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Review Paper

Political Economy of the 'Virtual' Internationalisation of Higher Education to Foster Glocal Sustainable Development

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ABSTRACT

Background: The COVID-19 pandemic challenged the higher education institution's face-to-face education. Higher education institutions have overcome this challenge through enhanced virtual education which has provided further opportunities to the higher education institutions. One of these opportunities is the 'virtual' internationalisation of higher education which enables higher education institutions to reach more students globally.
Purposes: This paper aims to investigate the 'virtual' internationalisation of higher education's role in glocal sustainable development and how to enhance its use to support glocal sustainability and sustainable development. This paper emphasises importance of political economy of the 'virtual' internationalisation of higher education to support glocal sustainable development and environmental policies.
Methodology/Approach: The aim of this paper is achieved based on an in-depth literature review.
Findings: This paper highlights effective, strategic and successful 'virtual' internationalisation of higher education's role in competitiveness of higher education institutions. This paper highlights political economy of the 'virtual' internationalisation of higher education and provides recommendations and key success factors for the 'virtual' internationalisation of higher education to enhance glocal sustainable development and sustainability as well as environmental policies. This paper emphasises importance of considering the 'virtual' internationalisation of higher education in countries' sustainable development plans, strategies and policies.
Discussion: Effective and strategic 'virtual' internationalisation of higher education can support higher education institutions' competitive advantage globally. They can support higher education institutions' success in getting intelligent students from all over the world. This can further contribute to their competitiveness. Furthermore, this can enable them to employ, in these 'virtual' internationalisation of higher education programmes, globally competitive and competent academic staff from all over the world. This paper can be useful to academics, policy-makers and researchers in the relevant field.

INTRODUCTION

Internationalisation of higher education has been fostered recently. Experiences and lessons learnt from as well as successful cases in student and academic exchange programmes (e.g., European Union's Erasmus programme), and research funds and programmes enabling and encouraging international collaborations (e.g., Horizon 2020, British Council's research funds and researcher links). Furthermore, collaborations between HEIs (higher education institutes) in different countries (e.g., dual diploma programmes) encouraged internationalisation in higher education which has been added to the competitiveness factors in higher education and to the sustainable development. Internationalization process has become a standard (Poulova & Simonova, 2015). Tanhueco-Nepomuceno (2019) emphasised importance of internationalization highlighting its contribution to the institutional growth and countries' economic interests.

The COVID-19 pandemic has further fostered online education and VIHE ('virtual' internationalization of higher education). The COVID-19 pandemic has challenged the higher education and HEI (higher education institution)'s face-to-face education. As UNESCO (the United Nations Educational, Scientific and Cultural Organization)'s data revealed, approximately 1.2 billion students at all education levels have stopped getting face-to-face education due to the pandemic (ECLAC-UNESCO, 2020). Pandemic conditions have necessitated online learning which has been widespread recently especially through integration of internet into the education (Koksal, 2020). The COVID-19 pandemic has affected higher education's functioning globally (Farnell, 2021) as well as face-to-face internationalization of education. International students encountered challenges due to the COVID-19 pandemic caused lockdowns' uncertainties (e.g., their status on campus and in their host country, their decision whether or not to return home) (Schleicher, 2020). The COVID-19 pandemic has accelerated online learning and affected how teaching and research, university operations and governance are performed (Farnell, 2021). The COVID-19 pandemic crisis acted as an opportunity for education modernization as well as digital solutions using pedagogic approaches (Anderson, 2020; Trombly, 2020 as cited in Ilovan, 2020).

The VIHE has changed the competition pattern and further intensified intensive competition among HEIs globally increasing the need for HEIs to differentiate themselves, to strengthen their core competency as well as to establish and take part in strategically competitive international HEIs clusters. HEIs' effective, successful and strategic VIHE can enable them to get advantages of the virtual education as well as advantages of internationalization of higher education. Furthermore, it can act as a strategic competitive advantage of HEIs and make a multiplier effect in increasing their capacity to innovate, and educate. Additionally, from the political economy aspect, it can influence sustainable development globally and locally. Gradstein, Justman, & Meier (2004, p. 2) emphasise importance of the education's political economy as follows: "*A theoretical understanding of the political economy of education is necessary for disentangling the complex links between education, growth, and income distribution and for formulating effective policies designed to improve the public financing and provision of education.*" There is increase in e-learning alliances in developed and under-developed countries (Kenney, Hermens, and Clarke, 2004). This increase can support their capacity building. The VIHE can also support glocal capacity building for solving glocal problems so that sustainability can be fostered glocally at all levels (e.g., urbanization, industrial developments). For this reason, based on an in-depth literature review, this paper aims to investigate VIHE's role in glocal sustainable development and how to enhance its use to support glocal sustainability and sustainable development.

VIHE'S ROLE IN THE GLOCAL SUSTAINABLE DEVELOPMENT

'Virtual' internationalization and virtual globalization in higher education can contribute to the glocal sustainable development. HEIs' effective, successful and strategic VIHE can result in changes in competition in countries and in fostering their sustainable development (Figure 1). The development gap among the countries can influence welfare allocation and wellbeing as well as their sustainable development. 'Virtual' internationalization can have potential for HEIs to get benefit from internationalization and online education which can result in multiplier effect.

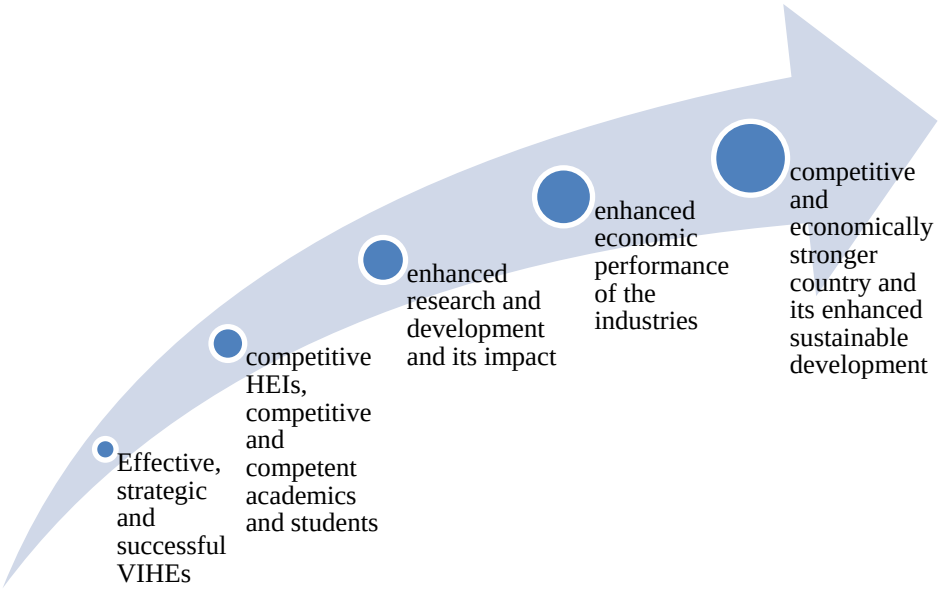

Figure 1. VIHE's impact on countries' competitiveness and sustainable development *(Source: Authors)*

'Virtual' internationalization and globalization in higher education can contribute to the global sustainable development enabling creation of synergy and added-value in education, training, research and development as well as resource allocation. This situation can have potential for supporting under-developed or less developed countries as well. For example, less developed countries can catch e-education technology (Hu, Noman, Irshad, Awais, Tang, Farooq, & Song, 2021). Furthermore, glocal sustainable development can be supported by achieving sustainable development of each country and by achieving contribution of each country to the global sustainable development. In other words, achieving sustainable development locally can contribute to, support and enable global sustainable development. For this reason, as supporting each country's sustainable development in compliance with the UN (United Nations) SDGs (Sustainable Development Goals) can contribute to the global wellbeing and welfare, all countries need to collaborate in enhancing each other's sustainable development. Effective virtual internationalisation of HEIs can support sustainable development of collaborating countries enabling scientific synergy creation through collaboration of academics and students as well as through integrated use of universities' resources and campuses. All countries need their intelligent and talented brains to achieve their sustainable development and added-value creation for their next generations and sustainability of the world resources. VIHE can enable smart and talented students to remain in their home country and contribute to its sustainable development while getting education and training internationally so that brain drain can be prevented. Brain drain is one of the inhibiting factors which can obstacle sustainable development of the countries. Effective, successful and strategic VIHE can reduce and eliminate brain drain problem as it can enable students and academics to remain and work in their countries and in their HEIs while being integrated into other HEIs in different countries. VIHE can enable academics to collaborate with other academics internationally or globally while remaining and working in their home countries and universities. In other words, VIHE and virtual globalization in higher education can enable keeping the academics and students in their home countries while enabling them to contribute to, collaborate with and take part in education and research programs internationally and even globally. Kenney et al.

(2004, p. 370) highlighted increase in e-learning alliances in developed and under-developed countries. In this way, the adverse impacts of brain drain in the development of the countries can be eliminated and/or minimized as 'virtual' internationalization can contribute to the elimination and/or minimization of the brain drain problem. VIHE enabled higher education as well as research and development can be achieved locally while they are performed at the international and global levels. Furthermore, VIHE enabled collaboration among HEIs can support capacity building, education quality and research and development impact of each collaborating HEI. In this way, VIHE can enable capacity building in different countries to support their sustainable development and to enhance wellbeing and welfare of their people. "Sustainability is also directly related to teaching, being a key concept in education" (Zamora-Polo, & Sánchez-Martín, 2019 as cited in Toader et al., 2021, p. 3). Online education can play significant role in providing and wide spreading sustainability education all around the world. There are many successful virtual higher education [e.g., TU Delft's Sustainable urban development program (TU Delft website., n.d.)] programmes. As sustainability education can play significant role in the creation of sustainable cities, solving of unsustainable urbanization problems, and transformation of cities into the sustainable ones, VIHE in the field of sustainability can foster capacity building for enhancing glocal sustainability performance and glocal sustainable development. Additionally, VIHE can contribute to the sustainability and to reduce environmental footprint through reduction in the need for traveling for international education and research purposes.

Effective use of technology in education can act as a leverage in the success and effectiveness of education supporting students to achieve their full capacity. Enabling each student to fulfil his/her capacity can further contribute to the sustainable development. As availability of necessary technologies is important to enable VIHE, technology can act as an enabler factor which can be further improved to further enhance VIHE's contribution to create synergy in glocal capacity building, innovation capacity and glocal sustainable development. For example, borderless education is influenced by developments in the field of ICT usage (Poulova and Simonova, 2015). Furthermore, AI (Artifical Intelligence) can contribute to the achievement of the fourth SDG related with education and solution of education challenges (UNESCO, n.d.). AI can enable students (Plitnichenko, 2020): to design their schedule and study whenever and wherever they wish; to experience personal approach through individual tasks, personal recommendations, etc. which can enhance their engagement; tailored lessons complying with different learning groups' needs and enabling each student to get answers to his/her questions via personal virtual assistant; to experience reduced pressure and stress in the classroom while increasing enthusiasm to study. AI technologies' integration into the education needs to support human capacities and to protect human rights (UNESCO, n.d.). AI and education are related with learning with and about AI as well as preparing for AI (UNESCO, n.d.).

VIHE SUPPORTED SUSTAINABILITY AND VIHE'S ROLE IN THE GLOCAL SUSTAINABILITY

VIHE can contribute to increase and enhance capacity of humanity to support glocal sustainable development as well as to solve and collaborate in solving global problems. For example, emphasising importance of transnational collaborations, internationalization and digitalization of higher education for teaching sustainability competencies, Caniglia et al. (2018)'s research provides a glocal model for transnational collaboration for sustainability. VIHEs focusing on global problems (e.g., sustainability) can enable synergy creation in these problems through international collaboration of VIHE partners. VIHE's effectiveness level relies on its compliance with sustainable development plans and its contribution to sustainable development and sustainability. VIHE's on strategic topics fostering added-value creation and capacity building can further support sustainable development. Effective, successful and strategic VIHE can provide the following potential main contributions to the glocal sustainable development especially at the individual (i.e., students and academics), HEI, country and global levels (Figure 2):

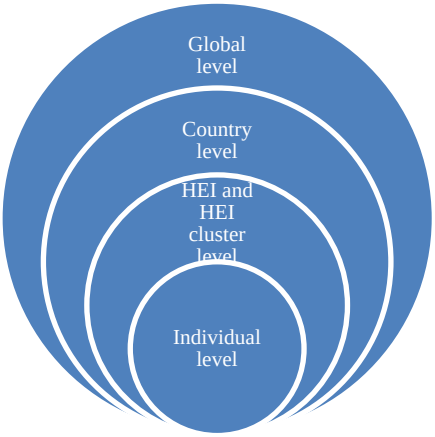

Figure 2. Levels of VIHE's contribution to the sustainable development and sustainability *(Source: Authors)*

- **At the individual level:** VIHE can provide benefit of internationalisation to the academics and students. Students at all levels of higher education (e.g., BSc, MSc, PhD levels) can reach to the high standard level of education wherever they are so that they can achieve their best in compliance with their capacity. Effective, successful and strategic VIHE can support global sustainable development jump by inclusion of all talented and intelligent students to the higher education and sustainable development of their countries. Enabling all people to get education in compliance with their capacity can support glocal sustainable development and humanity's wellbeing and welfare. Furthermore, VIHE can support students who have accessibility problems as they do not need to travel long distances to get the education. Based on their

specialisation and expertise areas, academics can collaborate with other academics in their HEI's international HEI cluster. This situation can foster their research and development activities' impact and success as well as of the quality of their lectures. For example, internationalisation of higher education can enable academics to participate in international academic activities and globalized academic communities (Solomon & Zukas, 2006 as cited in Poulova & Simonova, 2015: 1186). Furthermore, as the Canary Islands case revealed Erasmus Master Programmes on Innovation and Higher Education at a regional level can provide various advantages (e.g., promotion of internationalization and regional cooperation) (Santamarta & Mora-Guanche, 2015). Furthermore, brain drain problem can be minimized as they can collaborate globally while remaining in their countries. Their academics capacities and capabilities can be further enhanced through collaborating with the academics in their HEI's international cluster. Intelligent and talented students can get benefit from the VIHE as they can get the relevant education/training and/or they can participate in research and development in HEIs in different countries even if they remain in their country. Similarly, academics can collaborate globally while remaining and working in their country. Especially, at the master and PhD levels, this situation can enable them to achieve their full capacity and their impact on research and development activities as they can collaborate with and learn from well-known academics and experts in that particular field. Furthermore, they can benefit from the infrastructure of HEIs in VIHE. HEIs can share their resources within their HEIs international VIHE cluster. This situation can further provide opportunities to students and academics supporting the quality and competitiveness of their lecturing and research and development activities. Effective and successful 'virtual' higher education can support HEIs international clusters to reach talented students all around the world and include them to the higher education system supporting them to achieve their capacity and self-fulfilment.

- **At the HEI level:** HEIs can remain and become more competitive in case they can strategically achieve and establish successful HEIs' international clusters for VIHE. VIHE can result in changes in competition in higher education. VIHE can be considered as a game changing factor changing the competition as competition among HEIs is not only in the fields of research and development, face-to-face and online education but also in the field of virtual internationalisation. Intensified competition among HEIs can act as a driver factor for continuous improvement in education, research and facilities. Catching and attracting the most successful students can become even more challenging due to the intensive competition among the HEIs. The VIHE has changed the competition pattern and intensified competition among HEIs globally. Intensified competition necessitates HEIs to differentiate themselves and to strengthen their core competency and acquire new core competencies. HEIs can get benefit from attracting talented and intelligent students from all over the world. The more competitive a HEI is, the more attractive it can become for talented and intelligent students globally. Similarly, the more competitive a HEI is, the more attractive it can become for competent academics. In other words, HEI and its cluster for virtual internationalisation can influence HEIs' competitiveness. For this reason, scope of the competition has been widened to cover competition both at the HEI level and competition at the HEI cluster level. HEIs' international clusters consisting of HEIs having complementary competencies can get benefit from the cluster's infrastructures, labs etc., education programmes and research and development activities. Strategically successful and effective HEIs' international clusters can enable HEIs in that cluster to further enhance their capacity and to build capacity especially with the help of their complementary competencies and complying institutional cultures (Figure 3). HEIs can be encouraged more to increase their competitiveness level in the field of research and development, and lecturing. This situation can further encourage HEIs' overall quality improvement. As HEIs clusters for competitive virtual international higher education can encourage them to collaborate with competitive HEIs, HEIs having low competitiveness level can encounter risk of remaining outside of these clusters or establishing clusters with HEIs having relatively low competitiveness level. This situation can further reduce their competitiveness level in case their HEIs cluster is not successful and effective. Self-quality control among HEIs globally can be observed. HEIs can benefit from the increased synergy in attracting successful students and academics globally. HEIs remaining relatively passive or acting in delay in this virtual internationalization trend, can loss or experience reduction in their competitiveness level. Furthermore, competition among HEIs has been intensified through enhanced technologies.

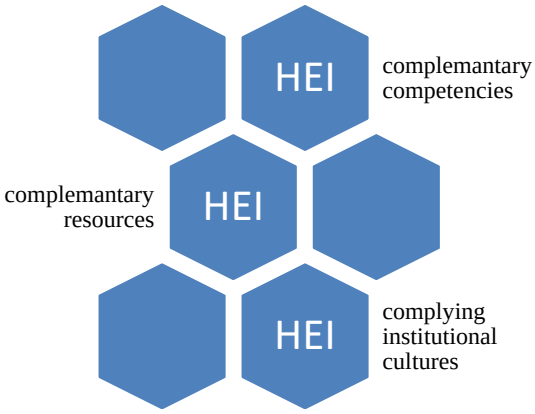

Figure 3. Characteristics of HEIs cluster in the VIHE *(Source: Authors)*

Drivers for and advantages of the VIHE need to be covered considering drivers for and advantages of both online education and scientific collaboration at the higher education level as well as internationalisation of higher education. VIHE can benefit from and be enabled by the online learning and collaboration. Online education can provide many advantages including: scheduling flexibility, ability to choose either traditional or accelerated courses (Broderick, n.d.); lower total costs especially due to no need for on-campus housing or meal nor for commuting (Broderick, n.d.); flexibility in geographic location (no need for moving expenses, etc.) which can support reduction in the cost of living (Broderick, n.d.); contribution of experts in different institutions to the online courses (UIS, n.d.); ability of students to have access to resources available in different places (UIS, n.d.) and to study courses recorded (EF English Live, n.d.); technology supported learning (e.g., videos, live exams) (EF English Live n.d.); increased student satisfaction through effective communication and flexibility of online learning (Elshami et al., 2021); online learning being a useful tool for curriculum delivery under the pandemic conditions (Elshami et al., 2021). The COVID-19 pandemic challenged higher education globally. Unless the necessary technologies for online education were available, the education at all levels could have been suspended or obstacled under the pandemic. Pandemic has increased students' involvement in online learning (Jamalpur, Kafila, Chythanya and Kumar, 2021). Many HEIs have shifted to the virtual education (Jamalpur, Kafila, Chythanya, and Kumar, 2021). The pandemic has provided opportunities to the higher education such as: acceleration of higher education transformation, improvement in learning process, adaptation of virtual mobility and 'internationalisation at home', prioritisation of higher education's social dimension in European higher education systems (Farnell, 2021). HEIs' international institutional branding can influence their competitiveness level. HEIs effective, successful and strategic VIHE can provide added value in research and development as well as in education as it can enable competitive advantage. 'Virtual' collaboration of HEIs in different countries can enable the collaborative HEIs to get benefit from each other's infrastructure and resources through virtually integrated campuses. These international and 'virtual' university alliances/clusters can enhance competitiveness of each university taking part in the alliance/cluster in case they are effective, successful and strategically viable.

- **At the country level:** Effective, successful and strategic VIHE can have potential to contribute to the reduction in the development gap among underdeveloped, developing and developed countries. Furthermore, it can contribute to the solution of the brain drain problem. Considering the potential impacts of the VIHE on sustainable development and achievement of the effective environmental policies, this topic needs to be covered in the development plans of the countries.
- **At the global level:** Effective, successful and strategic 'virtual' higher education can support global sustainable development as it can enable students and academics to achieve their best working in their home country, the science to progress even more faster, the competition to become even more intensive both at the HEI level and at the HEI cluster level, the quality of HEIs and higher education to be improved. Students and academics in the HEIs' international clusters can contribute to the global sustainable development and collaborate in solving global problems. VIHE can be a tool for achieving sustainable development glocally. Sustainable development achieved locally can contribute to the global sustainable development.

RECOMMENDATIONS AND KEY SUCCESS FACTORS FOR THE VIHE TO ENHANCE GLOCAL SUSTAINABLE DEVELOPMENT

Sustainable Development Policies Covering VIHE

'Virtual' internationalization and globalization of HEIs and political economy of their VIHEs can be considered and covered in the countries' development plans as effective, strategic and successful VIHE can affect and contribute to their sustainable development, innovation capacity and added-value creation in all industries. VIHE's capacity to create synergy through integration of talented and successful experts, academics and students from all over the world on virtual platforms which are both local and global, enabling them to stay local while contributing glocally and collaborating globally can contribute to the global sustainable development, local and global capacity building, enhancement in the innovation capacity and added-value creation glocally (Figure 4).

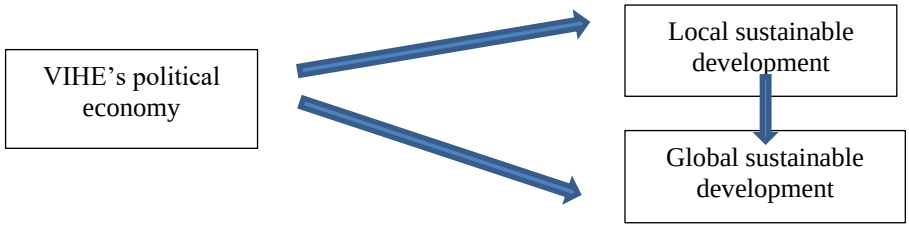

Figure 4. VIHE's political economy impact on local and global sustainable development *(Source: Authors)*

Policy aspect of VIHE needs to be considered so that effectiveness and success of VIHE's can be supported. Countries' sustainable development plans can be one of the main factors affecting VIHE's widespread and impact on society, science, and economy. Furthermore, policies' effectiveness can be enhanced in case they rely on the accurate data. Data management is important for effective education policies (Lennox et al., 2021). Additionally, experiences and lessons learnt at all education levels can be integrated to the education policies to enable continuous improvement at all education levels including the higher education. For example, pandemic resulted in rethinking education system and a requirement of digital and non-digital modalities' mix (Lennox et al., 2021) as well as in importance of adequate and equitable allocation of pandemic response resources to HEIs (Freeman et al.,

2021). In compliance with the importance of policy aspect in education, Tanhueco-Nepomuceno (2019) highlighted researches to be carried out in the field of policies on inter-institutional arrangements, measures to manage out brain drain; mechanism at the Ministry level to monitor the internationalisation programs and their quality; knowledge transfer as a source of economic growth (Tanhueco-Nepomuceno, 2019). Kenney et al. (2004) have emphasised government's role in supporting e-learning through their policies.

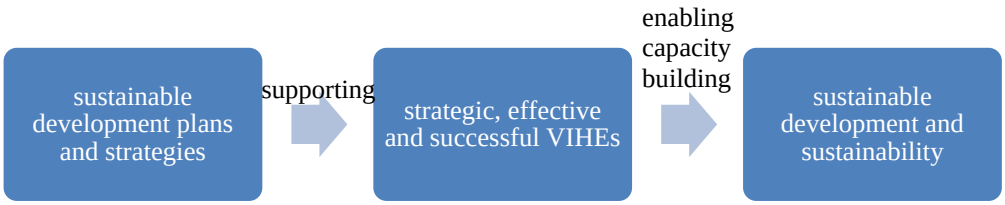

Figure 5. Sustainable development plans and strategies supporting VIHEs *(Source: Authors)*

The HEI and Countries' HEI Policies

Countries HEI policies are important for supporting VIHE at the HEI level and for encouraging establishment of VIHEs focusing strategic topics capable of supporting added-value creation and sustainable development. For this reason, countries HEI policies need to consider political economy aspect of the VIHEs and their role in sustainable development and sustainability. VIHE needs to be covered within the scope of the strategic management of HEIs. Tanhueco-Nepomuceno (2019, p. 152) emphasised importance of "articulated visions, missions, goals, and core values" and well-defined strategic plans for internationalization. Furthermore, AI can be covered in education policies considering its multidisciplinary nature and investment requirements (UNESCO, 2019). Additionally, establishment of the HEIs international clusters is a critical aspect in the success in the HEI's virtual international higher education. HEIs international cluster can be established considering core competencies of each HEI giving priority to the HEIs having complementary core competencies, complying institutional cultures and strategies. Effective VIHE necessitates HEIs to collaborate with the most compliant HEIs in different countries. This compliance can be assessed at the HEI level as well as at the discipline-based requirements level. As collaborating HEIs need to collaborate in harmony their institutional cultures' compliance can influence their success. Institutional cultural challenges need to be addressed in the VIHE. Availability of necessary internal resources and supportive culture at the institution level can support internationalisation (Tanhueco-Nepomuceno, 2019). Furthermore, collaborating HEIs can gain advantages and increase their competitiveness levels both at the local and global levels especially through their complementary core competencies. HEIs can get benefit from the integration of their complementary core competencies to further enhance their competencies, capacities, capabilities and resources to outperform other HEIs and to foster the quality of education and impact of their research and development. For this reason, 'virtual' internationalization of each HEI needs to be planned and executed strategically complying with its strategic management decisions. Furthermore, the performance of each activity within the scope of internationalization needs to be monitored.

Factors, which can influence VIHE's success and online education quality, need to be considered and addressed in the management of VIHE process. Online education's quality can be enhanced through allocation of time, expertise and investments required, enhanced pedagogical skills, training of human resources, and enhanced digital literacy of academics and students (Ilovan 2020). Furthermore, technical assistance and students' enthusiasm are important for enhancing faculty satisfaction in online education (Elshami et al., 2021). Student and lecturer interactions (Jamalpur, Kafila, Chythanya, & Kumar, 2021), communication, feedback, and level of information (Poulova, & Simonova, 2015) can support online education as well. Additionally, subject specific conditions are important for identifying the best method on instruction (e.g., some subjects, such as surgery, require both physical movement and practice) (UIS, n.d.).

VIHEs resilience to the online learning challenges need to be enhanced. There are many e-learning related challenges which include "… *access to appropriate technology, scalability, measurement, and changed governance structures* …" (Kenney, Hermens, & Clarke, 2004, p. 370). Students' need to be ensured to have access to the web, computer etc. Students' attention to the lectures needs to be kept high during the online lectures. Furthermore, McKeown & McKeown (2019) (as cited in Madhesh, 2021) emphasised difficulty of deaf students in distance learning. Madhesh (2021) emphasised deaf students' exclusion from alternative education methods in Saudi Arabia in the pandemic (Madhesh, 2021). Furthermore, Elshami et al. (2021)'s research revealed that students encountered challenges related with long learning sessions and technology whereas academics encountered challenges due to increase in workload and preparation time, and due to technical problems. Additionally, online education problems at different education levels can be encountered at the higher education level as well. For example, problems related with online education at the college level include: students' belief that the tuition fees need to be reduced in case courses are fully taught online (Oneclass blog 2020 cited in Hess, 2021); students' withdrawal from the school (Oneclass blog 2020 cited in Hess, 2021); students' dissatisfaction of the online classes' quality (Oneclass blog 2020 cited in Hess, 2021); students' difficulty in concentrating and in collaborating with peers (Sallie Mae 2021; Hess, 2021). Alam & Parvin (2021)'s research revealed that the pre-pandemic students' job-readiness scores were higher than students in the pandemic period. Online education can challenge education quality and students' performances.

Discipline-based requirements and challenges, which can be encountered in the VIHE, need to be considered to enhance success and effectiveness of VIHEs. Each discipline can get benefit from and encounter different challenges due to the VIHE. For example, according to the Chang, Wang, Lin, Cheng, & Chiang (2021)'s research on dental education, integration of face-to-face and online learning is considered as the future of the dental education and dental students assessed online learning as more effective than face-to-face learning. Furthermore, Jamalpur, Kafila, Chythanya, & Kumar (2021)'s research on engineering education emphasised importance of usage of different digital learning resources by the academics.

HEIs need to be informed about and get inspired from successful cases of VIHE as successful cases for VIHE can motive other HEIs to establish their HEIs international cluster. Examples for successful cases in different disciplines include: a universally applicable international telecooperative project (Rauer, Kroiss, Kryvinskai, Engelhardt-Nowitzki, & Aburaia, 2021); the "Excellent Teaching and Learning in Engineering Science" project (Grodotzki, Ortelt, & Tekkaya, 2018); the model of InterUniversity Study (Poulova & Simonova, 2015); Tanhueco-Nepomuceno (2019)'s framework for creating an internationalized campus; online teaching to master and PhD groups in social economy and non-governmental organizations in different countries (Parra, 2017). Additionally, successful and effective e-learning platforms can play important role in creation of glocal synergy. Furthermore, HEIs need to be informed about failures in the VIHE as these failure cases can contribute to the lessons learnt and to further improve the virtual internationalization process based on the critical success factors enhanced through the lessons learnt.

CONCLUSION

This paper examined VIHE's role in glocal sustainable development and how to enhance its use to support glocal sustainability and sustainable development. Even if the COVID pandemic challenged HEI's face-to-face education, HEIs have overcome this challenge mainly through enhanced virtual education which has provided further opportunities to the HEIs especially in the field of the VIHE. Enhanced 'virtual' education has supported HEIs to overcome the pandemic challenge and provided further opportunities to the HEIs (e.g., VIHE). This internationalisation type can enable HEIs to contribute to their capacity to reach more students globally supporting them to reach to and attract successful and intelligent students globally. As competitive HEIs can have more opportunity to attract more successful and intelligent students, their competitiveness can be further enhanced. Furthermore, HEIs which are globally competitive can hire and attract globally competitive academics. HEIs' and their international clusters' effective, successful and strategic VIHE can contribute to the improvement in their education and innovation capacity as well as in their research and development activities through synergy created by talented and intelligent students, competent academics, integrated use of resources, labs and complementary core competencies of the HEIs in their international cluster. This situation can further contribute to the sustainable development of countries as effective, strategic and successful VIHEs in compliance with their sustainable development and environmental policies can contribute to the quality and competitiveness of their education as well as innovation capacity.

VIHE has changed the competition pattern and intensified competition among HEIs globally. Intensified competition necessitates HEIs to differentiate themselves and to strengthen their core competency. Furthermore, HEIs' international institutional branding can influence their competitiveness as well. Discipline-based requirements and challenges as well as cultural challenges, however, need to be addressed in the VIHE. Additionally, the VIHE needs to be supported by the foreign branch campuses and establishment of the effective collaborations among HEIs clusters.

Today's education will shape the future. As in compliance with VIHE's political economy, today's education level can influence sustainable development as well as humanity's capacity and capability, effective investment in education, effective use of education technologies and effective education policies covering all levels of education can support the sustainable development and competitive advantage of countries. Furthermore, political economy of the effective, successful and strategic VIHE can affect the capacity building of collaborating HEIs and their countries in dealing with global problems (e.g., climate change, urbanization problems) through effective integration of collaborating HEIs' resources. For these reasons, effective, successful and strategic VIHEs can provide advantages especially at the individual (i.e. student, academics), HEI, country and global levels. It can support glocal sustainable development, environmental policies and increase in the welfare, wellbeing of the people. Furthermore, it can foster countries' capability and capacity building as well as added value creation. It can enable them to get benefit from know-how and knowledge gained through effective and strategic VIHEs and global collaboration synergy to solve local and global problems (e.g., urbanization problems, need for enhancing sustainability performance and reducing environmental footprint) hindering glocal sustainable development.

Potential challenges of and key success factors for the VIHE need to be considered for enhancing its effectiveness and success. Complementary core competencies, complying working cultures, continuous improvement in research and development as well as education, lessons learnt from success and failure cases need to be covered in the VIHE. Discipline specific requirements, student and academic specific requirements and technology investment related requirements need to be addressed. Each HEI needs to cover the VIHE in its strategic management. VIHE can enrich internationalisation of higher education. Depending on discipline specific and HEI cluster specific requirements, it can be used as complementary option to face-to-face internationalisation of higher education as well.

VIHE needs to be used as a strategic tool for enabling and supporting sustainable development both locally and globally as achievement of the local sustainable development is the key for achievement of the global sustainable development. As in case each country can achieve its best and highest performance in sustainable development, global sustainable development can be supported. Whether or not the VIHEs act as a driver for or inhibiting factor of local and global sustainable development, depends on each HEI's

strategic management, each VIHE's HEIs strategies and principles and on each country's sustainable development. For this reason, each HEI in the 'virtual' internationalisation cluster needs to respect to other HEIs in its cluster enabling establishment of long-term strategic 'win-win' relationship supporting each HEI's capacity building and competitiveness as well as contributing to the sustainable development of the countries where these HEIs are physically located. In other words, all HEIs and their VIHE clusters and countries' education policies need to focus on how to fulfil and achieve entire capacity of their people (e.g., students, academics at all levels) and their infrastructure (e.g., laboratories, know-how) to increase and achieve the potential synergy for capacity building, innovation, added-value creation, and sustainable development. This paper is expected to be useful to academics, policy-makers and researchers in the relevant field as well as to all stakeholders of sustainability.

Ethics and Consent: Ethical approval was not sought for the present study because data set has not been used. Ethics committee permission is not applicable because this article does not contain any studies with human or animal subjects.

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Research Paper

Students' Opinions on the Usage of Mobile Augmented Reality Application in Health Education

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ABSTRACT

The use of mobile augmented reality technology has recently improved in education and training methods. Studies have shown that this new technology has a positive effect on education and students. This study aims to present a synthesis of the studies on mobile augmented reality in health education with a critical approach and to develop suggestions for future researchers. In addition, by presenting an application on the effect of the use of augmented reality in health education on the performance of students, it is aimed to investigate the students' perspectives on the use of this technology and its use as an educational tool in teaching-learning through students' perspectives. For this purpose, an anatomy application for anatomy lesson was designed with Unity 3B platform, Blender and After Effect, and 150 students studying at Vocational Department of Health Services were asked to experience the augmented reality application developed. Mobile augmented reality application was made available to students during the application process. as a result, "Student Views Questionnaire on the Use of Augmented Reality Application in Health Education" was applied. Frequency and percentage distributions were used to determine student views. The results obtained in the research show that students respond positively to the use of technology and they believe that the use of technology in the learning-teaching process will increase their performance.

INTRODUCTION

The rapid inclusion of technology in education started to play the main role in the success of the learning process, there was a presentation of different technologies, and one of them is augmented reality. This technology has been used to offer solutions to the problems faced by education and to create an interactive learning environment that can be an advantage to improve students' learning and increase their knowledge and skills. Augmented reality is a technology used to demonstrate the interaction between the real world and the virtual world, where users can place models and objects in the real world and then interact with it.

Applications designed with the use of hardware and software in Augmented reality technology together provided a new opportunity for more interaction with learners, showed more interest in education, provided educational gains, and increased the effectiveness of the learning process. After the introduction and use of this technology in computers, developers thought of ways to make this technology available to every user, anytime and anywhere. Developers have started designing apps that can be used on mobile phones and tablets, helping the technology spread and become famous, and mostly used in apps drifting from Snapchat and Facebook to E-commerce, being a part of learning and education methods. Augmented reality applications have made it easier for mobile users to experience the real world and engage more with the real world, and devices that support AR are becoming more common, with affordable costs and different features.

This study tries to find out how the new augmented reality technology affects students' performance while studying and how you can strike the right balance without missing any of the available methods. These methods differ from traditional methods, (Textbooks). Health education is becoming a complex issue today and teachers face difficulties in providing solutions because of the wide variety of information that needs to be presented in different ways. The health education sector has begun to depend on software and hardware developers to provide technological solutions to improve health education and has begun to undergo changes involving the complete digitalization of medical records, and there have been changes in social-ethical issues related to health education. A study by (Güze, 2015) noted that there is a gap between developers and clinicians, as well as universities and educational facilities, with the result being ineffective technology that frustrates and overwhelms health education professionals and clinicians. This has resulted in the technology being offered by developers being ignored as a solution to education and learning problems. Some difficulties also arose as time constraints within the training program, lack of cadavers, it was also stated that the training process was handled by non-medical teachers and trainers due to the lack of institutions with professional clinical care. Recommendations included developing relationships with both clinicians and researchers for anatomy education programs, thereby advancing teaching and research. One of the solutions offered is computer-assisted teaching, the development in computer technology has undergone a rapid change since the last few years, many computer-assisted teaching applications have been created,

and various techniques and tools have been provided for the development of intelligent systems. Developers started to produce and develop an effective technology, researchers started to focus primarily on computer assistant training to train teachers, and teachers were not satisfied with the workshops and training that is given by the education authorities at their professional beginnings. Then, labs and computers also need a technical assistant if an error occurs in the application being used, as they require more training to understand how applications work.

This study highlights a technology delivered on a handheld device (mobile/tablet filled with camera) application designed to be involved in higher education as a learning tool for students that allows users to interact with it. With its (MAGAU) technology features, it supports students to learn anatomy lesson, the lessons include many hands-on sessions in the learning curriculum, after the end of the practical sessions in laboratories and universities, most of the students have trouble remembering details after they finish the lessons (Weking & Santoso, 2020). These problems can be solved by using mobile learning as a tool in learning methods, and in order to achieve this goal, it is important to understand these problems and make sure that the application is the perfect solution. The application re-examines or changes the subject more regularly using Mobile Augmented Reality (MAGAU) innovation, also our aim is to guide students and universities to fast learning practice using this application and the biggest finding of this study is to help students, self-study and self-study due to lecture-based education programs Avoid minimizing editing time for the resulting congestion learning.

Purpose of the Research

The general aim of the research is to determine the effect of the augmented reality system on student performance from the student's opinions. There are various studies on the use of mobile technology in undergraduate and graduate education in various countries, but without measuring the students' perspective on this technology. In this sense, the goal is to clarify students' use cases for augmented reality systems in learning process. It aims to provide students with perspectives on the use of mobile augmented reality application as an educational technology tool clarify the factors limiting the adoption of augmented reality applications in health education activities. Research questions are:

- What is the use of Augmented Reality in the field of education?
- What are the materials used in the health education process?
- What are the students' views on the effects of augmented reality applications in health education on the learning process?
- What are the evaluations of the mobile augmented reality application (MAGAU) on the subject content?
- What are the design considerations of the mobile augmented reality Application (MAGAU)?
- What are your suggestions for using the (MAGAU) app for classroom teaching and learning needs?

METHOD

In this section, the research model, study group, data collection and application, data analysis and interpretation are given, and studies on each sub-title are explained in detail.

Research Model

In terms of the purpose and method of this research, the scanning model for due diligence is used. It is a descriptive research based on Gazi University Health Services Profession Students in the School of Health; Mobile device augmented reality application It includes an evaluation of its use in education. “Survey research has brought the social sciences the opportunity to work numerically. Statistics concept, techniques and processes are widely used. In other words, survey studies are based on statistical measurements. Usually this type question paper (questionnaire) or interview technique is used in researches” (Gökçe, 2004, p, 60).

The (MAGAU) application is designed using the Vuforia SDK and Unity and Blender and Adobe after effect for animation and color, the system is used to store 3D objects and store multiple image targets, there are two parts of the application, (See Figure 1, Figure 3), Marker and Unmarked. In the first part, the user This is the part where he clicks the button in the main menu where the 3D objects appear and controls the 3D objects and rotates the 3D objects. The second part of the application is the marker part where the camera will open. The pictures in the book can be traced after scanning, successfully detecting the models, and can be examined clearly.

In order to achieve the designed system in this study a various tools used in this project were Vuforia and Unity, and the ready 3D models design face took five stages to complete the application.

Phase 1: Designing and creating the UI hierarchy that connects all implementation phases and represents the startup scene

Phase 2: Downloading and uploading the 3D models and adjusting the sizes and colors of the models with the blender program and adding them to the scenes with the description of each model and information that will help to understand the model description.

Phase 3: In the use of the application in the fifth scene, the image target from the anatomy book is prepared and edited using the camera, making it visible and clear.

Phase 4: Framework programming of augmented reality based on Vuforia SDK and Unity Diversion Engine as framework development environment.

Phase 5: Unity is used as a framework build phase and coordinated with the Android SDK, the final item implementation is accessible for installation and use.

Phase 6: Finally, the app is released on Game jolt free platform.

System Description

According to the (MAGAU) system figures, (See Figure 2) is the part where the 3D capture module appears, clicks the button in the main menu, controls the 3D objects and rotates the 3D objects. The second part of the application (Figure 1) is the marker part where the camera will open, and after the pictures in the book are scanned, the followed picture is targeted and the displayed models are successfully detected and can be examined clearly.

System Design

(MAGAU) application is designed using Vuforia SDK and Unity and Blender, system Used to store 3D objects in unity database and store multiple image targets, it has two parts, (Figure 1,2, and 3), Marker and Unmarked. In the first part, the user Click the button in the main menu where 3D objects appear and check the 3D objects and it is the part where it rotates 3D objects. The second part of the application is, where the camera will open, the marker part. After the pictures in the book are scanned, they can follow, the models are successful. clearly identified and can be examined clearly.

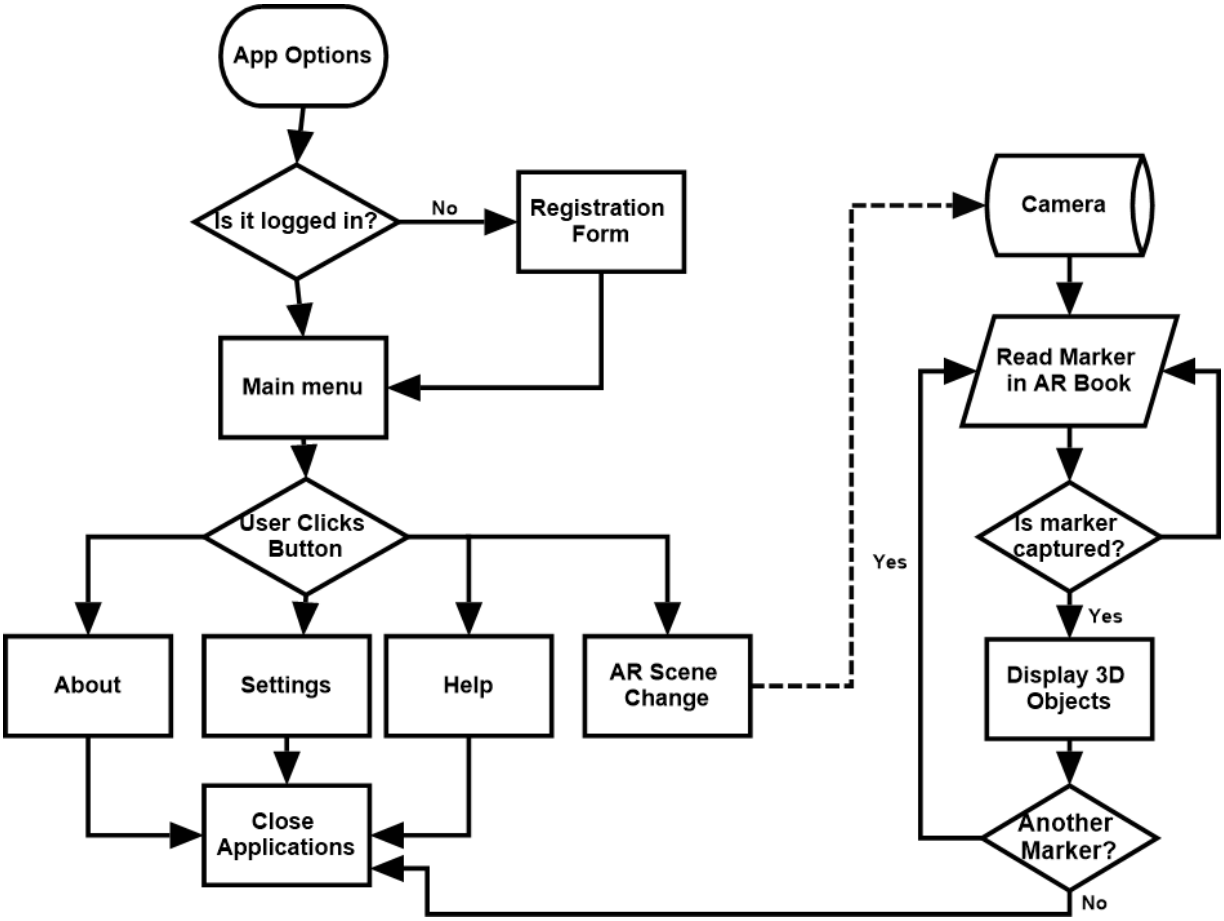

Figure 1. Flow chart of the AR Anatomy Marker tracking

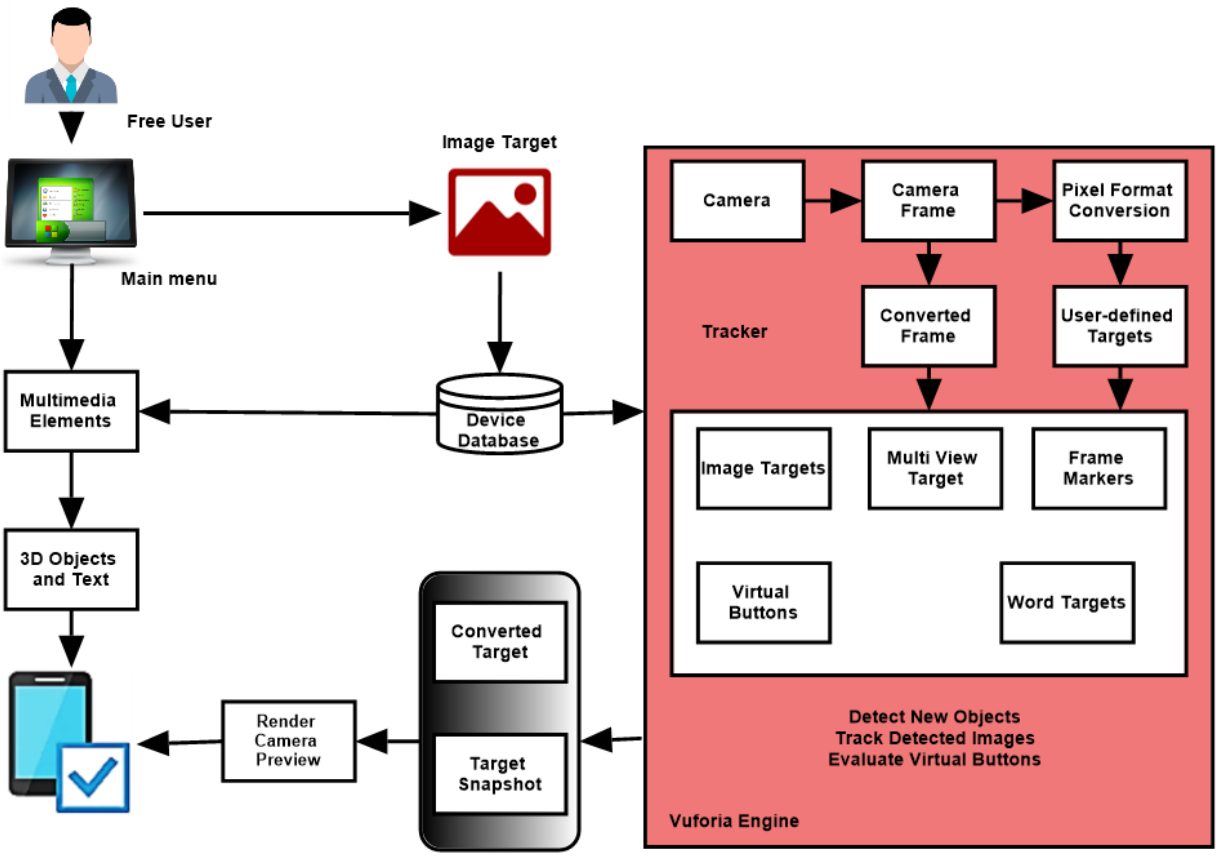

Figure 2. Architectural System Design

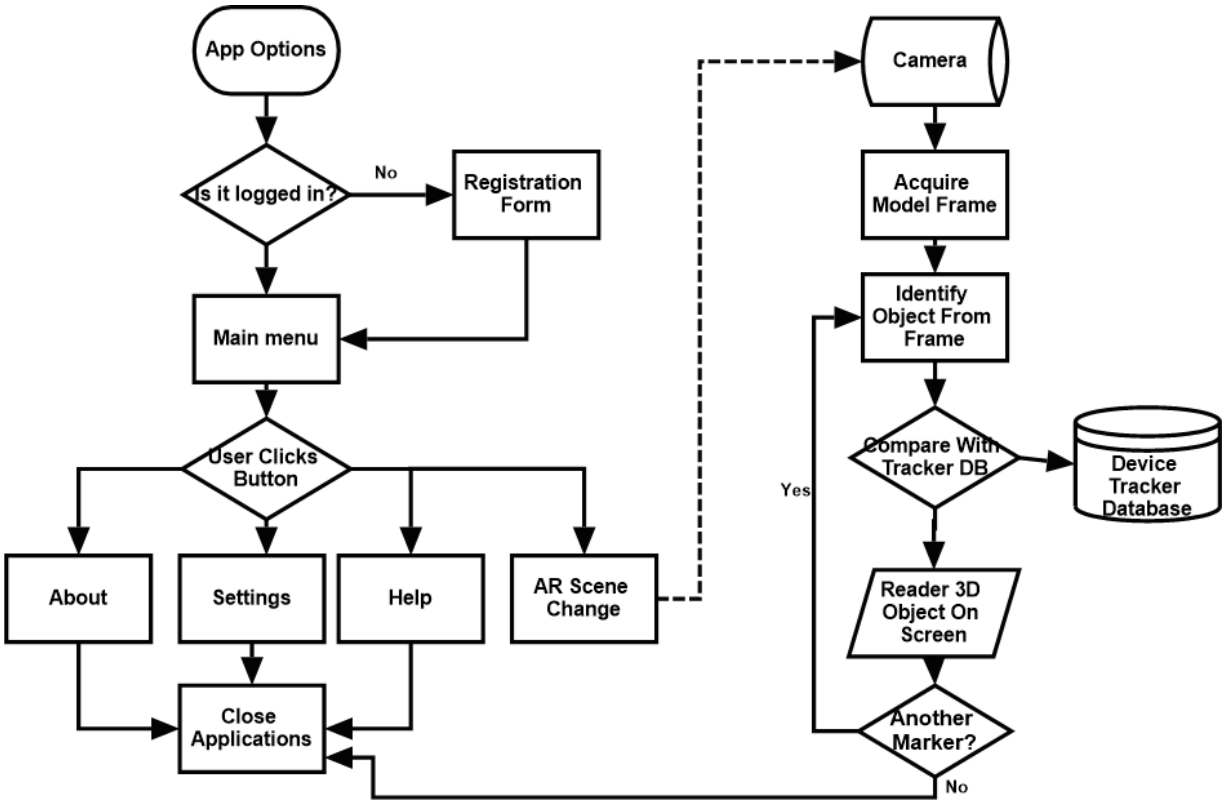

Figure 3. Flow chart of the AR Anatomy Marker-less tracking

Participants

Gazi University Health Services Vocational School has a total of 1405 students studying in their 1st and 2nd grades in all departments. Considering the departments with anatomy lessons; A total of 1213 students studying in their 1st and 2nd year, including 193 students in the First and Emergency Aid Department, 191 students in the Pathology Laboratory Techniques

Department, 195 students in the Medical Documentation and Secretarial Department, 193 students in the Medical Imaging Techniques Department, 200 students in the Medical Laboratory Techniques Department, and 241 students in the Elderly Care Department. There are approximately 600 students in the departments that have anatomy lessons in the 1st year. It is planned to get the opinions of around 200 students for the questionnaire developed for the Mobile Augmented Reality Anatomy Application (MAGAU) developed for the use of augmented reality and Anatomy courses.

