social context. They emphasized that increasing educators' awareness of GenAI tools, maintaining teacher-student dialogue to promote critical thinking and ethical awareness, and enriching their pedagogies regarding GenAI will support the development of student self-regulation.

When their views on the effective use of GenAI in educational environments were examined, the students stated that ChatGPT and DALL-E were easy to use in the learning process, contributed to organizing understanding by supporting the development of initial knowledge, helped them search for relevant content for homework/tasks, and helped generate initial ideas for homework/tasks. In addition, the students stated that ChatGPT provided instant feedback to students' questions and facilitated their individual learning. Similar opportunities are mentioned in the literature. Laurent (2023) reported that GenAI tools offer exciting opportunities for individual learning, make lessons interactive, and facilitate understanding of complex topics. GenAI tools help students develop academic writing by generating ideas, synthesizing information, and summarizing a lot of data (Chan & Zhou, 2023). The students stated that the risks and concerns regarding the use of GenAI tools reduced student activity by causing them not to spend effort on homework/tasks, and diminished creativity by being an obstacle to generating new ideas. Some students stated that the GenAI was overly trusted in terms of the accuracy of the information produced by ChatGPT, and that plagiarism and lack of academic honesty increased as the information was copied verbatim. The students also reported that DALL-E damaged the capacity for individual research and that incompatible ideas and visuals were produced by the tools. Similar risks and challenges are mentioned in the literature. Students have concerns that GenAI may hinder their critical thinking skills and creativity (Ghotbi et al., 2022) and have a negative effect on their specifically human values (Gillissen et al., 2022). Hawkins (2023) reported that over-reliance on GenAI tools negatively affects the development of creative thinking and communication skills. Yılmaz and Yılmaz (2023) stated that GenAI technologies can lead students to becoming complacent and that this situation increased concerns about their professional development.

The students gave their views on the paths that could be followed in terms of the efficient use and integration of GenAI tools in educational environments. They emphasized that planning and implementing processes that encourage the use of GenAI tools is very important. Chan and Hu (2023) stated that the use of AI technologies is currently increasing in every field and that students' AI literacy should be developed so they are able to use these technologies. In this context, they stated that educators should develop targeted interventions. The students expressed their view that it is necessary to inform students about the use of GenAI tools, and their potential benefits, risks and limitations. Chan (2023) emphasized that higher education institutions should provide training to students about the use of GenAI technologies and the potential benefits, risks and challenges of these technologies. He also stated that institutions should restructure their policies, curricula and teaching approaches within the framework of GenAI technologies. Finally, some students also stated that it is necessary to limit the

use of GenAI for purposes other than education. Understanding students' intentions and concerns regarding the use of GenAI tools will help educators effectively integrate these tools into educational environments (Chan & Hu, 2023). In this context, it may be necessary to develop students' GenAI literacy, assign tasks that will enable them to use GenAI tools more actively and effectively, and integrate GenAI tools into course curricula. In addition, developing policies for the responsible and ethical deployment of GenAI and providing relevant training programs may be effective solutions for the efficient use of these tools.

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