It is planned to get the opinions of around 200 students for the questionnaire developed for the Mobile Augmented Reality Anatomy Application (MAGAU) developed for the use of augmented reality and anatomy course. The study group selected in this study were Gazi University Health Services Vocational Department students for the survey, but the application was tested by Gazi University computer engineering department. 13 students tested the application and added their comments and changes, and also by healthcare professionals and intern health education students in Turkey. Tested online by 42 healthcare professionals from different departments who participated in the survey. And lastly, it was conducted with 150 students by face-to-face interviews, participated in the survey while they were studying at the Health Services Vocational department, necessary permission was obtained from the department manager and department chair in order to apply the survey in the 2020-2021 academic year, brief information was given to the students and an introductory video was used for the anatomy application (Table 1). An online link was provided to them with a questionnaire about their employment, 22 of these questions were accepted as valid.

Table 1. The student and gender distributions

Demographic information	**Categories**	**F**	**%**
Gender	Male	29	19.3
	Woman	121	80.7
Age	16 – 20 age difference	109	72.7
	21 – 25 age difference	41	27.3
Department	Department of Medical Documentation and Secretarial	126	84.0
	Department of Medical Imaging Techniques	6	4.0
	Medical Laboratory Techniques Department	18	12
	Total	150	100

Mobile AR (MAGAU) in Use

Clicking the first button change as AR in the main menu (MAGAU) will switch to the marker less part of the application where the camera is turned on and the 3D models are transferred to the scene, and the models shown in the figure are on different pages and are shown below. The list and numbers can be changed by pressing, so the next 3D model will also contain text container when models change, each with information about the 3D model. The (MAGAU) AR mobile app has been designed using new packages introduced that help to combine the marker and unmarked design of the AR app, but the modern design of this app, (Figure 4), will help future researchers do more work using the new features in Unity and this application is specially designed for health education students and their reviews will help to give the use of this application and more applications in the future.

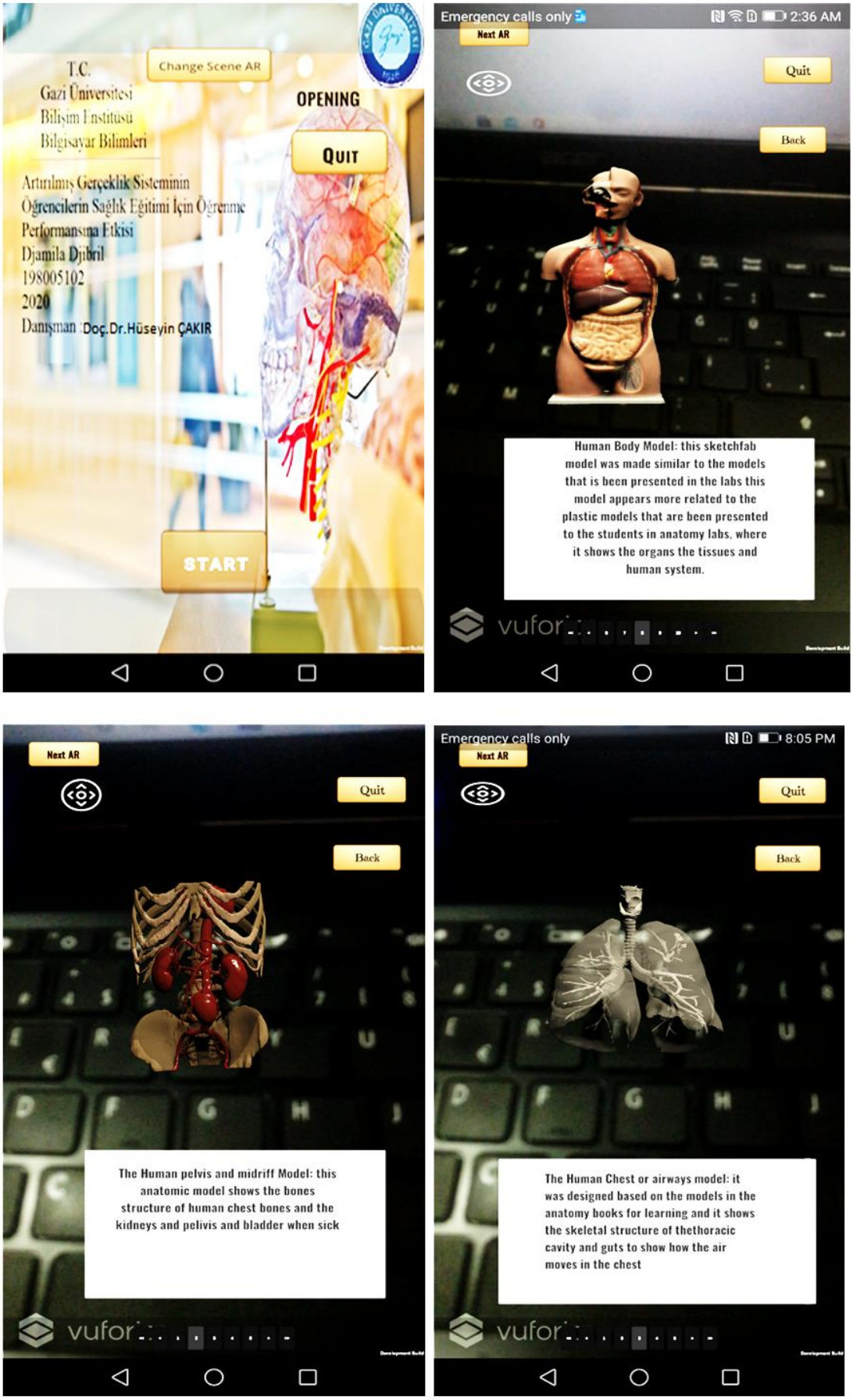

Figure 4. MAGAU Application.

Analysis and Interpretation of Data

The data obtained from the document and literature review were used in the introduction and findings and comments section of the research. The data collected as a result of the surveys were converted into numerical data in the form of frequency (f) and % distribution table. Obtained results charts and then necessary explanations and comments were made for each chart. While evaluating the findings obtained from the study, IBM SPSS Statistics v22.0 program was used for statistical analysis.

Data Collection

Research data were collected through a questionnaire developed by the researchers. The measurement tool, which is prepared to get the opinions of individuals and groups in various fields and includes the demographic information of the group to be reached, is called a questionnaire (Sönmez & Alacapınar, 2019). While preparing the survey questions, related studies in the literature were used. In order to ensure the content validity of the questionnaire, a total of three experts, one in the field of health and two experts in the field of information technologies, were consulted. Prepared survey First of all, it was applied to 12 students and the missing and wrong places were corrected.

Data Analysis

In this study, the first factor refers to what is called quantitative methods as it refers to two separate experimental processes. A survey was conducted on the students with an open-ended interview questionnaire. As a result of the literature review, an appropriate questionnaire was created and as a result, the data option in this questionnaire was used. With the literature review prepared using the data scale (Serin, 2020), 22 questions were divided into two parts, and the first questions were demographic questions about the participant's age, gender, and whether or not they were students of which department. There were 2 categorical questions about their views, the second part of the questions was 11 questions were used to measure the Anatomy mobile augmented reality use in scale questions. The scale showing the purpose of the research, the application was shared with the students and sent via WhatsApp, and after testing, they were asked to fill out the questionnaire, how the users could interact with the application, and how and with the future intention of the design. Technology use and acceptance based on work done by (Weking and Santoso, 2020) 8 questions about user experience, suggestions for future intentions and these statements were evaluated with 3 points Yes– No-Maybe/somewhat.

Fundamental frequency analysis: it is a statistical method often used to trust how much value we have or how many times an event has occurred, a vital area of insight that negotiates the number of events (repeats) and analyzes measures of central tendency. In our study, where we measured the number of occurrences of each participant, the frequency value of each question was the appropriate method since there were not many values in our study.

The data options were analyzed using IBM SPSS version 20.0, the first part was evaluated with frequency analysis and the scale questions were analyzed in the statistical structure. To determine the characteristics of the participants, first frequency analysis was applied, then scale measurement was applied and the proposed research was tested with structural research. The result will determine whether the students' perspective on the use of this technology is positive or not, and they agree that the use of this technology in the teaching and learning process in health education will increase the performance of the students.

RESULTS

A survey was conducted to measure the students' perspectives on how the application design can be successful and can be used as an educational tool, the interview-survey gave positive results and the aim of the study is to learn whether the application design is successful or not. The designed application can meet the expectations of the students and can help increase their academic achievement performance and motivate them to use AR technology, the students' great support for the use of the technology in which the application is presented has affected the attitudes of the students towards the use of the application in learning the anatomy lesson according to the survey about the designed application, the student showed a positive response, it was quite informative and easy to use and fun so students suggested creating more apps and it needed to stand out from other AR apps to get different results.

As mentioned earlier, due to the rapid change in teaching and learning methods, attitudes and future use intentions implying that universities and education must keep up with this change have been found to be effective.

The good part of technology is that the application can be used without internet access, it does not require a technical audience or supervisor, and it will use social media, which eliminates the excuses of teachers like students and will waste time, because education systems are falling behind in rapidly increasing technology competitions. will lag behind international methods that use more advanced technology in teaching-learning methods used in education systems. In the survey results, it was also stated that it is very difficult for universities to adopt this type of technology in their teaching methods, but the state and related institutions are willing to apply it through training to teachers who can apply it as a teaching method. It is necessary for education systems to be successful in global competition. In addition, more research is needed to measure the use of augmented reality technology in the education system in Turkey, especially in areas such as health education.

Qualitative research has been conducted on a limited number of students to understand their perspectives and also to measure the factors that make AR technology effective and the technology that may limit its use and applications in universities, and how this

technology may have future effects on students' performance The purpose of the current study is to be used as a learning tool. The distribution of the resulting questionnaire on the use of technology was presented, which was to examine the students' perspective on the use of Mobile AR technology through students' opinions:

1.1. Use of Augmented Reality in Education: As mentioned, AR technology had a positive effect on the students in our study. In order to measure this effect, we needed to know the student's state of knowledge, use this technology in their studies and outside the classroom, and find out whether there is any background knowledge about AR. This goal was based on three survey questions, we would analyze the results as it shown below:

1.Do you know about augmented reality?

Table 2 shows the students' prior knowledge of AR applications.

Table 1. Students' prior knowledge of AR applications

Answer	F	%
Yes	46	30.7
No	48	32.0
Maybe	56	37.3
Total	150	100.0

2. Have you used augmented reality applications before?

Table 3 shows the utilization of AR applications. Accordingly, **s**ome students (17.3%) said they had experienced and used these AR games for a while, but most of the students (68.7%) said they did not use these applications or tried any AR applications. 14% of the students stated that they used game applications, not educational applications.

Table 3. Utilization of AR applications

Answer	F	%
Yes	26	17.3
No	103	68.7
Maybe	21	14.0
Total	150	100.0

1.2. Materials used in the health education learning process: In general, students in education tend to use different educational tools to learn and facilitate the learning process. Students tend to use mobile phones in their classes as shown in Table 4. The students were asked whether they used any material in their education and while they stated that they used it, the most used material is mobile phones, web pages and e-books, computers, and they prefer watching videos from the internet.

1.Which materials do you use for educational purposes in the training process?

Table 4 shows the results of the students' usage on educational materials.

Table 4. Students' usage of educational materials

Materials used in health education learning	F	%
Computer	36	24.0
Telephone	34	22.7
Telephone; Computer	3	2.0
Book	28	18.7
Book; Telephone	1	.7
Book; Web Page	4	2.7
No	2	1.3
Video	15	10.0
Video; Telephone	1	.7
Video; Book	4	2.7
Video; Web Page	3	2.0
Web Page	18	12.0
Web Page; Telephone	1	.7
Total	150	100.0

1.3. Student views on the effects of augmented reality applications in health education on the learning process: Students' views on the general effects of augmented reality applications on the health education learning process were measured to know the students' perspective on the general use of AR application in the learning process in the past and up to now. More explicit about this technology usage via questions are as follows:

1.Is it useful for you to use the augmented reality application in the classroom?

Table 5 shows the results on the whether it is useful to use AR in the classroom. The results clearly indicated that students mostly found the application useful (73.3%). 6% of the students stated that they did not have any prior knowledge about AR use. Moreover, some students (20.7%) also indicated that they are not certain about usefulness of the MAGAU since they had no prior knowledge about it before (6%).

Table 2. Usefulness of augmented reality

Answer	**F**	**%**
Yes	110	73.3
No	9	6.0
Maybe	31	20.7
Total	150	100.0

The results of the questionnaire asked the students (See Table 5) were generally related to the background information about augmented reality and they stated that they had knowledge (30.7%) and that they saw (MAGAU) AR applications and games but did not use them. (37.3%) stated that they had knowledge about AR technology through social media and the internet, while

2.Does the augmented reality application provide a better understanding of the subject content of the course?

Table 6 shows the results on the whether the augmented reality application provide a better understanding of the subject content of the course. Students (74.7%) stated that applications designed in AR for health education and teaching health courses were very useful, but 21.3% of the students are not certain about a better understanding of the subject, because they think they need also traditional materials when testing applications in the classroom. On the other hand, 4.0% of the students think that AR does not provide a better understanding.

Table 3. Students' views on the effects of augmented reality

Answer	**F**	**%**
Yes	112	74.7
No	6	4.0
Maybe	32	21.3
Total	**150**	**100.0**

3.Do you think that the use of augmented reality applications will make the information more permanent?

Table 7 shows the results on the whether the use of augmented reality applications will make the information more permanent. Students (73.3%) said that AR apps helped students remember information and maintain attention during the lesson. However, 23.3% of the students still thought that students should use the apps with their traditional materials. On the other hand, 3.3% of the students think that information is not more permanent and cannot be helpful when using it.

Table 4. Permanence of information in augmented reality

Answer	**F**	**%**
Yes	110	73.3
No	5	3.3
Maybe	35	23.3
Total	**150**	**100.0**

4.Does using a reality application increase students' interest in the teaching process?

Table 8 shows the results on whether AR application increases students' interest in the teaching process. Students stated that they agreed that the application designed with AR technology had a really great effect on students' interest in the teaching process (76%). AR applications support teachers who tend to use this technology in their classrooms to make their students more engaged in the learning process. 19.3% of the students think that it is a tool that can be used, but still need training from the instructors to use it more easily in the lesson. On the other hand, 4.7% of the students think that it does not affect the students.

Table 5. Students' interest on the effects of augmented reality

Answer	**F**	**%**
Yes	114	76.0
No	7	4.7
Maybe	29	19.3
Total	**150**	**100.0**

5.Does using an AR application increase students' performance in the learning process?

Table 9 shows the results on whether using an AR application increase students' performance in the learning process. Students expressed their views and (76%) supported and agreed that this technology can make a positive difference in students' performance in and out of the classroom and have a positive impact on their learning processes. 21.3% of the students think that it can be used, but more instruction should be applied by teachers to guide students. On the other hand, 2.7% of the students think that using an AR application does not increase the performance of students in the learning process.

Table 6. Students' views on the effects of augmented reality

Answer	F	%
Yes	114	76.0
No	4	2.7
Maybe	32	21.3
Total	**150.0**	**100.0**

1.4. Evaluations of the mobile augmented reality application (MAGAU) on the subject content: For this study, we created a mobile AR that can be used in the classroom and outside and can also be used as a teaching tool in the teaching-learning process. The application was evaluated in two parts, the first part was about the subject. The second part was about the design of the application and the evaluation of mobile AR design:

1.Does the Mobile Augmented Reality Anatomy App (MAGAU) help students learn more about anatomy?

Table 10 shows the results on whether the students think that MAGAU help students learn more about anatomy. The students (71.3%) liked the application and saw that the app met the content of the subject. However, some students thought the app would help students partially, but not like traditional books (26%). On the other hand, 2.7% of the students think that it does not help students learn more about anatomy.

Table 7. MAGAU' potential to help students learn more about anatomy

Answer	F	%
Yes	107	71.3
No	4	2.7
Maybe	39	26.0
Total	**150**	**100.0**

2.Does the Mobile Augmented Reality Anatomy Application (MAGAU) provide easy and comfortable use?

Table 11 shows the results on whether the students think that MAGAU also provide easy and comfortable use. Results show that after the students tested the application and used in their phones to learn, they indicated that the app could be used easily (66%). On the other hand, some students thought it would take time to determine its effect (30%). 4% of the students think that the app is not easy to use and comfortable.

Table 11. Easy and comfortable use MAGAU

Answer	F	%
Yes	99	66.0
No	6	4.0
Maybe	45	30.0
Total	**150**	**100.0**

3.Does the Mobile Augmented Reality Anatomy Application (MAGAU) allow students to use anatomy outside the classroom?

Table 12 shows the results on whether the students think that MAGAU allow students to use anatomy outside the classroom. The students (74%) approved that the designed application could be used after the lessons and could be a part of books and traditional materials, and some students (22%) stated that it could be used but still need more development and pedagogical approach. Other students stated that it would not be used after the classroom (4%).

Table 8. The use of MAGAU outside the classroom

Answer	F	%
Yes	111	74.0
No	6	4.0
Maybe	33	22.0
Total	150	100.0

4.Does the Mobile Augmented Reality Anatomy Application (MAGAU) design meet the needs of the students?

Table 13 shows the results on whether student think that MAGAU design meet the needs of the students. The students clearly indicated that MAGAU is helpful for the first year of the anatomy course, and the application help students better understand the learning issues regarding anatomy (60.7%). Most students think MAGAU is very helpful and facilitate the learning process and make students focus and interest very high. 2.7% of the students clearly thought that the app does not meet their needs. 36.7% of the students think that MAGAU can help partly in the learning process, and still need some technical and pedagogical guidance.

Table 9. Meeting the needs of the students in MAGAU

Answer	F	%
Yes	91	60.7
No	4	2.7
Maybe	55	36.7
Total	150	100.0

5.Is the Mobile Augmented Reality Anatomy Application (MAGAU) suitable for delivering educational content?

Table 14 shows the results on whether student think that MAGAU is suitable for delivering educational content. The majority of the students (75.3%) stated that they would definitely show more interest in testing and using the application, and they agreed that it could be an educational tool, while 22% of the students thought it was very useful as an educational tool, but under certain conditions, and 2.7% of the students thought that the students would not use it.

Table 10. Suitability of the MAGAU in terms of delivering educational content

Answer	F	%
Yes	113	75.3
No	4	2.7
Maybe	33	22.0
Total	150	100.0

6.Do you think the use of Mobile Augmented Reality Anatomy Application (MAGAU) will need teacher guidance?

Table 15 shows the results on whether student think that the use of MAGAU need any teacher guidance. The students stated that since the application is a mobile application (50.7%) and do not need any teacher guidance, while 8.7% of the students thought that there must be definitely teacher guidance in the app. Some students are not certain about teacher guidance in the app (40.7%) since they believe some kind of technical assistance would be helpful in the app.

Table 11. Teacher guidance of MAGAU

Answer	F	%
Yes	76	50.7
No	13	8.7
Maybe	61	40.7
Total	150	100.0

1.5. Design considerations of mobile augmented reality Application (MAGAU): In these seven objectives, we tried to evaluate the application design from the perspective of students who can easily use the application, and the design meets the pedagogical learning and teaching structure with 6 questions in the questionnaire:

1.Are you generally satisfied with using the Mobile Augmented Reality Anatomy Application (MAGAU)?

Table 16 shows the results on whether the students are satisfied with using MAGAU. Students expressed their opinions about the feature that allows the user in the application to rotate the model and add movement (62.7%) and hence they are very satisfied, while some students are not satisfied since they think some features are not working as they think (3.3%). Moreover, some student also think that the users must be allowed to change the rotation features in the app (34%).

Table 12. Students' satisfaction in using the MAGAU

Answer	F	%
Yes	94	62.7
No	5	3.3
Maybe	51	34.0
Total	150	100.0

2.Do you find the Mobile Augmented Reality Anatomy Application (MAGAU) unnecessary and complex?

Table 17 shows the results whether students think that MAGAU is complex to use and includes unnecessary information. The students expressed their opinions possitively (60.7%) about the ability to use MAGAU and said that the app is easy to use in terms of selecting 3D models in the application. 16.7% of the studens indicated that the app is very confusing to use, while 22.7% of the students thought that they need guidance and instructions for using the MAGAU.

Table 17. The complexity of MAGAU

Anser	F	%
Yes	25	16.7
No	91	60.7
Maybe	34	22.7
Total	150	100.0

3.Is it possible to quickly access the Mobile Augmented Reality Anatomy Application (MAGAU)?

Table 18 shows the results whether students think that they have easily access to MAGAU application. In this sense, students expressed their opinions positively(58.7%), indicatig that they easily installed the app into their phones. However, 10.0% of the students indicated that quick access is not available and hard to find the app on the phone. Moreover, some students are not certain about accessing the app, since they thought that app is new; hence it takes time to find the app on the phone.

Table 13. Students' opinions about quick access to MAGAU

Answer	F	%
Yes	88	58.7
No	15	10.0
Maybe	47	31.3
Total	150	100

4.Does Mobile Augmented Reality Anatomy App (MAGAU) 3D models load fast?

Table 19 shows the results on whether the students think that MAGAU is fast or not. In this regard, the students expressed their opinioans positively about the speed in the application (60%), while 4% of the students thought that MAGAU is not fast and not loading quickly. Also, some students alos indicated that they encountered minor problems regarding loading and uploading and they said that it depends on memory and brand of the phone (36%).

Table 19. Evaluation of MAGAU in terms of speed

Answer	F	%
Yes	90	60.0
No	6	4.0
Maybe	54	36.0
Total	150	100.0

5.Does the Mobile Augmented Reality Anatomy Application (MAGAU) have a user-friendly interface design?

Table 20 shows the results on whether students think that interface design of MAGAU is user-friendly or not**.** 60.7% of the students stated that they thought the interface design was friendly and easy to use, while 8% of the students thought it was difficult to use MAGAU. Also, 31.3% of the students are not certaion about whether interface design of MAGAU is user friendly or not.

Table 14. Evaluation of MAGAU in terms of interface design

Answer	F	%
Yes	91	60.7
No	12	8.0
Maybe	47	31.3
Total	150	100.0

6.Is the information about the 3D models of the Mobile Augmented Reality Anatomy Application (MAGAU) effective and understandable?

Table 21 shows the results on whether MAGAU is effective and understandable. Students stated that the application was effective and they liked the MAGAU as 3D models in English, while 2.7% of the students thought they did not like the MAGAU. Some students also are not certain about the effectiveness of the application. They indicated that it would be difficult to learn with MAGAU (23.3%).

Table 15: Effectiveness of MAGAU application

Answer	**F**	**%**
Yes	111	74.0
No	4	2.7
Maybe	35	23.3
Total	150	100.0

1.6. Suggestions for using the (MAGAU) app for classroom teaching and learning needs: These sub-goals focus on student suggestions and current and future perspectives on this technology in the two questions included in the questionnaire:

1.Would you recommend using the Mobile Augmented Reality Anatomy Application (MAGAU) as teaching material?

Table 22 shows the results on whether students recommend MAGAU as a teaching material. Students stated that they mostly recommend using mobile application (MAGAU) (78%). On the other hand, 2% of the students do not suggest using MAGAU as educational tools and as a part of the learning-teaching process. 20% of the students consider using MAGAU if there were necessary materials and fitted learning-teaching environment.

Table 16. Recommendation of MAGAU as a teaching material

Answer	**F**	**%**
Yes	117	78.0
No	3	2.0
Maybe	30	20.0
Total	150	100.0

2.Would you like the Mobile Augmented Reality application to be developed for other courses (MAGAU)?

Table 23 shows the results on whether MAGAU might be used for other courses. Table 23 shows that students approved (79.3%) their views on suggesting that the application be used as an educational tool and improved accordingly. 18.7% of the students are not sure about whether MAGAU might be used as an educational tool by developing it, while (2%) disagred that the application can help in other courses.

Table 17. MAGAU' potential use for other courses

Answer	**F**	**%**
Yes	119	79.3
No	3	2.0
Maybe	28	18.7
Toplam	**150**	**100.0**

CONCLUSION AND RECOMMENDATIONS

As we have seen the effects of AR technology in different areas, as stated in the literature review section, education experts have also started to focus on the effects of technology in education, and the reason for the spread of these studies is that the students experience educational materials and the images and models in health education are augmented reality that provides both fun and permanence in learning. This study is based on a mobile augmented reality application (MAGAU) to determine the power of technology to be used as part of the learning and teaching process. their use of this technology and their perspectives were tried to be determined. According to the results of the analysis, the overall outlook showed a positive outlook, but we will try to evaluate it according to the aims of the study:

• *What is the use of Augmented Reality in the field of education?*

The overall result was that the students were not that familiar with augmented reality, we measured the result with two questions and because of the use of social media and video, the students were aware of it, but they did not use it in their studies.

• *What are the materials used in the health education process?*

Students stated that they use different materials with traditional materials such as books and notebooks, video and mobile phones, and most of the students use mobile phones. reading or memorizing in schools, which makes it easy to apply mobile learning to the curriculum of students' work.

• *What are the students' views on the effects of augmented reality applications in health education on the learning process?*

The students stated that they experienced their views positively and that they thought that using this technology would have a positive effect on their learning processes, and that they wanted to use it in different fields and courses, especially in higher education.

• *What are the evaluations of the mobile augmented reality application (MAGAU) regarding the subject content?*

The application designed for this study was designed to meet all the pedagogical needs of the students and their perspectives were positive, the students stated how easy it was to use and set up the program, and they accepted the designed application, but some students expressed their opinions on this subject. Since the app (MAGAU) is designed for anatomy class, it should be with more models and information in the future.

• *What are the evaluations of mobile augmented reality Applications (MAGAU) in design?*

Application designed for an anatomy course (MAGAU) students stated that they have a positive attitude towards the application design, the application interface is for educational purposes and the design meets all the requirements and can be used easily, positively affecting their studies and education. The design is easy and simple to use.

• *What are your suggestions for using the (MAGAU) application for classroom teaching and learning needs?*

The students made many suggestions, suggested that the application be used in learning materials as an educational tool, suggested that more applications should be developed for other lessons, and that the application designed in this study should be used in classrooms to increase the interaction of students. As a result, as seen in the survey results, the students expressed their opinions as follows:

Making Lessons More Responsive: The main purpose of using technology in education is to make lessons more interesting and increase students' interest and interest, AR technology helps teachers achieve more than that, lecturers quickly attract students' attention. (Serin, 2020). It also increases levels of interaction Brings unique topics like anatomy to life, builds hypotheses and coherent thinking, and makes learning more engaging than ever before. In this way, students can learn through experiential learning by trying several cycles to discover the most perfect and foremost suitable combinations.

Collaboration with students: When using AR technology, the classroom is filled with fun and lessons become more challenging and students are locked into learning through this technology. Augmented reality in teaching has been shown to advance teacher-student collaboration in classrooms (Weking & Santoso, 2020).

Making the Leading Innovation: Currently teachers can use AR technology and create lessons in a more engaging way, being unfamiliar with new developments and advancements is not regulation, or perhaps educators and teachers need to learn how to work and use it. AR technology applications to follow the trail of the modern student, it takes a few seconds to scan the images in the books and display them in 3D or 2D format, use this content to grab the attention of the students with the help of simulations keep them locked up and let them know until they are fully mastered (Taçgin & Tacgin, 2020).

Using Innovation for Assessment: Assessment can be fun, teachers can use augmented reality in teaching and do that too, students can use these apps to bolt on their answers Another interesting way to create an energizing assessment method is to use puzzles and quizzes this may not work for every point, history, biology or ponder on topics such as learning mathematical equations (Serin, 2020).

It is estimated that there will be 2.4 billion users for mobile augmented reality by 2023, as augmented reality benefits the in-game world and its use in education areas increases. As a result of developments, augmented reality can replace reading materials, white papers and printed brochures. With this mobile learning model, it makes it easy for everyone to access learning materials. The gamification of augmented reality can make students' mental states more positive with the educational environment. It makes learning curious, fun, easy, develops collaboration and skills.

Scope for Further Research: The scope of the study is limited to the number of participants and demographic characteristics. In further studies, research can be conducted with more participants.

Ethics and Consent: Ethics committee approval for this study was received from the Ethics Committee of Gazi University (Date: January 20, 2022; Approval Number: 2022/018).

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Research Paper

A Novel Approach to Identify Difficult Words in English to Promote Vocabulary Acquisition of Children Dually Diagnosed with Autism Spectrum Disorder and Hearing Loss

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ABSTRACT

Usage of complex words causes significant problems not only in reading but in writing as well and eventually leads to poor academic achievement of students, poorer particularly for hearing impaired children. The dual diagnosis of Autism Spectrum Disorder (ASD) and hearing impairment pose additional challenges mainly due to the difficulties that come with making accurate decisions. Hence, parents must be provided with the information about the signs and symptoms of ASD and deafness or partial hearing loss, as well as appropriate intervention strategies. Although different learning activities can be used to enlarge such children's vocabulary, if the presented words are difficult to learn, it will be very hard to realize this. Identifying difficult words and replacing them with simple ones both make the readability of a text easier and help such children enhance their vocabulary knowledge in a shorter period of time. Therefore, in this study we propose a classification approach that identifies difficult words among a given set of words in English. The lexical and semantic features of the words in the dataset were extracted based on the language rules specific to hearing impaired children. In the classification approach, five popular classification algorithms were used and the algorithms' performance in identifying difficult words was evaluated using various performance metrics. As the results show, the K-Nearest Neighbors algorithm is the most suitable algorithm for identifying difficult words in English for the target group.

INTRODUCTION

Children with Autism Spectrum Disorder (ASD) have impairments in social and communication skills. ASD can be diagnosed using specific tests but the diagnosis can only be confirmed by a clinician or professional (Phillips et al., 2021). The Autism Diagnostic Observation Schedule is one of the tests used in the diagnosis of ASD. For children with hearing impairment, the test can be adapted by using sign language. On the other hand, another ASD diagnostic test, the Autism Diagnostic Interview-Revised (ADI-R), could be adapted with some visual tools to help determine whether a child has ASD, hearing loss, or both (McTee et al., 2019).

Children with ASD often have additional diagnoses (Szymanski & Brice, 2008). It is known that hearing impairment existence among children with ASD is higher compared to typically developing children (Trudeau et al., 2021). Children with hearing impairment isolate themselves socially because of the communication related difficulties they experience (VanDam & Yoshinaga-Itano, 2019). They also have difficulties in communicating with gestures and expressing their feelings through facial expressions (VanDam & Yoshinaga-Itano, 2019). Hearing difficulties and ASD often overlap, which make autism traits worse and diagnoses more complicated (Myck-Wayne, Robinson, & Henson, 2011). Children with ASD have tremendous demands from their families and this may make hearing loss go unnoticed (Myck-Wayne, Robinson, & Henson, 2011). Because not reacting to noises, speech delay and problems, consistently repeated words, behavioral problems, having trouble communicating, lack of attention, lack of eye contact and clumsiness are common signs and symptoms of hearing loss and they may be understood as being symptoms of ASD (VanDam & Yoshinaga-Itano, 2019). Therefore, at an early age, listening and communication skills of children must be evaluated so that signs of hearing loss and ASD can be identified (Trudeau et al., 2021). Then, if needed, appropriate intervention can be initiated as soon as possible in order to relieve parents of a massive challenge (Wiley, Gustafson, & Rozniak, 2014).

Individuals with hearing impairment generally experience a great deal of difficulty in acquiring spoken languages contrary to their natural acquisition of signed languages (Berent, 2001). Due to not being able to have full access to the sounds and intonations of a spoken language, individuals with hearing impairment have a significant difficulty in the spoken language acquisition processes and even if they succeed in acquiring the spoken language, the process occurs at a considerably slower rate compared to normally hearing individuals (Quigley & King, 1980). Therefore, most individuals with hearing impairment do not accomplish full acquisition of a spoken language and have constant difficulties in written expression and reading comprehension (Berent, 2001).

Sentences are made by the combination of simple words, complex words or both. If a text consists of many complex words, it becomes a difficult one which leads to problems not only in writing but in reading as well. Compared to their normal hearing peers, such texts are more difficult for children with hearing impairment to learn and understand. Using different activities and flash cards,

speech language therapists, their parents and teachers help children with hearing impairment learn new words and enlarge vocabulary. Nevertheless, if words in a text are difficult to learn, to develop understanding of the word in children's mental lexicon will still be considerably difficult. In English, the grammatical order of words is known as Subject, Verb, and Object. On the other hand, children with hearing impairment as English learners do not follow this order (Berent, 2001). As a consequence, when they are asked to read and write, it becomes a serious challenge for them. Therefore, significant time and effort from parents, teachers and speech language therapists are required to address all these difficulties.

In this paper, we propose a novel approach to identify difficult words among a given set of words in English so that difficult words in a text can be replaced with easier ones and this way that activities to promote vocabulary acquisition can be coordinated better. In the dataset (Ansar, Qamar, Bibi, & Shaheen, 2019) we used for classification study, the lexical and semantic features of the words are based on the language rules specific to children with hearing impairment. The rest of this paper is as follows. The next section provides information about our approach proposed for pre-intervention phase carried out for children with hearing impairment. The third section presents the results of our classification study. Finally, the paper is concluded in the fourth section.

Dataset and Novel Approach for Pre-Intervention Phase

Dataset

The dataset used in the study was taken from the study carried out by Ansar, Qamar, Bibi, and Shaheen (2019). The dataset consists of 1000 words: a total of 600 words as the training set and a total of 400 words as the test set. It was collected from the English textbooks and online sources being taught at elementary and secondary level schools established specifically for children with hearing impairment. Before building the dataset, unstructured data was first reviewed by a group of experts and then preprocessed. This way, the generation of linguistic rules that helps to label a particular word as difficult or not difficult accurately was possible. The rows in the dataset were reviewed by the experts and a word was accepted as difficult if 2 or more experts decided that it was difficult (Ansar, Qamar, Bibi, & Shaheen (2019). The features that make a word difficult are listed in Table 1.

Table 1. Features that make a word difficult (adapted from (Ansar, Qamar, Bibi, & Shaheen, 2019))

Features of Words	Characteristics
Character count	Increasing the number of characters in a word makes the word more difficult.
Syllable count	Increasing the number of syllables in a word makes the word more difficult.
Part of speech tags	Compared to adjectives and verbs, nouns are easier to learn. Adverbs are the most difficult since they describe an abstract idea. Children with hearing impairment can learn concrete words easier than abstract words.
Presence of ch, st, th, f, or sh	If ch, st, th, f, or sh is present in a word, the word is considered difficult. Because ch, st, th, f, and sh can produce high-frequency sounds during pronunciation.
Presence of c or k	Depending on context, pronunciation of c and k are different or the same. This makes it difficult for children with hearing impairment to recognize during writing or reading, what to read.
Presence of g or j	Depending on context, pronunciation of g and j are different or the same. This makes it difficult for children with hearing impairment to recognize during writing or reading, what to read.
Frequency of occurrence	If a word appears in a text less frequently, it is deemed as difficult otherwise easy.

Classification Algorithms

The following list briefly describes classification algorithms used in this study. The reason for preferring these algorithms is that their working principles are different from each other, except for Support Vector Machine and Sequential Minimal Optimization algorithms.

- K-Nearest Neighbors (KNN): It is a supervised learning algorithm and mostly used for classification and sometimes for regression. As its name suggests that it considers *k* nearest neighbors (data points) to predict the class or continuous value for the new data point (Ma, Du, & Cao, 2020). It finds the nearest neighbors in a dataset by using distance metrics in order to realize classification and its success generally depends on the distance metrics preferred in the study and the number of neighbors represented by *k* (Jiang, Pang, Wu, & Kuang, 2012; Xia et al., 2015).
- Naive Bayes (NB): It is a probabilistic classification method based on the well-known Bayes' theorem. It calculates the probability that a new data belongs to any of the existing classes using the classified sample data. The class with the highest probability among the values found is accepted as the class to which the sample belongs (Bermejo, Gámez, & Puerta, 2011).
- Linear Discriminant Analysis (LDA): It was first developed by R. A. Fisher for binary classifications in 1936 (Cohen, Cohen, West, & Aiken, 2002). It was later generalized by Rao (1948). In discriminant analysis, discriminant functions allow distinguishing classes from each other and this way it is decided which class the new sample should be included in (McLachlan, 1992). The LDA finds a linear combination of features that characterizes or separates two or more classes of

objects or events (Han et al., 2020). Although the resulting combination may be used as a linear classifier, the LDA is typically used for dimensionality reduction before later classification (Li et al., 2021).

- Support Vector Machine (SVM): In this algorithm, each data item is plotted as a point in the n-dimensional space (where *n* is the number of features) with the value of each feature being the value of a particular coordinate. Next, the classification is performed by finding the hyperplane that distinguishes quite well from the two classes. In this regard, support vectors are just the coordinates of the observation. Therefore, the SVM is just a boundary that best separates the two classes (Cortes & Vapnik, 1995).
- Sequential Minimal Optimization (SMO): It is an algorithm for solving the quadratic programming (QP) problem that arises during the training of SVMs without the need for any extra matrix storage and numerical QP optimization steps (Platt, 1998). At each step, the SMO selects two Lagrange multipliers to jointly optimize, finds optimal values for these factors, and updates the SVM to reflect the new optimal values (Platt, 1998).

Metrics

Depending on the success of predictions, related values are presented in a confusion matrix as shown in Figure 1. These values are grouped in four groups. In this study, these four groups have the following meanings.

- True Positive (TP): If the algorithm used predicts an easy word as an easy word.
- True Negative (TN): If the algorithm used predicts a difficult word as a difficult word.
- False Positive (FP): If the algorithm used predicts a difficult word as an easy word.
- False Negative (FN): If the algorithm used predicts an easy word as a difficult word.

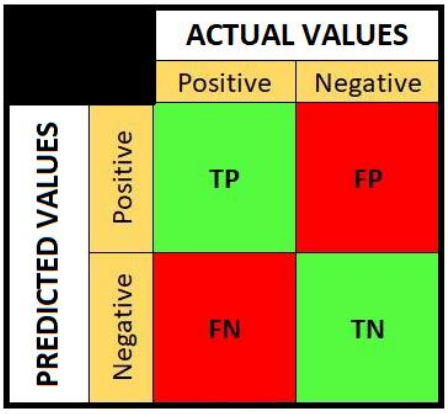

Figure 1. Confusion matrix

Basic metrics commonly used in classification studies are listed in Table 2. As explained in Table 2, while accuracy considers all correct and incorrect predictions, other metrics focus on different aspects of classification. While recall is the answer to the question of how many TPs are correctly identified, precision shows how many of the values predicted as positive are actually positive (Tharwat, 2021). Except for the ones listed in Table 2, Cohen's Kappa coefficient (abbreviated as Kappa), Root Mean Square Error (RMSE) and Area Under the Curve (AUC) are used in this study. Receiver Operating Characteristic (ROC) curve is a probability curve, while AUC represents the decomposable measure or degree of parameters. A ROC curve makes it possible to visualize to what extent the classes for which the model results are to be predicted differ (Bradley, 1997; Martínez-Camblor, Pérez-Fernández, & Díaz-Coto, 2021). A high AUC score indicates good separation between classes (easy word, difficult word). The Kappa statistic represents the extent to which the data collected are correct representations of the variables measured (McHugh, 2012). Finally, RMSE is a measure of accuracy and allows comparing prediction errors of different models for a particular dataset (Hyndman & Koehler, 2006).

Table 2. Basic metrics commonly used in classification studies

Metric	Interpretation	Formula
Accuracy	It indicates the overall performance of a classifier.	(TP+TN)/(TP+TN+FP+FN)
Precision	It indicates how accurate the positive predictions are.	TP/(TP+FP)
Recall	It indicates the coverage of actual positive samples.	TP/(TP+FN)
Specificity	It indicates the coverage of actual negative samples.	TN/(TN+FP)
F-measure	It is a hybrid metric particularly suitable for imbalanced datasets.	2TP/(2TP+FP+FN)

Classification Results and Analysis

The flowchart of the proposed approach is shown in Figure 2. The dataset used in this study, in which the training and test sets are found, consists of 1000 words. In this dataset, 520 of the words are easy words and 480 of them are difficult words. In this study, different from the previous study that used the same dataset (Ansar, Qamar, Bibi, & Shaheen (2019), the training and test sets were combined and cross validation was applied. Thus, it was possible to test all the words.

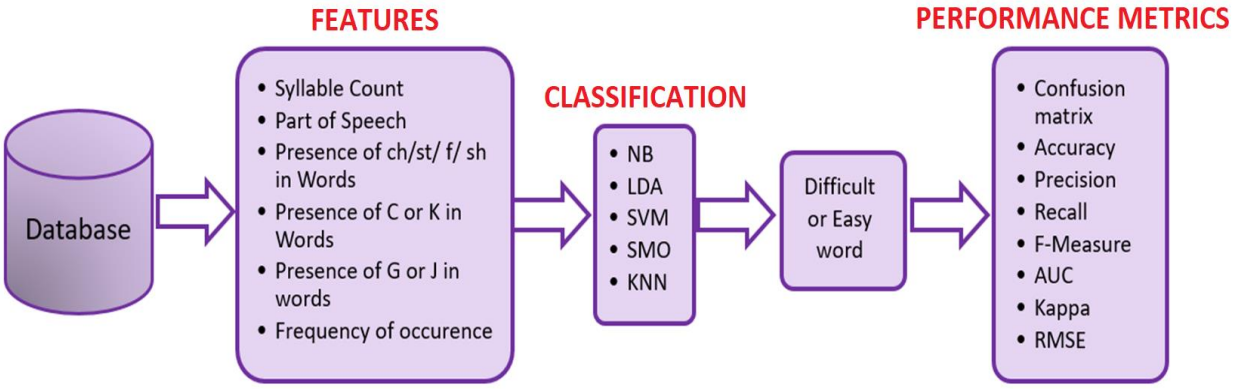

Figure 2. Flowchart of the proposed approach

Confusion matrices consisting of information about the number of words that the classification algorithms predicted correctly and incorrectly are given in Figure 3. In addition, the number of correctly and incorrectly predicted words belonging to each algorithm is given in Figure 4. As it can be seen in Figure 4, the KNN and SVM algorithms were the most successful ones in predicting the words correctly, and the LDA showed the worst performance in classifying the words. In the confusion matrices, the parts indicated in green are TP and TN values. These are the number of words that the algorithms predicted correctly. As it can be seen in the confusion matrices, the NB algorithm predicted 463 of 520 easy words correctly and 57 of them incorrectly. While identifying 480 difficult words, the NB algorithm classified 30 difficult words as easy words. The KNN correctly predicted the highest number of difficult words and the highest number of easy words. Therefore, it had the best performance. Compared to the others, the LDA correctly predicted the least number of difficult words and the least number of easy words. While calculating the performance metrics of the algorithms, precision, recall, F-measure and AUC values were calculated separately in order to examine their performance in predicting both easy words and difficult words. The performance metrics are given in Figure 5.

Naive Bayes				
	Predicted class			
Actual Class		Easy	Difficult	Total
	Easy	TP=463	FN=57	520
	Difficult	FP=30	TN=450	480
	Total	493	507	1000
LDA				
	Predicted class			
Actual Class		Easy	Difficult	Total
	Easy	TP=460	FN=60	520
	Difficult	FP=39	TN=441	480
	Total	499	501	1000
SVM				
	Predicted class			
Actual Class		Easy	Difficult	Total
	Easy	TP=497	FN=23	520
	Difficult	FP=30	TN=450	480
	Total	527	473	1000
SMO				
	Predicted class			
Actual Class		Easy	Difficult	Total
	Easy	TP=469	FN=51	520
	Difficult	FP=36	TN=444	480
	Total	505	495	1000
KNN				
	Predicted class			
Actual Class		Easy	Difficult	Total
	Easy	TP=501	F=19	520
	Difficult	FP=28	TN=452	480
	Total	529	471	1000

Figure 3. Confusion matrices that show the prediction power of the classification algorithms used in this study

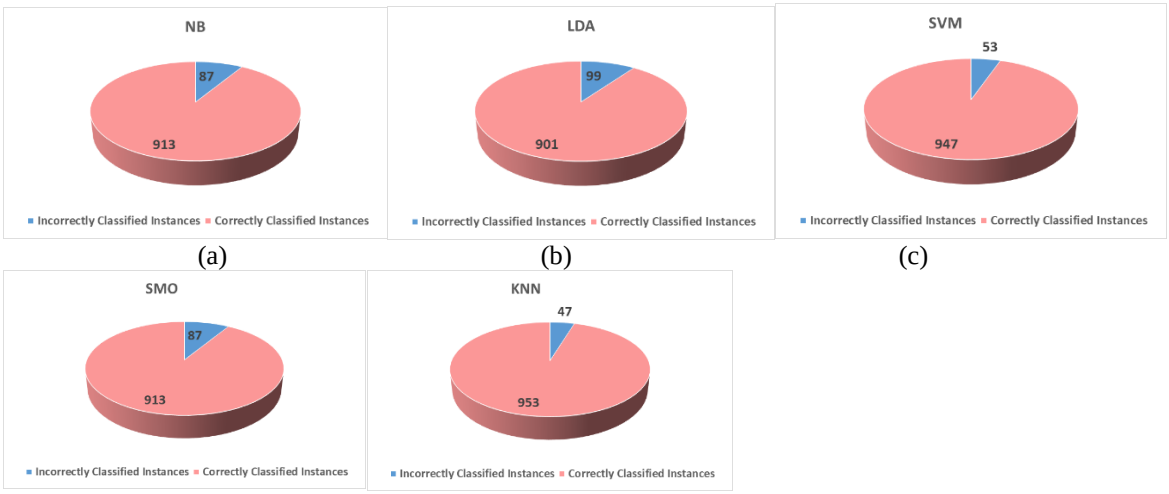

Figure 4. Number of correctly or incorrectly classified words: (a) NB, b) LDA, c) SVM, d) SMO, e) KNN

Figure 5. Performance metrics of the classifiers used in this study: a) Precision, b) Recall, c) F-Measure, d) AUC, e) Kappa, f) RMSE, g) Accuracy (%)

As shown in Figure 5, the highest Precision and Recall values were achieved by the KNN algorithm, followed by the SVM algorithm. On the other hand, the lowest Precision and Recall values were achieved by the LDA algorithm. Since the KNN algorithm achieved the highest AUC value, it can be seen as the best algorithm when the differentiation performances of all the algorithms were considered. When the Kappa values of all the algorithms were considered, it can be seen that the KNN algorithm achieved the highest value and the LDA algorithm achieved the lowest value. RMSE is checked to understand how much error has been generated when a prediction has been realized. The KNN algorithm achieved the lowest RMSE and the SMO algorithm achieved the highest RMSE. The KNN achieved the highest F-Measure values, too. Finally, the highest accuracy was achieved by the KNN algorithm and the lowest accuracy was achieved by the LDA algorithm. The overall results confirm the success of the KNN algorithm over the others. Compared to an accuracy of 92% achieved by the C4.5 algorithm (Quinlan, 1993) in (Ansar, Qamar, Bibi, & Shaheen, 2019), in this study both the KNN and SVM algorithms achieved slightly higher accuracy rates. However, this may be a consequence of the fact that the dataset was used in this study in a different way.

CONCLUSION

ASD interferes with an individual's communication and socialization skills. Although ASD is not curable, various therapies can help children with ASD, especially medium to high-functioning ones, to live independently. As the literature shows, children with hearing impairment have higher chances of having ASD; therefore, hearing impairment needs to be identified at an early age. This way a timely diagnosis of ASD can be realized and then timely intervention can be ensured because hearing impairment can interfere negatively with children's development in terms of social, communication and language skills. It is known that complex words are both difficult to be read and written. The use of complex words makes it harder for hearing impaired children to read and understand. Therefore, such difficult words must be identified and be replaced with simple ones so that such children can read and understand more easily and enhance their vocabulary knowledge in a shorter period of time.

In this study a classification approach was proposed to identify difficult words among a given set of words in English. The classification approach is based on the language rules specific to hearing impaired children. A dataset consisting of 1000 words, 520 easy words and 480 difficult words, was used and different from the previous studies, the training and test sets were combined and cross validation was applied. In this way all the words were tested. To make a fair comparison five different classification algorithms were chosen and their performances were analyzed based on the well-known performance metrics. As the results proved, the KNN algorithm had the best performance in identifying difficult words in English. Future work of this study consists of developing a mobile application that analyzes a document to decide whether it is suitable for being used for children dually diagnosed with ASD and hearing loss and making word appropriate replacements in the document to make it more suitable if needed. It is believed that such an application will probably be helpful for parents to decide which materials are more suitable for their children or need to be revised.

Ethics and Consent: This article does not contain any studies involving human participants performed by any of the authors.

Conflicts of Interest and Authorship: No conflicts of interest and authorship to declare.

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Research Paper

Learners' Perceptions Towards Dual-Coding in Adaptive Hypermedia Environments: Listening Texts, Keywords and Visuals

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ABSTRACT

In this study, 56 participants' (N= 56) perceptions towards dual coding in design of audio-only listening texts (i.e. re-provision of the same audio-only listening texts in the form of audio-only listening texts + keywords or supplementary contextual visuals + keywords at non-initial phases of the while listening stage) in a hypermedia listening application for foreign language learning (FLL) were investigated. The study also investigated whether there were any differences between the participants' perceptions in terms of gender, age, job and FLL period. The study was both quantitative and qualitative in nature. The results of the study were analysed with SPSS (i.e. Mean, Std. Deviation, Independent Samples t Test, ANOVA, Pearson Correlation test, Chi-square). The results revealed that the language learners (LLs) were overwhelmingly in favour of the use of the dual coding in design of audio-only listening texts (i.e. re-provision of the same audio-only listening texts in the form of audio-only listening texts + keywords or supplementary contextual visuals + keywords at non-initial phases of while listening stage) in a hypermedia listening application for FLL. The majority of the LLs believed that not only did such a design benefit them in different ways, but it also contributed to the enhancement of their learning. The participants also felt that such a design could and should have been further improved. Moreover, the results revealed that there were significant differences between the participants' perceptions towards the re-provision of the same audio-only listening texts with keywords, and (supplementary contextual) visuals + keywords.

INTRODUCTION

The outstanding differences between adaptive hypermedia environments (HEs) and conventional materials (CMs), and the positive aspects of the former are already documented very well in a wide range of pertinent studies (Abobaker & Hussein, 2012; Baturay et al., 2010; Cárdenas-Claros, 2021; Chou, 2012; Mosalanejad et al., 2012; Turel, 2011, 2015a, 2015b, 2016, 2018; Yu et al., 2010). In this research article, initially the positive aspects of HEs are briefly examined in terms of foreign language learning (FLL) hypotheses and theories.

It is the availability, combination and personalised simultaneous delivery of a wide range of digital elements on the same digital computer platform that make adaptable HEs more efficient (Turel, 2021a, 2021b; Herron et al., 2002; Ridgway, 2000). In other words, adaptable HEs provide multidimensional, multi-sensory learning environments in which personalised rich, efficient, instant, comprehensible, optimum and meaningful input and feedback can be presented on the same digital platform (Turel, 2021a, 2021b, 2018, 2016; Cárdenas-Claros, 2021, 2009;). In HEs, language learners' (LLs) attention can be attracted to adaptive and combined forms, and meaning in input. Such a pedagogically rich availability and an efficient design correspond with different pedagogical principles, instructional design models (e.g. Turel, 2021c), relevant hypothesis and theories such as the comprehensible input hypothesis and theory (Tschirner 2001, p.311; Schmidt, 1990, p.139), the dual-coding theory, the generative theory of multimedia (Ginther, 2002; Mayer, 1997), the noticing hypothesis (Nicholas et al. 2001, p.721; Schmidt 1990, p.141), and the redundancy hypothesis (Al-Seghayer, 2001; Sherwood et al., 1987).

Adaptive HEs give learners flexible control, ease of personalised use, and a navigational and tension-free learning environment particularly during self-study. This is a requirement of both person perception theory and social learning theory (Robinson, 1991, p.157). Adaptive HEs also provide the opportunity for the learners to produce immediate, multidimensional and multi-sensory output (Turel, 2018, 2015a; Türel, 2012), which is a requirement for comprehensible output. Enabling LLs to produce comprehensible output can promote noticing and contribute to FLL through 'hypothesis testing'. Such opportunities can serve as a metalinguistic function (i.e. the ability/opportunity to think about and analyse the produced forms and structures) (Shehadeh, 2002, p.608; Tschirmer, 2001, p.311), as well.

Such positive aspects of adaptive HEs motivate learners and are appreciated by them (Turel, 2018, 2010), are praised (Herron et al., 2002) and considered 'very helpful' (Tschirmer, 2001, pp.312-3). The mentioned positive aspects are also a requirement of the social-psychological theory and the socio-educational model, both of which focus on the role of attitudes and motivation in FLL (Gardner, 1985, p.158).

Optimum and personalised input in different forms (i.e. glossaries, feedback, audio-only listening texts + keywords, audio-only listening texts + visuals + key words, audio-only listening texts + captions and so on) grant interactivity. LLs can access such useful features in adaptive HEs without losing time. For example, unfamiliar syntax, lexis, listening texts and feedback can be explained or given through hyperlinks and/or optimum combinations (De Ridder, 2002). Such a provision meets both visual and acoustic needs of LLs. It can also help LLs to find out what and why they cannot understand, and overcome the complications (Turel, 2012).

Cultural differences featured in the listening texts can be presented in plain words and through simple interactive and adaptive samples, contextual visuals or video clips in the form of annotations, feedback or advance organisers (Turel, 2014a; Turel & McKenna, 2013). This is a requirement of the socio-cultural theory. This theory focuses on and emphasises the importance of culture in FLL (Platt & Brooks, 2002, p.369; Vygotsky, 1978).

The above mentioned positive aspects of adaptive HEs help LLs to develop effective strategies, contribute in terms of comprehension and retention of the listening texts (Türel, 2012; Moreno & Mayer, 2002; Mangiafico, 1996). Such positive functions make more real-world learning contexts and more authentic and interactive tasks available (Ashworth, 1996).

To be able to design listening input effectively and efficiently in adaptive HEs, we are required to bear in mind the requirements of a wide range of instructional design models (Turel 2021c; Gardner, 1985), theories and hypothesis such as dual-coding theory (Paivio, 2006, pp. 82-86), the generative theory of multimedia (Ginther, 2002; Mayer, 1997), the redundancy hypothesis (Al-Seghayer, 2001; Sherwood et al., 1987), the comprehensible input hypothesis and theory (Tschirmer 2001, p.311; Schmidt, 1990, p.139), working memory and the noticing hypothesis. It is argued that materials designers and developers must provide learners of any subject with the opportunities to have direct experience with things, as "things are essential, words only accidental; things are the body, words but the garment; things are the kernel, words the shell and husk. Both should be presented to the intellect at the same time, but particularly the things, since they are as much objects of understanding as is language" (Comenius, 1896 translation, p. 267; cited in Piaget, 1993).

So far studies (e.g. Cárdenas-Claros, 2021; Paivio, 2006, pp. 82-86; Ginther, 2002; Mayer, 1997; Al-Seghayer, 2001; Sherwood et al., 1987; Tschirmer 2001, p.311; Schmidt, 1990, p.139; Sherwood et al., 1987; Tschirmer 2001, p.311; Richardson, 2003; Purnell & Solman 1991; Chun & Plass, 1996, 1997; Lomicka, 1998) continue to favour dual coding and require us to design listening texts efficiently and effectively in adaptive HEs.

Thus, giving language learners the opportunity to re-listen to/re-view the same *audio-only listening texts* in the form of *audio-only listening texts + keywords* or *audio-only listening texts +* (supplementary contextual) *visuals + keywords* at the non-initial listening in HEs can be more effective in promoting comprehension and recall of instructional texts (i.e. listening texts, pronunciation, lexis and syntax). Such a provision can enhance LLs' acquisition (Thompson & Paivio, 1994).

In this study, therefore, the target LLs were exposed to multiple forms of the same *audio-only listening texts* (i.e. *audio-only listening texts* at the first phase of listening, and *audio-only listening texts + keywords* or *audio-only listening texts +* (supplementary contextual) *visuals + keywords* at the non-initial listening stages) as an aid to help them to comprehend and acquire the instructional texts.

Providing the same *audio-only listening texts* in different / multiple forms (i.e. *audio-only listening texts + keywords* or *audio-only listening texts +* (supplementary contextual) *visuals + keywords*) in adaptive HEs delivers LLs with the opportunity to repeat the same *audio-only listening texts* in different forms. Not only does repetitions in different forms makes learning process less boring and motivate learners (i.e. contributing to dynamism), but repetitions of the same *audio-only listening texts* in different forms result in better recollection (Tyler et al., 1979; Xue et al., 2010), as repetitions require more effort. Thus, the research questions of this study are:

1. What are the participants' general perceptions of re-listening to/re-viewing the same *audio-only listening texts* with *keywords* or (supplementary contextual) *visuals + keywords* at the non-initial phases of the while-listening stage in adaptive HEs for FLL?
2. Are there any differences between the participants' perceptions in terms of their personal characteristics (i.e. gender, age-group, third language, language learning period, level in English, level in listening, level in computing, feeling confident while learning English etc.) as well as between their perceptions towards dual coding (i.e. *audio-only listening texts* with *keywords* or supplementary contextual *visuals + keywords*) in design of the *audio-only listening texts* in adaptive HEs for FLL?

The aim of the study

This study aimed to find out how the participants of this study valued (a) the provision of *keywords* or (supplementary contextual) *visuals + keywords* with the same *audio-only listening texts* at the non-initial phases of the while-listening stage in adaptive HEs for FLL. The study also intended to find out (b) whether there were any differences between the participants' perceptions in terms of gender, age, job and FLL period as well as between their perceptions towards dual coding in design of *audio-only listening texts* in adaptive HEs for FLL. The nature of the study is emphasised below in 'the procedure' section.

METHODOLOGY

Research Design

Quantitative and qualitative researches were used (Tseng & Yeh, 2013; Masgoret & Gardner, 2003). The research questions required the use of questionnaires, and interviews in the form of open-ended questions (Tseng & Yeh, 2013; Nunan, 1993). For the participants' profiles questionnaire, Brett's data collecting procedures (1999) were used, although new items were added and the existing ones were further improved and tested. Data collecting questionnaires regarding the participants' perceptions of re-listening to/re-viewing the same *audio-only listening texts* with *keywords* or (supplementary contextual) visuals + *keywords* at the non-initial phases of the while listening stage in adaptive HEs for FLL were prepared and pilot tested by the author of this study. Their Cronbach's Alpha is below.

The participants' pre-exposure characteristics questionnaire consisted of 10 general items such as occupation, gender, age, other languages, English learning period etc. and 13 Likert scale items such as 'feeling' and 'how often' questions. The questionnaire about the provision of the same *audio-only listening texts* with *keywords* ($\alpha = .832$) included 11 Likert scale items from strongly disagree to strongly agree. The questionnaire about the provision of the same *audio-only listening texts* with (supplementary contextual) *visuals* + *keywords* ($\alpha = .904$) included 11 Likert scale items from strongly disagree to strongly agree. Cronbach's Alpha of both combined (22 Likert scale items from strongly disagree to strongly agree) is $\alpha = .927$. All items also featured multiple measures of similar attitudes so that inaccurate answers could be guarded against.

Fifty-six participants answered the questionnaires about the re-provision of the same *audio-only listening texts* with *keywords* or (supplementary contextual) visuals + *keywords* at the non-initial phases of the while-listening stage in adaptive HEs for FLL. This was immediately after using the hypermedia listening software. Majority of the participants (i.e. fifty-four participants, which is given in the 'findings' section below) answered the open-ended questions, while some gave long and detailed answers; the others preferred short answers, which is understandable. Answering the open-ended questions required more time and effort in comparison to ticking one or a few available options out of a group of options. Thus, it is believed that this was the reason why not all of the participants answered the open-ended questions. Both quantitative and qualitative data collection was anonymous. The collected data were not shared with anyone who knew the participants. Furthermore, the qualitative data were analysed by three different researchers to avoid subjective interpretation and were categorised according to categories that were extracted from the data itself and then applied.

The participants

The participants of this study were 56 non-native speakers (37.5% male, 58.9% female, 3.6% no-answer). Their level in listening was intermediate (i.e. pre-intermediate: 28.6%, intermediate: 53.6%, upper-intermediate: 17.9). All of the participants were undergraduate students. They were computer literate (i.e. Level 1- Basic User: 17.9, Level 2: 10.7, Level 3: 26.8, Level 4: 23.2, Level 5 – Proficient user: 5.4). They were learning English as a foreign language. Their age-range was: 20 and below age-group: 41.1%, 21-25 age-group: 53.6%, 26-30 age-group: 3.6%, and 31 and above age-group: 1.8%. Majority never used any FLL software before (No - never used: 82.1, Yes: 16.1, and no-answer: 1.8).

The hypermedia listening application

The hypermedia listening application was designed and developed by the author of this study. The listening application was the right level for the target LLs (i.e. intermediate). The listening application aimed to develop and practise the participants' listening skills and to improve their listening-development as a part of FLL. To succeed this target, a wide range of gradual tasks were provided to help the participants in practising and developing their acoustic and visual channels, receptive and productive skills. The target participants were instructed (a) at what stage of listening what kind of strategies they needed to follow and what they needed to do, (b) how they could improve and develop their listening and listening-skills, and (c) why they needed to study in the instructed ways. While improving their listening skills and development, the hypermedia listening application also aimed to help the participants to become familiar with the target culture, different accents, authentic language and its features such as intonation and stress, fillers, false starts, grammatical mistakes and so on. The hypermedia listening application was also expected to improve the target LLs' vocabulary and pronunciation, both of which are necessary and essential for listening development and improvement. The hypermedia listening application was professional, as it was designed and created according to educational findings in the fields of FLL, design of adaptive hypermedia learning environments, and computer assisted language learning (CALL). Furthermore, the listening application was designed in a way so that the research questions could be investigated.

The hypermedia listening application consists of three units (Table 1): (a) Smoking II: Introduction, (b) Smoking II: Do they smoke? and (c) Smoking II: Smoking in Public. Each unit consists of two sections. In the first section of each unit, the participants listen to the *audio-only listening texts* and answer the pertinent gradual questions (Figure 1). In the second section of each unit, the participants re-listen to/re-view the same *audio-only listening texts* with *keywords* (Figure 2) or (supplementary contextual) *visuals* + *keywords* (Figure 3) and answer the pertinent gradual questions.

Table 1. The listening texts accessed by the participants

The media types accessed by the participants		
Unit	**Length**	**Media Type** (in order of exposure)
Smoking II: Introduction	00:14 + 00:20	(Firstly) tasks + audio-only listening texts; (Secondly) tasks + the same audio-only listening texts + keywords or (supplementary contextual) visuals + keywords
Smoking II: Do they smoke?	00:23	(Firstly) tasks + audio-only listening texts; (Secondly) tasks + the same audio-only listening texts + keywords or (supplementary contextual) visuals + keywords
Smoking II: Smoking in Public	00:58 + 00:51 + 00:35	(Firstly) tasks + audio-only listening texts; (Secondly) tasks + the same audio-only listening texts + keywords or (supplementary contextual) visuals + keywords
The entire audio	03:21	

Figure 1. A sample of the first section of 'Smoking II: Do they smoke?' unit, at which the participants listen to *the audio-only listening texts* and answer the pertinent gradual questions/activities

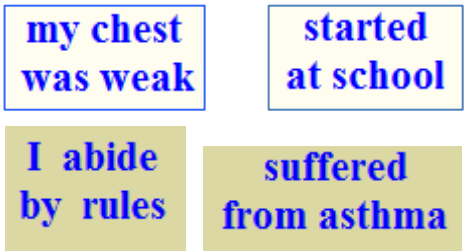

Figure 2. Samples of the second section of the first unit, at which the participants re-listen to/re-view the same *audio-only listening texts* with ***keywords*** and answer the pertinent gradual questions

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Figures 3: A sample of the third section of the first unit, at which the participants re-listen to/re-view the same *audio-only listening text* with (*supplementary contextual*) ***visuals*** + ***keywords*** and answer the pertinent gradual questions

The procedure

The participants accessed the hypermedia listening application voluntarily in the same class at different times during the academic year. Since the lab had 30 PCs, a maximum of 30 participants could use the listening application at one time. The participants were introduced to the hypermedia listening application in the first five minutes of the first session. The participants were then requested to complete the participants' profiles questionnaire. After that, the participants were free to use the hypermedia listening application as they wished. The participants used the application as long as and in the way they wanted. After they had used the application, they answered the questionnaires (i.e. Likert scale items from strongly disagree to strongly agree, 1 to 5). The interviews were conducted after the participants had answered the questionnaires.

FINDINGS

The results were presented in two parts, corresponding to the two above mentioned research questions. The quantitative data were analysed with SPSS. The analysis of the qualitative data was conducted by examining the participants' responses gathered from the open-ended questions. It focussed on the shared themes among the responses. In the analysis and discussion of the qualitative data, ranges of themes emerging from the qualitative data were identified. These emerging data were consistent with the results of the quantitative data.

Re-listening to the same 'audio-only listening texts' with 'keywords' or (supplementary contextual) 'visuals' + 'keywords' at the non-initial phases of the while listening stage is useful

The analysed results indicate that the participants' general perceptions of re-listening to the same *audio-only listening texts* with *keywords* (Table 2) or (supplementary contextual) *visuals* + *keywords* (Table 3) *at the non-initial phases of the while-listening stage* are very positive (Tables 2 and 3 respectively). The participants believe that (1) *keywords* pertinent to the same *audio-only listening texts* should be provided (M = 4.55, Table 2). Providing *keywords* pertinent to the same *audio-only listening texts* helps them (2) focus on listening (M = 4.36), (3) understand better (M = 4.50), (4) learn new words (M = 4.29), (5) understand main words better (M = 4.34), (6) learn main words (M = 4.23), (7) understand difficult words (M = 4.27), (8) learn difficult words (M = 4.23), (9) learn private names (M = 4.14), (10) learn the target language (M = 4.34), and (11) be better prepared for the target / real-world (M = 3.82).

Table 2. Mean score for the participants' general perceptions of re-listening to/re-viewing the same '*audio-only listening texts'* with '*keywords'* at the non-initial phases of the while listening stage

Items	N	Mean	Std. Deviation
1. '*Keywords*' pertinent to the same '*audio-only listening texts*' should be provided (at the non-initial phases of the while listening stage)	56	4.55	.711
2. Providing 'keywords' pertinent to the same '*audio-only listening texts*' (at the non-initial phases) helps you focus on listening	56	4.36	1.017
3. Providing '*keywords*' pertinent to the same '*audio-only listening texts*' (at the non-initial phases) helps you to understand better	56	4.50	.874
4. Providing 'keywords' pertinent to the same '*audio-only listening texts*' (at the non-initial phases) helps you to learn new words	56	4.29	1.140

5. Providing '*keywords*' pertinent to the same '*audio-only listening texts*' (at the non-initial phases) helps you to understand main words better	56	4.34	1.164
6. Providing '*keywords*' pertinent to the same '*audio-only listening texts*' (at the non-initial phases) helps you to learn main words	56	4.23	1.236
7. Providing '*keywords*' pertinent to the same '*audio-only listening texts*' (at the non-initial phases) helps you to understand difficult words	56	4.27	.924
8. Providing '*keywords*' pertinent to the same '*audio-only listening texts*' (at the non-initial phases) helps you to learn difficult words	56	4.23	1.250
9. Providing '*keywords*' pertinent to the same '*audio-only listening texts*' (at the non-initial phases) helps you to learn private names	56	4.14	1.394
10. Providing '*keywords*' pertinent to the same '*audio-only listening texts*' (at the non-initial phases) helps you to learn the target language	56	4.34	.900
11. Providing '*keywords*' pertinent to the same '*audio-only listening texts*' (at the non-initial phases) prepares you better for the target- / real-world	56	3.82	1.363
1= Strongly disagree 2= Disagree 3= Neutral 4= Agree 5= Strongly agree			

The participants believe that (1) (supplementary contextual) *visuals + keywords* pertinent to the same *audio-only listening texts* should be provided at the non-initial phases of the while listening stage (M = 4. 21, Table 3). Providing (supplementary contextual) *visuals + keywords* pertinent to the same *audio-only listening texts* helps them (2) focus on listening (M = 4.39), (3) understand better (M = 4.45), (4) learn new words (M = 4.61), (5) understand main words better (M = 4.45), (6) learn main words (M = 4.50), (7) understand difficult words (M = 4.21), (8) learn difficult words (M = 4.16), (9) learn private names (M = 4.04), (10) learn the target language (M = 4.20), and (11) be better prepared for the target / real-world (M = 4.14).

Table 3. Mean score for the participants' general perceptions of the re-listening to the same '*audio-only listening texts*' with (supplementary contextual) '*visuals'* + '*keywords'* at the non-initial phases of the while listening stage

Items	N	Mean	Std. Deviation
1. Supplementary contextual '*visuals*' and '*keywords*' pertinent to the same '*audio-only listening texts*' should be provided (at the non-initial phases of the while listening stage)	56	4.21	1.261
2. Providing supplementary contextual '*visuals*' and '*keywords*' pertinent to the same '*audio-only listening texts*' (at the non-initial phases) helps you focus on listening	56	4.39	.908
3. Providing supplementary contextual '*visuals*' and '*keywords*' pertinent to the same '*audio-only listening texts*' (at the non-initial phases) helps you understand better	56	4.45	.952
4. Providing supplementary contextual '*visuals*' and '*keywords*' pertinent to the same '*audio-only listening texts*' (at the non-initial phases) helps you learn new words	56	4.61	.867
5. Providing supplementary contextual '*visuals*' and '*keywords*' pertinent to the same '*audio-only listening texts*' (at the non-initial phases) helps you understand main words	56	4.45	.893
6. Providing supplementary contextual '*visuals*' and '*keywords*' pertinent to the same '*audio-only listening texts*' (at the non-initial phases) helps you learn main words	56	4.50	.786
7. Providing supplementary contextual '*visuals*' and '*keywords*' pertinent to the same '*audio-only listening texts*' (at the non-initial phases) helps you understand difficult words	56	4.21	.868
8. Providing supplementary contextual '*visuals*' and '*keywords*' pertinent to the same '*audio-only listening texts*' (at the non-initial phases) helps you learn difficult words	56	4.16	.987

9. Providing supplementary contextual '*visuals*' and '*keywords*' pertinent to the same '*audio-only listening texts*' (at the non-initial phases) helps you learn private names	56	4.04	1.206
10. Providing supplementary contextual '*visuals*' and '*keywords*' pertinent to the same '*audio-only listening texts*' (at the non-initial phases) helps you learn the target language	56	4.20	.961
11. Providing supplementary contextual '*visuals*' and '*keywords*' pertinent to the same '*audio-only listening texts*' (at the non-initial phases) prepares you better for the target-/real-world	56	4.14	1.271
1= Strongly disagree 2= Disagree 3= Neutral 4= Agree 5= Strongly agree			

As for the analysis of the answers to the open-ended questions, most of the qualitative results supported the quantitative data. When the participants were asked: "What do you think of re-listening to the same *audio-only listening texts* with *keywords* or (supplementary contextual) *visuals + keywords* at non-initial phases of the while listening stage?" and "What are the advantages and / or disadvantages of re-listening to the same *audio-only listening texts* with *keywords* or (supplementary contextual) *visuals + keywords* at non-initial phases of the while listening stage in terms of understanding the listening texts and learning the target language?" the following reactions were revealed:

Providing the same *audio-only listening texts* with *keywords* or (supplementary contextual) *visuals + keywords* at the non-initial phases of the while listening stage has a positive effect, is more effective and more beneficial (54 times mentioned by different participants out of 56).

> *"Such a design [providing the same audio-only listening texts with visuals and keywords]* ***has a positive effect****, as visuals are more permanent" (Participant GR201)*
>
> *"Providing [the same audio-only] listening texts with visuals and keywords is* ***50% more effective*** *than only providing [audio-only] listening texts.* ***Visuals are more permanent****, but providing [the same audio-only] listening texts with visuals and keywords is* ***more beneficial****. (Participant GR202)*
>
> *"[Providing the same audio-only listening texts with] both visuals and keywords is* ***very good****. In this way, people can* ***understand difficult words better****"(Participant GR204)*
>
> *"Such a design [providing the same audio-only listening texts with visuals and keywords] is v****ery good and effective****. It is* ***really very good****. Re-listening [to the same audio-only listening texts] with visuals and keywords is* ***very efficient****" (Participant GR205)*
>
> *"[Providing the same audio-only listening texts with] visuals and keywords is* ***the right thing to do****.* ***Such a design is very important for listening****. (Participant GR206)*
>
> *"Such a design is* ***more permanent in terms of remembering the input****" (Participant GR207)*
>
> *"[Providing the same audio-only listening texts with visuals and keywords]* ***becomes more permanent****" (Participant GR2013)*
>
> *"[Such a design] is positive. …* ***has no negative effect****" (Participant GR2014)*
>
> *"I have no idea.* ***I do not think that it has any negative effect****" (Participant GR2015)*
>
> *"[Providing the same audio-only listening texts with visuals and keywords]* ***is more effective****" (Participant GR2019)*
>
> *"I think it is* ***more useful****. When we miss the key words, we have difficulty in understanding the following segments. If one uses only the auditory function of their brain, they can understand the listening text, but if one also sees keywords and pertinent visuals, then they can fully understand the listening text. In my opinion, [such a design]* ***has very positive effects****" (Participant GR2021)*
>
> *"In my opinion, [such a design] can be* ***useful****, but makes learning easy. Therefore, I am in favour of [providing visuals + keywords with the audio-only listening texts at re-listening stage]" (Participant GR2029)*
>
> *"[Such a design]* ***has many positive effects****. [It]* ***makes understanding easy****" (Participant GR2030)*
>
> *"I think [such a design]* ***is good and positive****" (Participant GR2031)*
>
> *"Certainly [such a design]* ***has very positive effects****. If visuals and keywords are provided in this way, it becomes* ***entertaining*** *(Participant GR2034)*

Providing the same *audio-only listening texts* with (supplementary contextual) *visuals + keywords* at non-initial phases of the while listening stage is useful for understanding the *audio-only listening texts* (53 times mentioned)

*"**Visuals are always useful for understanding** [the audio-only listening texts]. **Visuals help understand better** and **visuals are more permanent** in comparison to audio-only" (Participant GR203)*

*"The assumption underlying this is that **such a design helps to understand the listening text better**" (Participant GR206)*

*"In my opinion, **such a design is very useful**. Definitely, **visuals and key words made the listening text more meaningful**. For example, when I listened to the audio-only version of the listening text, I could not understand what Lisa and Barbara's jobs were. However, **when I re-listened to the same listening text with visuals and keywords, then I understood better**. In my opinion, such a design is very positive" (Participant GR208)*

*"[Providing the same audio-only listening texts with visuals and keywords] **fills in the missing gaps**. [Such a design] **helps us understand** [listening texts] **faster**" (Participant GR209)*

*"[Providing the same audio-only listening texts with visuals and keywords] **is also useful for understanding**.*

*"[Such a design] **helps understand** [the listening texts] (Participant GR2014)*

*"Keywords should be provided. Definitely [Keywords] **enable us to understand** [the listening texts] **better**" (Participant GR2016)*

*"With visuals, [the listening texts] **became more understandable**. ...**Visuals made the listening texts understandable** as well as helped us learn" (Participant GR2018)*

*"[Providing the same audio-only listening texts with visuals and keywords] **helps us to understand quickly**" (Participant GR2020)*

*"With keywords, **I understood the speaker better**. **I grasped the topic of the listening text**. Listening to with keywords motivated me. In my opinion, [such a design] is very positive. [Such a design] **also enables us to understand private names**. Designing in this way helps us **understand what we listen to better**" (Participant GR2022)*

*"Keywords enable us **to understand most of the listening text** and answer the pertinent questions" (Participant GR2023)*

*"Providing both visuals and keywords affected us positively. The assumption underlying this is that by linking these keywords and visuals with the listening text, **we understood the listening texts more easily**" (Participant GR2024)*

*"Provision of the keywords **helps a lot; as a result, we do not have difficulty in understanding** [the listening texts]. [Such a design] motivates us" (Participant GR2025)*

*"Visuals certainly **help us understand the content** [of listening texts)" (Participant GR2026)*

*"Certain keywords **enable us to understand the listening text**" (Participant GR2027)*

*"When I listen to the listening texts, I have difficulty in understanding. However, when there is a clue, then that **helps me understand a bit**..." (Participant GR2032)*

*"In my opinion, visuals and keywords should be provided with the listening texts. I have realised in this experiment that **I understand better when visuals are provided with the listening texts**" (Participant GR2033)*

Providing the same *audio-only listening texts* with (supplementary contextual) *visuals + keywords* at non-initial phases of the while listening stage helps learn more effectively (24 times mentioned)

*"[Providing the same audio-only listening texts with] visuals and keywords are **more effective** in learning" (Participant GR203)*

*"[Providing the same audio-only listening texts with] visuals and keywords **is convenient for** our [language] development. Especially visuals and re-listening to the same listening texts in different formats are more permanent in terms of learning" (Participant GR207)*

"Visuals made the listening texts understandable as well as helped us learn" (Participant GR2018)

*"Providing the same audio-only listening texts with visuals and keywords **makes listeners better learners**" (Participant GR2023)*

*"[Providing the same audio-only listening texts with visuals and keywords**] increases the speed of learning and makes it easier for us to understand**" (Participant GR2023)*

*"Keywords should be provided at least once or twice so that we **can remember certain things**" (Participant GR2025)*

> *"Visuals **make learning permanent** and **help the development of visual memory**. Certain keywords enable us to understand the listening text. Using both visuals and keywords **make comprehended input permanent**" (Participant GR2027)*
>
> *"[Such a design] **affects in very positive ways**. It is very useful for understanding English [the listening texts] easily and better. It is helpful in terms of speaking, as well" (Participant GR2028)*
>
> *"... I even **memorised most of the provided keywords**" (Participant GR2034)*
>
> *"Providing listening texts with keywords or visuals and keywords **makes learning easy** and **helps us understand better and enables us to focus on carefully**. In short, **it contributes positively to our understanding and learning**" (Participant GR2036)*
>
> *"**We can acquire new words through the provision of the keywords with the listening text**. At the same time, **it helps us in our daily conversations**" (Participant GR2037)*
>
> *"Yes, certainly! Keywords or visuals and keywords **are useful in understanding** the listening texts and **learning** [the target language]…even if it is limited" (Participant GR2038)*
>
> *"In my opinion, providing the listening texts with keywords and visuals **helps us understand listening texts better as well as learn new words**. In this way, we figure out the meaning of unfamiliar words and **learning becomes more permanent**" (Participant GR2042)*

Providing the same *audio-only listening texts* with (supplementary contextual) *visuals + keywords* at non-initial phases of the while listening stage is useful for drawing attention to salient features of the listening texts (12 times mentioned)

> *"[Providing the same audio-only listening texts with visuals and keywords] enables me **to pay attention to the** keywords that I could not realise before and understand better" (Participant GR2019)*
>
> *"Providing the same audio-only listening texts with visuals and keywords **enables our brain to keep a new word in long term memory**" (Participant GR2023)*
>
> *"In my opinion, **a listening text should feature in both visuals and keywords so that we can focus on content more**" (Participant GR2026)*
>
> *"... I even **memorised most of the provided keywords**" (Participant GR2034)*
>
> *"... and **enables us to focus on carefully**. In short, it contributes positively to our understanding and learning" (Participant GR2036)*
>
> *"... [Such a design] will **help us focus on the features** [of the listening texts] **that we should have paid attention to**. As a result, we better benefit from such listening [such a design]" (Participant GR2046)*
>
> *"Provision of the keywords is useful. For example, it **enables us to focus on what we need to**. …'**Seeing helps us remember**' " (Participant GR2049)*

Two participants (out of 56) comment that such a design enables them to overcome unfamiliar accents.

> *"Positive effects: At the first listening, as **accents** were unfamiliar, it was difficult to understand. However, due to keywords or visuals and keywords, the second listening was much more easier I think. …" (Participant GR2040)*
>
> *"While listening to the audio-only versions of the listening texts, I could not understand due to unfamiliar words as well as their **accents**. Visuals made the listening texts understandable as well as helped us learn. …" (Participant GR2018)*

Moreover, two participants (out of 56) indicate that such a design motivates them as well as helps them learn private names.

> *"With keywords, I understood the speaker better. I grasped the topic of the listening text. Listening to with keywords **motivated** me. In my opinion, [such a design] is very positive. [Such a design] also enables us to **understand private names**. Designing in this way helps us understand what we listen to better" (Participant GR2022)*
>
> *"Provision of the keywords helps a lot, as a result, we do not have difficulty in understanding [the listening texts]. [Such a design] **motivates** us" (Participant GR2025)*

However, there were some negative comments emerged from the qualitative data, all of which are below (2 times mentioned)

> *"Certainly! Keywords are very useful for understanding the listening texts, **but visuals are not effective** …" (Participant GR2035)*
>
> *"In my opinion, keywords and visuals **should not be provided because in real-life such things are not available**… Watching films or video is better because word become more permanent." (Participant GR2056)*

Differences between the participants' perceptions and their characteristics, and correlations between the participants' perceptions

In this study, the differences between the participants' characteristics (i.e. gender, age-group, third language, language learning period, level in English, level in listening, level in computing, feeling confident while learning English etc.) and their perceptions towards the provision of *keywords* or (supplementary contextual) *visuals + keywords* with the same *audio-only listening texts* at non-initial phases of the while listening stage were not found to be statistically significant.

In terms of the participants' general perceptions towards the provision of *keywords* and (supplementary contextual) *visuals + keywords* with the same *audio-only listening texts* at non-initial phases of the while listening stage, the correlations were statistically significant (Table 4). The participants seemed to have high positive general perceptions (Tables 4 & 5) towards the provision of *keywords* and (supplementary contextual) *visuals + keywords* with the same *audio-only listening texts* at non-initial phases of the while listening stage in HEs for FLL. The participants seem to prefer (a) mostly the provision of (supplementary contextual) *visuals + keywords* (see Figure 3 above) with the same *audio-only listening texts*, and (b) secondly most *keywords* (see Figure 2 above) with the same *audio-only listening texts* (see Table 5).

Table 4. Correlations between the participants' perceptions towards the provision of '*keywords',* and (supplementary contextual) '*visuals'* + 'k*eywords'* with the same *audio-only listening texts* at the non-initial phases of the while listening stage in HEs for FLL

		Keywords	**(Supplementary Contextual) Visuals + Keywords**
Keywords	R	1	0,815
	p		**0,001***

*Correlation is statistically significant; a: 0,05; Pearson Correlation test

Table 5. Overall means of the participants' perceptions towards the provision of '*keywords'*, and (supplementary contextual) '*visuals'* + 'k*eywords'* with the same *audio-only listening texts* at the non-initial phases of the while listening stage in HEs for FLL

	N	**Mean**	**SD**
Keywords	56	4,28	0,68
(Supplementary contextual) 'visuals' + 'keywords'	56	**4,31**	0,72

DISCUSSION AND IMPLICATIONS

Dual-coding in designing 'audio-only listening texts' in hypermedia environments for FLL

The above-mentioned results match the existing findings of similar studies (Turel, 2015b, 2014b, 2011; Hsu et al., 2013; Türel, 2010; Cárdenas-Claros, 2009; Paivio, 2006; Purnell & Solman, 1991; Chun, & Plass, 1997). The results of this study also contribute further to the existing body of knowledge in terms of the role of dual coding in designing *audio-only listening texts* in HEs for FLL.

In this study, *audio-only listening texts* were provided at the initial phases (of the while-listening stage). At the non-initial phases (of the while-listening stage), the same *audio-only listening texts* were provided in the form of *audio-only listening texts + keywords*, and *audio-only listening texts* + (supplementary contextual) *visuals + keywords*. Only these were the focus of this study. At the final stages, *audio-only listening texts* + (full) *captions* were provided, which was not the focus of this study. In other words, more than one concurrent digital element on the same hypermedia environment, which aimed to teach one thing (thus, at least one available digital element was redundant), was provided. Such a design of *audio-only listening texts* in a hypermedia listening environment for FLL corresponds with the dual-coding theory, the generative theory of multimedia (Ginther, 2002; Mayer, 1997) and the redundancy hypothesis (Al-Seghayer, 2001; Sherwood et al., 1987), and also provides more paths of recall (Al-Seghayer, 2001; Paivio, 1986).

The results also psychologically match common sense; as such varied and enriched, but not overloaded combinations of the same *audio-only listening texts* in the same hypermedia listening application can avoid boredom and maintain motivation. "A more enriched learning experience occurs when LLs are presented with different styles of learning in both content and teaching style"' (Brickell, 1993, p.2), a challenge which is "often neglected" by instructional designers (McLoughlin, 1999, p.1). The results of the current study further matched the other findings in that the participants overwhelmingly appreciated the re-provision of the same *audio-only listening texts* in the form of *audio-only listening texts + keywords* or *audio-only listening texts* + (supplementary contextual) *visuals + keywords* at the non-initial phases in the hypermedia listening application for FLL, as most learners are visual in their learning (Reid 1987, pp. 96-7).

The re-provision of the same *audio-only listening texts* in the form of *audio-only listening texts + keywords* or *audio-only listening texts* + (supplementary contextual) *visuals + keywords* at the non-initial phases in the hypermedia listening application for FLL corresponds with the requirements of working memory, as it consists of separate processors for auditory and visual information (Kalyuga, 2000; Baddeley, 1992). Listening texts that can be processed using senses of both hearing and vision can expand limited working memory. The results also match the cognitive load theory (Kalyuga, 2000; Sweller, 1999), as such a provision of the listening texts decreases cognitive load because they consist of two different information sources (i.e. audio + keywords, audio +

visuals + keywords). Each of these different information sources requires the use of a separate learning processor (i.e. hearing, vision). These might be the reasons why the majority of the participants appreciated these particular designs of the *audio-only listening texts* in the specific hypermedia listening application for FLL.

The results of this study authenticate the related findings in the field of FLL (Turel, 2014b; Herron et al., 2002, p. 37; Ginther, 2002, pp. 133 - 67; Al-Seghaye,r 2001, p. 203; Brett, 1997, pp. 46-7; Secules et al., 1992, pp. 480-90; Rubin, 1994; Mueller, 1980, p. 340; Omagigo, 1979; Arnold & Brooks, 1976, pp. 713-16; Casambre, 1962, pp. 51-55). Illustrations/visuals generally facilitate intermediate learners' understanding, which is likely to result in FLL. The quantitative and qualitative data of this study clearly show that the majority of the participants are in favour of re-listening to/re-viewing the same *audio-only listening texts* in the form of *audio-only listening texts + keywords* or *audio-only listening texts +* (supplementary contextual) *visuals + keywords* at the non-initial phases in HEs for FLL. The results of this study, therefore, match the comprehension input hypothesis (Türel, 2010, p. 1610). The results also match what was pointed out by Peter (1994, p. 90) as well as Brett (1997, p. 46-7) in that it is said that (a) relevant information around the video stage area can be very useful, and (b) the combination of different digital learning elements are found most beneficial by LLs, and visuals (i.e. pictures) secondly most.

The results are consistent with the social learning theory (Robinson, 1989, pp. 119-33; Carroll, 1977, p. 507), as repeated exposure to similar or parallel listening texts contributes to learning. In this study, the participants are in favour of re-listening to/re-viewing the same *audio-only listening texts* in the form of *audio-only listening texts + keywords* or *audio-only listening texts +* (supplementary contextual) *visuals + keywords* at non-initial phases of the while listening stage.

Re-provision of the same *audio-only listening texts* in the form of *audio-only listening texts + keywords* or *audio-only listening texts +* (supplementary contextual) *visuals + keywords* at the non-initial phases can facilitate recognition, comprehension and learning (Jones & Plass, 2002, pp. 546-61; Al-Seghayer, 2001, pp. 202-32; Carroll, 1977, p. 509). The assumptions underlying these are that LLs recall better when they are assigned to combined-elements. The effects of visuals are much longer for pictorials (i.e. learners remember and learn better when one of the combined elements is visuals). This current quantitative and qualitative study fully supports these results, as well. Re-provision of the same *audio-only listening texts* in the form of *audio-only listening texts + keywords* or *audio-only listening texts +* (supplementary contextual) *visuals + keywords* at the non-initial phases is more likely to lead to acquisition (Long 1983, p. 138, Carroll 1977, p. 500).

The participants of this study, as mentioned above, were computer literate. This, under normal conditions, is the case with most of today's students. Today's students are generally digitally fluent and competitive, and thus they enjoy working with such hypermedia listening applications. The hypermedia listening application made use of for this study responds to today's digitally fluent students' demands and learning style preferences (Türel, 2013; Duncan-Howell, 2012). This might be another reason why the participants overwhelmingly appreciated the re-provision of the same *audio-only listening texts* in the form of *audio-only listening texts + keywords* or *audio-only listening texts +* (supplementary contextual) *visuals + keywords* at the non-initial phases.

Implications for the use of hypermedia environments and better design of 'audio-only listening texts' in such environments for intermediate language learners

Once more it has become clear that HEs are still not widely used at all in (some) educational institutions. HEs are also not integrated into most classrooms and FLL centres. In this study, for example, 82.1% of the participants indicated that they had never used any language software before. This finding matches other results (Türel, 2014, p. 179; Bax, 2003). To this end, the implication is this:

HEs need to, and have to, be made use of and integrated in all areas of education. This recommendation is a practical suggestion for the target educational institution as well as all Higher Education Institutions in Turkey. Many institutions, unfortunately, still do not have high-level structural factors and do not make efficient use of educational technology at different levels of education (Türel, 2013, p. 493). The target educational institution appears to be very slow in "taking the fullest advantage of the potential benefits that educational technology can offer at tertiary level" (Türel, 2013, p. 493). Many other researchers (e.g. Buchanan, 2013; Goktas, Yildirim, & Yildirim, 2009; Usluel & Seferoglu, 2004) put forward these suggestions, as well.

In terms of pedagogically effective and efficient design of *audio-only listening texts* in adaptive hypermedia listening applications for intermediate language learners, the implications are:

Comprehensible but slightly challenging *audio-only listening texts + tasks* should be provided at the initial listening phases (i.e. at the first phases of the while-listening stages). Target LLs should be required and encouraged to listen to the same *audio-only listening texts* a few times (when needed) and complete the provided gradual tasks.

The same comprehensible but slightly challenging *audio-only listening texts* should also be provided in the form of *audio-only listening texts + keywords* or *audio-only listening texts +* (supplementary contextual) *visuals + keywords* accompanied with gradual tasks at the non-initial listening phases of the while-listening stages. The provided listening texts in their new dual-coded forms should be re-viewed by the target LLs, and they should complete the accompanying gradual tasks, as well.

Why should adaptive hypermedia developers take into heed the implications put forward above? Providing *audio-only listening texts* at the initial listening phases (i.e. the first phases of the while-listening stages) requires target LLs to put more effort into the listening process. In other words, "pedagogically, language learners should not be spoon-fed. Language learners, instead, should be

guided, directed and motivated to try to understand by their own initially" (Turel, 2015b, p.52). Such a provision "requires language learners to make more effort to process and understand the *audio-only listening texts* on their own (i.e. meaning-negotiation process)' (Turel, 2015b, p. 52). This implication is the requirement of the depth processing theory, which suggests that without enough effort (deep processing) input will not be remembered (Craik & Lockhart, 1972).

Similarly, re-providing the same *audio-only listening texts* in the form of *audio-only listening texts + keywords* or *audio-only listening texts +* (supplementary contextual) *visuals + keywords* at the non-initial listening phases of the while-listening stages provides 'a more enriched learning experience', as discussed above in more detail.

Provision of *audio-only listening texts* at initial listening phases of the while-listening stages, and re-provision of the same *audio-only listening texts* in the form of *audio-only listening texts + keywords* or *audio-only listening texts +* (supplementary contextual) *visuals + keywords* at non-initial listening phases of the while-listening stages would have a positive enhancement of motivation, LLs' listening development and on preparation for the real world. Failing to take into account these practical recommendations, however, can lead to poor motivation, less comprehension and ineffective FLL. The assumption underlying this is that attitudes of language learners are always related to achievement (Masgoret & Gardner, 2003, pp. 123-63; Linebarger, 2001, pp. 288-298; Baltova, p. 2000; Chapelle & Jamieson, 1991, p. 43). Furthermore, learners' learning style preferences, instructional design models, a wide range of learning hypothesis (i.e. noticing hypothesis,) and theories (i.e. the comprehension input theory, the dual-coding theory, the attention theory), epistemology, senses of human beings, the concern in the field of hypermedia and relevant findings in the field of FLL, authenticity, the realities of the real-word and common sense require hypermedia developers to use varied combinations of *audio-only listening* texts at different phases of the while-listening stage so that effective and efficient adaptive hypermedia listening applications for FLL purposes can be designed and developed.

In sum, the implication of this study is that the same comprehensible but slightly challenging *audio-only listening texts* provided at initial listening phases of the while-listening stage should, and need to, be re-provided in the form of *audio-only listening texts + keywords* or *audio-only listening texts +* (supplementary contextual) *visuals + keywords* at the non-initial listening phases of the while-listening stages in hypermedia listening applications for intermediate language learners. The underlying assumptions for this implication are (a) the above argued reasons, and (b) the suggested design provides a repetitious exposure at different phases of the while-listening stages with different features of the same listening texts each time. This is, as discussed above, one of the invaluable factors in FLL. Such a recommended instructional design for HEs for listening development as a part of FLL can be a positive enhancement of better understanding of *audio-only listening texts* and efficient listening development as a whole.

Last, but not least, while the same *audio-only listening texts* is provided with additional *visuals* (i.e. *keywords*, or supplementary contextual *visuals + keywords*) at the non-initial listening phases of the while-listening stages for intermediate language learners, the requirements of the cognitive load theory (Kalyuga, 2000, p. 161; Sweller, 1999) and working memory should not be ignored by hypermedia developers. In short, we -hypermedia developers- need to be precise and keep the balance, as emphasised in a Kurdish proverb: "Plough deeply, neatly but do not hurt the oxen". Ignoring such important pedagogical design implications can decrease the effectiveness of multiple modalities in re-providing the same *audio-only listening texts* in different forms. Not only can such a failure cause cognitive overload or make misuse of working memory resources available for learning, but it can also hinder acquisition (Kalyuga, 2000, pp. 161-72).

Further research (i.e. experimental research) should investigate whether re-provision of the same *audio-only listening texts* in the form of *audio-only listening texts + keywords* or *audio-only listening texts +* (supplementary contextual) *visuals + keywords* at non-initial listening phases of the while-listening stages in hypermedia listening applications for intermediate language learners improves listening development and contributes to FLL or not.

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Research Paper

Examination of Digital Game Addiction Levels of Adolescent Mainstreaming Students

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ABSTRACT

This study aims to examine the digital game addiction levels of adolescent mainstreaming students in terms of various variables. 157 adolescent mainstreaming students between the ages of 12-18 who attend secondary school, Anatolian High School, Vocational and Technical Anatolian High School, and Vocational Education Center in Düzce province participated in the research. Data were collected using the Demographic Data Form and the Digital Game Addiction Scale in the study, which is designed with the single survey model. As a result of the research, the digital game addiction levels of mainstreaming students among adolescents were found to be low in general. While there was no significant difference between digital game addiction levels of adolescent mainstreaming students according to grade level, type of disability, and degree of disability, there was a significant difference according to gender and type of school attended. Suggestions for further research and applications are included.

INTRODUCTION

Play is an action and activity that is freely consented to, performed completely by the rules, within the limits of a certain time and place, has a purpose, is accompanied by a sense of tension and joy, and the consciousness of "being different" from "ordinary life" (Huizinga, 2007). Digital games, in other words, video games, are very useful tools for learning some knowledge, skills, and strategies and ensuring the long-term persistence of these learnings (Gros, 2014). Academic studies on digital games go back to the early 1980s. Researches on the effects of digital games or video games on social life, teaching video games to individuals with disabilities, the importance of acquiring digital skills show the effect of technology on leisure time activities (Bryce & Rotter, 2006). Digital games or video games have benefits for coping with problems, increasing self-confidence, and increasing visual attention skills, as well as, they are fun and provide people the opportunity to relax and rest and especially educational games are positively related to school success (Yalçın Irmak & Erdoğan, 2016). Sedlak, Doyle, and Schloss (1982) pointed out the need to teach age-appropriate entertainment and leisure time activities to individuals with disabilities and pointed out the benefits of including digital games or video games in the education plans of adolescents with disabilities.

In addition to the various benefits of educational use of digital games, some experimental studies show that in extreme cases, excessive digital game playing leads to destructive potential effects and unhealthy habits on individuals exhibiting compulsive and/or addictive behaviors, just like other types of addiction (Griffiths, 2014; Jeong & Kim, 2011). Although the term addiction is not widely used by clinical psychologists, game addiction is the most common term used in the literature to describe excessive, obsessive, compulsive, and generally problematic use of video games (Lemmens, Walkenburg, & Peter, 2009). Digital game addiction is defined as an impulse control disorder characterized by symptoms such as difficulty in controlling the time spent in the game, loss of interest in other activities, continuing to play despite negative effects, and experiencing a sense of deprivation when unable to play (Yalçın Irmak & Erdoğan, 2016). Although digital games have become a very popular leisure activity among adolescents, research reveals that a very small proportion of adolescents exhibit problematic gaming behavior, including those with learning disabilities. (Griffiths, 2010).

When the studies on digital game addiction in the literature are considered in terms of participant groups, it is seen that they are divided into two as studies with adolescents (Chiu, Lee, & Huang, 2004; Rooij, Schoenmakers, Vermulst, Eijnden, & Mheen; Horzum, 2011; Şahin & Tuğrul, 2012; Zhu, Zhang, Yu & Bao, 2015) and studies with adults (Bhagat, Jeong & Kim, 2020; Jeong, Kim, Lee & Lee, 2016; Kneer, Rieger, Ivory & Ferguson, 2014).

When the researches are considered in terms of variables affecting digital game addiction, it is seen that, while studies with adolescents mostly examine both demographic and psychological variables such as gender, grade, socioeconomic level, education level of parents, family functions, and psychological health (Chiu et al, 2004; Coutelle et al, 2017; Horzum, 2011; Rooij et al., 2011; Şahin & Tuğrul, 2012; Zhu et al, 2015), studies with adults mostly examine psychological variables such as loneliness, need for social interaction, depression, and self-regulation skills (Bhagat et al, 2020; Jeong et al, 2016; Kim, E., Namkoong, Ku, & Kim,

2008; Kneer et al, 2014; Weinstein, 2010). A limited number of studies have been found in the literature on digital game addiction of adolescents with disabilities (Bayrak, 2022; Bekar, 2018; Coutelle et al., 2021; Griffiths, 2010; Kislyakov, 2017).

Coutelle et al. (2021) compared the results of 15 studies in a compilation study in which they examined the use of digital games of individuals with Autism Spectrum Disorder (ASD) in the context of digital game addiction and limited interest in digital games. As a result of the study, it was reported that video game use, which can be defined as digital game addiction, is observed in male adolescents with ASD who do not have an intellectual disability. It has been taken into account that addictive processes work together with restricted interests, which is among the characteristics of ASD.

Griffiths (2010) discussed the addictive behavior of a 15-year-old male adolescent with a learning disability, who exhibited addiction to various computer and internet applications, within the scope of a case study. As a result of the study, it was stated that increasing parental control over the digital games played by adolescents, integrating the games in the educational context, and intervention programs can reduce addiction and turn them into beneficial use.

In the study of Kislyakov (2017), in which he examined the opinions of teachers working with individuals with special needs to determine the risk factors affecting the antisocial behavior of adolescents with intellectual disabilities, digital game addiction was discussed together with socially negative behaviors such as asociality, low maturity level, distrust to the outer world and bullying. It was stated digital game addiction in adolescents with intellectual disabilities was reported as low as 3.98% by the teachers.

Studies in Turkey indicate that adults with attention deficits are accompanied by various addiction conditions like smart phone, social media, alcohol and substance addictions (Bayrak, 2020; Bekar, 2018; Tufan & Yaluğ, 2010; Tuğlu & Şahin, 2010). Difficulties in communication and social skills and impulsive behaviors can also cause addiction problems in individuals with learning difficulties (Al-Dababneh & Al-Zboon, 2018; Üdücü, 2019). Attention deficit and hyperactivity disorder (ADHD) can be a risk factor for computer game addiction also (Bekar, 2018). Since the educational settings where individuals with attention deficit and learning difficulties are placed are mostly mainstreaming settings, it is important to evaluate mainstreaming students in terms of digital game addiction and other addictions.

Although there are many studies in the literature examining the level and risk factors of adolescents' digital game addiction, a limited number of studies have been found on digital game addiction of adolescents with disabilities (Bayrak, 2020; Bekar, 2018; Coutelle et al., 2021; Griffiths, 2010; Kislyakov, 2017), and there has been no study examining digital game addiction of adolescent mainstreaming students. Therefore, this study aims to examine the digital game addiction of adolescent mainstreaming students in terms of various variables.

The Purpose of the Study

This study aims to examine the digital game addiction levels of adolescent mainstreaming students in terms of various variables. The sub-objectives that are aimed to be examined in line with this general purpose are as follows:

1. What is the level of digital game addiction of adolescent mainstreaming students?
2. Does the level of digital game addiction of adolescent mainstreaming students differ in terms of the student's age, gender, type of disability, level of disability, and the type of school attended?

METHOD

Research Model

This research was designed with the single survey model. Single survey models are research models made to determine the occurrence of variables one by one, type, or amount. In such models, the event of interest is tried to be described separately (Karasar, 2000). In this study, digital game addiction levels of adolescent mainstreaming students were analyzed and described in terms of various variables. For this reason, it can be said that the research is suitable for the single survey model.

Sample

The study group of this research was determined by the cluster sampling method. Sampling made when all clusters in the universe have an equal chance of being selected one by one is called cluster sampling (Karasar, 2000). In cluster sampling, groups are randomly selected and all units in the selected groups are sampled. For a unit to be included in any randomly selected group, it must have a common feature with other units in that group (Karagöz, 2017). In this study, a sample of 157 people was reached by cluster sampling method from a universe consisting of mainstreaming students aged 12-18 who attend secondary school, Anatolian High School, Vocational and Technical Anatolian High School, and Vocational Education Center in Düzce province. Demographic data of the study group is given in Table 1.

Table 1. Demographic data

		N	%
Grade Level	11-13	51	32,48
	14-16	77	49,04
	17-19	29	18,47
Gender	Female	121	77,07
	Male	36	22,92
Type of Disability	Spesific Learning Disability	108	68,8
	Attention Deficit and Hyperactivity Disorder (ADHD)	10	12,1
	Mental Disability	7	4,5
	Physical Disability	11	7
	Visual Impairment	6	3,8
	Auditory Impairment	3	1,9
	Autism Spectrum Disorder (ASD)	2	1,3
	Down Syndrome	1	,6
Level of Disability	Mild Disability	138	87,89
	Moderate Disability	13	8,28
	Severe Disability	6	3,82
Type of School Attended	General High School	4	2,54
	Vocational High School	52	33,12
	Vocational Education Center	47	29,93
	Secondary School	54	34,39

Data Collection

Ethics committee approval was received for this study from Bolu Abant İzzet Baysal University, Human Research Ethics Committee in Social Sciences with the letter dated 01/06/2021 and numbered 2021/06. Verbal informed consent was obtained from all subjects before the study. The Digital Game Addiction Scale (DGAS-7) and demographic data form were transferred to the digital platform using Google Forms, and the data were collected by being delivered to the students between June and October 2021 through school administrations and school counselors.

Data Collection Tools

Demographic Data Form

The Demographic Data Form was developed by the researchers by examining the literature. The Demographic Data Form consists of the variables like age, gender, type of disability, degree of disability, and type of school attended.

Digital Game Addiction Scale (DGAS-7)

DGAS-7, developed by Lemmens et al. to determine the problematic digital game playing behaviors of adolescents between the ages of 12-18, is a seven-item short form of DGAS-21, consisting of 21 items and seven sub-dimensions. The Turkish adaptation of the scale and the validity-reliability study of the Turkish form were carried out by Yalçın Irmak and Erdoğan (2015). The validity and reliability values of the scale, which has a five-point Likert type and single-factor structure, were found to be 0.92 for Cronbach's alpha, CFI=0.904, RMSEA=0.053 (90% CI=0.049 and 0.056), and it was stated that it could be used in adolescents.

Monothetic and polythetic diagnoses were used to determine whether an adolescent is addicted to digital games with the help of DGAS-7. According to the monothetic diagnosis, if the person scores three (sometimes) or more on seven of the seven items; according to the polythetic diagnosis, if he scores three (sometimes) on at least four of the seven items, he is defined as a game addict (Yalçın Irmak & Erdoğan, 2015).

Monothetic and polythetic typologies differ mainly in their requirements for the identification of samples/specimens. A typology is monothetic if possession of a unique set of features is both necessary and sufficient for identifying a sample/specimen as belonging to a specific element of the typology. On the contrary, a polythetic typology is formed by grouping together those elements within a particular sample which have the greatest number of shared characteristics. No single feature is either necessary or sufficient in polythetic typologies. The objects/samples or specimens are grouped to maximize overall similarity within each group (Bailey, 1973).

In the diagnosis of gaming addiction, polythetic diagnosis requires that the addicts have half (or more) of the recommended criteria; monothetic diagnosis requires having all of the criteria (Lemmens et al., 2009).

Lemmens et al. (2009) mentioned two different arguments predicting that the monothetic approach would give better results in predicting gaming addiction, although the DSM applied polythetic diagnosis in diagnosing pathological gambling behaviors. The first is that the polythetic diagnosis overestimates the number of gaming addicts. Second, according to several researchers, negative life consequences are a crucial element in distinguishing addiction from habits. According to this view, criteria conflict, withdrawal from the addictive substance, and problems indicate negative life consequences and pathological tendencies. Because the monothetic format requires that all criteria of game addiction are met, this format automatically incorporates the endorsement of the criteria for negative life consequences. Herewith, a more accurate distinction is made between habit and addiction (Lemmens et al., 2009). In the consideration of all these arguments, Lemmens et al. (2009) stated that they adapted both monothetic and polythetic diagnostics, during the development process of the original form of the Digital Game Addiction Scale.

DATA ANALYSIS

Normality Test

To decide on the tests to be carried out to examine the digital game addiction levels of adolescent mainstreaming students in terms of various variables, the kurtosis and skewness values and the normality of the scale scores were tested with the Kolmogorov-Smirnow Test which is applied in case the group size is greater than 30 (Can, 2017). According to Kolmogorov Smirnov-Z [K-S=0,107; *p*=,000], kurtosis [0,029; S.E=0,385] and skewness [0,659; S.E=0,194] data, the distribution in the scale scores is not found to be normal. Therefore, the Mann-Whitney U test is applied in cases where the distribution is not normal and the number of groups is two, and the Kruskal Wallis H-Test is applied in cases where there are more than two. The statistical significance level is accepted as .05.

FINDINGS

1.What is the level of digital game addiction of adolescent mainstreaming students?

According to the monothetic diagnosis, individuals who score three (sometimes) or more on seven of the seven items in DGAS-7 are considered game addicts, while according to the polythetic diagnosis, if they score three (sometimes) or more on at least four of the seven items, they are considered game addicts.

a. Determination of digital game addiction level of adolescent mainstreaming students according to monothetic diagnosis

Table 2. Descriptive distribution of adolescent mainstreaming students who have game addiction according to monothetic diagnosis

	f	%
Non-addicted to games	147	93,6
Addicted to games	10	6,4

When Table 2 is examined, it is seen that the number of adolescent mainstreaming students who are not game addicts is 147 (93.6%), while the number of game addicts is 10 (6.4%) according to the monothetic diagnosis.

a.Determination of digital game addiction level of adolescent mainstreaming students according to polythetic diagnosis.

Table 3. Descriptive distribution of adolescent mainstreaming students who have game addiction according to polythetic diagnosis

	f	%
Non-addicted to games	95	60,5
Addicted to games	62	39,5

When Table 3 is examined, it is seen that the number of adolescent mainstreaming students who are not game addicts is 95 (60.5%), while the number of game addicts is 62 (39.5%) according to the polythetic diagnosis.

The mean score of the participants in DGAS-7 is 15.12, and the standard deviation is 6.18. Considering that the highest score that can be obtained from the scale is 35 and the lowest score is 7, it can be said that the scores of adolescents who are mainstreaming students are below the average score and their digital game addiction levels are low.

Adolescent mainstreaming students were asked to indicate how often they experienced the answers to the following questions in the last 6 months. The average scores of the participants on the basis of items are presented in Table 4.

Table 4. *Average scores of scale items*

Items	$\bar{X}$	Sd
1. Did you think about playing a game all day long?	2,24	1,39
2. Did you spend increasing amounts of time on games?	2,36	1,30
3. Did you play games to forget about real life?	2,49	1,30
4. Have others unsuccessfully tried to reduce your game use?	2,32	1,41
5. Have you felt bad when you are unable to play?	1,88	1,16
6. Did you have fights with others (e.g., family, friends) over your time spent on games?	1,99	1,26
7. Have you neglected other important activities (e.g., school, work, sports) to play games?	1,86	1,20

According to Table 4, the three items with the highest average score of the participants are the 3rd, 2nd and 4th items. Item 3 is about playing games to forget about the real life, item 2 is about increasing amounts of time on games, and item 4 is about the failure of others to reduce the individual's game use.

2.Does the digital game addiction level of adolescent mainstreaming students differ in terms of the student's age, gender, type of disability, level of disability, and the type of school attended?

a.Kruskal Wallis H test result according to the grade level of adolescent mainstreaming students

The results of the Kruskal Wallis H test of DGAS-7 scores of adolescent mainstreaming students according to grade level are given in the table.

Table 5. Kruskal Wallis H test results of DGAS-7 scores according to the grade level of adolescent mainstreaming students

Grade Level	N	Mean Rank	sd	Chi-Square	*P*
11-13	51	72,29	2	1,650	,438
14-16	77	82,30			
17-19	29	82,03			

As can be seen in Table 5, there is no significant difference between the Kruskal Wallis test results of DGAS-7 scores of adolescents with mainstreaming students according to grade level (χ^2 [sd=2, n=157] =1,650, p>0,05).

b.Mann-Whitney U test results according to the gender of adolescent mainstreaming students

Table 6. Mann-Whitney U test results of DGAS-7 scores according to the gender of adolescent mainstreaming students

Gender	N	Mean Rank	Rank Sum	U	P
Female	36	52,94	1906,00	1240,00	,000
Male	121	86,75	10497,00		

As seen in Table 6, it is found that there is a statistically significant difference between the levels of digital game addiction of females and males according to the Mann Whitney U test results of DGAS-7 scores according to the gender of adolescent mainstreaming students . ([U:1240,00] p<.05). Considering the mean rank, it is understood that the digital game addiction levels of males are higher than females.

According to the effect size analysis on the size of the significant difference [r= Z / √N), r=-3,924/(√157] effect size is found r=.31. About the effect size ranges determined by Cohen, it is stated that the r-value indicates a small effect at the level of .10, a medium effect at the level of .30, and a large effect at the level of .50 (Cohen, 1988; Field, 2009). Hereunder, it can be said that gender has a moderate effect on digital game addiction levels of adolescent mainstreaming students.

b.Kruskal Wallis H test result according to the type of disability affected by adolescent mainstreaming students.

Tablo 7. Kruskal Wallis H test results of DGAS-7 scores of adolescent mainstreaming students according to disability type

Type of Disability	N	Mean Rank	sd	Chi-Square	*P*
Spesific Learning Disability	108	75,61	7	11,476	,119
ADHD	19	101,55			
Mental Disability	7	98,93			
Physical Disability	11	78,95			
Visual Impairment	6	56,33			
Auditory Impairment	3	38,50			
ASD	2	122,00			
Down Syndrome	1	85,75			

As can be seen in Table 7, there is no significant difference between the Kruskal Wallis test results of DGAS-7 scores according to the type of disability of adolescent mainstreaming students. (χ^2 [sd=7, n=157] =11,476, p>0,05).

a.The result of Kruskal Wallis H test according to the disability level of adolescent mainstreaming students

Table 8. Kruskal Wallis H test results of DGAS-7 scores according to the disability level of adolescent mainstreaming students

Disability Level	N	Mean Rank	sd	Chi-Square	*P*
Mild	138	76,78	2	5,194	,074
Moderate	13	106,23			
Severe	6	71,08			

As can be seen in Table 8, there is no significant difference between the Kruskal Wallis test results of DGAS-7 scores according to the disability level of the adolescent mainstreaming students. (χ^2 [sd=2, n=157] =5,194, p>0,05).

a.The result of the Kruskal Walis H test according to the type of school attended by the adolescent mainstreaming students

Table 9. Kruskal Wallis H test results of DGAS-7 scores according to the type of school attended by adolescent mainstreaming students

Type of School Attended	N	Mean Rank	sd	Chi-Square	*P*	Significant Difference
Secondary School	54	72,56	3	11,829	,008	3-1,3-4,3-2,
Anatolian High School	4	38,88				1-4,1-2,
Vocational and Technical Anatolian High School	52	95,06				
Vocational Education Center	47	72,05				

As seen in Table 9, it is found that DGAS-7 scores differ significantly according to the type of school attended by adolescent mainstreaming students according to the Kruskal Wallis test result. (χ^2 [sd=3, n=157] =11,829, p<0,05). Considering the mean rank of the groups, it is seen that adolescent mainstreaming students attending Vocational and Technical Anatolian High School got the highest score from DGAS-7, followed by adolescent mainstreaming students attending secondary school, Vocational Education Center, and Anatolian High School, respectively.

According to the effect size analysis on the size of the significant difference [($\eta^2 = \chi^2/(N-1)$, $\eta^2=11,829/(157-1)$] effect size is found $\eta^2=0,075$ (Green ve Salkind, 2005; Akt. Can, 2017). About the effect size ranges determined by Cohen, 0.01 indicates a small effect, 0.06 indicates a medium effect, and 0.14 indicates a large effect for the η^2 value (Ellis, 2010; Özçomak ve Çebi, 2017). Hereunder, it can be said that the type of school they attend has a great effect on the digital game addiction levels of adolescent mainstreaming students.

DISCUSSION, CONCLUSION, AND RECOMMENDATIONS

As a result of the research, digital game addiction levels of adolescent mainstreaming students were found to be low in general, considering both the monothetic and polythetic definitions and the average scores of the participants from the scale. The three items with the highest average score of the participants are about playing games to forget about the real life, increasing amounts of time on games, and the failure of others to reduce the individual's game use. Studies reveal that a very small proportion of adolescents exhibit problematic gaming behavior, including those with learning disabilities (Griffiths, 2010). Şahin and Tuğrul (2012) conducted a study on 372 students, 178 females, and 194 males, attending the 4th and 5th grades to determine the computer game addiction levels of 4th and 5th-grade students. As a result of this research, they reported that the students' computer game addiction scores were low in general. Rooij et al. (2011) conducted a longitudinal study with 1572 Dutch high school students aged between 13 and 16 in 2008 and 1476 in 2009 to determine the characteristics of adolescents addicted to digital games and found out that game addiction was as low as 3% among Dutch adolescents. Kislyakov (2017) examined teachers' views, who work with individuals with special needs in the research, conducted to determine the risk factors that affect the antisocial behavior of adolescents with intellectual disabilities. As a result of this research, it is stated that teachers reported digital game addiction of adolescents with intellectual disabilities as low as 3.98%. On the other hand, Özdarendeli (2021), in his study examining internet addiction, focus of control and family relations of children aged 14-16 with learning disabilities, determined that children with learning disabilities have a high level of internet addiction, are self-controlled and have unhealthy family functions. This study is conducted with 157 adolescent mainstreaming students, 121 of whom were males, and 36 were females. The digital game addiction level of the participants is found low. This finding supports the information, about the digital game addiction level of adolescents reported in the literature.

In this study, the digital game addiction level of adolescent mainstreaming students has been examined in terms of variables such as grade level, type of disability, disability level, and type of school attended. In studies conducted with adolescents in the literature, it has been observed that digital game addiction is examined only with demographic variables (Horzum, 2011; Şahin & Tuğrul, 2012) or with both demographic and psychological variables (Chiu et al., 2004; Rooij et al., 2011, Zhu et al., 2015). Several studies have found that gender and family functions generally affect adolescents' digital game addiction level (Chiu et al., 2004; Coutelle et al.,

2017; Horzum, 2011; Rooij et al., 2011; Şahin & Tuğrul, 2012; Zhu et al., 2015). In a study by Üdücü (2019), which compared the internet addiction levels of individuals aged 10-16 with and without learning disabilities, the internet addiction levels of 139 students, 58 of whom had learning disabilities and 81 of whom had normal development, were examined. It was found that the internet addiction levels of the participants did not change according to gender and other familial characteristics such as income status, education of parents and being apart or together. Bekar (2018), in a study conducted with 200 children between the ages of 10-13 with and without ADHD, found that children with ADHD have more computer game addictions. This study has examined the digital game addiction level of adolescent mainstreaming students with demographic variables such as grade level, type of disability, disability level, and type of school attended. While there has been no significant difference between the digital game addiction levels of the participants according to the grade level, type of disability, and disability level, there is a significant difference according to gender and type of school attended. This difference may be due to the fact that male and female students have different interests according to the type of school they attend.

The digital game addiction levels of the males are higher than the females and that gender has a moderate effect on the digital game addiction levels of the adolescent mainstreaming students. In many studies, it has been reported that the gender variable has a significant effect on the level of digital game addiction. (Chiu, Lee and Huang, 2004; Coutelle et al., 2017; Horzum, 2011; Şahin & Tuğrul, 2012). In studies on adolescents in Turkey, digital game addiction of males is high (Horzum, 2011; Şahin & Tuğrul, 2012), while Chiu et al. (2004) found that females had higher levels of digital game addiction than males in a study conducted with Taiwanese children and youth. When this finding of the study is evaluated together with the studies in the literature, it can be said that gender affects digital game addiction in general.

According to the type of school attended, the digital game addiction levels of the adolescent mainstreaming students attending Vocational and Technical Anatolian High School were found to be the highest, followed by the adolescent mainstreaming students attending secondary school, Vocational Education Center and Anatolian High School, respectively. It has been determined that the type of school he/she attends has a great effect on the digital game addiction of adolescent mainstreaming students. Afacan and Ozbek (2019) conducted a study with 596 high school students, 304 of whom were female and 292 were male, in order to examine social media addictions of high school students in terms of various variables. As a result of the research, it was found that the social media addiction levels of high school students were moderate, and there was no significant difference between the gender, age and class level of the students and their social media addictions, while a significant difference was found between the type of high school they attended and their social media addiction. It was found that the social media addiction levels of the students attending Vocational and Technical Anatolian High School were higher than the students attending Anatolian High School. On the other hand, high school type was determined to have a small effect on social media addiction. This finding in the literature supports the research finding. The type of school attended may have an impact on digital game addiction as it consists of individuals with similar interests and creates a common environment.

This research is limited to examining the digital game addiction levels of adolescent mainstreaming students in terms of various demographic variables, and in line with the results obtained, it is recommended that further studies examining the risk factors affecting digital game addiction of individuals with disabilities in the context of both demographic and psychological variables should be applied on different study groups. In addition, it is recommended to organize interventions to prevent digital game addiction of these individuals and include their families in these practices, and inform them about digital game addiction.

Ethics Committee Approval: Ethics committee approval was received for this study from Bolu Abant İzzet Baysal University, Human Research Ethics Committee in Social Sciences with the letter dated 01/06/2021 and numbered 2021/06. Verbal informed consent was obtained from all subjects before the study.

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Research Paper

An Examination of the Relationship between College Students' Cyberbullying Awareness and Ability to Ensure their Personal Cybersecurity

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ABSTRACT

The purpose of this study is to examine the relationship between college students' cyberbullying awareness and their ability to ensure their personal cybersecurity. A total of 401 students participated in this study. The Ability to Ensure Personal Cybersecurity Scale, the Cyberbullying Awareness Scale, and a Personal Information Form developed by the researcher were all used during data collection. A relational screening model was used in this study. Also, an unpaired t-test, one-way analysis of variance (ANOVA), and Pearson's correlation coefficients were utilized during data analysis. Study results revealed that college students are highly capable of ensuring their personal cybersecurity and possess high levels of cyberbullying awareness, that female students possess significantly higher levels of cyberbullying awareness compared to male students, and that there is a moderate, positive correlation between college students' cyberbullying awareness and their ability to ensure their personal cybersecurity. Also, college students' levels of cyberbullying awareness vary based on their reasons for using the internet and their propensity towards both online catfishing and cyberbullying others. Furthermore, college students' ability to ensure their personal cybersecurity was similarly found to differ based on their reasons for using the internet, the degree to which they had been exposed to cyberbullying, and their propensity toward online catfishing.

INTRODUCTION

In today's world, where new technological developments are a daily occurrence and the internet, mobile devices, and computers are becoming more ever more advanced, it is nearly impossible to remain unplugged and stay away from technology. People who have had to spend most of their time at home due to the COVID-19 pandemic, which emerged in December 2019 in Wuhan, China and has spread throughout the entire world, use technology for various activities such as online shopping, research, visiting social networks, and watching movies. A report (2021) by a creative agency called We Are Social revealed that 5.22 billion people (66.6%) of the world's population, which consists of nearly 7.83 billion people, are mobile phone users, 4.66 billion (59.5%) are internet users, and 4.2 billion (53.6%) are social media users and also touched on how these numbers are increasing day by day. The most striking matter discussed in the report is the fact that worldwide, the average amount on time spent online amounts to seven hours per day. In the same report, the number of internet users in Turkey was reported as 65.8 million, while 60 million were found to actively use social media. The average daily internet use in Turkey was found to be eight hours per day, higher than the worldwide average. According to a Household Use of Information Technologies study (2021) conducted by TURKSTAT (Turkish Statistical Institute), the percentage of internet users for 17 to 74-year-olds in Turkey was found to be 82.6%. Based on users' sex, this rate was found to be 87.7% for male users and 77.5% for female users. It was also found that the rate of household internet access reached 92%, while the rate of consistent internet usage hit 80.5%.

Relevant sets of digital data show that the increase in the use of technology over the years, the active, worldwide use of virtual worlds by a variety of age groups, informatics systems, technological advancements, and the convenience of many technological devices (smart phones, computers, tablets etc.) have become indisputable facts of life (Batmaz and Ayas, 2013:44; Peker, 2019:345; Şenol, 2017:1). Several factors such as the boundless opportunities offered in digital environments, the ability to infinitely surf the web, the ability to easily access information, the opportunity to become famous in a short amount of time, and the feeling of comfort and confidence while freely stating opinions online have created a new concept known as online disinhibition. Even though this restriction-free environment has some advantages, it also comes with several problems caused by users' insensitive and obtuse posts (Aktan and Çakmak, 2015:16; Suler, 2004:321; Yavanoğlu, Sağıroğlu and Çolak, 2012:15).

These problems include humiliation, ostracization, real-life threats carrying over into digital environments (Bayram and Saylı, 2013), security issues, privacy violations, cyber threats (Karaoğlan Yılmaz, Yılmaz and Sezer, 2014:177; Şenol, 2016: 11), inappropriate websites (promoting the use of drugs and/or glorifying violence), fraud, sexual harassment-related content (child pornography) (Eroğlu and Güler, 2015:119), theft, fake accounts, terrorist propaganda and other felonious material (Hekim and Başıbüyük, 2013:136), video game and internet addiction, access to inaccurate information and/or harmful content on the internet

as well as activities associated with violence, hate speech, and/or racism (Çubukçu and Bayzan, 2013:4), and malware such as Trojan horse viruses, spyware, computer worms, and many other types of viruses (Öğün and Kaya, 2013:151).

The fact that these problems have been encountered all over the world has turned them into a universal matter of concern (Baştürk and Sayımer, 2017: 2; Pekşen, Süslü, and Oktay, 2018: 1880). People expressing their emotions, thoughts, and views in digital environments may cause those who disagree to display adverse reactions such as anger, aggression, instances of hate speech, and racist language; anger and aggression in particular have recently become significantly more noticeable in virtual and digital worlds (Kozan and Bulut Özek, 2019:108). The virtual conveyance of such feelings by ill-intentioned people to the innocent or vulnerable via messages, videos, or emails has led to the emergence of a relatively new concept in the literature: cyberbullying.

The term cyberbullying was coined by a Canadian educator, Bill Belsey, in the early 2000s, and it has since become the subject of many studies (Yaman, Karakülah, and Dilmaç, 2013). Cyberbullying is also known as digital bullying, online bullying, electronic bullying (Kowalksi and Limber, 2007), mobile phone bullying, and internet bullying (Tamer and Vatanartıran, 2014:4) in the relevant literature. Cyberbullying can be exposed and detected by checking bullies' computer systems, mobile phones and/or other technological devices (Patchin and Hinduja, 2006:148; Peker and Ekinci, 2016:2127; Price and Dalgleish, 2010:51; Smith and Ananiadou, 2003:189), emails, personal websites, blogs, discussion forums, social networks, text and video messages, and/or instant messages (Belsey, 2021; Gökçe Turan, 2021:114; Peker and Ekinci, 2016:2128; Smith et al., 2008:376). There are many definitions of cyberbullying in the relevant literature as researchers have failed to agree on a single definition.

Lacey (2007) states that cyberbullying is an exhibition of violence and aggression in social contexts over various communication mediums, while Willard (2007) defines it as a body of misbehaviors that manifest themselves through sending or posting inflammatory content to others using technologies such as computers, smartphones, and the internet. Smith et al. (2008) identifies it as a set of aggressive actions performed multiple times by a single person or a group of people using communication technologies against those who have difficulty defending themselves. Cyberbullying is also defined as "a set of intentional, consistent, and hostile behaviors exhibited by a single person or a group of people to hurt others using information and communication technologies" (Belsey, 2021; Price and Dalgleish, 2010:51). Taking these definitions into account, it is evident that cyberbullying is, by its very nature, performed using communication technologies, contains intentional and hostile behaviors, aims to hurt and harm others, and targets vulnerable people.

Analysis of the characteristics of cyberbullying reveals that regardless of their physical strength, an individual can turn into a cyberbully as long as they have enough knowledge about digital environments (Patchin and Hinduja, 2006) and can easily victimize the gullible and/or those who lack situational awareness. In addition, a victim of cyberbullying can be bullied online regardless of time and place and can also receive distressing text messages and emails at any time (Kowalski and Limber, 2007:23; Patchin and Hinduja, 2006:150; Slonje and Smith, 2008:148). Moreover, cyberbullying can affect larger numbers of people when compared to traditional bullying, where the number of bystanders is smaller. For instance, when a violent act occurs in a school setting, there might be five or ten people in a classroom or hallway, while a video posted and spread on the internet can be viewed by millions of people (Campbell, 2005:3; Peker and Ekinci, 2016:2127; Slonje and Smith, 2008:148)

Furthermore, while bullies' identities are usually known in traditional bullying, it is easier for cyberbullies to remain anonymous on the internet and social media (Baştürk and Sayımer, 2017: 2; Belsey, 2021; Campbell, 2005:3; Dikmen and Çağlar, 2017:101; Morales, 2011:407; Slonje and Smith, 2008:148; Tamer and Vatanartıran, 2014:4). It should also be kept in mind that the faintest ink is more powerful than the strongest memory. Put another way, even though the victim is subjected to hurtful deeds in traditional bullying, the incident can be forgotten over time. However, insults, distressing content, and/or messages posted by a cyberbully can be viewed dozens of times by the victim in cyberbullying; thus, it may have a larger impact on the victim when compared to traditional bullying (Campbell, 2005:3). When the aforementioned characteristics of cyberbullying are considered as a whole, it is clear that cyberbullying is both detrimental and damaging.

In digital environments, cyberbullying can manifest itself in a variety of different ways: invasion of privacy, insult, assault (Doğan, Çaka, and Şahin, 2016:507; Yavanoğlu, Sağıroğlu, and Çolak, 2012:18), harassment, humiliation, profanity, defamation, sending hurtful or abusive photos and/or messages (Peker and Ekinci, 2016:2128), hate speech (Hanewald, 2008:2), making rude, discouraging, or embarrassing comments (Ybarra and Mitchell, 2004:1308), or even anonymously sending spam emails and/or email viruses (Arıcak et al., 2008:253). While these vulnerabilities and adverse elements of digital environments lower people's trust in virtual mediums, it becomes evident that necessary precautions must be taken to prevent cyberbullying.

The number of cyber threats increases at the same rate as the rapid advancement of technology that has little to no restrictions on usage. Vulnerabilities become more prominent in these platforms as there is a lack of proper personal information security, determination of legal boundaries, and web filtering (Avcı and Oruç, 2020:288). Individuals are not well-informed about the risks they may encounter, especially because they use the internet improperly and possess low awareness of threats that target their personal information (Aslankara and Usta, 2018:121; Çam and Aslay, 2019:2; Öğütçü, Testik, and Oumout, 2016:83-84). A study conducted by Öğütçü (2010) showed that people's levels of awareness regarding information security weren't very high. Results from the same study also revealed that individuals haven't developed any behaviors that enabled them to take precautions against cyber threats. In their study, Tekerek and Tekerek (2013) found that participants had very low awareness of matters such as creating strong passwords, malware protections, document protection, safe online communication, security of personal computers, online chat rooms, and general internet safety.

In a study conducted by Erdoğmuş (2017), cybersecurity awareness was found to have the most positive effect on information security awareness among individuals. In addition, another study by Avcı and Oruç (2020) revealed that 92% of students who participated in the study had never received any cybersecurity or information security training.

People usually think that they are completely safe while surfing the internet due to the presence of antivirus software and other protective measures. However, spyware and computer viruses increase the risk of various threats on the internet. Therefore, the need to raise awareness of security and privacy matters takes on renewed urgency. Although it is not at all true to say that users are solely accountable for their own security in digital environments, they have to take precautions in order to protect themselves (Furnell, 2008).

It is important to raise awareness of information security in order to minimize risk factors in digital environments and to ensure that users feel secure (Abawajy, 2012:238; Öğütçü, 2010:1-2; Sasse, Brostoff and Weirich, 2001:122; Yılmaz, Ulus, and Gönen, 2015:143). Much suffering and aggrievement can be prevented by becoming aware of problems with and taking necessary security precautions on digital mediums (Abawajy, 2012:237; Arıcak, Kınay, and Tanrıkulu, 2012; Aslan and Önay Doğan, 2017:105; Doğan, Çaka, and Şahin, 2016:518; Eminağaoğlu and Gökşen, 2009:7; Karaoğlan Yılmaz, Yılmaz, and Sezer, 2014:177; Keser and Güldüren, 2015:1169; Odacı and Çelik, 2018:1176; Önaçan and Atan, 2016:13; Sertçelik, 2015:39; Yenilmez and Seferoğlu, 2013:423) and thusly, individuals can become more conscious of the effects of cyberbullying.

Awareness can be defined as sensitivities developed by an individual that are employed when they come across any potentially unfavorable situations (Bayezid, 2000:100; Bridge and Duman, 2019: 159; Krahé, Möller, Berger, and Felber, 2011; Rohrmann, Netter, Hennig, and Hodapp, 2003, Akt. Tanrıkulu, Kınay, and Arıcak, 2013:40) or as their tendency to avoid or ignore threatening stimuli (Roger and Schapals, 1996). Individuals may face dangerous situations in everyday life as well as in digital environments and may develop sensitivities towards them. Thus, cyberbullying awareness can be defined as "a set of behaviors that keep individuals away from actions which may lead to them being exposed to cyberbullying while using technological devices such as smart phones, enable users to become more aware of cyberbullying threats, help them take precautions against said threats, and ensure that they pay more attention to possible threats" (Tanrıkulu, 2011, Akt., Tanrıkulu, Kınay, and Arıcak, 2013). It is crucial for both individuals and institutions to be well-informed about cybersecurity so that they are conscious of risks they may encounter in digital environments and aware of risks and problems that may occur in said environments. Therefore, it is also important to be familiar with cybersecurity terminology and concepts. In addition, raising cyberbullying awareness will both reduce the risk of people being cyberbullied and prevent others from becoming victims of cyberbullying (Doğan, Çaka, and Şahin, 2016:518).

It is essential to rigorously train new users about online risks, particularly when they first start using digital environments. One study noted that behaviors that constitute risks on virtual media gradually intensify during adolescence between the ages of 15 to 18 and subsequently lessen during the university years when individuals step into young adulthood and levels of awareness increase (Aslankara and Usta, 2020:136). Even though the intensity of cyberbullying depends on age and starts to decrease during the university years, its effects continue to impact individuals who were exposed to it in the past. In Arıcak's study (2009) of college students, it was found that 19.7% of the participants had cyberbullied others at least once in their lives and more than half of the participants (54.4%) had cyberbullied at least once in their lifetime.

Similarly, another study done by Dilmaç (2009) revealed that 22.5% of college students had cyberbullied others while 55.3% stated that they had been cyberbullied at least once in their lifetime. Obviously, the results and data from both Arıcak's and Dilmaç's study paint similar pictures and illustrate the gravity of the situation. College students' ability to ensure their own cybersecurity and their levels of cyberbullying awareness have become an issue of concern during the COVID-19 pandemic even more so than before as they spend more time online consuming entertainment, researching, and using social media. This study examines the relationship between college students' ability to ensure their personal cybersecurity and their cyberbullying awareness.

Purpose and Goals

The main purpose of this study is to examine the relationship between college students' cyberbullying awareness and their ability to ensure their personal cybersecurity. The secondary objective of the study is to answer the questions below:

1. To what extent are college students able to ensure their personal cybersecurity and to what degree are they aware of cyberbullying?
2. Does college students' levels of cyberbullying awareness and their ability to ensure their personal cybersecurity differ significantly based on sex, college grade level, college departments, the amount of time they spend on the internet, their reasons for using the internet, whether or not they employ catfishing, and whether or not they had been cyberbullied and/or have ever cyberbullied others?
3. Is there any statistically significant relationship between college students' ability to ensure their personal cybersecurity and their cyberbullying awareness?

METHOD

Model

A relational screening model, one of the designs used in quantitative research, was used in this study. As the relationship between college students' cyberbullying awareness and their ability to ensure their personal cybersecurity was examined within the purview of this study, a relational screening model was deemed an appropriate way to analyze this relationship. Relational screening models are research models that aim to describe the relevant features of a situation by determining the relationship between specific variables (Karasar, 2003:77).

Population and Sample

The population of this study consisted of a total of 401 undergraduates (301 (75.1%) female and 100 (24.9%) male students), who were selected using a relevant sampling method, studying in a variety of different departments at Bartın University in Turkey during the 2020-2021 academic year.

Table 1. Demographic Profile of the Participants

Demographic Variables of College Students		N	%
Sex	Female	301	75.1
	Male	100	24.9
College Grade Level	Freshman	112	27.9
	Sophomore	70	17.5
	Junior	106	26.4
	Senior	113	28.2
Department	Elementary-Level Mathematics Teacher Education	60	15
	Theology	64	16
	Psychological Counselling and Guidance	225	56.1
	Elementary-Level Classroom Education	21	5.2
	Social Studies Teacher Education	31	7.7
Daily internet use	1-3 hours	106	26.4
	4-5 hours	187	46.6
	6+ hours	108	26.9
Reasons for Using Internet	Study - Research	119	29.7
	Movies – Music - Entertainment	54	13.5
	Social Media	203	50.6
	Keeping up with news and the world	25	6.2
Catfishing	Yes	74	18.5
	No	327	81.5
Being cyberbullied	Yes	140	34.9
	No	261	65.1
Cyberbullying others	Yes	20	5
	No	381	95
Total		401	100

Data Collection Tools

Personal Information Form: In this study, a personal information form was used to collect undergraduate students' demographic data including sex, grade level, and department. The personal information form also contains relevant questions that helped the researcher get more familiar with the participants, such as the amount of time they spend on the internet, their reasons for using the internet, the degree to which they had been exposed to cyberbullying, and their propensity toward online catfishing.

Cyberbullying Awareness Scale

The Cyberbullying Awareness Scale was created by Tanrıkulu, Kınay, and Arıcak (2013). After conducting factor analysis, a scale consisting of one factor that accounts for 46.65% of the total variance was devised. The internal consistency coefficient for the scale was found to be between 0.83 and 0.90, while the split-half reliability coefficient was calculated to be between 0.75 and 0.84. The item-total correlation score of the scale fell between 0.42 and 0.63 for the integrated group; the mean scores of 27% of the upper and lower groups were found to be statistically significant.

The scale consists of 13 items, and scores on the scale vary based on participants' answers: *No* = 1 point, *Sometimes* = 2 points, and *Yes* = 3 points. The lowest score that a participant can get from the scale is 13, while the highest score is 39. The higher the score that a participant gets, the more likely it is that they have higher levels of cyberbullying awareness.

Ability to Ensure Personal Cybersecurity Scale

The Ability to Ensure Personal Cybersecurity Scale was developed by Erol, Şahin, Yılmaz, and Haseski (2015) and consists of 25 items and five sub-dimensions that seek to determine individuals' ability to ensure their own cybersecurity. The sub-scales are Personal Privacy Protection (ten items), Avoiding Unreliable Sources (four items), Prevention and Precaution (five items), Payment Information Security (two items), and Remaining Anonymous (four items). Also, the M6, M8, M13, M14, M18, M19, M20, M21, M25, and M26 items were set as reversed items. Each score that a participant receives by responding each item represents a trait: *Never* = 1, *Rarely* = 2, *Sometimes* = 3, *Often* = 4, *Always* = 5. After conducting a factor analysis, a scale that consisted of five factors was created, and it accounted for 48.026% of the total variance. In order to calculate the internal consistency of the scale, the Cronbach's alpha coefficient (α) was used. It was found to be 0.735 for the entire scale, which has five sub-dimensions, while it was calculated to be 0.763 for the Personal Privacy Protection sub-dimension, 0.771 for the Avoiding Unreliable Sources sub-dimension, 0.704 for the Prevention and Precaution sub-dimension, 0.829 for the Payment Information Security sub-dimension, and 0.557 for the Remaining Anonymous sub-dimension.

Data Collection and Analysis

The scales and the personal information form were posted on Google Forms by the researcher. Prior to the process of answering questions, participants were given a brief rundown and asked to fill out the assessment tools on a volunteer basis. Data gathered from participants' answers was entered into a computer, and SPSS 22.0 (Statistical Package for the Social Sciences) was used to analyze the data set. A relational screening method was used during data analysis. Before conducting data analysis, the data set was tested for normality, and both kurtosis and skewness were found to fall between -2 and +2. Also, the Kolmogorov-Smirnov value was calculated to be $p>0.05$, which indicated that the data is normally distributed.

The independent *t*-test was used to identify statistical differences between two groups, while one-way ANOVA was used while comparing more than two groups. After conducting the one-way ANOVA test on normally distributed data, the Tukey Test, a type of post hoc test, was used to find out which specific groups' means were different. Lastly, correlation analysis was used to determine the relationship between the variables related to sensitivity: the ability to ensure personal cybersecurity and cyberbullying awareness.

FINDINGS

Data obtained from the personal information forms given to students to answer the study question and findings from quantitative data analysis of the scales used in this study are presented in this section.

To what degree are college students who participated in this study aware of cyberbullying (Cyberbullying Awareness Levels – CAL)?

Table 2. Descriptive Data regarding the Cyberbullying Awareness Scale

Sub-dimensions	N	$\overline{X}$	Highest Possible Score	Standard Deviation
CAL	401	33.20	65	3.92

Table 2 contains the means and standard deviations of participants' scores from the CAL scale. The scale, which has a single dimension, consists of 13 items. The highest score a participant can get from the scale is 65.00 while the lowest score is 13.00. The mean and the standard deviation were calculated to be $\overline{X}$= 33.20 and SD=3.92 respectively. Also, the mean was found to be higher

the median (32.50), which indicates that college students who participated in this study possess high levels of cyberbullying awareness.

To what extent are college students who participated in this study able to ensure their personal cybersecurity (Ability to Ensure Personal Cybersecurity – AEPC)?

Table 3. Descriptive Data regarding the Ability to Ensure Personal Cybersecurity Scale and its Sub-dimensions

Sub-dimensions	N	$\overline{X}$	Highest Possible Score	Standard Deviation
Personal Privacy Protection	401	36.34	50	5.51
Avoiding Unreliable Sources	401	16.33	20	3.70
Prevention and Precaution	401	16.00	25	4.06
Payment Information Security	401	8.08	10	2.31
Remaining Anonymous	401	13.46	20	2.66
AEPC TOTAL **Total**	401	90.24	125	10.73

Table 3 contains college students' scores from the Ability to Ensure Personal Cybersecurity Scale as well as means and standard deviations regarding the sub-dimensions of the scale. The Personal Privacy Protection sub-dimension has 10 items, and the highest score a participant can get is 50.00. The mean and the standard deviation of this sub-dimension were found to be $\overline{X}$= 36.34 and SD= 5.51 respectively. The mean of the Personal Privacy Protection sub-dimension is higher than the median (25.00). The second sub-dimension, Avoiding Unreliable Sources, consists of four items, and the highest score a participant can get from this sub-dimension is 20.00. The mean and the standard deviation of this sub-dimension were found to be $\overline{X}$= 16.33 and SD= 3.70 respectively. The mean of the Avoiding Unreliable Sources sub-dimension is higher than the median (10.00). The third sub-dimension, Prevention and Precaution, consists of five items, and the highest score a participant can get from this sub-dimension is 25.00. The mean and the standard deviation of this sub-dimension were found to be $\overline{X}$= 16.00 and SD= 4.06 respectively. The mean of the Prevention and Precaution sub-dimension is higher than the median (12.50).

The fourth sub-dimension, Payment Information Security, contains two items, and the highest score a participant can get from this sub-dimension is 10.00. The mean and the standard deviation of this sub-dimension were found to be $\overline{X}$= 8.08 and SD= 2.31 respectively. The mean of the Payment Information Security sub-dimension is higher than the median (5.00). The last sub-dimension, Remaining Anonymous, consists of four items, and the highest score a participant can get from this sub-dimension is 20.00. The mean and the standard deviation of this sub-dimension were found to be $\overline{X}$= 13.46 and SD= 2.66 respectively. The mean of the Remaining Anonymous sub-dimension is higher than the median (10.00). The highest score a participant can get from the entire scale is 125.00 and the mean and standard deviation of the scale as a whole were found to be $\overline{X}$= 90.24 and SD= 10.73 respectively. The mean of the scale is higher than the median (62.50) which shows that college students are highly capable of ensuring their personal cybersecurity.

Does college students' ability to ensure their personal cybersecurity and their levels of cyberbullying awareness differ significantly based on sex, college grade level, academic department, the amount of time they spend on the internet, propensity toward catfishing, and whether or not they had been cyberbullied and/or cyberbullied others?

The *t*-test was used to analyze whether or not there is a statistically significant difference between both college students' ability to ensure their personal cybersecurity and their levels of cyberbullying awareness and variables such as sex, catfishing, being cyberbullied, and cyberbullying. Results gathered from this analysis are shown in the relevant tables.

Table 4: *t*-Test Results of the Relationship between both Participants' Cyberbullying Awareness Levels (CAL) and their Ability to Ensure Personal Cybersecurity (AEPC) and Sex

Variables	**Sex**	**N**	$\overline{X}$	**SD**	**df**	**t**	**p**	**Cohen's d**
AEPC Total	Male	100	90.36	12.25	399	.121	**.90**	-
	Female	301	90.20	10.20				
CAL Total	Male	100	32.09	5.20	399	-3.529	**.00**	**.40**
	Female	301	33.84	3.95				

Table 4 shows the results from the independent samples *t*-test, which indicate that there isn't any statistically significant difference between the means of the AEPC and sex ($t(399) = .121$, $p>.05$). The mean value for male students ($\overline{X}_{male}$=90.36) was found to be higher than that of the female students ($\overline{X}_{female}$=90.20) in terms of their ability to ensure personal cybersecurity. Results from the independent sample *t*-test also show that there is a statistically significant difference between means of the CAL and sex ($t(399) = -3.529$, $p<.05$). The mean value for female students ($\overline{X}_{female}$=33.84) was higher than that of the male students ($\overline{X}_{male}$=32.09) in terms

of their levels of cyberbullying awareness; that is to say, the significant difference found in the *t*-test favors female students. In addition, the Cohen's d coefficient, which is designed to reveal the effect size of the difference between two groups, indicates that the effect size (0.40) is medium.

Table 5: *t*-Test Results of the Relationship between both Participants' Cyberbullying Awareness Levels (CAL) and their Ability to Ensure Personal Cybersecurity (AEPC) and Catfishing

Variables	Catfishing	N	□	SD	df	t	p	Cohen's d
AEPC Total	Yes	74	85,36	10,21	399	-4,433	**.000**	.57
	No	327	91,35	10,55				
CAL Total	Yes	74	32,45	5,22	399	-2,073	**.039**	**.27**
	No	327	33,61	4,11				

As shown in Table 5, the difference between the means of the AEPC and the catfishing variable was found to be statistically significant ($t(399) = -4.433$, $p<.05$) after conducting the independent samples *t*-test, which shows whether or not college students' ability to ensure their personal cybersecurity is affected by catfishing. Mean values show that students who said *no* ($\overline{X}_{no}=91.35$) when asked whether or not they catfish online were found to have a higher mean than those who said *yes* ($\overline{X}_{yes}=85.36$); the significant difference found in the *t*-test favors the students who said *no*. Also, the Cohen's d coefficient, which is designed to reveal the effect size of the difference between two groups, indicates that the effect size (0.57) is medium. Moreover, the difference between the means of the CAL scale and the catfishing variable was found to be statistically significant ($t(399) = -3.529$, $p<.05$) after conducting the independent samples *t*-test, which shows whether or not college students' levels of cyberbullying awareness is affected by catfishing. Mean values show that students who said *no* ($\overline{X}_{no}=33.61$) when asked whether or not they catfish online were found to have a higher mean than those who said *yes* ($\overline{X}_{yes}=32.45$); the significant difference found in the *t*-test favors the students who said *no*. The Cohen's d coefficient, which is designed to reveal the effect size of the difference between two groups, indicates that the effect size (0.27) is small.

Table 6: *t*-Test Results of the Relationship between both Participants' Cyberbullying Awareness Levels (CAL) and their Ability to Ensure Personal Cybersecurity (AEPC) and Being Cyberbullied

Variables	Being Cyberbullied	N	$\overline{X}$	SD	df	t	p	Cohen's d
AEPC Total	Yes	140	88,04	10,60	399	-3,043	**.003**	.32
	No	261	91,42	10,63				
CAL Total	Yes	140	33,63	4,56	399	-,779	**.436**	-
	No	261	33,27	4,24				

Table 6 shows that the difference between the means of the AEPC and the being cyberbullied variable was found to be statistically significant ($t(399) = -3.043$, $p<.05$) after conducting the independent samples *t*-test, which shows whether or not college students' ability to ensure their personal cybersecurity is affected by being cyberbullied. Mean values show that students who said *no* ($\overline{X}_{no}=91.42$) to whether or not they had been cyberbullied were found to have higher mean than those who said *yes* ($\overline{X}_{yes}=88.04$); the significant difference found in the *t*-test favors the students who said *no*. Also, the Cohen's d coefficient, which is designed to reveal the effect size of the difference between two groups, indicates that the effect size (0.32) is medium. Also, the difference between the means of the CAL and being cyberbullied variable was found to be statistically significant ($t(399) = -0.779$, $p>.05$) after conducting the independent samples *t*-test, which shows whether or not college students' levels of cyberbullying awareness are affected by being cyberbullied. Mean values show that students who said *yes* ($\overline{X}_{yes}=33.63$) when asked whether or not they had been cyberbullied were found to have a higher mean than those who said *no* ($\overline{X}_{no}=33.27$).

Table 7: *t*-Test Results of the Relationship between both Participants' Cyberbullying Awareness Levels (CAL) and their Ability to Ensure Personal Cybersecurity (AEPC) and Cyberbullying Others

Variables	Cyberbullying Others	N	$\overline{X}$	SD	df	t	p	Cohen's d
AEPC Total	Yes	20	87,85	10,81	399	-1,025	**.306**	-
	No	381	90,37	10,72				
CAL Total	Yes	20	31,05	4,90	399	-2,494	**.013**	**.57**
	No	381	33,52	4,30				

Table 7 shows that the difference between the means of the AEPC and cyberbullying others variable was found to be statistically significant ($t(399) = -1.025$, $p>.05$) after conducting the independent samples *t*-test, which shows whether or not college students' ability to ensure their personal cybersecurity is affected by cyberbullying others. Mean values show that students who said *no* ($\overline{X}_{no}=90.37$) when asked whether or not they had cyberbullied others were found to have a higher mean than those who said *yes* ($\overline{X}_{yes}=87.85$). Also, the difference between the means of the CAL and cyberbullying others variable was found to be statistically significant ($t(399) = -2.494$, $p<.05$) after conducting the independent samples *t*-test, which shows whether or not college students' levels of cyberbullying awareness are affected by cyberbullying others. Mean values show that students who said *no* ($\overline{X}_{no}=33.52$) to whether or not they cyberbully others were found to have higher mean than those who said *yes* ($\overline{X}_{yes}=31.05$); the significant

difference found in the *t*-test favors the students who said *no*. The Cohen's d coefficient, which is designed to reveal the effect size of the difference between two groups, indicates that the effect size (0.57) is medium.

Descriptive statistics and one-way ANOVA were used while analyzing the effects of college students' grade level, department, daily internet use, and reasons for using the internet on both their ability to ensure personal cybersecurity and their cyberbullying awareness. Also, within the purview of the data obtained from the one-way ANOVA, the Tukey Test, a type of post hoc test, was used to find out which specific groups' means were different with regard to statistically significant sets of data. Findings can be found in relevant tables.

Table 8. Descriptive Statistics regarding Participants' College Grade Level

Variables	**College Grade Level**	**N**	$\overline{X}$	**SD**
AEPC	Freshman	112	90,28	11,47
	Sophomore	70	88,82	8,39
	Junior	106	90,12	10,70
	Senior	113	91,20	11,30
	Total	401	90,24	10,73
CAL	Freshman	112	34,00	4,03
	Sophomore	70	33,52	3,73
	Junior	106	32,68	4,93
	Senior	113	33,40	4,41
	Total	401	33,40	4,35

Table 9. Results from One-Way ANOVA that Shows the Difference Between Participant's College Grade Level and the AEPC and CAL Scales

Variables		Sum of Squares	df	Mean Square	F	p	(Tukey)
AEPC	Between Groups	246,034	3	82,011	0,710	.55	-
	Withins Groups	45632,524	397	115,447			
	Total	46078,559	400				
CAL	Between Groups	95,110	3	31,703	1,677	.17	-
	Withins Groups	7505,44	397	18,905			
	Total	7600,554	400				

Table 9 contains data from one-way ANOVA that shows the difference between participants' college grade level and both the AEPC and CAL scales. There wasn't any statistically significant difference found between participants' college grade level and their ability to ensure their personal cybersecurity (F (3.397) = 0.710; p>.05). Also, no statistically significant difference was found between participants' levels of cyberbullying awareness and their college grade level (F (3.397) = 0.710; p>.05).

Table 10. Descriptive Statistics regarding College Students' Reasons for Using Internet

Variables	**Reasons for Using Internet**	**N**	$\overline{X}$	**SD**
AEPC	I- Study, research	119	92,59	11,41
	II-Film, music, fun	54	90,83	11,13
	III-Social media	194	88,11	9,73
	IV- Keeping up with news and the world	34	93,26	10,94
	Total	401	90,24	10,73
CAL	I- Study, research	119	34,10	4,26
	II-Film, music, fun	54	32,59	4,29
	III-Social media	194	33,48	4,17
	IV- Keeping up with news and the world	34	31,79	5,31
	Total	401	33,40	4,35

Table 11. One-Way ANOVA and Tukey Test Results that Show Differences between College Students' Reasons for Using Internet and Total Scores of AEPC and CAL Scales

Variables		Sum of Squares	df	Mean Square	F	p	(Tukey)
AEPC	Between Groups	1868,29	3	622,766	5,592	**.001**	I>III; IV>III Eta-squared (η2): 0,04
	Withins Groups	44210,26	397	111,361			
	Total	46078,55	400				
CAL	Between Groups	182,71	3	60,905	3,260	**.022**	I>IV Eta-squared (η2): 0,02
	Withins Groups	7417,83	397	18,685			
	Total	7600,55	400				

Table 11 reveals results from one-way ANOVA, which is used to determine whether or not there is a statistically significant difference between college students' reasons for using the internet and the total scores of AEPC and CAL scales. Based on the results, there was a statistically significant difference between college students' reasons for using the internet and their ability to ensure their personal cybersecurity (F (3.397) = 5.592; p<.05). The Tukey test, a type of post hoc test, was used to find out which specific groups' means were different after variances were found to be equal. Based on the Tukey test results, there was a statistically significant difference between the means of participants whose reasons for using the internet is study/research ($\overline{X}$= 92.59) and those who use the internet for social media ($\overline{X}$= 88.11); additionally, college students who said they use the internet for keeping up with news and the world ($\overline{X}$= 93.26) and those who use the internet for social media ($\overline{X}$= 88.11) have significantly different means. Put another way, participants whose reason for using the internet is study/research are more capable of ensuring their personal cybersecurity when compared to those who use the internet for social media. Similarly, participants whose reason for using the internet is keeping up with news and the world are more capable of ensuring their personal cybersecurity when compared to those who use the internet for social media.

The eta-squared (η2) value, which measures effect size, was calculated to be 0.04, which reveals that participants' reasons for using the internet accounts for 4% of their ability to ensure their personal cybersecurity. In addition, there was a statistically significant difference found between participants' levels of cyberbullying awareness and their reasons for using the internet (F (3.397) = 3.260; p<.05). The Tukey test, a type of post hoc test, was used to find out which specific groups' means were different after variances were found to be equal. Based on the Tukey test results, there was a statistically significant difference found between means of participants whose reasons for using the internet are study/research ($\overline{X}$= 34.10) and those who use the internet for keeping up with news and the world ($\overline{X}$= 31.79). The significant difference found in the test favors college students who use the internet for study/research. In other words, students whose reasons for using the internet are study/research possess higher levels of cyberbullying awareness than those who use the internet for keeping up with news and the world. The eta-squared value that measures the effect size was calculated to be 0.02, which reveals that participants' reasons for using the internet accounts for 2% of their levels of cyberbullying awareness.

Table 12. Descriptive Statistics regarding College Students' Departments

Variables	**Department**	**N**	$\overline{X}$	**SD**
AEPC	Elementary-Level Mathematics Teacher Education	60	89,08	10,81
	Theology	64	91,40	12,02
	Psychological Counselling and Guidance	225	90	10,26
	Elementary-Level Classroom Education	21	90,19	9,64
	Social Studies Teacher Education	31	91,87	12,01
	Total	401	90,24	10,73
CAL	Elementary-Level Mathematics Teacher Education	60	33,80	4,15
	Theology	64	33,43	4,48
	Psychological Counselling and Guidance	225	33,16	4,37
	Elementary-Level Classroom Education	21	31,61	4,04

	Social Studies Teacher Education	31	35,48	4,03
	Total	401	33,40	4,35

Table 13. One-Way ANOVA and Tukey Test Results that Show Differences between College Students' Departments and Total Scores of AEPC and CAL Scales

Variables		Sum of Squares	df	Mean Square	F	p	(Tukey)
AEPC	Between Groups	261,83	4	65,45	0,566	.68	-
	Withins Groups	45816,72	396	115,69			
	Total	46078,55	400				
CAL	Between Groups	222, 92	4	55,73	2,991	**.019**	V>III; V>IV Eta-squared (η2): 0,02
	Withins Groups	7377,62	396	18,63			
	Total	7600,55	400				

Table 13 reveals results from one-way ANOVA, which is used to determine whether or not there is a statistically significant difference between college students' departments and the total scores of AEPC and CAL scales. There wasn't any statistically significant difference found between college students' departments and their ability to ensure their personal cybersecurity (F (4.396) = 0.566; p>.05), while there was a statistically significant difference between their cyberbullying awareness and their college departments (F (4.396) = 2.991; p<.05). The Tukey test, a type of post hoc test, was used to find out which specific groups' means were different after variances were found to be equal. Based on the Tukey test results, a statistically significant difference was found between students in the social studies teacher education department ($\overline{X}$= 34.10) and those in the psychological counseling and guidance department ($\overline{X}$= 31.79). Also, there was a statistically significant difference found between students who study social studies teacher education ($\overline{X}$= 34.10) and those who study elementary-level classroom education ($\overline{X}$= 31.79). The significant difference found in the test favors college students who study social studies teacher education. That is to say, students whose department is social studies teacher education possess significantly higher levels of cyberbullying awareness when compared to those who study psychological counseling and guidance and elementary-level classroom education. The eta-squared value (η2) that measures the effect size was calculated to be 0.02, which reveals that participants' reasons for using the internet accounts for 2% of their levels of cyberbullying awareness.

Table 14. Descriptive Statistics regarding College Students' Daily Internet Use

Variables	**Daily Internet Use**	**N**	$\overline{X}$	**SD**
AEPC	1-3 hours	106	90,73	10,39
	4-5 hours	187	90,09	10,63
	6+ hours	108	90,02	11,29
	Total	401	90,24	10,73
CAL	1-3 hours	106	33,09	4,58
	4-5 hours	187	33,18	4,38
	6+ hours	108	34,09	4,05
	Total	401	33,40	4,35

Table 15. One-Way ANOVA and Tukey Test Results that Show Differences between College Students' Daily Internet Use and Total Scores of AEPC and CAL Scales

Variables		Sum of Squares	df	Mean Square	F	p	(Tukey)
AEPC	Between Groups	34,771	2	17,385	0,150	.86	-
	Withins Groups	46043,788	398	115,68			
	Total	46078,55	400				
CAL	Between Groups	70, 605	2	35,302	1,866	.15	-
	Withins Groups	7529,949	398	18,919			
	Total	7600,55	400				

Table 15 reveals results from one-way ANOVA, which was used to determine whether or not there is a statistically significant difference between college students' daily internet use and total scores of AEPC and CAL scales. There wasn't any statistically significant difference found between college students' daily internet use and their ability to ensure their personal cybersecurity (F (2.398) = 0.150; p>.05). Similarly, there wasn't any statistically significant difference between college students' levels of cyberbullying awareness and their daily internet use (F (2.398) = 1.866; p>.05).

Is there a statistically significant relationship between college students' levels of cyberbullying awareness and their ability to ensure their personal cybersecurity?

Pearson's correlation coefficient was used to measure the statistical relationship between college students' levels of cyberbullying awareness and their ability to ensure their personal cybersecurity. Findings obtained from this analysis are shown in Table 16.

Table 16. Pearson's Correlation Coefficient Analysis of the Relationship between College Students' Levels of Cyberbullying Awareness and their Ability to Ensure their Personal Cybersecurity

Variables		AEPC	CAL
AEPC	r	1	,311**
	p		,000
	N		401
CAL	r		1
	p		
	N		
**p<.001			

As shown in Table 16, there is a positive, moderate, and statistically significant relationship (r=0.31, p<.01) between college students' scores from the AEPC and CAL scales. That is to say, as college students' levels of cyberbullying awareness increase, their level of ability to ensure their personal cybersecurity also increases.

DISCUSSION, CONCLUSION and RECOMMENDATIONS

Discussion and Conclusion

This study examines the relationship between college students' levels of cyberbullying awareness and their ability to ensure their personal cybersecurity.

Analysis of the question "*To what degree are college students aware of cyberbullying?"* shows that college students who participated in this study possess high levels of cyberbullying awareness. Results of this study are similar to findings obtained from a variety of studies conducted by Gezgin and Çuhadar (2012), Uysal, Duman, Şahin, and Yazıcı (2014), Aktan and Çakmak (2015), Dikmen and Çağlar (2017), Odacı and Çelik (2018), Kozan and Özek (2019), Bridge and Doğan (2019), Hendekçi and Kadiroğlu (2020), and Gelmez (2020). Similarly, in their study, Uysal, Duman, Şahin, and Yazıcı (2014) found that participants were well aware of the types of cyberbullying they might encounter in digital environments and tend to take necessary measures to ensure their personal cybersecurity against potential cyberattacks.

Also, Odacı and Çelik (2018) noted that participants possess cyberbullying awareness as they were well-informed regarding etiquette in technology; however, Hendekçi and Kadiroğlu (2020) stressed that the main reason why participants develop cyberbullying awareness is because they themselves have been cyberbullied in digital environments. People who spend a significant amount of time online may be cyberbullied more frequently due to the fact that they are unable to know the intentions of the people whom they interact and communicate with. As a result, people learn how to be more cautious in digital environments over the years to protect themselves from such interactions and create an online environment for themselves where they communicate with those whom they know and visit trustworthy websites they are familiar with.

Analysis of the question "*To what extent are college students able to ensure their personal cybersecurity?"* showed that college students are highly capable of ensuring their personal cybersecurity. Results obtained from this study dovetail neatly with results from previous studies conducted by Avcı and Oruç (2020) and Karacı, Akyüz, and Bilgici (2017). Given that college students possess higher levels of awareness and common sense when using the internet (Aslankara and Usta, 2020), it is safe to say that they are well-equipped to ensure their personal cybersecurity. Akgün and Topal (2015) stated that surprisingly, there wasn't any statistically significant difference between participants who attended information security training and those who didn't.

Analysis of the question *"Does college students' ability to ensure their personal cybersecurity and their levels of cyberbullying awareness differ significantly based on sex?"* revealed that college students' levels of cyberbullying awareness significantly differ based on their sex, but there wasn't any statistically significant difference found between college students' sex and their ability to ensure their personal security; the difference regarding levels of cyberbullying awareness favors female students. A close scrutiny of a variety of previous studies in the relevant literature that target students from different ages (middle school, high school, college students) shows that there is a statistically significant relationship between participants' levels of cyberbullying awareness and sex; female participants were found to possess higher levels of cyberbullying awareness compared to male participants in many studies (Aktan and Çakmak 2015; Ata and Adnan, 2016; Bridge and Duman, 2019; Dikmen and Çağlar, 2017; Gelmez 2020; Gezgin, and Çuhadar, 2012; Hendekçi and Kadiroğlu, 2020:21; Horzum and Ayas, 2013; Odacı and Çelik, 2018; Peker, 2019; Pınar, Cesur, Koca, Sayın, and Sancak, 2017).

These results dovetail with the findings of this study. İkiz (2009) and Horzum and Ayas (2013) attributed the results that found that women possess higher levels of cyberbullying awareness to the fact that women are by nature more empathetic. Also, İkiz (2009) pointed out that parenting styles and gender role expectations in Turkish culture play a role in creating this situation. Peker (2019) noted that women are more cautious and aware of dangers in digital environments compared to men as they are more sensitive to potential threats in real-life environments as well. Pınar, Cesur, Koca, Sayın, and Sancak (2017) pointed out that Turkish women have higher emotional intelligence due to their roles and the values imposed upon them by Turkish society and are more aware of how to protect themselves from cyberbullying. Aktan and Çakmak (2015), on the other hand, found out that women possess higher levels of cyberbullying awareness compared to men simply because they don't feel secure in digital environments.

They also noted that women are able to actively use virtual mediums by creating environments that allow them to feel more secure. Taking all these findings into account, it is safe to say that women are more cautious as they are worried that they may be cyberbullied in digital environments as a result of real-life bullying they had had to face in society; they tend to avoid putting themselves into situations where they may be cyberbullied, and consequently they develop cyberbullying awareness. However, contrary to the results of this study, some studies suggest that there is no statistically significant relationship between cyberbullying awareness and sex (Ayas and Horzum, 2011; Uysal, Duman, Şahin, and Yazıcı, 2014; Kozan and Özek, 2019). Uysal, Duman, Şahin, and Yazıcı (2014) ascribed this finding to the fact that college students tend to attach importance to such matters and their point of view is pretty much the same regardless of their sex.

No statistically significant difference was found between sex and the ability to ensure personal cybersecurity. As such, the results of this study dovetail with the findings of several studies in the relevant literature (Gökmen and Akgün, 2015; Karacı, Akyüz, and Bilgici, 2017; Subramaniam, 2017; Yiğit and Seferoğlu, 2019). Therefore, it can be stated that both female and male students have similar capacities when it comes to ensuring their personal cybersecurity. However, contrary to the findings of this study, several studies conducted by Tekerek and Tekerek (2013), Akgün and Topal (2015), and Karakaya and Yetgin (2020) showed that female students are highly capable of ensuring their personal cybersecurity, more so than their male counterparts.

Analysis of the question "*Do college students' levels of cyberbullying awareness and their ability to ensure their personal cybersecurity differ significantly based on their propensity to catfish?"* revealed that there was a statistically significant difference found between catfishing and college students' ability to ensure their personal cybersecurity; the difference favors students who said *no* when asked whether or not they catfish online. Individuals typically set up a fake online identity because they are worried about being harmed in some way or about unwittingly becoming a part of illegal or illicit activities. During adolescence in particular, people may catfish because they haven't yet reached the age of criminal responsibility and also have lower levels of information security awareness. However, it can be assumed that college students have higher levels of both cognition and awareness (Aslankara and Usta, 2020), and they should be better equipped to ensure their personal cybersecurity as well.

There was also a statistically significant difference between cyberbullying awareness and catfishing; the difference regarding levels of cyberbullying awareness favors students who said *no* when asked whether or not they have ever engaged in online catfishing. It appears that students who possess higher levels of cyberbullying awareness and sensitivity visit secure websites without the need to catfish or construct a fake identity. However, contrary to the findings of this study, a study conducted by Dikmen and Çağlar (2017), showed that there was no statistically significant relationship between cyberbullying awareness and catfishing or frequency of catfishing.

Analysis of the question "*Do college students' levels of cyberbullying awareness and their ability to ensure their personal cybersecurity differ significantly based on whether or not they had been cyberbullied?"* revealed that there was a statistically significant difference between a student's experience being cyberbullied and their ability to ensure their personal cybersecurity; the difference favors students who said *no* when asked whether or not they have ever been cyberbullied. As stated by Aslankara and Usta (2020), given that the frequency of many risky behaviors in digital environments decreases particularly during the college period (entry into adulthood) where people have higher levels of awareness in general, it is safe to state that college students are more conscious of ensuring their personal cybersecurity, and consequently, they aren't cyberbullied by others. On the other hand, there was no statistically significant relationship found between cyberbullying awareness and incidences of being cyberbullied. Similarly, both Odacı and Çelik (2018) and Dikmen and Çağlar (2017) found that there wasn't any significant relationship between cyberbullying awareness and incidences of being cyberbullied.

Moreover, a study conducted by Gezgin and Çuhadar (2012) revealed that cyberbullying awareness isn't affected by whether or not people are expose to cyberbullying. This could be explained by the fact that the number of people in the sample group who had been cyberbullied is considerably lower than the number of people who haven't been cyberbullied. Also, people who have been exposed to cyberbullying firsthand may possess low levels of cyberbullying awareness and lack an empathetic perspective. Our study showed that the mean values of both cyberbullying awareness and participants' answers when asked whether or not they had been cyberbullied were very close, which indicates that people may be indifferent to and/or dismissive of cyberbullying in general regardless of whether or not they had been cyberbullied.

Analysis of the question "*Do college students' levels of cyberbullying awareness and their ability to ensure their personal cybersecurity differ significantly based on cyberbullying others?"* revealed that there was a statistically significant relationship between college students' cyberbullying awareness and whether or not they had cyberbullied others; the difference favors students who said *no* when asked whether or not they had cyberbullied others. This result reveals that people who are conscious of negative aspects of digital environments and consequently develop awareness tend not to exhibit behaviors such as cyberbullying others. A

study conducted by Dikmen and Çağlar (2017), on the other hand, showed that there wasn't any statistically significant relationship between cyberbullying awareness and cyberbullying others.

Our study revealed that there wasn't any statistically significant difference between cyberbullying others and the ability to ensure personal cybersecurity; this may be the result of the difference between the number of participants who answered *yes* or *no*. Also, college students' belief that they are not going to be cyberbullied could also stem from the idea that they take all necessary precautions in digital environments and/or the fact that they play down the importance of cyberbullying in general.

Analysis of the question "*Do college students' levels of cyberbullying awareness and their ability to ensure their personal cybersecurity differ significantly based on college grade level?"* revealed that there wasn't any statistically significant difference between college students' grade level and either their ability to ensure their personal cybersecurity or their cyberbullying awareness. This result dovetails with findings obtained from a study conducted by Gezgin and Çuhadar (2012). Taking this result into consideration, it can be asserted that college students from different grade levels are similar in terms of their levels of cyberbullying awareness and their ability to ensure their personal cybersecurity.

Analysis of the question "*Does college students' ability to ensure their personal cybersecurity differ significantly based on their reasons for using the internet?"* revealed that there was a statistically significant difference between college students' reasons for using the internet and their ability to ensure their personal cybersecurity. Simply put, college students who use the internet for study/research were found to be more capable of ensuring their personal security compared to those who use it for social media. Similarly, college students who use the internet to keep up with news and the world are more capable of ensuring their personal cybersecurity compared to those who use it for social media. Bearing this in mind, it can be asserted that college students who possess higher levels of awareness in digital environments and who use the internet for educational and academic purposes as well as keeping up with news and the world are quite capable of ensuring their personal cybersecurity.

Analysis of the question "*Do college students' levels of cyberbullying awareness differ significantly based on their reasons for using the internet?"* revealed that there was a statistically significant difference between college students' cyberbullying awareness and their reasons for using the internet. Thus, college students who use the internet for study/research have significantly higher levels of cyberbullying awareness compared to those who use it to keep up with news and the world. Similarly, in their study with pre-service teachers, Odacı and Çelik (2018) found that levels of cyberbullying awareness differ based on users' reasons for using the internet. They noted that people who use the internet for educational purposes appear to have higher levels of cyberbullying awareness compared to those who use it for entertainment; this can be considered a sign that people who use the internet for educational purposes are more cognizant of how they are using it.

Another study conducted by Bridge and Duman (2019) similarly revealed that teenage users' reasons for using the internet were studying, doing homework, playing online games, watching movies, connecting to social networks, online shopping, listening to music, checking personal emails, and various other activities; they found that scores from the cyberbullying awareness scale differ significantly based on users' reasons for using the internet. Thusly, teenagers who use the internet for doing their homework or studying were found to have higher levels of cyberbullying awareness than those who use it for playing online games. These results dovetail with the results of our study. It should also be noted that college students use the internet to advance in their academic lives as they have reached a certain level of maturity and are equipped with a relevant set of skills that allow them to more effectively use these mediums.

Analysis of the question "*Does college students' ability to ensure their personal cybersecurity differ significantly based on their departments?"* revealed that there wasn't any statistically significant difference between college students' departments and their ability to ensure their personal cybersecurity. However, a study conducted by Yiğit and Seferoğlu (2019) revealed that there were statistically significant differences between sub-scales created for their study and college students' ability to ensure their personal security; students whose departments were closely related to computer sciences such as computer education and instructional technology (CEIT) and computer programming were found to be better at ensuring their personal cybersecurity compared to students from other departments.

Analysis of the question "*Do college students' levels of cyberbullying awareness differ significantly based on their departments?"* revealed that there was a statistically significant difference between college students' levels of cyberbullying awareness and their departments. Based on these results, students from the social studies teacher education department have significantly higher levels of cyberbullying awareness than students from the psychological counselling and guidance department *and* students from the elementary-level classroom education department.

Analysis of the question "*Do college students' levels of cyberbullying awareness and their ability to ensure their personal cybersecurity differ significantly based on their daily internet use?"* showed that there wasn't any statistically significant difference between college students' daily internet use and their ability to ensure their personal cybersecurity. In their study, Yiğit and Seferoğlu (2019) found that students whose weekly internet use was 20 hours or more had a better understanding of personal cybersecurity than those whose weekly internet use was between 6 and 10 hours. However, all things considered, they stated that the evaluation of users' weekly internet use was not a very effective way to gain insight into students' ability to ensure their personal cybersecurity. Thusly, these results are somewhat similar to the results of our study.

Furthermore, a study conducted by Gökmen and Akgün (2015) similarly revealed that there wasn't any statistically significant difference between students' levels of knowledge regarding information security and their daily internet use. Contrarily, Akgün and Topal (2015) found that daily internet use had a significant effect on information security awareness. The analysis of the study question also revealed that there wasn't any statistically significant relationship between students' daily internet use and their levels of cyberbullying awareness. This result dovetails with results of studies conducted by both Dikmen and Çağlar (2017) and Gezgin and Çuhadar (2012). Keeping this in mind, it should be noted that the amount of time college students spend on the internet on a daily basis is fairly uniform.

Analysis of the question "*Is there any statistically significant relationship between college students' levels of cyberbullying awareness and their ability to ensure their personal cybersecurity?"* showed that there is a positive, moderate correlation between college students' cyberbullying awareness and their ability to ensure their personal cybersecurity. Thus, college students' levels of cyberbullying awareness increase as they become more capable of ensuring their personal cybersecurity. It appears that college students will have higher levels of cyberbullying awareness as they become more knowledgeable about ensuring their personal cybersecurity.

Recommendations

As a consequence, individuals who have developed an awareness of digital environments and who use the internet consciously are more aware of and sensitive to cyberbullying attacks and threats. Therefore, raising awareness of such matters and creating university classes where subjects such as information systems and internet security are taught could be beneficial in terms of reaching more people. As a final recommendation, universities could place more emphasis on promoting and enrolling students in classes that delve into these topics in detail.

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Research Paper

Examining the Prediction of Digital Game Addiction Awareness on Digital Educational Game Usage

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Awareness of digital game addiction
Digital educational games
Video games
Digital educational games usage

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ABSTRACT

Background: Individuals need to be conscious and aware not to experience the negative effects of digital games and identify the difference between dijital games and digital educational games. The use of digital educational games has four sub-dimensions. These are the "affective approach", the "perceived usefulness," "perceived control," and "behavioral approach" (Sarıgöz, Bolat, & Alkan, 2018). In this study, these sub-dimensions analyzed in the frame of digital game addiction awareness. Purposes: This study examines the predictors of pre-service teachers' awareness of digital game addiction and their use of digital educational games.
Methodology/Approach: The data of this study, in which the correlational predictive research method was used, were collected through the Digital Game Addiction Awareness Scale and the Digital Educational Game Use Scale.
Findings: As a result of the study in which 246 pre-service teachers participated; there is a negative relationship between pre-service teachers' awareness of digital game addiction and their emotional approach towards their use of digital educational games, their perceived usefulness of digital educational games, their perceived control in digital educational games using and their behavioral approaches to digital educational game use, which expresses the preference of digital educational games over other games, and the relationship between digital educational game playing situations are determined. In addition, it was determined that all of these relationships were predictive.
Discussion: Digital educational games are played to learn. While it is expected that teacher candidates' awareness of digital game addictions will increase, it is recommended to raise awareness of the benefits of digital educational games so that they do not have negative feelings about digital educational games.

INTRODUCTION

Digital games have an important place in human life thanks to the developing game technologies (e.g., mobile devices, game consoles, virtual reality, etc.). From 2015 to 2020, the number of individuals playing active digital games increased from 1.99 billion to 3.00 billion (Newzoo, 2021). A study conducted in 2020 predicted that 3.07 billion people will actively play digital games by 2023 (Clement, 2021). Therefore, it can be said that approximately one out of every two people in the world will actively play digital games for up to a few years. There are multiple reasons for this situation to occur. People play digital games to meet new people, adapt to the outside world, relax, have fun, and improve their problem-solving and logical thinking (Entertainment Software Association, 2021; Sağlam & Topsümer, 2019). In addition, digital games increase attention and improve task change skills (Benoit et al., 2020; Cardoso-Leite et al., 2016). Considering all these positive situations, it can be said that the use of digital games will increase even more, and they will have an important place in human life. The widespread use of digital games, the prediction that this use will increase in the future, and the positive thoughts of individuals about these games bring to mind digital game addiction.

Digital game addiction is defined as the result of individuals playing uncontrolled, excessive (long) digital games, not being able to stop the urge to play, integrating the game with their daily real life, inability to find time to fulfill their responsibilities due to excessive use, preferring to play games instead of real lives, and these negative behaviors, the inability to solve the problems in daily life and the aggressive behavior (Eni, 2017; Lemmens et al., 2011). Contrary to the positive situations mentioned above, individuals with addiction to digital games may experience negative situations caused by digital games. It is seen that this phenomenon is included as "Internet Gaming Disorder" in the Diagnostic and Statistical Manual of Mental Disorders (DSM-5) book published by the American Psychiatric Association (APA) (American Psychiatric Association, 2013).

Uncontrolled digital gameplay by individuals addicted to digital games exposes individuals to various negative situations caused by digital games. It is seen that these are grouped into two categories as psychological and physical effects. Psychological effects: There are mental disorders such as the increased tendency to bullying, anxiety level disorders, depression, increased tendency to display aggressive/violent behavior, exhibiting asocial behaviors, and feeling of loneliness. Physical negative effects are; development due to excessive use is expressed as sleep quality and nutritional irregularities, waist-neck pain, postural deformation, dry eyes, pain and redness in the eyes, carpal tunnel syndrome, obesity, neglect in self-care skills (Akçayır, 2013; Ballard et al.,

2009; Brown & Bobkowski, 2011; Bruni et al., 2015; Gentile et al., 2012; Kılıç, 2019; Lemmens et al., 2011; Mentzoni et al., 2011; Mustafaoğlu & Yasacı, 2018; Nazlıgül et al., 2018; Ögel, 2012; Republic of Turkey Ministry of Health, 2018; Wack & Tantleff-Dunn, 2009). These situations caused by digital games draw attention to individuals' digital game playing behaviors and digital game addiction.

Individuals need to be conscious and aware not to experience the negative effects of digital games. In the examinations made according to the demographic characteristics of the individuals, it is seen that the age range of the majority is from adolescence to adulthood (Turkish Statistical Institude, 2018, 2020). In another study conducted in all age groups, it was stated that 80% of individuals who play digital games are 18 years or older (Entertainment Software Association, 2021). It is thought that individuals who play digital games are at a young age and may be exposed to addictive use due to their age (Canoğulları, 2014; Yalçın-Irmak & Erdoğan, 2015). Considering that the number of young and child individuals in Turkey's population is high, it is essential to pay attention to the risks that digital games may cause and take all kinds of precautions to prevent these risks (Turkish Statistical Institude, 2021).

Some duties and responsibilities fall on both their families and teachers at the point of determining the digital game addiction status of young people. It is thought that the determination of these negative use cases by teachers, especially in school environments where their families cannot observe, may allow earlier measures to be taken against the negative behaviors of young individuals and the behavior not to progress further. In other words, it is thought that digital game addiction situations can be prevented thanks to teachers who can be a support mechanism for their students at this point. The essential need for this is for teachers to gain the necessary knowledge and skills to understand, internalize, and detect digital game addiction.

In addition to the teachers' awareness of digital game addiction. Digital educational games help students increase their motivation in their learning processes, provide engagement, and realize effective learning (Huang, 2011; Jackson et al., 2018; Papastergiou, 2009; Prensky, 2003; Sánchez-Mena et al., 2017). In addition, it helps students to develop their cognitive, spatial and motor skills together with their information and communication technologies skills in their learning processes (Felicia, 2009). As stated above, digital games, which have an addiction and negative effects, can facilitate teachers' tasks and create an enjoyable learning environment for students when used for educational purposes (Kapidere, 2021). Arising due to their current use; It is seen that digital games that cause negative effects such as addiction, aggressive behaviors and health problems are not educational-purposed (Anderson et al., 2010; Gentile, 2011; Kuss, 2013). The studies state that the negative effects of digital games such as addiction and aggressive behaviors are exaggerated in educational-oriented use, and the positive effects they will provide in their use as educational tools are ignored (Bösche & Kattner, 2013). Therefore, teachers' awareness of non-educational digital game addiction may cause them to ignore or not distinguish the positive effects that may occur against educational digital games, have prejudices and negative thoughts, reduce their use in educational environments, and even not to use them. It is essential to examine pre-service teachers' awareness of educational digital games within their usage trends.

This research examines the predictor of digital educational game use by pre-service teachers' awareness of digital game addiction. The use of digital educational games is defined in four sub-dimensions. These are the "emotional approach," which is defined as the state of experiencing negative feelings such as fear and anxiety before and while playing the game, the "perceived usefulness" which is defined as acting by believing that educational games are beneficial depending on the advantages offered, and the game by acting emotionally and reactively while playing the educational game. It is "perceived control," which is defined as the perception of taking control in terms of completing tasks and helping other players, and "behavioral approach," which expresses positive behavior towards playing educational digital games instead of playing non-educational digital games (Sarıgöz et al., 2018). In addition, their awareness of digital game addiction in predicting their use of digital educational games, in general, was also examined. In this direction, answers to the following questions were sought:

1. Does pre-service teachers' awareness of digital game addiction predict their emotional approach to educational digital game use?
2. Does pre-service teachers' awareness of digital game addiction predict their perception of usefulness in the use of educational digital games?
3. Does pre-service teachers' awareness of digital game addiction predict their perception of controlling in educational digital game use?
4. Does pre-service teachers' awareness of digital game addiction predict their behavioral approach to educational digital game use?
5. Does pre-service teachers' awareness of digital game addiction predict their use of digital games?

METHOD

Research Design

This study examined whether pre-service teachers' digital game addiction awareness predicted their educational digital game use. The correlational predictive research method, one of the quantitative research methods, was used as a research design in the study. Correlational predictive research methods refer to estimating the other by having information about one of the characteristics of individuals who have at least two variables known to be related (Fraenkel et al., 2012).

Participants

The research was carried out at the Faculty of Education of a state university located north of Turkey. 274 pre-service teachers participated in the study. 13 of the students refused to participate in the study during data collection. 15 students stated that they have never played digital educational games in their lives. Valid data were obtained from 246 pre-service teachers. Demographic information of the participants is given in Table 1.

Table 1. Demographic information of the participants

		n	%
Gender	Woman	192	78.0
	Man	54	22.0
Department	Primary Education	40	16.3
	Science Education	15	6.1
	Elementary Mathematics Teaching	22	8.9
	Fine Arts Teaching	13	5.3
	Pre-School Teaching	66	26.8
	Social Studies Teaching	45	18.3
	Turkish Language Teaching	45	18.3
Age	17-18	41	16.7
	19-20	156	63.4
	21-22	32	13.0
	23+	17	6.9
Personal Computer Ownership	No Computer	101	41.1
	1-3 Year	55	22.4
	4-6 Year	30	12.2
	7-9 Year	18	7.3
	10+ Year	42	16.9
Other Types of Digital Games Played by Participants	Role Play (Example: The Sims etc.)	48	19.5
	Strategy (Example: Age of Empires etc.)	48	19.5
	War (Example: Call of Duty etc.)	85	34.6
	Fight (Example: Street Fighter etc.)	38	15.4
	Adventure (Example: Grand Theft Auto etc.)	57	23.2
	Massive (Example: Counter Strike etc.)	49	19.9
	Sports (Example: Pro Evolution Soccer etc.)	46	18.7
	Riddle/Puzzle (Example: Tetris etc.)	131	53.3

As seen in Table 1, 192 (78.0%) of the students participating in the research were female, and 54 (22.0%) were male. 40 (16.3%) of the participants were from the Department of Primary Education, 15 (6.1%) from the Department of Science Education, 22 (8.9%) from the Department of Primary Education Mathematics Teaching, 13 (5.3%) from the Department of Fine Arts Education, 66 (26.8%) from the Department of Pre-school Education, 45 (18.3%) students from Social Studies Teaching and 45 (18.3%) students from Turkish Language Teaching departments participated. 41 (16.7%) of the students were at the age of 17-18, 156 (63.4%) were at 19-20, 32 (13.0%) were 21-22 years old and 17 (6.9%) students were at the age of 23 and over. 101 (41.1%) of the students stated that they did not have a personal computer. 55 (22.4%) of them had a personal computer for 1-3 years, 30 (12.2%) for 4-6 years, and 18 (7.3%) for 7-9 years. The number of students who have had a personal computer for 10 years or more is 42 (=6.9%). When digital games played by participants were examined, it is seen that 48 (19.5%) of them were playing role-playing games, 48 (19.5%) of them were playing strategy games, 85 (34.6%) of them were playing war games, 38 (15.4%) of them were playing fighting, 57 (23.2%) stated that they preferred adventure games, 49 (19.9%) massive, 46 (18.7%) sports and 131 (53.3%) riddle/puzzle type digital games.

Data Collecting Tools

Digital Game Addiction Awareness Scale: In the study, the "Digital Game Addiction Awareness Scale" developed by Tekkurşun Demir and Cicioğlu (2020) was used to determine pre-service teachers' awareness of digital game addiction. The scale was developed in a 5-point Likert format (1=Strongly Disagree, 5=Strongly Agree) with individuals aged 18-43, and consists of 12 items and 2 factors (Internal Awareness, External Awareness). The Cronbach Alpha Coefficient of the overall scale is .88. Similarly, the Cronbach Alpha Coefficient calculated in this study is .90.

Digital Educational Game Usage Scale: In the study, the "Digital Educational Game Usage Scale" was developed by Bonanno and Kommers (2008) and adapted into Turkish by Sarıgöz, Bolat, and Alkan (2018) was used to determine pre-service teachers' use of digital educational games. The scale was developed in a 5-point Likert format (1=I totally disagree, 5=I totally agree) with the students studying at the education faculty. The scale has 21 items with 4 factors: Affective Component (α=.79), Perceived Usefulness (α=.77), Perceived Control (α=.79), and Behavioral Components (α=.80). The Cronbach Alpha Coefficient for the overall scale is .78. In this study, the Cronbach Alpha Coefficient is .81 for overall scale. In addition, the Cronbach alpha coefficient of the sub-

factors of the scale are .80 for Affective Component, .79 for Perceived Usefulness, .83 for Perceived Control, and .80 for Behavioral Components in this study.

Data Collection and Analysis

Demographic information, "Digital Game Addiction Awareness Scale," and "Digital Educational Game Usage Scale" are included in the measurement tool created to collect data. Scale forms were transferred to the web environment via Google Forms. The students of the Faculty of Education were informed about the study. The weblink of the scales was shared with the students who volunteered to participate in the research. A preliminary analysis was made with the collected data, and the data set formed by the valid data was determined. The "Emotional Approach" sub-dimension of the Digital Educational Game Usage Scale was reverse scored for ease of interpretation.

In the data analysis, the Simple Linear Regression Model was used to examine the pre-service teachers' general awareness of digital game addiction to predict their use of digital educational games. Before proceeding to the analysis, the relationships between the variables were examined to estimate the models. Pearson Product Moments Correlation Coefficient was used to determine the relationships. Before applying the regression models, sufficient participants, normal distribution, linear relationship between dependent and independent variables, and homogeneous distribution of variances were examined for the Simple Linear Regression Model. The assumption of sufficient participants was examined because the number of observations stated by Alpar (2013) was 20 times the number of variables. The assumption that the distribution is normal was examined with histogram plots of the residuals. The assumptions of the linearity of the relationship between the variables and the homogeneity of the variances were examined with the scatter plot of the residuals.

FINDINGS

The study examined the predictors of teacher candidates' digital game addiction awareness levels and its sub-dimensions on digital educational game use. The findings obtained in this direction are presented below.

The study examined the predictive status of pre-service teachers' awareness of digital game addiction (ADGA) on their digital educational games uses (DEGU). Descriptive analyses, Pearson Product Moments Correlation and simple linear regression analysis, were performed while conducting this study. In the analysis, the relationship between the variables was examined to estimate descriptive statistics and the regression model (Table 2).

Table 2. The Correlation Coefficient Analysis Results

	Pearson Moments Correlation Coefficient					$\bar{X}$	Ss	Min.	Max.
	EA	PU	PC	BA	DEGU				
ADGA	-.23*	-.14**	-.26*	-.20*	-.29*	3.76	.73	1.25	5.00

** p<.01; ** p<.05;* ***EA:*** *Emotional Approach,* ***PU:*** *Perceived Usefulness,* ***PC:*** *Perceived Control,* ***BA:*** *Behavioral Approach,* ***DEGU:*** *Digital Educational Game Uses*

When Table 2 is examined, there is a significant negative correlations between the pre-service teachers' ADGAs ($\bar{X}$=3.60; Sd=.84; Min=1.00; Max=5.00) and their emotional approach (r=-.23, p<.01), their perceived usefulness. (r=-.14, p<.05), perceived controls (r=-.26, p<.01), behavioral approaches (r=-.20, p<.01), and general conditions (r=-. 29, p<.01). Considering these relationships, a simple linear regression analysis was performed.

Assumptions are tested before performing a simple linear regression analysis. The assumption of normal distribution of the data was examined with histogram plots of residual values (Figure 1).

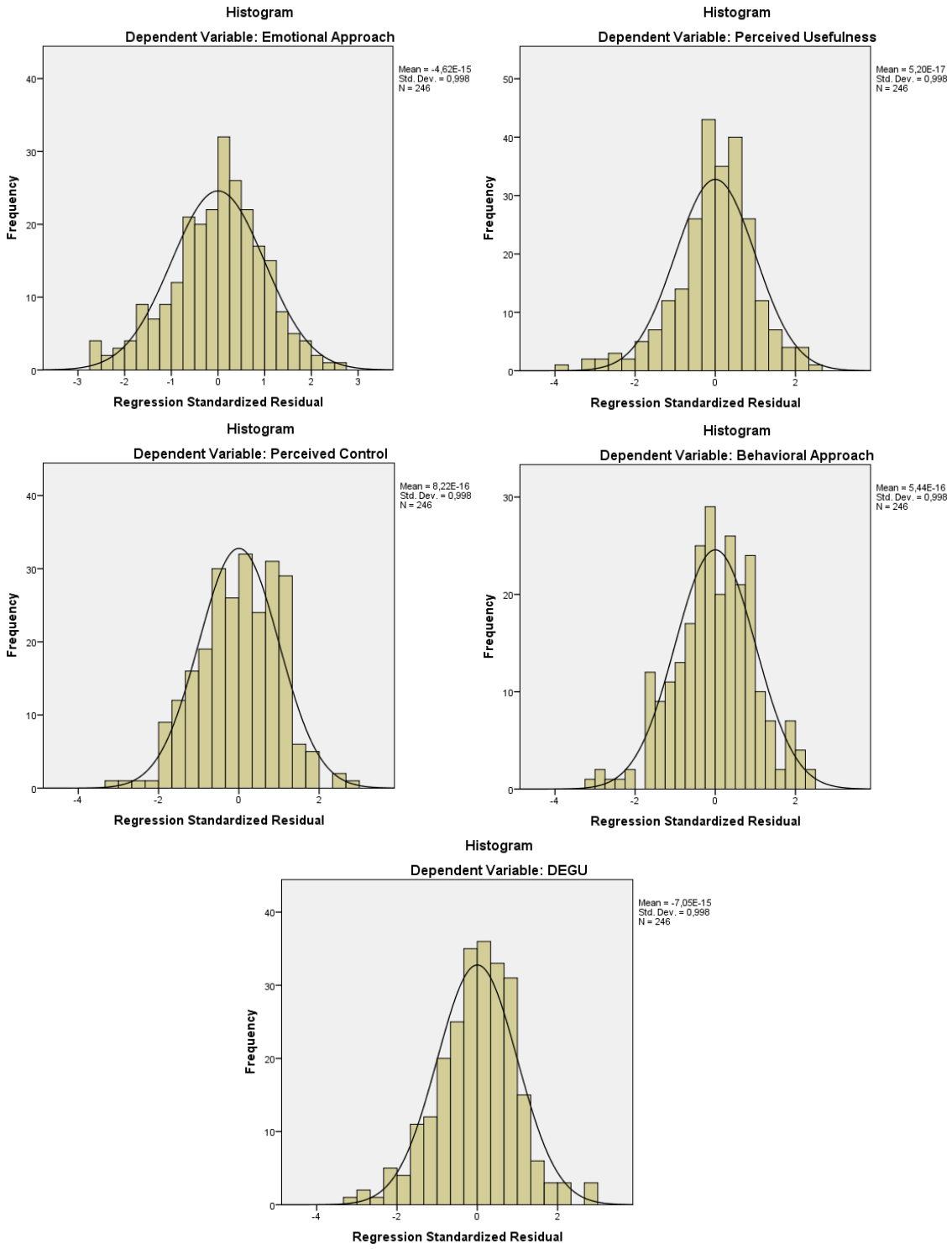

Figure 1. Histogram Plots of Standardized Residuals of a Simple Linear Regression Model

As can be seen in Figure 1, it is seen that the distributions of the residuals formed after the regression analysis are close to normal. The assumptions of linearity of data and homogeneity of variances were examined with scatter plots of residuals and predicted values (Figure 2).

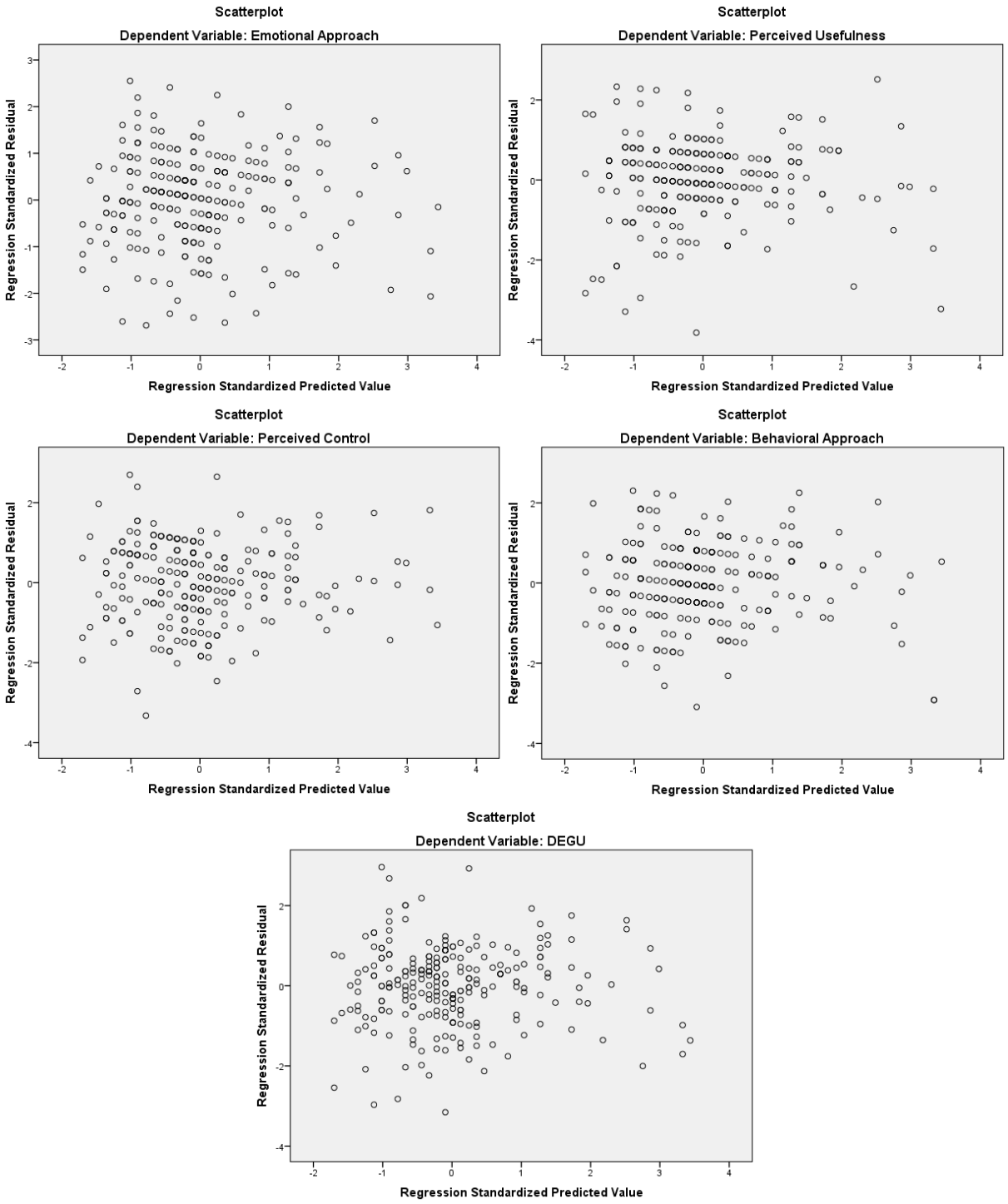

Figure 2. Scatterplots of Standardized Residuals and Standardized Predicted Values of a Simple Linear Regression Model

In the scatter plots of the standardized residuals and standardized predicted values examined in Figure 2, it is seen that the assumptions of the linearity of the data and the homogeneity of the variances are met. Accordingly, the simple linear regression analysis results in which the pre-service teachers' ADGAs' predictiveness of DEGU were examined below (Table 3).

Table 3. Simple Linear Regression Analysis Results

		b_j	S(b_j)	β	t	p
EA	(Constant)	3.62	.17	-	20.95	.00*
	ADGA	-.17	.04	-.23	-3.76	.00*
PU	(Constant)	3.66	.18	-	20.42	.00*
	ADGA	-.11	.04	-.15	-2.34	.00*
PC	(Constant)	4.22	.19	-	21.46	.00*
	ADGA	-.22	.05	-.26	-4.23	.00*
BA	(Constant)	3.89	.19	-	20.16	.00*
	ADGA	-.16	.05	-.20	-3.17	.00*
DEGU	(Constant)	3.85	.13	-	28.69	.00*
	ADGA	-.16	.03	.29	-4.76	.00*

EA: n=246, R=.23, R^2=.05, F=14.18, p<.01; **PU:** n=246, R=.15, R^2=.02, F=5.48, p<.05; **PC:** n=246, R=.26, R^2=.06, F=17.92, p<.01; **BA:** n=246, R=.20, R^2=.04, F=10.07, p<.01; **DEGU:** n=246, R=.29, R^2=.08, F=22.70, p<.01

** p<.01*

When Table 3 is examined, it is seen that the simple linear regression model predicting their emotional approach towards DEGU is significant (F=14.18, p<.01). According to this, it was seen that the ADGAs of the teacher candidates were a predictor of their emotional approach towards DEGU (t=-3.76, p<.01). This model explains 5% of the pre-service teachers' emotional approaches to DEGU. It can be said that each standard deviation increase in ADGA will cause a decrease of -.17 level in their emotional approach towards DEGU.

It was determined that the simple linear regression model predicting the perceived usefulness of prospective teachers for DEGU was significant (F=5.48, p<.05). As a result of the analysis, it was seen that the pre-service teachers' ADGAs significantly predicted their perceived usefulness towards DEGU (t=-2.34, p<.01). 2% of the perceived usefulness differences of prospective teachers towards DEGU can be explained with this model. According to this, it can be said that each standard deviation increase in ADGA will cause a decrease of -.11 in the perceived usefulness of the prospective teachers towards DEGU.

It was seen that the regression model, which predicted the pre-service teachers' perceived control of DEGU, was significant (F=17.92, p<.01). According to this, it was seen that the pre-service teachers' ADGAs significantly predicted their perceived control of DEGU (t=-4.23, p<.01). The model explains 6% of their perceived control of DEGU. According to this, each standard deviation increase in the ADGAs of the pre-service teachers will cause a decrease of -.22 in their perceived control of the DEGU.

It was determined that the simple linear regression model predicting the behavioral approaches of prospective teachers towards DEGU was significant (F=10.07, p<.01). It has been seen that the prospective teachers' ADGAs are a significant predictor of their behavioral approaches towards DEGU (t=-3.17, p<.01). This model explains 4% of pre-service teachers' behavioral approaches to DEGU. Accordingly, it can be said that each standard deviation increase in the ADGA of the pre-service teachers will cause a decrease of -.16 in their behavioral approach towards DEGU.

It was determined that the regression model, in which the pre-service teachers' prediction of DEGU was examined, was significant (F=22.70, p<.01). Accordingly, it was seen that the ADGAs of the teacher candidates were a significant predictor of the DEGU (t=-4.76, p<.01). The model explains 8% of the differences in the prospective teachers' DEGU. Accordingly, it can be said that each standard deviation increase in the ADGAs of the teacher candidates will decrease the DEGU at the level of -.16.

CONCLUSION AND DISCUSSION

This study examined whether pre-service teachers' awareness about digital game addiction predicted their use of digital educational games. The results and discussion obtained from the research findings are presented below.

As a result of the research, it was seen that there is a weak negative relationship between pre-service teachers' awareness of digital game addiction and their emotional approach to their use of digital educational games. According to this result, as pre-service teachers' awareness about the negative effects of digital game addiction increases, individuals' positive emotional approaches towards digital educational games decrease. When the pre-service teachers' awareness of digital game addiction was examined, it was determined that it was a predictor of their emotional approach to digital educational game use, albeit at a low level. This situation shows the possibility that the pre-service teachers' feelings and thoughts about non-educational digital games may also be valid for educational digital games. It is seen that this inference is included in the studies conducted by Dönmez (2018) and Keskin (2019), in which the relationship between mindfulness and digital game addiction is examined, and there is an inverse relationship between the level of consciousness and digital game addiction. Studies examining non-educational computer games have determined that there is a positive relationship between addiction and a positive emotional approach to games (Jeong & Kim, 2011; Wong & Lam, 2016; Yılmaz et al., 2020). Addiction situations of individuals can provide a positive emotional approach to games. On the other hand, it is normal for an individual aware of the negative effects of digital games on people's daily lives to have negative feelings towards games. However, in the study conducted by Kneer et al. (2014) with gamers, it was determined that they were aware of the risks from digital game addiction but were not in a negative mood despite these risks. It can be said that this result is due to the

characteristics of the study participants. When the literature is examined, it is seen that although there are studies (Sarıgöz, 2019) in which pre-service teachers' opinions are presented, similar to this situation, that digital educational games will not cause any negative situation, it is seen that the view given in these studies is not evaluated in the context of digital game addiction awareness. As a result, it can be said that pre-service teachers reflect their negative feelings about digital games to digital educational games as well.

The study examined the relationship between pre-service teachers' awareness of digital game addiction and their perceived usefulness of using digital educational games. As a result of the examination, it was seen that there was a fragile negative relationship between them. Accordingly, as teacher candidates' awareness of digital game addiction increases, their perceived usefulness from digital educational games will decrease. Pre-service teachers' awareness of digital game addiction as a predictor of their perceived usefulness from digital educational games was investigated. As a result of the examination, it was a low-level predictor. Similar to the previous sub-factor, it shows that the possibility that pre-service teachers' feelings and thoughts about non-educational digital games may also be valid for educational digital games may also be valid for this factor. As an important proof of this, it can be shown that when digital games are used in educational environments, although the permanence of learning (Natale, 2002), the motivation of students and their participation in the lesson increase (Alaswad & Nadolny, 2015; Spires, 2015; Tural-Sönmez & Dinç-Artut, 2012), and the content is beneficial for the development of different types of cognitive skills (Akcaoglu, 2013; Baek, 2010; Sitzmann, 2011; Spires, 2015; Uttal et al., 2013), pre-service teachers have a negative tendency towards the usefulness of digital educational games. Bösche and Kattner (2013) explained this situation as the negative effects of games are exaggerated, and therefore their benefits are ignored. Contrary to the finding obtained in the research, it is seen in the literature that although the pre-service teachers know that digital games have negative effects and problematic sides, there is also a study (Sarıgöz, 2019) in which the views that students will learn easily and quickly with the correct use of them in educational environments. However, the presentation of this opinion by only one participant reduces the generalizability of the result. As a result, it can be said that the perceived benefits of digital educational games by pre-service teachers with awareness of digital game addiction are lower.

The relationship between pre-service teachers' awareness of digital game addiction and perceived control of digital educational game use, which expresses their perceptions of emotional and behavioral control in the game, was examined. It was determined that there was a weak negative relationship between them. In addition, the predictive status of this relationship was examined, and it was determined that awareness of digital game addiction was a low predictor of perceptions of control in digital educational games. Accordingly, it can be said that with the increase of pre-service teachers' awareness of digital game addiction, the control behaviors perceived by individuals in digital educational games will decrease. Regarding this result, it is stated that individuals with high control perceptions increase their digital game-playing behaviors (Hartmann & Klimmt, 2006). However, in a study examining digital game playing behaviors, it is stated that individuals who experience introversion and emotional instability, which are the effects of addiction, have difficulty in controlling their digital game behaviors (Yang & Tung, 2007). On the contrary, in a study conducted with gamers, it was determined that players have low awareness of the risks of playing digital games and have high control behaviors (Wong & Lam, 2016). Based on these studies, it can be thought that digital game addiction has different views on the loss of control in individuals. However, the striking point in all studies is that the participants have different characteristics and the focused games are not educational. In the study conducted by Sarıgöz (2019), pre-service teachers stated that they might need help while playing the digital educational game and encounter a problem, so it is difficult to control. However, the findings obtained in this study were not evaluated considering the awareness of digital game addiction.

The study examined the relationship between pre-service teachers' awareness of digital game addiction and their behavioral approaches to digital educational game use, which expresses their preference for digital educational games over other games. As a result of the examination, it was seen that there was a weak and negative relationship between them. According to this relationship, the increase in pre-service teachers' awareness of digital game addiction means that their behavioral approaches towards digital educational game use will decrease. The predictive status of this relationship was examined. It was observed that pre-service teachers' awareness about digital game addiction predicted their behavior of choosing digital educational games at a low level. According to a study conducted by Topçu et al. (2014); Although the pre-service teachers know that digital educational games are helpful in educational environments, they stated that they could not use them due to difficulties in classroom management, the possibility of not providing the software and hardware support that may be needed for the game, and lack of technical knowledge. In a study conducted by Sarıgöz (2019), pre-service teachers stated that although they are conscious of the benefits of digital educational games, they avoid playing digital games, hesitate, and only play when they are told they will play when they have sufficient knowledge. It has been stated that the reason for this situation is that the long time spent in front of the computer will reveal the addiction situations. It can be said that individuals who are aware of this situation will not prefer digital educational games to other digital games and their behavioral approaches are similar.

In the study, the relationship between pre-service teachers' awareness of digital game addiction and their digital educational game playing status was examined. As a result of the examination, it was seen that there was a weak negative relationship between them. This relationship indicates that with the increase in pre-service teachers' awareness of digital game addiction, their playing digital educational games decreases. The predictive status of this situation was examined, and it was seen that pre-service teachers' awareness about digital game addictions predicted their digital educational playing behaviors at a low level. Teacher candidates who are aware of the negative effects of digital game addiction are expected to have a negative attitude towards these games. It has been determined that attitude has a mediating role in predicting the behavior of awareness towards a non-educational game addiction (Hussein et al., 2017). In various studies (Camilleri & Camilleri, 2019; Huang, 2019; Panagiotarou et al., 2020; Sánchez-Mena et al., 2017), handled according to the Technology Acceptance Model and the Planned Behavior Theory, which is a model that explains the use of technologies, have been determined that a positive attitude towards educational games is a positive predictor of their use

of educational digital games. Accordingly, it can be said that pre-service teachers' attitudes towards non-educational digital games, who are aware of the negative effects of digital game addiction, reflect on their educational digital game use.

Limitations of the Study and Recommendations

This study examined whether the awareness of pre-service teachers about digital game addiction predicted the use of digital educational games. The results obtained in the study contain some limitations. The data obtained in the research are limited to the participants' self-perceptions. Researching with pre-service teachers in an education faculty reduces its external validity. It is essential to evaluate the research results within the framework of these limitations. Considering the limitations of the research, suggestions were made for practice and research in line with the results obtained.

The most important feature of digital educational games that distinguishes them from other types of digital games is not that they are played for purposes such as having fun and passing the time. Digital educational games are played to learn. While it is expected that teacher candidates' awareness of digital game addictions will increase, it is recommended to raise awareness of the benefits of digital educational games so that they do not have negative feelings about digital educational games. Pre-service teachers should be informed about the different aspects of digital educational games from other types of digital games. Regarding this situation, it is recommended to reveal the differences between the game types, determine the addiction situations, determine the addictive elements, and establish criteria for their use in the selection of digital educational games, rather than the purposes of using the games.

Conflicts of interest and authorship: Authors have no conflicts of interest to declare.

Ethics Committee Approval Information: Ethics committee approval for this study was received from the Ethics Committee of Kastamonu University (Date: 02/02/2022 Approval Number: 2022-2-26).

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Research Paper

Examining the Usability of e-Content in Different Forms for Increasing Digital Parenting Competencies

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ABSTRACT

A usability test during the development of learning material can reduce many usability problems. Furthermore, this can increase the quality and efficiency of the material. Therefore, the purpose of this study is to evaluate the usability of e-contents developed to increase parents' digital parenting competencies and awareness. In this study, a usability test was created for online content. Materials for video and visual aided written material usability were designed and used for this study, including an online content usability questionnaire. Field experts' opinions were taken, and usability tests were conducted with real users. Alexander (2013) developed these usability tests and adapted into Turkish by Pekyürek and Yıldız-Durak (2021). This study follows usability principles to determine the usability of various online videos and visually supported materials to increase parents' digital parenting competencies and awareness. Usability test results were revealed through descriptive statistics. This research helps parents better understand the possibilities, potentials, and limitations in designing educational online content on digital parenting. On the other hand, this usability test has the potential to detect the usability of educational videos in different fields.

INTRODUCTION

Since the 1980s, the technology change has accelerated, and the field of information and communication technologies (ICT) has been affected by this change (Vural, 2013). According to the data obtained at the beginning of 2022, mobile devices, which are among the ICT, have reached 5.31 billion individuals, and the Internet has reached 4.95 billion individuals (We Are Social, 2022). Considering these data, mobile devices and Internet usage are essential in ICT.

The field of education has been affected by the changes in technology, especially mobile devices and the Internet, which have been used in the learning process (Krull & Duart, 2017). This change in the learning process has expanded the production and use of content that can be used on the Internet to increase knowledge and skills (Drexler et al., 2008; Greenhow et al., 2009; Grosseck, 2009). In addition, content supported by multimedia elements such as video, sound, and graphics contributes positively to the learning process (Frazel, 2010; Robin, 2008). Among the e-content types that have started to be used, there are explanatory videos, digital stories, e-books, infographics, and learning content can be presented on the Internet with these content types (Gedik, 2021; Korat & Shamir, 2007; Sarıtepeci & Durak, 2016). While explanatory videos and digital stories are used as video-based e-content types, e-books and infographics are used as visually supporting written materials. Among these learning contents, explanatory videos offer educational content aimed at gaining new skills for its audience, with audio and video support. In addition, animated videos used to make complex subjects easier to understand are also included in this genre (Gedik, 2021). The different aspect of digital stories from explanatory videos is that they consist of stories produced in digital environments, supported by multimedia such as pictures, music, and graphics within the framework of a particular scenario (Sarıtepeci & Durak, 2016; Sarıtepeci, 2022; Yıldız-Durak, 2018). E-books are e-contents published digitally created from text, pictures, or both by using information technologies. These contents are presented in book format (Korat & Shamir, 2007). Unlike e-books, infographics are the contents in which the primary information is concentrated and visualized for the reader. In other words, it is an effective graphical data transfer method in which the information is simply presented to the reader by purifying it from its complexity (Schroeder, 2004).

E-content development consists of analysis, design, development, implementation, and evaluation processes (Muruganantham, 2015). After the prepared e-content for a purpose is produced and presented to the end-user, examining the effect on the individuals benefiting from this content is included in the evaluation of the product. In this process, the concept of usability comes into play. Usability is the study of how useful the resulting e-content is, and this process also guides developers who want to introduce new products (Lewis, 2006). Nielsen (1993) stated that usability consists of five interrelated features and these features are (a) learnability, (b) efficiency of use, (c) memorability, (d) few and non-catastrophic errors, and (e) subjective satisfaction. In addition,

the International Organization for Standardization (ISO) (1998) standards include effectiveness, efficiency, and satisfaction factors as usability factors. In ISO standards, effectiveness is defined as the situations in which users perform the given tasks correctly. Efficiency, on the other hand, is expressed as the degree of effort of users while performing tasks. Lastly, satisfaction is emphasized as the feelings and thoughts of users about the application they use. These factors must be taken into account for the product to undergo a valid evaluation process. When we look at usability studies, the interaction of information systems with people is generally examined and there are not many studies examining the e-contents in these systems (Freire et al., 2012; Sancar-Tokmak et al., 2020).

Parents need to learn about certain basic topics in order to gain digital parenting competencies. It is seen that the dimensions of digital citizenship are taken as a basis in order to determine this basic subject and information. Therefore, raising awareness of parents on the definition of digital parenting, digital ethics, digital communication, digital literacy, digital commerce, digital security, digital law, and digital health will enable them to gain digital parenting competencies (Yaman et al., 2019). Individuals who can follow the developments in the digital environment, master the risks and advantages in the digital environment and guide their children against them are expressed as individuals with digital parenting competencies (Yurdakul et al., 2013). There are different studies in the literature in which e-content is used to improve the digital competencies of parents. Clarkson and Zierl (2018) developed the e-Parenting: High-Tech Kids Program to raise awareness of digital parenting. Jent et al. (2021) have created e-books as part of the Parent-Child Interaction Therapy program. Zhang-Kennedy et al. (2017) have designed an interactive educational e-book called Cyberheroes, which aims to introduce children to the concepts of online privacy at an early age. These developed applications are made available to parents in online environments. In all these studies, it has been concluded that e-contents positively affect the targeted digital competencies of parents. These results show the importance of e-contents in helping individuals acquire digital parenting competence. However, the latent purpose of each researcher is to present the valuable information contained in the e-contents they create to parents or their target audience clearly and understandably. At the same time, it is to present these contents in a remarkable, persistent, and memorable way without taking the user's time. In other words, the usability of the study e-contents is desired to be satisfactory. Therefore, it is necessary to work on the usability of the created e-content. For that reason, within the scope of this study, the usability of e-contents in different forms to increase parents' digital parenting competencies was investigated. The results obtained from this study, which investigates the usability of e-content developed by researchers, will ensure that effective e-contents are presented to researchers in the literature. In summary, this study aims to contribute to the development and evaluation processes of e-contents and to contribute to usability studies.

The purpose of the study

This study aimed to evaluate the usability of e-contents developed to increase parents' digital parenting competencies and awareness. Within the scope of this research, there is a search for this question answer "What is the usability level of the developed e-contents?".

METHOD

Research Model

Usability research was used in the study. The evaluation criteria determined by Alexander (2013) and adapted into Turkish by Pekyürek and Yıldız-Durak (2021) were used as a reference. For this study, e-contents were presented to the participants, and they were allowed to examine the e-contents completely without intervening by using their technological tools in an environment of their choice. Users were supported only when necessary. At the end of the whole process, usability tests were presented to the participants. In this study, the experiences of users who use e-contents for the first time while performing the given tasks were determined.

Participants of usability studies of developed e-contents

In this section, the participants of the usability studies of e-contents in the form of explanatory video, digital story, e-book, and infographic, for which sample images are presented, are mentioned.

Participants of video usability studies

Video usability studies of the developed explanatory videos and digital stories were carried out with 12 parents with different socio-demographic characteristics whose children are studying at K-12 secondary school (5th, 6th, 7th and 8th grade). The distribution by gender of the participants in the first group, who watched e-contents in explanatory video or digital story types, is given in Table 1.

Table 1. Distribution of the participants who watched the video by gender

Gender	n	%
Female	6	50
Male	6	50
Total	12	100

According to Table 1, 6 of the parents participating in the study were female, and 6 were male. The rate of female parents participating in the study is 50%, and the rate of male parents is 50%. The age distribution of participants who watched e-contents in explanatory video or digital story types is given in Table 2.

Table 2. Distribution of the participants who watched the video by age

Age range	n	%
35-44	8	66.67
45-54	3	25
55 and above	1	8.33
Total	12	100

According to Table 2, 8 of the parents participating in the study are between the ages of 35-44, 3 are between the ages of 45-54, and 1 is 55 and over. Among the parents who participated in the study, the rate of those aged 35-44 was 66.67%, the rate of those aged 45-54 was 25%, and the rate of those aged 55 and over was 8.33%. The distribution by gender of the children of the participants, who watched e-contents in explanatory video or digital story types, is given in Table 3.

Table 3. Distribution of the children of the participants who watched the video by gender

Gender	n	%
Girl	9	75
Boy	3	25
Total	12	100

According to Table 4, 9 of the children of the parents participating in the study were girls, and 3 were boys. Among the children of the parents participating in the study, the rate of girls is 75%, and the rate of boys is 25%. The distribution of the children of the participants who watched e-contents in the types of explanatory videos or digital stories according to their grades is given in Table 4.

Table 4. The distribution of the grade levels of the children of the participants who watched the video

Grade	n	%
5th grade	3	25
6th grade	2	16.67
7th grade	2	16.67
8th grade	5	41.67
Total	12	100

According to Table 4, 3 of the children of the parents participating in the study are 5th-grade students, 2 of them are 6th-grade students, 2 of them are 7th-grade students, and 5 of them are 8th-grade students. Among the children of the parents in the study, the rate of those studying in the 5th grade is 25%, the rate of those studying in the 6th grade is 16.67, the rate of those studying in the 7th grade is 16.67%, and the rate of those studying in the 8th grade is 41.67%. The distribution of the participants who watched e-contents in explanatory video or digital story types according to their educational status is given in Table 5.

Table 5. Distribution of the participants who watched the video according to their educational status

Educational level	N	%
Primary school	1	8.33
Secondary School	1	8.33
High school	3	25
Undergraduate	6	50
Postgraduate	1	8.33
Total	12	100

According to Table 5, one of the participating parents is a primary school graduate, one secondary school graduate, three high school graduates, six undergraduate, and one postgraduate. Among the parents participating in the study, the rate of primary school graduates is 8.33%, the rate of secondary school graduates is 8.33%, the rate of high school graduates is 25%, the rate of undergraduate is 50%, and the rate of the postgraduate is 8.33%. Table 6 shows the distribution of participants who were shown e-contents in explanatory video or digital story types according to their closeness to their children.

Table 6. Distribution of the participants who watched the video according to their degree of affinity to children

Affinity	N	%
Mother	6	50
Father	6	50
Total	12	100

According to Table 6, 6 of the parents in the study are the child's mother and 6 are the child's father. The rate of mothers who participated in the study is 50%, and the rate of fathers is 50%.

E-Book and Infographic Usability Studies Participants

Participants in these studies are also individuals who are consulted for expert opinions on the same content. These participants are not only experts in their fields but also parents. Six parents participated in the e-book and infographic usability studies. Experts in the field of Computer and Instructional Technologies Education and one expert in the field of Lifelong Learning and Adult Education participated in the usability studies of e-contents in the types of e-books and infographics as parents.

Data collection tools

In this study, three data collection tools were used: Parent Information Form, Video Usability Test and Visual Assisted Written Material Usability Test.
Parent Information Form was prepared by the researcher. This form consists of 7 items: gender, age, educational status, gender of the child, the class in which the child was educated, affinity to the child, and the level of use of information technologies.

Video Usability Test is a Turkish usability test developed by Pekyürek and Yıldız-Durak (2021), using the test used in the study conducted by Alexander (2013), and was used in this study. The test consisted of 11 items. In this tool, 5-point Likert (5-Strongly Agree, ….1-Strongly Disagree) rating is used. Examples of questions included in this test are as follows:

- The content I watched was easy to watch
- The content I watched was catchy.
- The visuals in the content I watched were progressing simultaneously with the voice acting.
- In the content I watched, there were elements (image, animation, object, sound, etc.) that were not directly related to the subject.

Visual Assisted Written Material Usability Test is a Turkish usability test developed by Pekyürek and Yıldız-Durak (2021), utilizing the test used in the study conducted by Alexander (2013). The test consisted of 11 items. In this tool, 5-point Likert (5-Strongly Agree, ….1-Strongly Disagree) rating is used. Examples of questions included in this test are as follows:

- The content was easy to understand.
- The content contained useful information.
- The content contained distracting elements.

E-Content usability application

Usability studies of developed e-contents to increase digital parenting competencies were carried out. The application process of usability studies is shown in Figure 1.

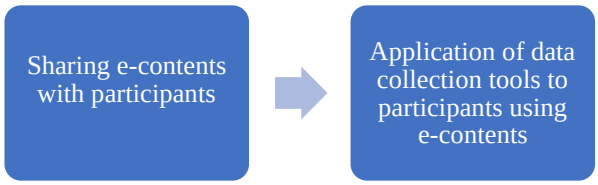


Figure 1. The usability implementation process of e-contents

As presented in Figure 1, e-contents in the form of explanatory videos, digital stories, e-books, and infographics developed to increase digital parenting competencies were shared with the participants using social media tools. They were asked to benefit from the shared e-contents, and usability tests were applied. In usability studies, the usability of explanatory video and digital story types in video format were investigated together. Again, in usability studies, the usability of e-contents in the form of e-books and infographics, which are in the format of visually supported written material, were investigated together.

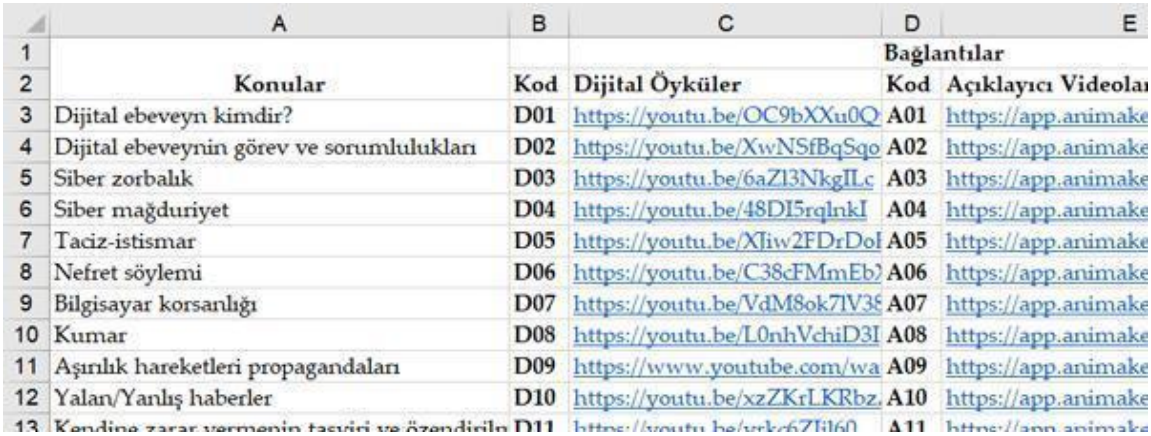
Studies before the implementation process of the usability of e-Content

Before moving on to the usability application process of e-contents, e-contents prepared to improve the competence and awareness of parents were uploaded to social media environments.

E-Content usability implementation process

A separate code number has been given to each of the contents prepared to improve the competence and awareness of parents uploaded to social media environments. Tables have been prepared by specifying the links that will enable access to the contents

next to the code numbers. A sample image from the table prepared for e-contents in explanatory video and digital story types is presented in Figure 2.



	A	B	C	D	E
1				Bağlantılar	
2	Konular	Kod	Dijital Öyküler	Kod	Açıklayıcı Videola
3	Dijital ebeveyn kimdir?	D01	https://youtu.be/OC9bXXu0Q	A01	https://app.animake
4	Dijital ebeveynin görev ve sorumlulukları	D02	https://youtu.be/XwNSfBqSqo	A02	https://app.animake
5	Siber zorbalık	D03	https://youtu.be/6aZI3NkgILc	A03	https://app.animake
6	Siber mağduriyet	D04	https://youtu.be/48DI5rqlnkI	A04	https://app.animake
7	Taciz-istismar	D05	https://youtu.be/XJiw2FDrDoI	A05	https://app.animake
8	Nefret söylemi	D06	https://youtu.be/C38cFMmEb2	A06	https://app.animake
9	Bilgisayar korsanlığı	D07	https://youtu.be/VdM8ok7lV3	A07	https://app.animake
10	Kumar	D08	https://youtu.be/L0nhVchiD3I	A08	https://app.animake
11	Aşırılık hareketleri propagandaları	D09	https://www.youtube.com/wa	A09	https://app.animake
12	Yalan/Yanlış haberler	D10	https://youtu.be/xzZKrLKRbz.	A10	https://app.animake
13	Kendine zarar vermenin tasviri ve özendirilm	D11	https://youtu.be/vrkc6ZjiJ60	A11	https://app.animake

Figure 2. File view of access links for e-contents in explanatory video and digital story types[a]

From the table shown in Figure 2, the participants were asked to watch using the explanatory video and digital story link they wanted. In addition, they noted which content they evaluated during the evaluation process by noting the code number next to the link of the content they watched. A sample image from the table prepared for e-contents in e-book and infographic types is presented in Figure 3.

	A	B	
1	Kod	E-Kitaplar	Bağlantısı
2	E1	Bilişim Suçları	https://drive.google.com/file/d/1j067
3	E2	Dijital Bağımlılık	https://drive.google.com/file/d/1hAky
4	E3	Gizlilik El Kitabı	https://drive.google.com/file/d/13Dm
5	E4	Hacker	https://drive.google.com/file/d/1JAU
6	E5	Hackerlik	https://drive.google.com/file/d/1wKY
7	E6	Sanal Dünyada Bağımlılık Davranışları	https://drive.google.com/file/d/1M2fZ
8	E7	Siber Tehditler	https://drive.google.com/file/d/10V8H
9	E8	Siber Zorbalık	https://drive.google.com/file/d/1AMjf
10	E9	Türkiye'de Bilişim Hukuku	https://drive.google.com/file/d/1gWA
11			
12	Kod	Infografikler	
13	I1	Dijital Ebeveynlik	https://drive.google.com/file/d/1Gen
14	I2	Çevrim-içi riskler	https://drive.google.com/file/d/1k19x
15	I3	DijitalEtik	https://drive.google.com/file/d/1dJbu
16	I4	Dijital Güvenlik	https://drive.google.com/file/d/1-SN
17	I5	Dijital Hukuk	https://drive.google.com/file/d/1ZOfj
18	I6	Dijital İletişim Araçları	https://drive.google.com/file/d/1-lAh-
19	I7	Sosyal Medya Ortamları	https://drive.google.com/file/d/1el7q
20	I8	Dijital Vatandaşlık	https://drive.google.com/file/d/1oRp
21	I9	Dijital Vatandaşlık Boyutları	https://drive.google.com/file/d/1lYR5
22	I10	Dijital Dünyada Fiziksel ve Psiolojik Sağlık	https://drive.google.com/file/d/1ARq
23	I11	Dijital Sağlık	https://drive.google.com/file/d/1hiOF
24	I12	Dijital Ticaret	https://drive.google.com/file/d/1Mdfl

Figure 3. Access links of e-contents in e-book and infographic types, file images

Participants were enabled to benefit from the table shown in Figure 4 by using the e-book and infographic link they wanted. In addition, they were asked to indicate which content they evaluated during the evaluation process by noting the code number next to the link of the content they benefited from.

Collection and analysis of usability data of developed e-contents

Data collection tools were applied to the participants in an online environment. Quantitative and qualitative data were collected within the scope of the research. Quantitative data were obtained by applying the "Video Usability Test" for the usability of e-contents in the types of explanatory videos and digital stories and the "Visual Supported Written Material Usability Test" for the

[a] Source: Web: http://ebeveyn.erbakan.edu.tr/uygulama.html
Android App: https://play.google.com/store/apps/details?id=com.dijital.ebeveynlik
IOS App:https://apps.apple.com/tr/app/dijital-ebeveynlik/id1613705846?l=tr

usability of e-contents in the type of e-books and infographics. Qualitative data were collected using open-ended questions included in usability tests. Descriptive analysis of quantitative data (arithmetic mean and standard deviation) was performed using the SPSS 22 program.

FINDINGS

The research problem is "What is the usability level of the e-contents to be developed?". In the study carried out for this problem, four different types of e-content were used. These e-content types are explainer videos, digital stories, e-books, and infographics. Within the scope of the study, two different usability tests, Video Usability Test and Visual Assisted Written Material Usability Test, were used.

E-contents in the types of explainer videos and digital stories are in video format. For this reason, the Video Usability Test was applied to these two types of e-content. During this application, the participants watched by choosing either of these two types of content. Participants, who watched e-content in video format, evaluated these two different types together. Visual Assisted Written Material Usability Test was applied for e-contents in the type of e-books and infographics. The participants, who benefited from e-contents in the e-book type and e-contents in the infographic type, evaluated these two different types separately.

Three separate usability data were obtained: (i) data obtained from e-contents in video type, (ii) data obtained from e-contents in e-book type, and (iii) data obtained from e-contents in infographic type. A descriptive analysis of the obtained data was carried out. The findings obtained as a result of descriptive analyzes are presented as percentages. The statistical representation of the usability data obtained from the e-contents in the developed explanatory video and digital story types is presented in Table 7.

Table 7. Video usability statistics

Video Usability Scale Items	% 1	% 2	% 3	% 4	% 5
The content I watched was easy to watch.	0	0	14.3	7.1	78.6
The content I watched was easy to understand.	0	0	14.3	0	85.7
Watching the content I was watching was time-consuming.	35.7	28.6	14.3	14.3	7.1
The content I watched was catchy.	0	0	24.4	14.3	64.3
The content I watched contained useful information.	0	0	14.3	7.1	78.6
The duration of the content I watched was appropriate.	7.1	0	7.1	28.6	57.1
The audio and visuals in the content I watched were related to each other.	0	0	14.3	14.3	71.4
The visuals in the content I watched were progressing simultaneously with the voice acting.	0	0	21.4	7.1	71.4
The content I watched was remarkable.	0	7.1	14.3	28.6	50
In the content I watched, there were elements (image, animation, object, sound, etc.) that were not directly related to the subject.	71.4	7.1	7.1	0	14.3
There were distractions in the content I watched.	71.4	7.1	0	0	21.4

According to Table 7, the parents who participated in the research rated the expression "The content I watched was easy to watch" with 3 for 14.3%, 4 for 7.1%, and 5 for 78.6% for e-content in video format. Parents rated the content I watched as easy to understand with 14.3% as 3 and 85.7% with 5 points. Parents rated the phrase "Watching the content I watched was time-consuming" with 35.7% as 1, 26.8% with 2, 14.3% with 3, 14.3% with 4, and 7.1% with 5. Parents rated the phrase "The content I watched was catchy" with 24.4% as 3, 14.3% with 4, and 64.3% with 5 points. Parents rated the content that "I watched contained useful information" with 14.3% as 3, 7.1% with 4, and 78.6% with 5 points. Parents rated the expression "The duration of the content I watched was appropriate" with 7.1% as 1, 7.1% with 3, 28.6% with 4, and 57.1% with 5. Parents rated the phrase "The voiceovers and visuals in the content I watched were related to each other" as 3, 14.3%, and 71.4% as 5, respectively. Parents rated the expression "The visuals in the content I watched were progressing simultaneously with the voiceover" with 21.4% as 3, 7.1% with 4, and 71.4% with 5 points. Parents rated the statement "The content I watched was remarkable" with 7.1% as 2, 14.3% with 3, 28.6% with 4, and 50% with 5. Parents rated the expression "There were elements (picture, animation, object, sound, etc.) that are not directly related to the subject in the content I watched" with 71.4% as 1, 7.1% with 2, 7.1% with 3, and 14.3% with 5. Parents

rated the expression “There were distractions in the content I watched” with 71.4% as 1, 7.1% with 2, and 21.4% with 5. The statistical representation of usability data obtained from e-contents in the e-book type of this problem is presented in Table 8.

Table 8. E-book usability statistics

E-book Usability Scale Items	**% 1**	**% 2**	**% 3**	**% 4**	**% 5**
The content was easy to understand.	0	0	16.67	50	33.33
The content was catchy.	0	0	33.33	33.33	33.33
The content contained useful information.	0	0	0	50	50
The content was remarkable.	0	0	0	66.67	33.33
The content contained elements (pictures, etc.) that were not directly related to the subject.	66.67	16.67	0	16.67	0
There were distractions in the content.	83.33	0	0	0	16.67

According to Table 8, the parents who participated in the research rated the phrase “The content was easy to understand for e-book type e-contents” with three for 16.67%, four for 50%, and five for 33.33%. Parents rated the content as catchy as 33.33%, four by 33.33%, and five by 33.33%. Parents rated the phrase “The content contained useful information” with scores of four by 50% and five by 50%. Parents rated the content as “remarkable” with a score of 4 by 66.67% and a five by 33.33%. Parents rated the content as “catchy” as 1 for 66.67%, 2 for 16.67%, and 4 for 16.67%. Parents rated the content as catchy, with 1 for 83.33% and 5 for 16.67%. The statistical representation of the usability data obtained from the infographic-type e-contents of this problem is presented in Table 9.

Table 9. Infographic usability statistics

Infographic usability scale items	**% 1**	**% 2**	**% 3**	**% 4**	**% 5**
The content was easy to understand.	0	0	0	50	50
The content was catchy.	0	0	0	33.33	66.67
The content contained useful information.	0	0	0	50	50
The content was remarkable.	0	0	33.33	50	16.67
The content contained elements (pictures, etc.) that were not directly related to the subject.	66.67	16.67	0	0	16.67
There were distractions in the content.	66.67	0	16.67	16.67	0

According to Table 9, the parents who participated in the research rated the phrase "The content was easy to understand" for e-content in the infographic type with a rate of four for 50% and a score of five for 50%. Parents rated the content as catchy, with 33.33% as four and 66.67% as five points. Parents rated the phrase "The content contained useful information" with scores of 4 by 50% and five by 50%. Parents rated the content as remarkable as 33.33%, four by 50%, and five by 16.67%. Parents rated the phrase "There were elements in the content that are not directly related to the subject (pictures, etc.)" with one for 66.67%, two for 16.67%, and five for 16.67%. Parents rated "There were distractions in the content" with 1 for 66.67%, 3 for 16.67%, and 4 for 16.67%.

Within the scope of the research, the answer to the question "What are parents' experiences regarding e-contents?" has been researched. Regarding this, "What did you like most in the videos you watched? What were the points you didn't like?" questions were asked, and their opinions were sought. In this theme, the views on the popular aspects of the e-contents in the explanatory video and digital story types in video format are presented in Table 10.

Table 10. Favorite features of videos

Theme	Code	f
Favorite aspects of watching videos	Informative	12
	Understandable language	6
	Catchy	6
	Up-to-date information	3

When the views of the parents in Table 10 are examined, the aspects they like about the videos they watch are informative (f=12), using understandable language (f=6), catchy (f=6), and containing up-to-date information (f=3). Some of the parent comments are as follows:

(E10) "Very well prepared and their families very well informed."
(E26) "I found the videos very well-prepared tutorial."
(E40) "It answered all the questions we might encounter and it was a very educational and useful study. What I like the most is that instead of directing our children to the sites or games we want, it was very accurate that it would be more effective to spend time with them on the sites they want to be and to give warnings at that time."

This theme presents views on the disliked aspects of e-contents in video format explanatory video and digital story types in Table 11.

Table 11. Disliked features of videos

Theme	Code	f
The disliked aspects of the watched videos	The low number of voice actors	2
	Fluency needs improvement	2

When the views of the parents in Table 11 are examined, the aspects they dislike about the videos they watch are the low number of voice actors (f=2) and the need to improve fluency (f=2). Some of the parent comments are as follows:

E(21) "It was nice that it was in short chapters. Being more fluent and fast can attract more attention. In addition, the narrator's constant use of the phrase 'he said while conveying the dialogues reduces the interest."
E(38) "It was slow, I had to set the video speed to *1.75, but the animations were generally enjoyable. Although it is good that it is not long in terms of time, it has become too many in number. I also thought about what it would be like if there was a mutual communication between two people instead of "he said", "he said", "he said," in the voiceovers."

In line with the research on parental experiences, the participants were asked, "What did you like most about the documents you examined? What were the points you didn't like?" Parents' opinions were also asked by asking the question. In this theme, the views on the favorite aspects of e-contents in infographic and e-book types are presented in Table 12.

Table 12. Favorite features of documents

Theme	Code	f
Favorite aspects of the documents examined	Contribution to protecting our children	8
	Contains useful information	4
	Keeping the content up to date	4

When the views of parents in Table 12 are examined, they state their opinions about the documents they examined as contributing to the protection of our children (f=8), containing useful information (f=4), and being up-to-date (f=4). Some of the parent comments are as follows:

E(3) "As a parent, I liked that it made me realize that besides limiting internet use, it is also necessary to inform."
E(5) "The parts about how we should warn children about the use of digital media were very enlightening for us. There isn't a point we don't like."
E(22) "You have chosen the topics very well."

In this theme, views on the disliked aspects of e-contents in infographic and e-book types are presented in Table 13.

Table 13. Disliked features of documents

Theme	Code	f
Disadvantages of the examined documents	Selection of graphics	1
	Selection of texts	1

When the views of parents in Table 13 were examined, they indicated their opinions about the aspects they did not like about the documents they examined as the selection of graphics (f=1) and the selection of texts (f=1). One of the parent comments is as follows:

E(31) "Graphics and text could have been more professional."

In line with the research on parent experiences, the participants were asked, "What are your suggestions for improving the materials you have examined?" Parents' opinions were also asked by asking the question. In this theme, the views on the suggestions for all types of e-content are presented in Table 14.

Table 14. Suggestions for improving materials

Theme	Code	f
Aspects of the studied materials that need improvement	Continuation of the current	2
	Increasing the number of speakers	2

When the opinions of the parents in Table 4.17 are examined, they stated their opinions as to the continuation of their suggestions for improvement of the materials they examined (f=2) and increasing the number of voice actors (f=2). One of the parent comments is as follows:

E(40) "It might be good if the voiceovers are mutual communication."

CONCLUSION AND DISCUSSION

In this study, analyzes were made on the usability of the contents developed to improve the digital parenting of parents. The usability of the contents was evaluated in terms of ease of learning, pleasantness of the medium, usefulness of the medium, easy to use, and personal preference. Usability studies were conducted with 12 parents. Content in video type and content in written material type were evaluated using different measurement tools. When the usability of the video-type content is examined, it is concluded that the parents find the content primarily usable in terms of ease of understanding (%85,7) and the least in terms of attractiveness (%50) of the content. Nielsen (2000) argues that if the content on a web page is difficult to read, that page will not be used by people. In this context, the fact that the content of the video type is useful in terms of understanding will ensure the continuation of the desire of individuals to use these contents. Although the least usable part of the videos is remarkable, 9 out of 12 participants gave this item a score above the middle score of 3. In addition, the points by the participants to the item "It was time-consuming to watch the content I watched" show different distributions. Each content in the video type has been prepared in a way not exceeding three minutes. Taşdemir et al. (2004) highlighted that video watching should not exceed 10 minutes for each lesson hour (40 minutes) in video training. Based on this idea, each video can be considered a lesson as they deal with different topics. Thus, since the video content does not exceed the maximum duration of 10 minutes, it can be used in terms time-consuming. When qualitative data were examined, the participants received positive comments about the video content as it is informative, understandable language is used, catchy, and contains up-to-date information. It was determined that the participants expressed their opinions about the video content as the low number of voice actors and the lack of fluency. Although the low number of voice actors (f=2) is expressed as a negative opinion by the participants, the fact that half of the participants (f=6) say that fluent language is used brings the idea that the content will not pose a problem in terms of vocalization. In addition, it is possible to distinguish mutual conversations by using different intonations in vocalizations. Conversations are included in the content only in digital stories since there can be only one narrator of the story. Only one voice is included in this type. Explanatory videos do not contain any conversation, but again, such content is produced as a single narrator's voice. In addition, using the same voice has been the reason for preference since using different voices can distract the participants' attention. As a result, the usability of all video content is high in line with the ratings given by the users.

When the quantitative results for the infographic and e-book content were examined, it was seen that the features that the participants found the lowest usability in e-books were the intelligibility of the content (%33.33), the memorability of the content (%33.33), and the attention span (%33,33). These percentiles represent the lowest averages given to the five highest scores. Although this average seems low, the scores for these items are above the average score of three. Looking at the infographic content, the lowest usability feature is concluded that the content is remarkable. E-books contain more textual content, while infographics provide more summary information and support information with visuals. If a comparison is made between the two types, it is concluded that users find infographics more useful.

When the We Are Social (2022) report is examined, it is concluded that the most preferred e-content in Turkey is video content. In line with the statistics, it is concluded that people in our country prefer graphic-based content more than text-based content. In this respect, it is natural for statistics that e-books, text-based content, are less usable by users than infographics and videos, which are graphic-heavy. When the qualitative data on e-books and infographic contents are examined, it is liked in terms of contributing to the protection of children, having helpful content, and keeping the content up to date. The aspects that the users criticize regarding the arrangement of these contents were the direction of choosing graphics and texts more professionally. While creating the texts of the contents, the literature, the field experts, and the parents' opinions were used, and the content texts were created in this direction. The created texts were presented to expert opinions again, and the contents' development started at the end of the process. From this

point of view, the texts were produced by professionals. As a result, e-books and infographics are generally available to users, but the usability levels vary according to user preferences among the contents. As a result, it is concluded that in terms of ease of learning, pleasantness of the medium, usefulness of the medium, ease to use, and personal preference, the most usable content by the study group is video-based content. The second most usable content is infographics, and although the usability results are high, the least usable content is e-books compared to other content types.

Finally, when the suggestions of the participants for the development of the materials are examined, a continuation of the materials and the increase in the number of voice actors. Updating materials is of great importance to keep up to date with the developing technology in terms of offering different opportunities and bringing different measures. Materials should be used or developed with this recommendation in mind for future research.

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Research Paper

Effects of Cognitive Load Level on Students' Attitude towards the Gamified Course

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ABSTRACT

The aim of this study was to examine the effects of cognitive load level on students' attitude towards the gamified course. It was also found out the students' views regarding the 14-week gamified course. Participants consisted of 66 undergraduate students. 40 of them had low cognitive load level and 26 of them had high cognitive load level. According to the results, gamification enabled students to have a positive attitude towards the course, even though they had different cognitive load levels. Furthermore, it was determined a negative and medium significant correlation between the cognitive load and attitude of students with low cognitive load. The gamified course had a positive effect on the "Valuing" and "Positive Effects" sub-dimensions of the attitude in favor of students with low cognitive load. The positive views of many students in qualitative findings strengthened these results. While the gamified course had a negative effect on the "Resisting" sub-dimension in favor of students with high cognitive load, it did not have any significant effect on the "Cost Belief" sub-dimension. A few negative views of students in qualitative findings supported the items in these dimensions of attitude scale. Consequently, this study will strengthen the few studies examining both cognitive and affective effects of a gamified course on students. However, further studies need to confirm these results. For this reason, it is recommended to carry out such studies that reveal all the situations which can affect the attitude in the gamified course in order to achieve positive outcomes of students with different cognitive load levels.

INTRODUCTION

The gamification acts an umbrella by using the game elements in non-game context to increase user participation and experience (Deterding et al., 2011; Werbach & Hunter, 2012). It covers a variety of elements such as competition, progress, rewards, collaboration, and interaction among participants to achieve the goals (Kapp et al., 2014; Zichermann & Cunningham, 2011). The positive results especially in the commercial field (Yang et al., 2017) have accelerated the widespread use of gamification in many fields including education (Dichev & Dicheva, 2017; Simões et al., 2013).

The studies on gamification report a relationship between cognitive and emotional psychology (Mullins & Sabherwal, 2020). The main function of gamification is to increase students' motivation by activating their positive emotions, and to support their participation and engagement in the course by providing their cognitive interaction with activities related to learning targets (Buckley et al., 2017; Huang & Hew, 2021; Mullins & Sabherwal, 2020). The course supporting with gamification elements such as competition, rewards, points, badges, leaderboard, and level-up positively affects the cognitive engagement of students and facilitate learning as well as Kahoot and ClassDojo gamified applications (Erümit & Yılmaz, 2022; da Rocha Seixas et al., 2016; Sánchez-Mena & Martí-Parreño, 2017). In addition, the belief of usefulness of gamification drives them to positive emotions and behaviors regarding gamification as well (Sánchez-Mena & Martí-Parreño, 2017). The reward systems encourage to progress within an enjoyable learning environment. The leaderboards also work as a motivation source which providing to students instantly see their progress and compare it with classmates (Dominguez et al., 2013; Huang & Hew, 2021). In other words, these gamification elements have a positive effect on students in terms of emotional aspects.

Attitude towards the Gamified Course

Kapp et al. (2014) stated that using game elements changes behavior and even emotionally attitude. Indeed, the attitude is the critical factor to emerge of the desired behavioral outcome, as it is a predictor of the student's intention to perform a behavior (Fishbein & Ajzen, 1975). At this point, one of the functions of gamification is to ensure its positive reflection on learning by directly influencing the attitude. In other words, gamified elements enable to behaviors which bring about positive effects on learning when they create positive attitude (Deterding et al., 2011; Smith, 2017). Therefore, it is important to identify the attitude score as it provides not only during the learning experience but also an overall prediction regarding students' motivation and attitude towards future gamified courses (Dominguez et al., 2013; Luo et al., 2021).

Many studies results confirmed that gamification elements such as points, badges, leaderboard, and gamified applications had the potential to increase students' attitude towards the course (Ding et al., 2017; Dominguez et al., 2013; Tan & Hew, 2016). Bai (2021)

reported that most students had a positive attitude towards the use of leaderboards in a gamified course because of its potential to create a competitive and comparison environment. According to Özer et al. (2018), using Kahoot as a gamified tool positively influenced the teacher candidates' attitude towards the coding education. Similarly, Rahman et al. (2018) determined that students using Kahoot showed a quite positive attitude towards the gamification as a fresh approach in learning environment. Philpott (2020) revealed that students' high or middle ranking in leaderboard positively affected their performance, emotions, and attitude towards the gamified English course. Öden-Sercanoğlu et al. (2021) determined that using Kahoot as a gamified application in experimental group significantly increased the attitude of the vocational high school students towards the English course whereas attitude of control group decreased.

Galbis-Córdova et al. (2017) figured out that perceived attention, relevance, and confidence affected directly and positively the attitude of undergraduate students towards gamified course. Öztürk and Korkmaz (2020) determined that the gamification significantly increased the fifth grade students' total attitude as well as love, interest, motivation, and trust sub-dimensions except of benefit sub-dimension of attitude scale towards the social studies course more than traditional method. Smith (2017) revealed that gamification reduced students' belief on difficulty of the statistics course (the sub-factor of attitude) and facilitated learning. Sun-Lin and Chiou (2019) found out that the gamification significantly increased the sixth grade students' total attitude as well as enjoyment, motivation, and perceived value sub-dimensions except of confidence sub-dimension towards the algebra course more than control groups. Turan et al. (2016) obtained the qualitative findings that students had the positive attitude towards the gamified course. Yildirim (2017) revealed a significant difference between undergraduate students' attitude scores in affective sub-dimension in favor of gamified group whereas not any difference in emphasis sub-dimension.

Despite the mentioned positive results for attitude in gamified courses, some studies noticed that gamification had not any significant effect on students' attitude. Ertan (2020) determined that there was no significant difference between the attitude scores of the students according to the course achievement levels. According to Türkmen and Soybaş (2019), even if the attitude score of the experimental group was higher than the control group, there was no significant difference between fifth grade students' attitude towards the English course in control and experimental groups. Uz-Bilgin and Gul (2020) determined that the attitude score of experimental group using Edmodo badges was higher than control group. They also found out that although gamification was a positive effect on student's in-group interaction, it was not any effect on students' attitude towards collaborative learning environments.

It is also available the studies to reveal the negative effect of gamification on attitude. Hanus and Fox (2015) stated that students in gamified group were less satisfied than non-gamified group. Moreover, Philpott (2020) determined that the students' low ranking in leaderboard negatively affected their performance, emotions, and attitude towards the gamified English course. Ding et al. (2017) determined that a few of the participants indicated negative attitude towards the gamified course. According to Dominguez et al. (2013), some students had a negative attitude towards the gamified course as the leaderboard created a comparative and competitive learning environment. They also stated that this reaction was more likely to cause poor performance compared to the positive one.

Cognitive Load in Gamified Course

The gamification elements acting as external motivational stimuli at producing desired student's behaviors lead to strong or weak cognitive relationships between student's attitude and behavior (Mee et al., 2021). The success or failure in the gamification process can also trigger various emotions in students (Dominguez et al., 2013). For this reason, gamification is perceived as a useful approach to facilitate learning whereas as a potential risk for in-class atmosphere (Sánchez-Mena & Martí-Parreño, 2017).

The gamified activities including audio-visual materials and competitive tasks may cause highly cognitive effort in students (Becker, 2005). According to cognitive load theory, it is important to keep the cognitive effort and the working memory at optimal level for easily perceiving and encoding the knowledge in mind (Mavilidi & Zhong, 2019; Paas & van Merriënboer, 2020; Sweller, 2010). The simultaneous presentation of related content and materials may support this situation (Debue & van de Leemput, 2014). Cognitive absorption occurs in a positive way when effective stimuli are used to arouse the student's interest in learning (Wu, 2018).

In contrast, this situation may lead to overloading of limited capacity working memory and thus, negatively influence to students in cognitive aspect (Moreno, 2010; Sweller et al., 2019). Additionally, when students overcome this effort and challenge, the negative emotions may also emerge (Mullins & Sabherwal, 2020). In other words, unsuitable implementations in the learning process emerge negative feelings as well as high cognitive load by causing cognitive absorption in a negative way (Wu, 2018). Accordingly, it is critical point to investigate the gamified process by considering both cognition and emotion aspects (Mullins & Sabherwal, 2020).

Researches on cognitive load theory keep the importance depending on contributions to learning (Ayres, 2020). In this direction, it was available a few studies regarding cognitive load in gamified process. Wu (2018), in the study comparing different learning environments, revealed that cognitive load level of undergraduate students was lower, whereas their cognitive absorption and perception of learning performance were higher in the gamified group than the others groups. Wu also concluded that learning materials including rich media in gamification had the potential to facilitate students' cognitive absorption and positively affected their emotions.

According to Shaban et al. (2021), third grade students with a lower cognitive load level were better learning performance and perceived experience in the gamification activities. Furthermore, there was negative correlation between both learning performance

and experience, and cognitive load of students. They also determined that the students had generally optimum cognitive load during gamification, were eager to participate it, and enjoyed. Su (2016) revealed that gamification was not only a useful approach to decrease the learning anxiety and cognitive load but also to increase learning motivation and academic performance.
However, Turan et al. (2016) determined that students had highly cognitive load level in gamification process. Sevcenko et al. (2021) reported that cognitive load depended on not only the complexity of the activity but also timing of the task as it might quickly change when performing the task. They also stressed that even if each student was performing the same task, they might make different mental effort.

The contrasting results of the mentioned studies point out that it is important to decrease cognitive load level whereas increase learning performance of students in gamified activities (Shaban et al., 2021). Regardless of the reason of cognitive load, it should be applied the learning activities by considering the critical importance to manage it (Ayres, 2020; Sevcenko et al., 2021).

Purpose of the Study

It is necessity to highlight that integrating the gamification elements into the learning environments may not guarantee positive effect on learning outcomes. It is more important how gamification is implemented (Dominguez et al., 2013; Kapp et al., 2014; Uz-Bilgin & Gul, 2020). Yildirim (2017) concluded that even if gamification had not any cognitively effect on students, it had a significant positive affectively effect on them. Martí-Parreño et al. (2016) reported that although many teachers had positive attitude towards gamification, just a few of them regularly used the gamification in their courses.

It is available the criticisms regarding gamification (Luo et al., 2021), as it is an approach which directs the emotion and behavior of the participants (Kim & Werbach, 2016). The reward leads the ambition because of heavy competition. It causes students with lower ranking in the leaderboard have negative feelings (Hanus & Fox, 2015). It is important to prefer the suitable gamification tools and elements considering the context of learning process to stimulate positive feeling and desired behavior of student (Adams & Preez, 2022; Kapp et al., 2014; Werbach, & Hunter, 2012).

Consequently, gamification as an intermediary must successfully make changes attitude and behavior of learners in order to strengthen effectiveness of the instruction (Dichev & Dicheva, 2017). From this point, this study aims to use various gamification elements and tools to ensure students' positive attitude towards the course and keep their cognitive load at optimal level. For this reason, this study spreading a long-term process also aims to guide the future studies by explaining the reason which gamification elements and tools preferred throughout 14-week gamified course in the "implementation" section.

On the other hand, the positive findings of the mentioned studies show that gamification can be used to participate in the students not interested in the course and to increase their attitudes towards the course. However, many of these studies compare the students' attitude towards gamified and non-gamified course. Additionally, most of the studies about gamification focus on students' affective aspect, while just a few studies underline that it needs to be considered the cognitive aspect in gamification as well (Sevcenko et al., 2021; Shaban et al. 2021; Su, 2016; Wu, 2018).

As for this study, it was examined to the effects of cognitive load level on students' attitude towards the gamified course and their views. In this context, the results of this study will strengthen the literature regarding gamification in education the cognitive and affective aspect. Accordingly, the research questions of the study are following.

1. What are the cognitive load levels of the students in the gamified course?
2. What are the attitudes of students with low and high cognitive load levels towards the gamified course?
3. Do the cognitive load levels of students have a significant effect on the attitude towards the gamified course?
4. Are there any significant correlations between cognitive load and attitude of students with low and high cognitive load levels?
5. What are the views of students with low and high cognitive load levels regarding the 14-week gamified course?

METHOD

Research Design

The quantitative and qualitative research designs were applied in this study (Creswell, 2014). Quantitatively, it was determined whether there was a significant difference between the attitudes of students with low and high cognitive load towards the gamified course. In addition, it was figured out the correlation between the attitude and cognitive load of these students. As for qualitatively, it was revealed the positive and negative views of the students regarding the 14-week gamified process.

Participants

The participants determined by convenience sampling (Creswell, 2014) were 66 undergraduate students attending the gamified course conducted by the researcher. 40 students had low cognitive load level (CL_{Low}) while 26 students had high level (CL_{High}). In addition, the total 51 volunteer students (31 of them with CL_{Low} and 20 of them with CL_{High}) answered the structured interview questions. Demographic information of the participants is presented in Figure 1.

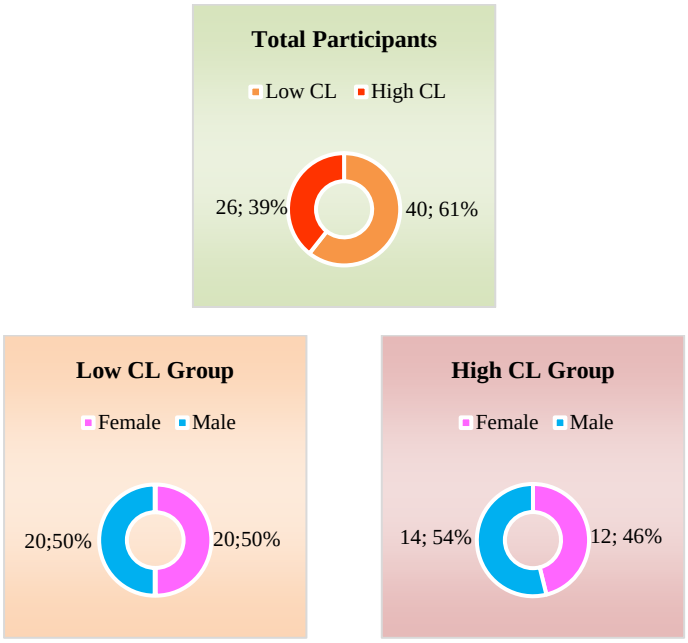

Figure 1. Demographic information of the participants

Data Collection Tools

Cognitive Load Scale was developed by Paas and van Merriënboer (1994) and Cronbach's alpha of the one-item scale was calculated as α =.82. This scale was 9-grades from 1=too low to 9=too high cognitive load level. According to this score range, students with less than five point (<5) were in CL_{Low} group, and with five or more (>=5) were in CL_{High} group. The scale was applied to found out students' mental effort level in the gamified course process, as well as to compare the attitudes and views towards this course of students with low and high cognitive load level.

Attitude Scale was applied by Koç (2014). The 27-items scale (α=.93) consisted of four sub-dimensions: Valuing (ten items, α=.94), Resisting (seven items, α=.89), Positive Effects (six items, α=.90), and Cost Belief (four items, α=.84). The rating of 5-point Likert scale was from 1 (strongly disagree) to 5 (strongly agree). It was assumed that the intervals was equal in the 5-point Likert rating scale. For the interpretation of arithmetic mean scores, the formula "Score Range = (Highest Value – Lowest Value) / 5 = (5 – 1) / 5 = 4 / 5 = 0.80" was used. Accordingly, score range was calculated as 1.00-1.80 (Strongly Disagree) "quite low attitude", 1.81-2.60 (Disagree) "low attitude", 2.61-3.40 (Neutral/Neither Disagree nor Agree) "medium attitude", 3.41-4.20 (Agree) "high attitude", and 4.21-5.00 (Strongly Agree) "quite high attitude". It was accepted that the students' attitude towards the gamified course were higher as the scores approached 5.00, and lower as they approached 1.00.

Structured Interview Guide was created by the researcher who was also the instructor of the course in order to the students freely answer the questions. Accordingly, it was asked open-ended questions to obtain their positive and negative views regarding the 14-week implementation and evaluation process in this gamified course. Although the form was applied online to all participants at the end of the course, some students did not answer the questions. Therefore, the response of the volunteer students were taken as qualitative data.

Gamifying of the Course Process

The gamified course process was based on one of the instructional design models, the Planning-Implementation-Evaluation model (Newby et al., 2000). This model was used to guide what and which educational resources such as learning and teaching approaches, instructional technologies, students and teachers, why, when, and how to integrate into the learning environments. According to course schedule, the gamified course lasted 14 weeks. Weekly course period were four lesson hours. The whole process in a semester conducted and managed by the researcher as this course instructor was completed in total 56 hours. The gamified course process is summarized in Figure 2.

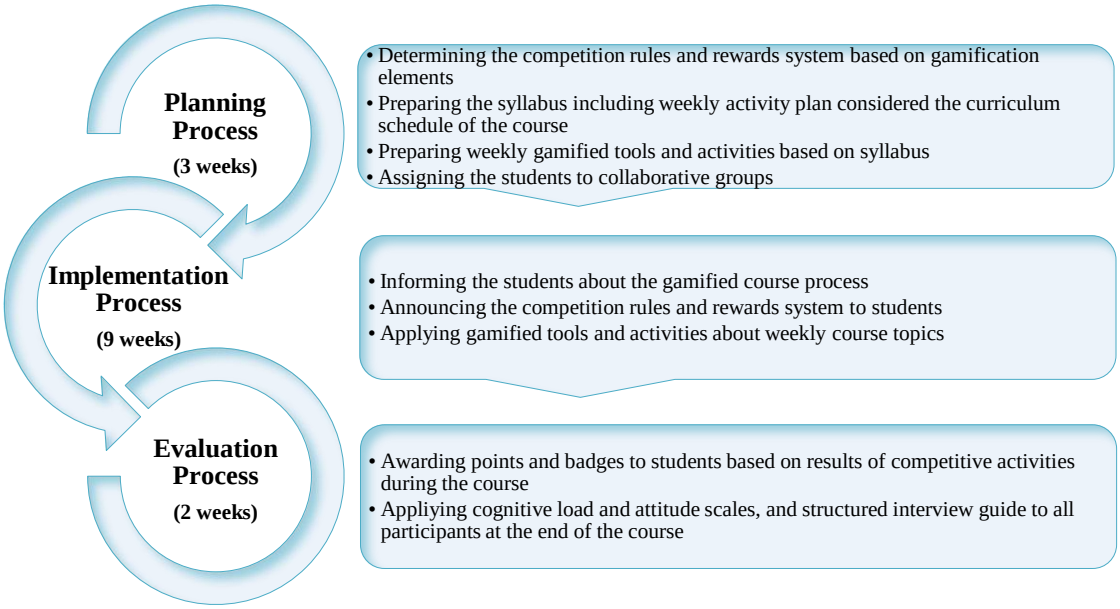

Figure 2. Summary of gamified course process

Planning Process

Firstly, the instructor, considering some gamification elements of Werbach and Hunter (2015), has determined the competition rules and rewards system on ClassDojo and Edmodo apps. Figure 3 shows how the gamified elements and tools are utilized in this study.

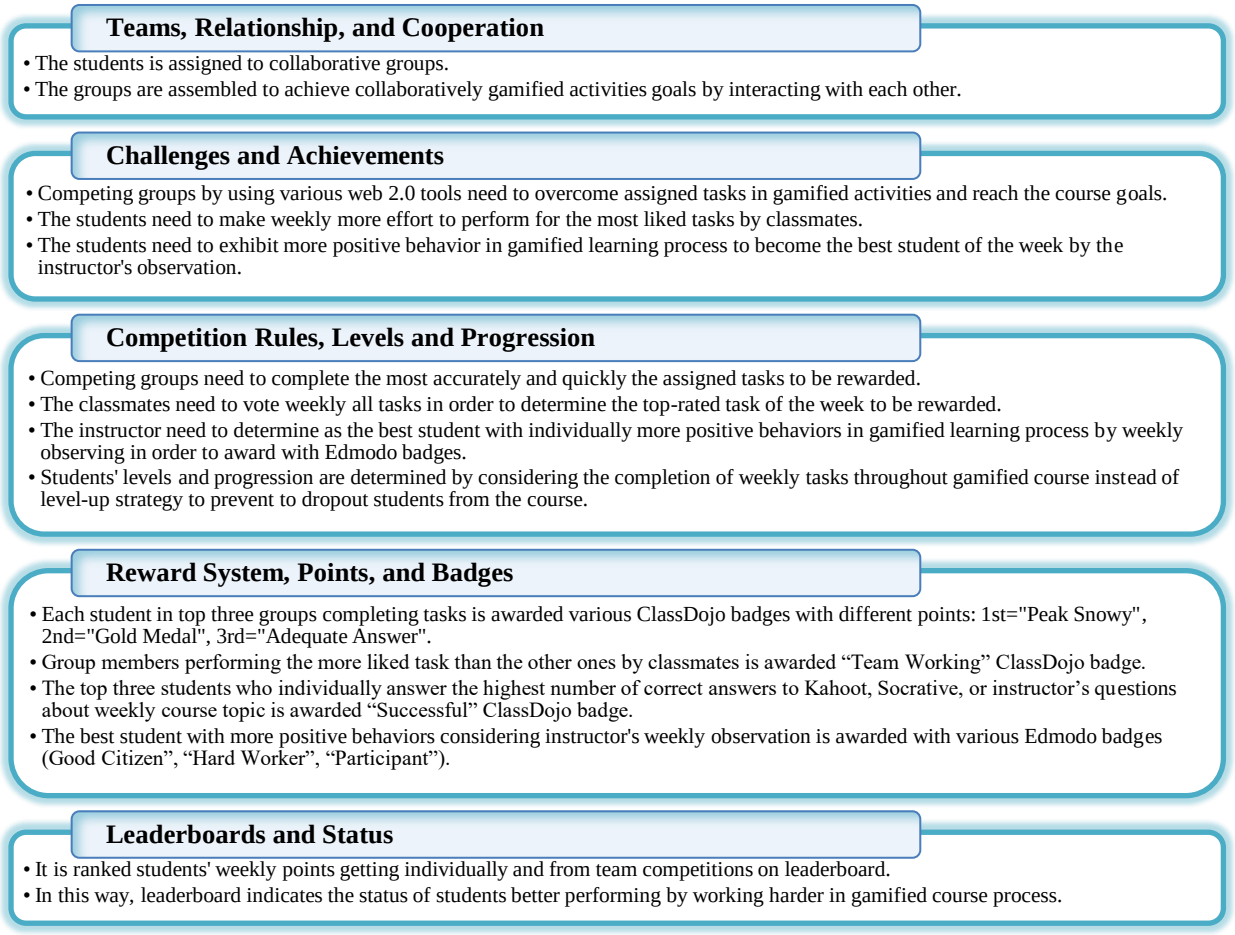

Figure 3. Utilizing the gamified elements and tools in the study

According to Figure 3, the students' levels and progression depend on their completion of weekly tasks using various web 2.0 tools (Jigsaw Puzzle, QR Code Hints, Padlet, Pawtoon, Storyboard.That, and Kahoot etc.) throughout the gamified course. Namely, unlike

the level-up strategy, the levels are not locked. The students who attend weekly lessons are able to pass that level. However, in order to continue their chance to be on the leaderboard, they have to get points and badges, and for this they have to attend the each lesson.

The task completion timing is adjusted on ClassDojo considering difficulty level of tasks, and thus, it is expected that each group completed these tasks in the same time. The members of the top three groups who completed the tasks most accurately and quickly are awarded ClassDojo badges with various names and different points by the instructor: 1st="Peak Snowy" (3 points), 2nd="Gold Medal" (2 points), 3rd="Adequate Answer" (1 point). ClassDojo badge named "Team Working" (1 point) are awarded to the group members performed the more liked task than the other ones by voting classmates. Additionally, the top three students individually who got the highest number of correct answers to Kahoot, Socrative, or instructor's questions about weekly course topic are awarded ClassDojo badge named "Successful" (1 point * student's rank in the list).

Furthermore, at the beginning of the implementation process, it is announced that the best student with more positive behaviors considering instructor's weekly observation will be rewarded with various named Edmodo badges after the lesson: "Good Citizen", "Hard Worker", and "Participant" (1 point). In this way, it is tried to keep activeness of students throughout the learning process and to prevent distraction of them.

After determining the competition rules and rewards system based on gamification elements, the instructor has prepared the syllabus with the weekly activity plan based on curriculum schedule of the course including knowledge on the critical features and implementation steps of various learning and teaching approaches. While preparing the activity plan, it has been considered the contents of undergraduate and graduate courses on gamification conducted by the instructional technology experts as well as literature. Additionally, the instructor as faculty member, who is an expert in instructional technologies, has been conducting this course about learning and teaching approaches for ten years, and frequently applying the online tools as well as various gamification elements in in-class activities. Accordingly, the activity plan and using web 2.0 tools, in which group members interact with each other to achieve the goals in gamified tasks related to weekly topics, is summarized in Figure 4.

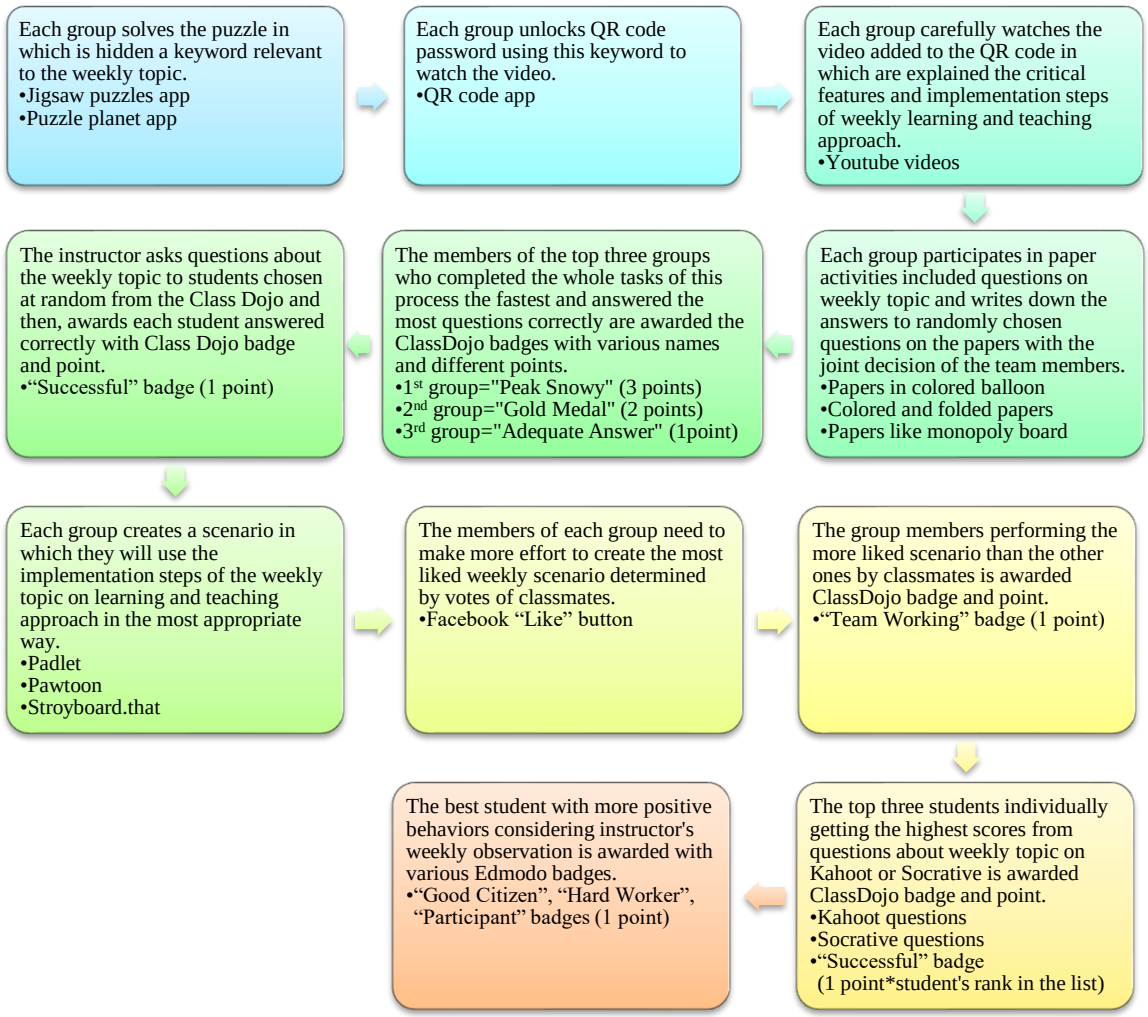

Figure 4. The activity plan

The instructor, considering the activity plan in Figure 4, has prepared weekly gamified tasks using various web 2.0 tools and in-class activities about course topics and then, has assigned the students to collaborative groups. Accordingly, gamification elements, tools, tasks and activities about weekly course topics has been carried out in implementation process based on the detailed planning in Figure 3 and Figure 4 above.

Implementation Process

According to activity plan, how to apply the gamified course process in four lesson hours per week is explained in-detail as follows:

In the first lesson of each week, each group solved the puzzle in which was hidden a keyword relevant to the weekly topic by using Jigsaw puzzle or Puzzle planet apps. Each group solving this puzzle unlocked password with QR code app on the phone using that keyword to watch the video. Then, each group carefully watched the Youtube video added to the QR code in which were explained the critical features and implementation steps of weekly learning and teaching approach. The groups could replay the video. However, it was recommended that groups watched the video carefully once to increase their chances of being #1.

In second lesson of each week, each group participated in paper activities included questions on weekly topic and wrote down the answers to randomly chosen questions on the papers with the joint decision of the team members considering the video content. These paper activities made modify from week to week as papers in colored balloon, colored and folded papers, or papers like monopoly board. The members of the top three groups who completed the whole tasks of this process the fastest, and answered the most questions correctly were awarded the ClassDojo badges with various names and different points: 1st group = "Peak Snowy" badge (3 points), 2nd group = "Gold Medal" badge (2 points), and 3rd group = "Adequate Answer" badge (1point). Following the paper activities, the instructor asked questions about the weekly topic to students chosen at random from the Class Dojo and then, awarded each student answered correctly with Class Dojo badge and point: "Successful" badge (1 point).

In third lesson of each week, each group created a scenario in which they used the implementation steps of the weekly topic on learning and teaching approach in the most appropriate way. The scenario creation apps varied from week to week as Padlet, Pawtoon, or Storyboard.That. The members of each group needed to make more effort to create the most liked weekly scenario determined by votes of classmates. Each group uploaded the created scenarios to the Facebook page of the course. The classmates voted on all scenarios with Facebook "Like" button. The group members performing the more liked scenario than the other ones by classmates was awarded ClassDojo badge and point: "Team Working" badge (1 point).

In fourth lesson of each week, the instructor applied the Kahoot or Socrative questions about weekly topic to all students. The top three students individually getting the highest scores from the app were awarded ClassDojo badge and point: "Successful" badge (1 point * student's rank in the list). Furthermore, at the end of the fourth lesson on that topic, the best student with more positive behaviors considering instructor's weekly observation was awarded with various Edmodo badges: "Good Citizen", "Hard Worker", or "Participant" badges (1 point). It is also presented some examples of activity photos regarding the gamified course in Figure 5.

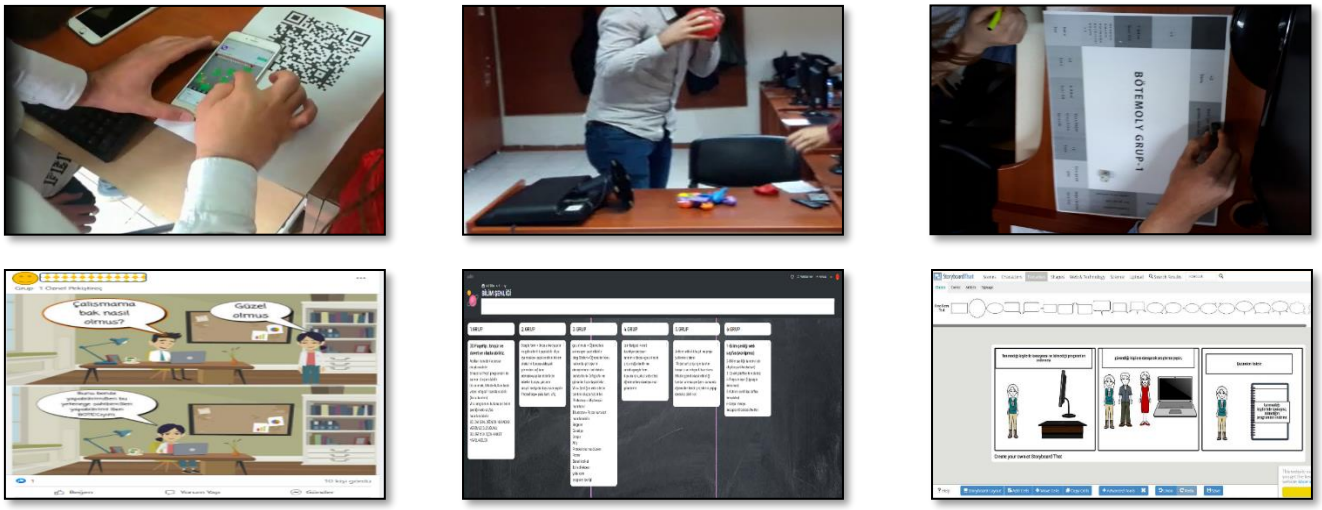

Figure 5. The gamified activity photos

Evaluation Process

The evaluation process continued throughout the gamified course, and various ClassDojo and Edmodo badges were given to students based on their weekly performance. Furthermore, the instructor determined the students who the most attendance the course, active participant, helpful, eager for performing the competition tasks in each week by observing, and then gave various Edmodo badges (1 point) to them for these positive behaviors. Moreover, the instructor did not announce to them which student earned which Edmodo badges on a weekly basis. In this way, the instructor tried to ensure continuity of their participation in the course by arousing curiosity among the students. The screenshots of ClassDojo leaderboard and Edmodo badges of the students at the end of the gamified process are presented in Figure 6.

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ClassDojo Leaderboard **Edmodo Badges**

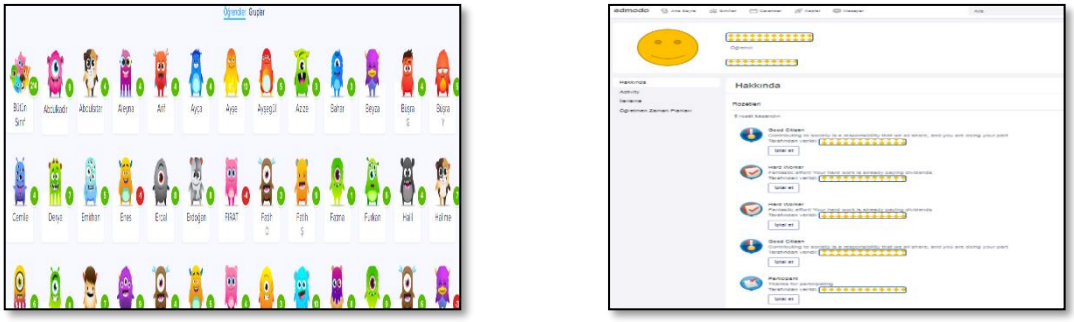


Figure 6. Screenshots of ClassDojo leaderboard and Edmodo badges

Finally, the instructor added each student's total points getting from ClassDojo and Edmodo badges throughout gamified course process to course score. At the end of the gamified course process, the instructor as the researcher applied the cognitive load and attitude scales to all participants. The volunteer students also fulfilled the online structured interview guide.

Data Analysis

For the quantitative data analysis was used SPSS 18. According to tests of normality, the dataset of students with CL_{Low} and CL_{High} were not a normal distribution, and Kolmogorov-Smirnov and Shapiro-Wilk results are presented in Table 1.

Table 1. Test of normality results

	Group	Kolmogorov-Smirnov			Shapiro-Wilk		
		Statistic	df	Sig.	Statistic	df	Sig.
Valuing	CL_{Low}	.140	40	.046	.866	40	.000
	CL_{High}	.164	26	.070	.870	26	.004
Resisting	CL_{Low}	.138	40	.053	.930	40	.016
	CL_{High}	.121	26	.200*	.974	26	.722
Positive Effects	CL_{Low}	.150	40	.025	.854	40	.000
	CL_{High}	.200	26	.009	.875	26	.005
Cost Belief	CL_{Low}	.160	40	.012	.955	40	.111
	CL_{High}	.138	26	.200*	.900	26	.016
Total Attitude	CL_{Low}	.090	40	.200*	.933	40	.020
	CL_{High}	.125	26	.200*	.968	26	.580
Cognitive Load	CL_{Low}	.310	40	.000	.838	40	.000
	CL_{High}	.220	26	.002	.872	26	.004

Considering test of normality results in Table 1, non-parametric tests were used for quantitative data analysis. For the first, second, and third research questions; Mann-Whitney U test was used to compare the attitude towards the gamified course of students with CL_{Low} and CL_{High}, as well as to examine cognitive load average of them. For the fourth research question, Spearman's rank correlation test was carried out to determine correlation between cognitive load and attitude of students with CL_{Low} and CL_{High}.

As to fifth research question, for the qualitative data analysis was used NVIVO 12. The views of students with CL_{Low} and CL_{High} regarding in 14-week gamified course were revealed in-detail by content analysis. Accordingly, first of all, codes were determined, and themes related to these codes were presented by dividing positive and negative views categories. The frequencies of students with CL_{Low} and CL_{High} for each theme were shown in comparison with bar-charts. These themes were supported by quotations of students expressions with ID no (Students with low CL level = CL_{Low} X, Students with high CL level = CL_{High} X).

RESULTS

Cognitive Load Levels of Students in Gamified Course

First of all, it was determined the cognitive load average of all students participating in gamified course. It was classified the students with less than five point (<5) as having low CL level (CL_{Low}), and with five or more (>=5) as having high CL level (CL_{High}) considering the score range of cognitive load scale. The descriptive results are lied out in Table 2.

Table 2. Cognitive load average and level of the students

Group	n	M	SD	Min.	Max.
CL_{Low}	40	2.75	.142	1.00	4.00
CL_{High}	26	6.15	.181	5.00	8.00
General CL	66	4.09	.234	1.00	8.00

According to Table 2, it was found out that the number of students with CL_{Low} was more than students with CL_{High} (n_{Low}= 40, M_{Low}=2.75 <5, n_{High}= 26, M_{High}=6.15 >5). In addition, it was determined that the general cognitive load average of all students participating in the gamified course was at a low level (n=66, M= 4.09<5).

The Mann-Whitney U test was used to determine whether there was a significant difference between students with CL_{Low} and CL_{High} in terms of cognitive load average. The test results are presented in Table 3.

Table 3. Mann-Whitney U test results of cognitive load averages of students with CL_{Low} and CL_{High}

Group	N	Mean Rank	Sum of Ranks	Mann-Whitney U	Z	p	η^2
CL_{Low}	40	20.50	820.00	.000	-6.967	.000	-.84
CL_{High}	26	53.50	1391.00				

The results in Table 3 indicated that there was a significant difference between the cognitive load averages of students with CL_{Low} and CL_{High}. Accordingly, it was compared the attitude towards the gamified course of these two different groups of students with CL_{Low} and CL_{High}.

Effects of Students' Cognitive Load Level on Attitude towards the Gamified Course

It was determined attitude averages of students with CL_{Low} and CL_{High}. Descriptive analysis results are presented in Table 4 according to total and sub-dimension of attitude average.

Table 4. Attitude averages of students with CL_{Low} and CL_{High}

Sub-Dimension	Group	M	SD	Min.	Max.
Valuing	CL_{Low} (n=40)	4.11	.113	1.30	5.00
	CL_{High} (n=26)	3.65	.149	1.00	5.00
Resisting	CL_{Low}	2.50	.122	1.29	4.43
	CL_{High}	3.25	.150	1.86	4.86
Positive Effects	CL_{Low}	4.27	.094	1.83	5.00
	CL_{High}	3.72	.172	1.00	5.00
Cost Belief	CL_{Low}	3.48	.104	2.00	4.75
	CL_{High}	3.67	.142	1.25	5.00
Total Attitude	CL_{Low}	3.63	.053	2.41	4.33
	CL_{High}	3.57	.107	2.15	4.85
General Attitude	All Students (n=66)	3.61	.052	2.15	4.85

According to Table 4, all students participating in gamified course had highly attitude towards the course (M= 3.61>3.4). In addition, it was determined that the attitudes of students with CL_{Low} were higher than students with CL_{High} (M_{Low}=3.63, M_{High}=3.57). On the other hand, it was found out that the averages of the attitude "Resisting" sub-dimension of students both with CL_{Low} and CL_{High} were lower than the other sub-dimensions (M_{Low}=2.50, M_{High}=3.25 <3.4).

The Mann-Whitney U test was used to determine whether there was a significant difference between students with CL_{Low} and CL_{High} in terms of attitude average. The test results are presented in Table 5.

Table 5. Mann-Whitney U test results of attitude average of students with CL_{Low} and CL_{High}

Group	N	Mean Rank	Sum of Ranks	Mann-Whitney U	Z	p	η^2
CL_{Low}	40	35.31	1412.50	447.500	-.952	.341	-.12
CL_{High}	26	30.71	798.50				

The results in Table 5 indicated that there was not any significant difference between the attitude averages of students with CL_{Low} and CL_{High}. However, the attitude of students with CL_{Low} was higher than with CL_{High}.

Effect of Students' Cognitive Load Level on Attitude "Valuing" Sub-Dimension

The Mann-Whitney U test was used to determine whether there was a significant difference between students with CL_{Low} and CL_{High} in terms of attitude "Valuing" sub-dimension average. The test results are presented in Table 6.

Table 6. Mann-Whitney U test results of attitude "Valuing" sub-dimension average of students with CL_{Low} and CL_{High}

Sub-Dimension	Group	N	Mean Rank	Sum of Ranks	Mann-Whitney U	Z	p	η^2
Valuing	CL_{Low}	40	38.98	1559.00	301.000	-2.884	.004	-.35
	CL_{High}	26	25.08	652.00				

The results in Table 6 indicated that there was a significant difference between the attitude "Valuing" sub-dimension average of students with CL_{Low} and CL_{High} in favor of students with CL_{Low}. Accordingly, the effect of the cognitive load level on the "Valuing" sub-dimension of the attitude towards the course was moderate ($p=.004<.05$, $\eta^2= -.35 >0.3$).

The Mann-Whitney U test was used to determine whether there was a significant difference between students with CL_{Low} and CL_{High} regarding average of each item in the "Valuing" sub-dimension of attitude scale. The test results are presented in Table 7.

Table 7. Mann-Whitney U test results regarding each item in "Valuing" sub-dimension of attitude scale of students with CL_{Low} and CL_{High}

Item	Group	M	SD	Likert Rating	Mean Rank	Sum of Ranks	Mann-Whitney U	Z	p
1. It is useful for teaching.	CL_{Low}	4.15	.893	Agree	37.73	1509.00	351.000	-2.539	.011
	CL_{High}	3.69	0.884	Agree	27.00	702.00			
3. It is in line with my perspective related to teaching.	CL_{Low}	4.03	.832	Agree	37.67	1507.00	353.000	-2.424	.015
	CL_{High}	3.58	.758	Agree	27.08	704.00			
5. I think it improves teachers.	CL_{Low}	4.02	1.097	Agree	37.13	1485.00	375.000	-2.072	.038
	CL_{High}	3.65	.892	Agree	27.92	726.00			
7. I care about using it.	CL_{Low}	4.13	.883	Agree	37.44	1497.50	362.000	-2.302	.021
	CL_{High}	3.73	.778	Agree	27.44	713.50			
9. I believe that it should be used in lessons.	CL_{Low}	4.23	.832	Agree	37.16	1486.50	373.500	-2.121	.034
	CL_{High}	3.81	.895	Agree	27.87	724.50			
11. I feel good when I use it.	CL_{Low}	4.05	.876	Agree	36.98	1479.00	381.000	-1.973	.049
	CL_{High}	3.62	.983	Agree	28.15	732.00			
13. The educational developments necessitate the use of it.	CL_{Low}	4.10	.810	Agree	37.78	1511.00	349.000	-2.496	.013
	CL_{High}	3.62	.852	Agree	26.92	700.00			
15. I think it is suitable for my personal characteristics.	CL_{Low}	4.07	.764	Agree	38.73	1549.00	311.000	-2.996	.003
	CL_{High}	3.38	.983	Agree	25.46	662.00			
17. I think using it professionalizes the teacher.	CL_{Low}	4.13	.853	Agree	37.39	1495.50	364.500	-2.173	.030
	CL_{High}	3.62	1.023	Agree	27.52	715.50			
19. It improves students' social skills.	CL_{Low}	4.18	.813	Agree	36.61	1464.50	395.500	-1.825	.068
	CL_{High}	3.85	.834	Agree	28.71	746.50			

According to the results for each item in the "Valuing" sub-dimension in Table 7, there was a significant difference between the students with CL_{Low} and CL_{High} in favor of students with CL_{Low}, except for item 19. However, the likert rating related to items of both students groups were "Agree".

Effect of Students' Cognitive Load Level on Attitude "Resisting" Sub-Dimension

The Mann-Whitney U test was used to determine whether there was a significant difference between students with CL_{Low} and CL_{High} in terms of attitude "Resisting" sub-dimension average. The test results are presented in Table 8.

Table 8. Mann-Whitney U test results of attitude "Resisting" sub-dimension average of students with CL_{Low} and CL_{High}

Sub-Dimension	Group	N	Mean Rank	Sum of Ranks	Mann-Whitney U	Z	p	η^2
Resisting	CL_{Low}	40	26.54	1061.50	241.500	-3.662	.000	-.44
	CL_{High}	26	44.21	1149.50				

The results in Table 8 indicated that there was a significant difference between the attitude "Resisting" sub-dimension average of students with CL_{Low} and CL_{High} in favor of students with CL_{High}. Accordingly, the effect of the cognitive load level on the "Resisting" sub-dimension of the attitude towards the course was moderate ($p=.000<.05$, $\eta^2= -.44 >0.3$).
The Mann-Whitney U test was used to determine whether there was a significant difference between students with CL_{Low} and CL_{High} regarding average of each item in the "Resisting" sub-dimension of attitude scale. The test results are presented in Table 9.

Table 9. Mann-Whitney U test results regarding the each item in "Resisting" sub-dimension of attitude scale of students with CL_{Low} and CL_{High}

Item	Group	M	SD	Likert Rating	Mean Rank	Sum of Ranks	Mann-Whitney U	Z	p
2. It is not suitable for this course.	CL_{Low}	2.17	1.107	Disagree	29.88	1195.00	375.000	-2.018	.044
	CL_{High}	2.73	1.151	Neutral	39.08	1016.00			
4. It is not suitable for my personal characteristics.	CL_{Low}	2.13	1.067	Disagree	27.43	1097.00	277.000	-3.325	.001
	CL_{High}	3.04	1.076	Neutral	42.85	1114.00			
6. I think it is quite difficult to apply it.	CL_{Low}	2.80	1.114	Neutral	27.96	1118.50	298.500	-3.005	.003
	CL_{High}	3.65	.977	Agree	42.02	1092.50			
8. I prefer to use what I know approaches rather than it.	CL_{Low}	2.70	1.285	Neutral	30.10	1024.00	384.000	-1.847	.065
	CL_{High}	3.27	1.116	Neutral	38.73	1007.00			
10. Using conventional approaches gives me confidence.	CL_{Low}	3.27	1.198	Neutral	30.36	1214.50	394.500	-1.706	.088
	CL_{High}	3.77	.992	Agree	38.33	996.50			
12. It does not fit my educational philosophy.	CL_{Low}	2.17	1.279	Disagree	27.55	1102.00	282.000	-3.222	.001
	CL_{High}	3.15	1.156	Neutral	42.65	1109.00			
14. It weakens the teacher's authority in the classroom.	CL_{Low}	2.25	1.256	Disagree	28.44	1137.50	317.500	-2.737	.006
	CL_{High}	3.15	1.287	Neutral	41.29	1073.50			

According to the results for each item in the "Resisting" sub-dimension in Table 9, there was a significant difference between the students with CL_{Low} and CL_{High} in favor of students with CL_{High}, except for item 8 and 10. However, the likert rating related to items of both students groups were mostly "Neutral".

Effect of Students' Cognitive Load Level on Attitude "Positive Effects" Sub-Dimension

The Mann-Whitney U test was used to determine whether there was a significant difference between students with CL_{Low} and CL_{High} in terms of attitude "Positive Effects" sub-dimension average. The test results are presented in Table 10.

Table 10. Mann-Whitney U test results of attitude "Positive Effects" sub-dimension average of students with CL_{Low} and CL_{High}

Sub-Dimension	Group	N	Mean Rank	Sum of Ranks	Mann-Whitney U	Z	p	η^2
Positive Effects	CL_{Low}	40	39.15	1566.00	294.000	-2.987	.003	-.36
	CL_{High}	26	24.81	645.00				

The results in Table 10 indicated that there was a significant difference between the attitude "Positive Effects" sub-dimension average of students with CL_{Low} and CL_{High} in favor of students with $CL_{Low.}$ Accordingly, the effect of the cognitive load level on the "Positive Effects" sub-dimension of the attitude towards the course was moderate ($p=.003<.05$, $\eta^2= -.36 >0.3$).
The Mann-Whitney U test was used to determine whether there was a significant difference between students with CL_{Low} and CL_{High} regarding average of each item in the "Positive Effects" sub-dimension of attitude scale. The test results are presented in Table 11.

Table 11. Mann-Whitney U test results regarding the each item in "Positive Effects" sub-dimension of attitude scale of students with CL_{Low} and CL_{High}

Item	Group	M	SD	Likert Rating	Mean Rank	Sum of Ranks	Mann-Whitney U	Z	p
16. It provides more permanent learning.	CL_{Low}	4.43	.636	Strongly Agree	38.25	1530.00	330.000	-2.737	.006
	CL_{High}	3.88	.864	Agree	26.19	681.00			
18. It develops a sense of responsibility in students.	CL_{Low}	4.32	.764	Strongly Agree	37.67	1507.00	353.000	-2.450	.014
	CL_{High}	3.88	.864	Agree	27.08	704.00			
21. It creates a positive atmosphere in the classroom.	CL_{Low}	4.05	.876	Agree	37.66	1506.50	353.500	-2.365	.018
	CL_{High}	3.54	.989	Agree	27.10	704.50			
23. The class becomes more active when it is applied.	CL_{Low}	4.47	.784	Strongly Agree	40.64	1625.50	234.500	-4.136	.000
	CL_{High}	3.65	.977	Agree	22.52	585.50			
25. It allows the teacher to get to know the student better.	CL_{Low}	4.20	.883	Agree	37.81	1512.50	347.500	-2.426	.015
	CL_{High}	3.65	1.018	Agree	26.87	698.50			
27. It supports students to establish better relationships with each other.	CL_{Low}	4.15	.662	Agree	35.92	1437.00	423.000	-1.390	.164
	CL_{High}	3.73	1.116	Agree	29.77	774.00			

According to the results for each item in the "Positive Effects" sub-dimension in Table 11, there was a significant difference between the students with CL_{Low} and CL_{High} in favor of students with CL_{Low}, except for item 27. However, the likert rating related to items of both students groups were mostly "Agree".

Effect of Students' Cognitive Load Level on Attitude "Cost Belief" Sub-Dimension

The Mann-Whitney U test was used to determine whether there was a significant difference between students with CL_{Low} and CL_{High} in terms of attitude "Cost Belief" sub-dimension average. The test results are presented in Table 12.

Table 12. Mann-Whitney U test results of attitude "Cost Belief" sub-dimension average of students with CL_{Low} and CL_{High}

Sub-Dimension	Group	N	Mean Rank	Sum of Ranks	Mann-Whitney U	Z	p	η^2
Cost Belief	CL_{Low}	40	30.54	1221.50	401.500	-1.570	.116	-.19
	CL_{High}	26	38.06	989.50				

The results in Table 12 indicated that there was not any significant difference between the attitude "Cost Belief" sub-dimension average of students with CL_{Low} and CL_{High} ($p=.116>.05$, $\eta^2= -.19 <0.3$). However, the attitude "Cost Belief" sub-dimension of students with CL_{High} was higher than with CL_{Low}.

The Mann-Whitney U test was used to determine whether there was a significant difference between students with CL_{Low} and CL_{High} regarding average of each item in the "Cost Belief" sub-dimension of attitude scale. The test results are presented in Table 13.

Table 13. Mann-Whitney U test results regarding the each item in "Cost Belief" sub-dimension of attitude scale of students with CL_{Low} and CL_{High}

Item	Group	M	SD	Likert Rating	Mean Rank	Sum of Ranks	Mann-Whitney U	Z	p
20. The use of it requires excessive preparation time.	CL_{Low}	4.15	.893	Agree	34.45	1378.00	482.000	-.539	.590
	CL_{High}	4.00	1.020	Agree	32.04	833.00			
22. It causes excessive noise in the classroom.	CL_{Low}	3.80	1.043	Agree	32.95	1318.00	498.000	-.305	.760
	CL_{High}	3.88	.993	Agree	34.35	893.00			
24. Applying it hinders the completion of the subjects.	CL_{Low}	2.82	.958	Neutral	30.44	1217.50	397.500	-1.675	.094
	CL_{High}	3.27	1.185	Neutral	38.21	993.50			
26. Discipline problems increase when it is applied.	CL_{Low}	3.13	1.067	Neutral	30.85	1234.00	414.000	-1.440	.150
	CL_{High}	3.54	1.104	Agree	37.58	997.00			

According to the results for each item in the "Cost Belief" sub-dimension in Table 13, there was not any significant difference between the students with CL_{Low} and CL_{High}. However, the likert rating related to items of both students groups were mostly "Agree".

Correlation between Cognitive Load and Attitude of Students with CL_{Low} and CL_{High}

Spearman's rank correlation test was carried out to determine correlation between cognitive load and attitude of students with CL_{Low} and CL_{High}. The detailed results in Table 14 indicated that a negative and medium level correlation was determined between cognitive load and attitude of students with CL_{Low} ($p<.05$). However, there was not a significant correlation between cognitive load and attitude of students with CL_{High} ($p>.05$).

Table 14. Correlations between cognitive load and attitude of students with CL_{Low} and CL_{High}

		Valuing	Resisting	Positive Effects	Cost Belief	Total Attitude	Cognitive Load
CL_{Low}	Valuing	1					
	Resisting	-.623**	1				
	Positive Effects	.789**	-.497**	1			
	Cost Belief	-.019	.367**	.066	1		
	Total Attitude	.596**	.080	.663**	.584**	1	
	Cognitive Load	-.236	-.071	-.159	-.154	-.332*	1
CL_{High}	Valuing	1					
	Resisting	.085	1				
	Positive Effects	.853**	.007	1			
	Cost Belief	.459*	.205	.551**	1		
	Total Attitude	.903**	.275	.885**	.614**	1	
	Cognitive Load	-.180	-.151	-.043	.109	-.117	1

*p<0.05. **p< 0.01.

Views of Students with Low and High Cognitive Load Level on the Gamified Course

The common themes emerged from views of total 51 volunteer students with CL_{Low} (n=31) and with CL_{High} (n=20) on the gamified course are presented in Figure 7.

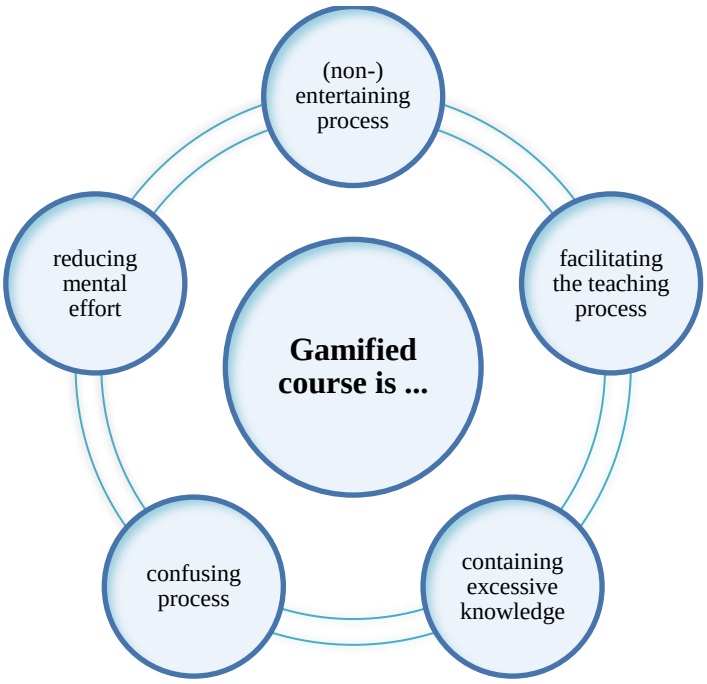
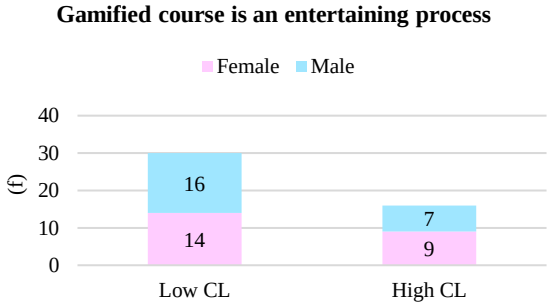
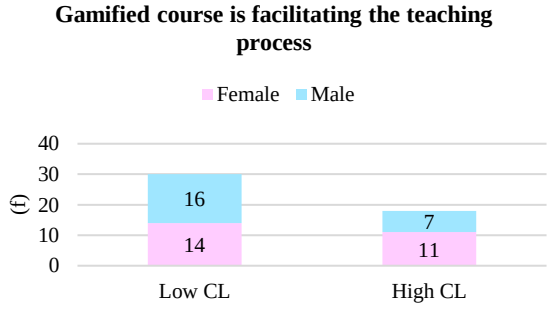


Figure 7. The common themes emerged from students' views

The themes in Figure 7 were presented by dividing positive and negative views categories. The frequencies of students with CL_{Low} and CL_{High} for each theme were shown in comparison with bar-charts. These themes were supported by quotations of students expressions with ID no (Students with low CL level = CL_{Low} X, Students with high CL level = CL_{High} X).

Positive Views of Students

According to "Positive Views" category, the bar-charts showing the frequencies of students with CL_{Low} and CL_{High} for the themes of "an entertaining process", "facilitating the teaching process" and "reducing mental effort", and quotations from students are presented in Figure 8.

Frequencies	Quotations
	*"I think that competitive activities using online tools make the lesson more fun and become us more active in the course." (CL_{Low} 26_Female)* *"I can say that we were more active in this course than in other courses. Because, the in-class activities were generally instructive and more entertaining, and the reward system was motivating." (CL_{High} 42_Female)*
	*"The activities made me better learn the subjects and helped me in the exams. Even if I forgot the information on the subject, I could answer the questions by remembering these activities. For this reason, I would like this learning method to be used in other lessons, and I think that a more permanent learning will be provided." (CL_{Low} 8_Female)* *"The competitive activities using web 2.0 applications were enjoyment and helped me to reinforce the subjects better. In addition, the ClassDojo made me ambitious to receive an award." (CL_{High} 65_Male)*

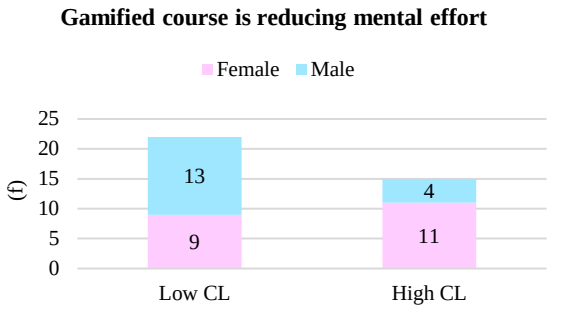
	*"I think that the group activities in this course are effective for learning and reduce mental effort." (CL$_{Low}$ 21_Male)* *"The competitive activities using web 2.0 applications made us better comprehend the subjects with less mental effort." (CL$_{High}$ 65_Male)*

Figure 8. Frequencies and quotations on themes in "Positive Views" category

The bar-charts in Figure 8 show that students with CL_{Low} stated positive views more than students with CL_{High}. While the frequencies of male students with CL_{Low} were higher than female students, the opposite results were observed in students with CL_{High}. On the other hand, the many students with CL_{Low} and CL_{High} stated that competitive activities made the learning process more fun, facilitated teaching and learning, and reduced the mental effort.

Negative Views of Students

According to "Negative Views" category, the bar-charts showing the frequencies of students with CL_{Low} and CL_{High} for the themes of "non-entertaining process", "containing excessive knowledge" and "confusing process", and quotations from students are presented in Figure 9.

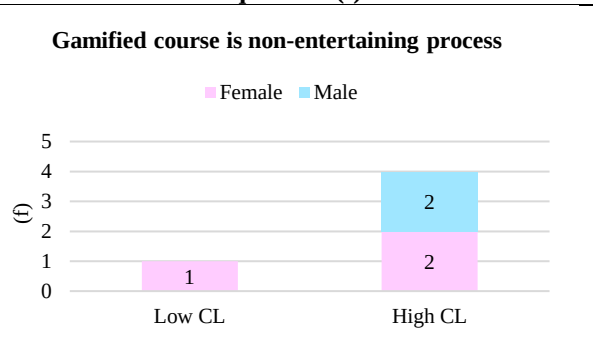
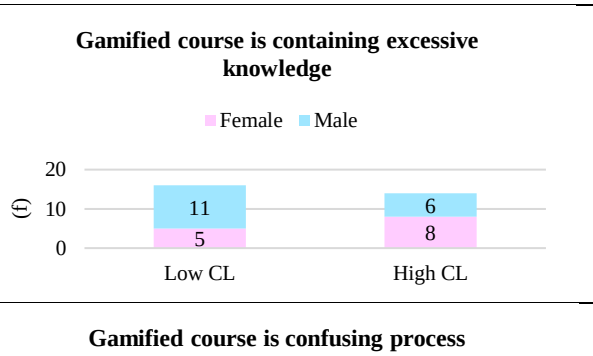
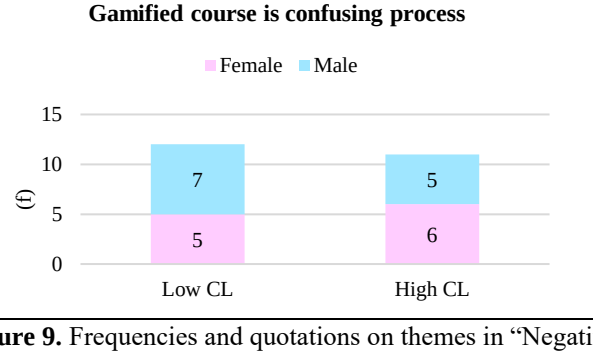
Frequencies (f)	Quotations
	*"I think that such activities negatively affected the interaction among students in the classroom by creating a very competitive environment. In addition, ranking of successful and unsuccessful students on the ClassDojo leaderboard decreased my attitude towards this course. Therefore, I did not enjoy this course in general." (CL$_{Low}$ 43_Female)* *"To be honest, the competition environment and group activities were boring and not enjoying for me." (CL$_{High}$ 18_Male)*
	*"Even though the time passed very quickly in this gamification-based course, I did not like the intensity of content and activities." (CL$_{Low}$ 43_Female)* *"The lessons in this course were very intense. I think this density should be reduced a little." (CL$_{High}$ 62_Female)*
	*"The lessons were confusing as the implementation process was so intense. I think that the activities should not be so intense in order to be more effective and efficient of this course." (CL$_{Low}$ 16_Male)* *"The excessive tasks caused cognitive load on the students, and the competitive learning environment complicated the learning process." (CL$_{High}$ 10_Female)*

Figure 9. Frequencies and quotations on themes in "Negative Views" category

The bar-charts in Figure 9 show that some students with CL_{Low} and CL_{High} had negative views of the gamified learning process at close frequencies. While the frequencies of male students with CL_{Low} were higher than female students, the opposite results were observed in students with CL_{High}. On the other hand, since the competitive activities negatively affected the interaction among students, it prevented some students from enjoying this process, even if they were few in number. In particular, the intensity of such

activities and the excessive content were important reasons for the negative views of some students. In addition, it was emphasized by some students with CL_{Low} and CL_{High} that this situation caused confusion.

DISCUSSION

In this study, it was found out that general cognitive load of all students participating in the gamified course were at low level as well as the number of students with CL_{Low} was more than students with CL_{High}. It is important to keep the cognitive effort and the working memory at optimal level for easily perceiving and encoding the knowledge in mind (Mavilidi & Zhong, 2019; Paas & van Merriënboer, 2020; Sweller, 2010). The simultaneous presentation of related content and materials may support this situation (Debue & van de Leemput, 2014). Accordingly, this finding was an indication that the majority of students made less mental effort in the gamification process. The positive views of both students with CL_{Low} and CL_{High} in the qualitative findings also supported this result. However, the necessity of performing gamified tasks may have created difficulties for some students (Sun-Lin & Chiou, 2019). Becker (2005) stated that multimedia materials and competitive activities in a gamified process may lead highly cognitive effort in some participants. In addition, Sevcenko et al. (2021) stressed that even if each student was performing the same task, they might make different mental effort. It can be said that the personal features of students are reflected in their mental efforts in the gamification process.

Although the attitudes of students with CL_{Low} were higher than students with CL_{High}, there was not any significant difference between the attitude averages of students with CL_{Low} and with CL_{High}. This result showed that all participants had high attitude towards the lesson, regardless of their cognitive load levels. Shaban et al. (2021) determined that the students who had generally optimum cognitive load during gamification, were eager to participate it. Philpott (2020) revealed that the leaderboard in the gamified course made the lessons fun and thus, especially, the high or middle ranking of students in leaderboard positively affected their performance, emotions, and attitude towards the gamified course. In addition, Bai (2021) reported that most students had a positive attitude towards the use of leaderboards in a gamified course with the potential to create a competitive environment. This result of the current study also proved that a course enriched with gamification elements significantly positive affected the students' attitude towards the course.

Wu (2018) concluded that learning materials including rich media in gamification had the potential to facilitate students' cognitive absorption and positively affected their emotions. Wu also revealed that cognitive absorption occurred in a positive way when effective stimuli were used to arouse the student's interest in learning and cognitive load level of students was lower in the gamified activities. Perhaps this was the reason why the attitudes of the students who were not cognitively challenged were higher than the others in this current study. In this current study, it was also determined a negative and medium level correlation between cognitive load and attitude of students with $CL_{Low.}$ Similarly, Shaban et al. (2021) found out that there was negative correlation between both learning performance and experience, and cognitive load of students as well.

There was a significant difference between the attitude "Valuing" sub-dimension average of students with CL_{Low} and CL_{High} in favor of students with $CL_{Low.}$ Accordingly, the effect of the cognitive load level on the "Valuing" sub-dimension of the attitude towards the course was moderate. Shaban et al. (2021) revealed that students with a lower cognitive load level were better learning performance, and enjoyed in the gamification activities. Erümit and Yılmaz (2022) determined that gamified course increased the active participation as well as competition. Öztürk and Korkmaz (2020) found out that students more liked the gamified lessons and their attitudes were higher. Sun-Lin and Chiou (2019) stated that students' attitude especially in the enjoyment dimension were higher in gamification. Accordingly, it can be said that gamification made learning activities more interesting to participate students in process.

These quantitative findings were also supported by qualitative findings of the current study. For example; students' views regarding participating in competitive activities using web 2.0 applications made the learning process more fun in gamified course supported the item 11 (I feel good when I use it). This perspective had more frequency in students with CL_{Low} than with CL_{High}. According to Öden-Sercanoğlu et al. (2021), using Kahoot gamified application in the course significantly increased the attitude of students towards the course. Özer et al. (2018) found out that students were more eager to participate in training and demonstrated positive attitudes after the implementation. Uz-Bilgin and Gul (2020) determined that the attitude score of students using Edmodo badges was higher in gamified course. Accordingly, the attention about various materials and activities may have triggered students' attitude towards the lessons in a positive way (Galbis-Córdova et al., 2017).

Especially some expressions of students with CL_{Low} that the gamified process facilitated learning also supported item 1 (It is useful for teaching.). In the study of Sánchez-Mena & Martí-Parreño (2017), some teachers thought that gamification was fun and facilitates learning as well as providing active participation. According to Galbis-Córdova et al. (2017), the fear of failure is important for students. The students state that gamification activities facilitate learning and reduce mental effort. This result indicates that students believe they will be successful in gamification activities. This situation may have affected their attitudes positively. Smith (2017) revealed that gamification reduced students' belief on difficulty of the course (the sub-factor of attitude) and facilitated learning. In summary, the students in this study may have high attitude towards the course because they believe that gamification will contribute to increasing the achievement of the course.

On the other hand, there was not any significant difference between students with CL_{Low} and CL_{High} for item 19 (It improves students' social skills.) with "Agree" likert rating in the "Valuing" sub-dimension. This finding shows that most students have the opinion

that gamified activities affect the interaction among students positively. Uz-Bilgin and Gul (2020) stressed that gamification was a positive effect on students' in-group interaction as well. However, contrary to this quantitative finding, qualitative findings showed that since the competitive activities negatively affected the interaction among students, it prevented some students from enjoying this gamified process. This indicate that the negative emotions may also emerge while students try to overcome this effort and challenge (Mullins & Sabherwal, 2020).

It was found out that the averages of the attitude "Resisting" sub-dimension of students both with CL_{Low} and CL_{High} were lower than the other sub-dimensions. In addition, there was a significant difference between the "Resisting" sub-dimension average of students with CL_{Low} and CL_{High} in favor of students with CL_{High}. Accordingly, the effect of the cognitive load level on the "Resisting" sub-dimension of the attitude towards the course was moderate. Philpott (2020) stated that for some students, the leaderboard used in gamified course was not fun and comparing peers with each other on this leaderboard caused negative feelings such as anxiety, and this situation negatively affected the attitude. Perhaps this situation was the reason why students with CL_{High} had lower attitude "Resisting" sub-dimension towards the gamified course than others.

The qualitative findings strengthened these results. For example; students' views related to not like this implementation which caused them to compete with each other supported the item 4 (It is not suitable for my personal characteristics.) and item 12 (It does not fit my educational philosophy.). This perspective had more frequency in students with CL_{High} than with CL_{Low}. According to Buckley et al. (2017), some students were unwilling towards the competitive activities in this course, and so they did not enjoy it. Ding et al. (2017) determined that a few participants indicated negative attitude towards the gamified course.

Moreover, some expressions of students with CL_{High} that the gamified process caused confusion and excessive intensity supported item 6 (I think it is quite difficult to apply it.) and item 14 (It weakens the teacher's authority in the classroom.). According to Dominguez et al. (2013), some students had a negative attitude towards the gamified course as the leaderboard created a competitive learning environment. They also stated that this reaction was more likely to cause poor performance compared to the positive one. Sánchez-Mena and Martí-Parreño (2017) stated that teachers did not like gamification because it took too much time and negatively affected the classroom atmosphere.

On the other hand, there was not any significant difference between students with CL_{Low} and CL_{High} for item 8 (I prefer to use what I know approaches rather than it.) and item 10 (Using conventional approaches gives me confidence.). However, the likert rating related to items in the "Resisting" sub-dimension of students with CL_{Low} and CL_{High} were mostly "Neutral". This finding shows that most of them have an undecided point of view in this sub-dimension of the attitude. The negative views in the qualitative findings also confirm this result as well. According to Sun-Lin and Chiou (2019), the requirement to perform the gamified tasks might have lead a challenge to students, and caused not positively respond to the confidence dimension of attitude scale. As pointed out by Buckley et al. (2017), it can be said that gamified intervention was not appropriate for students who preferred traditional teaching approaches.

There was a significant difference between the attitude "Positive Effects" sub-dimension average of students with CL_{Low} and CL_{High} in favor of students with $CL_{Low.}$ Accordingly, the effect of the cognitive load level on the "Positive Effects" sub-dimension of the attitude towards the course was moderate. The expressions of many students in qualitative findings strengthened the item 16 (It provides more permanent learning.) and item 23 (The class becomes more active when it is applied.) in attitude "Positive Effects" sub-dimension. This perspective had more frequency in students with CL_{Low} than with CL_{High}. Öztürk and Korkmaz (2020) revealed that the gamification significantly increased students' total attitude as well as love, interest, motivation, and trust sub-dimensions. In addition, Galbis-Córdova et al. (2017) figured out that perceived attention, relevance, and confidence affected directly and positively the attitude of undergraduate students towards gamified course.

On the other hand, there was not any significant difference between students with CL_{Low} and CL_{High} for item 27 (It supports students to establish better relationships with each other.) with "Agree" likert rating in the "Positive Effects" sub-dimension. This finding is an important indicator for most students that gamified activities positively affect the interaction among students. Sun-Lin and Chiou (2019) determined that the gamification significantly increased students' total attitude as well as enjoyment, motivation, and perceived value sub-dimensions towards the course. However, according to qualitative findings of the current study, a few students with CL_{Low} and CL_{High} claimed the opposite of these findings. These students stressed to not enjoy the learning process as competitive activities negatively affected the interaction among them. Accordingly, since the award leads to ambition due to heavy competition, it may lead negative feelings for students who are at the bottom of the leaderboard, or while them try to overcome this challenge (Hanus & Fox, 2015; Mullins & Sabherwal, 2020).

Although the attitude "Cost Belief" sub-dimension of students with CL_{High} was higher than with CL_{Low}, there was not any significant difference between this sub-dimension averages of the students. Accordingly, both students with CL_{Low} and CL_{High} mostly had a negative point of view regarding "Cost Belief" sub-dimension of attitude. The negative views of students in qualitative findings also confirmed the item 20 (The use of it requires excessive preparation time.) and item 22 (It causes excessive noise in the classroom.) in attitude scale. In particular, the intensity of gamified activities and the excessive content were important reasons for the negative views of some students. It was also emphasized by some students with CL_{Low} and CL_{High} that this situation caused confusion. Hanus and Fox (2015) determined that students' satisfaction tended to decrease over time in 16-week gamified course process. Accordingly, it can be said that the duration of gamification can affect the attitude. Moreover, Luo et al. (2021) revealed the teachers' anxiety

regarding management of gamified process in classroom. For this reason, it is critical to pay attention to the development and design of gamification learning content (Su, 2016).

CONCLUSION, LIMITATIONS, AND SUGGESTIONS

In this study with a long-term (14-week) implementation process, it was obtained both quantitative and qualitative data regarding the effect of cognitive load on attitude towards the gamified course. Accordingly, the cognitive load level of the students did not have a significant effect on the attitude towards the gamified course, and both students with CL_{Low} and with CL_{High} had highly attitude towards the gamified course. According to the qualitative results, the competitions and awards made in the gamified course aroused positive emotions in many students CL_{Low} and with CL_{High}, facilitated the learning of the subjects, and ensured their active participation in the lessons. As emphasized in the literature (Bai, 2021; Öztürk & Korkmaz, 2020; Philpott, 2020; Öden-Sercanoğlu et al., 2021; Sun-Lin & Chiou, 2019), these results in current study reveal that gamification is how a powerful and effective teaching and learning approach.

The gamified course had a positive effect on the "Valuing" and "Positive Effects" sub-dimensions of the attitude in favor of students with CL_{Low}. The positive views of many students in qualitative findings also strengthened these results. Wu (2018) stressed that using learning materials as an effective stimuli in gamification had the potential to facilitate the cognitive absorption of students and affected their emotions in positive way. Shaban et al. (2021) determined that students with a lower cognitive load level were better learning performance and perceived experience in the gamified activities. While gamified course had a negative effect on the "Resisting" sub-dimension in favor of students with CL_{High}, it did not have any significant effect on the "Cost Belief" sub-dimension. A few negative views of students in qualitative findings supported the items in these dimensions of attitude scale. That's why, even if it is perceived as a useful approach to facilitating learning, it should be taken into account that gamification may pose a potential risk to the classroom environment and some students (Kim & Werbach, 2016; Luo et al., 2021; Sánchez-Mena & Martí-Parreño, 2017) and should be applied the learning activities by considering the critical importance to manage cognitive load regardless of the reason of it (Ayres, 2020; Sevcenko et al., 2021). Accordingly, it is important to prefer the suitable gamification tools and elements considering the context of learning process to stimulate positive feeling and desired behavior of students (Adams & Preez, 2022; Kapp et al., 2014; Werbach, & Hunter, 2012).

Consequently, the results of this current study reveal that gamified process is an important opportunity for students to have a positive attitude towards the course, even if they have different cognitive loads level. Many studies about gamification focus on students' affective aspect, while just a few studies underline that it needs to be considered cognitive aspect (Sevcenko et al., 2021; Shaban et al. 2021; Su, 2016; Wu, 2018). In this context, the results of this study will strengthen the few studies related to effect of gamified course on the cognitive and affective aspect. However, further studies need to confirm these results. Moreover, it is necessity to highlight that integrating the gamification elements into the learning environments may not guarantee positive effect on learning outcomes (Dominguez et al., 2013; Kapp et al., 2014; Uz-Bilgin & Gul, 2020). In this line, the gamification need to change attitude and behavior of students in a positive way to be effective in a learning process (Dichev & Dicheva, 2017). For this reason, it is recommended to carry out such studies that reveal all the situations which can affect the attitude in the gamified course in order to achieve positive outcomes of students with different cognitive load levels.

On the other hand, this study without a control group is limited to comparing the attitudes of students with CL_{Low} and CL_{High} participating in a gamified course. During the implementation, scoring system was based on points and badges by rewarding weekly in-class activities to prevent to dropout students from the 14-week course process. Moreover, it was not examined to effect of the using gamification tools and elements on cognitive load of students in this gamified course. These are the limitations of this study. In future studies, it can be investigated which gamification elements, tools or activities may cause high and low cognitive load level.

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Research Paper

Developing Computational Thinking Scale for Primary School Students and Examining Students' Thinking Levels According to Different Variables

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ABSTRACT

In recent years, computational thinking has been considered as one of the 21st century skills that all students should have. Researchers emphasize the importance of determining and developing students' computational thinking levels from the earliest possible age. However, no measurement tool has been found in the literature that aims to reveal the computational thinking levels of primary school students. In this study, it was aimed to develop the computational thinking scale for primary school students and to examine the computational thinking levels of primary school students according to different variables (grade level, daily computer use time). In the first stage of the study, a scale with appropriate psychometric properties was developed to measure computational thinking. In the scale development phase of the research, exploratory sequential mixed methods research design was used. In the other phase of the study, it was investigated whether the computational thinking levels of primary school students differed according to the grade level and daily computer usage time without any intervention. For this reason, the research was carried out in accordance with the general survey model, which is one of the descriptive research types. For the first stage, the study group of the research consisted of 287 students studying in the 1st, 2nd, 3rd and 4th grades of primary schools in Ankara Golbasi district in the second term of the 2021-2022 academic year. In the process of examining the students' computational. thinking levels according to the variables of grade level and daily computer usage time, the study group consisted of a total of 96 students attending the primary education classes of a private school in Ankara in the second term of the 2021-2022 academic year. In this context, the one-dimensional computational thinking scale consisting of 17 items was applied to 287 primary school students and the obtained data were subjected to validity and reliability analysis. According to the explanatory factor analysis, the scale explains 46% of the total variance. When the results of the explanatory factor analysis are examined, it is seen that the factor loads of 17 items in the scale vary between 56 and .86. The internal consistency coefficient of the scale was found to be Cronbach Alpha .92. The developed scale was applied to primary school students in the next stage. As a result of the study, it was found that the generally computational thinking levels of primary school students differed significantly according to the grade level. On the other hand, it was observed that the students' computational thinking levels differed significantly according to the time spent in front of the computer daily, and the mean of the students' computational thinking scale increased as the daily computer use time increased.

INTRODUCTION

Today, the needs of societies, science and technology are changing rapidly. This situation undoubtedly changes the characteristics expected from individuals. Learning and teaching approaches, theories and strategies also differ in order to raise individuals with desired and needed characteristics (MEB, 2018). Individuals need new skills different from traditional methods at the point of accessing and using information, revealing new information and sharing the information produced (Polat, 2006). For this purpose, the "21st Century Learning Framework" has been determined by the "21st Century Skills" joint working group, which includes high-level companies and associations such as Microsoft, Lego, American Association of School Librarians, Pearson, National Education Association, Intel, Dell, Apple (DODEA, 2014). In line with this determined framework, the 21st century skills that individuals are expected to have been put forward in detail (P21, 2009). These skills are defined as three main themes: learning and innovation skills, life and career skills, knowledge, media and technology skills, and different skill groups under each theme (Kalemkus & Bulut Ozek, 2021). At this point, computational thinking emerges as one of the 21st century skills that every student should have (Grover & Pea, 2013; Gulbahar, Kert, & Kalelioglu, 2019).

Computational thinking is defined as mental processes used in areas such as understanding human behavior, designing systems, solving problems efficiently and effectively, being aware of information processing capacity, and designing autonomous processes (Wing, 2006). According to Barr and Stephenson (2011) computational thinking is explained as the reconstruction of data through abstractions such as models and simulations, use of the data and producing appropriate solutions to existing problems by considering the limits of computing. Computational thinking is also expressed as skills such as processing, building and transforming

information, technology literacy and creating creative and innovative products as a result of all these processes (Sendurur, 2018; Yolcu, 2018). Computational thinking is seen as a prerequisite for future professions and when evaluated in terms of 21st century competencies, it is considered as one of the basic skills such as reading, writing and calculation (Ambrosio, Almeida, Macedo, & Franco, 2014). Computational thinking develops skills such as problem solving, critical and logical thinking and creativity in individuals. It also prepares them for the global race and blends success in school life with success in real life (ISTE, 2011; Korkmaz, Ozden, Oluk, & Sarioglu, 2015). For this reason, in today's information and technology age, computational thinking is considered as attitudes and skills that can benefit not only computer engineers, but also all individuals from every profession, and it is emphasized that these skills should be gained to every student as early as possible (Wing, 2006). As a result, computational thinking defines skills such as processing, constructing and transforming information, technology literacy and creating creative and innovative products as a result of all these processes (Sendurur, 2018; Yolcu, 2018). Computational thinking is seen as a prerequisite for future professions and when evaluated in terms of 21st century competencies, it is considered as one of the basic skills such as reading, writing and calculation (Ambrosio, Almeida, Macedo, & Franco, 2014). For this reason, developed countries carry out studies to include more computational thinking in their K12 curricula and develop programs in which computational thinking takes a large place.

Research context

Education and training programs in Turkey are updated in accordance with the needs of the age. The special objectives of the Information Technologies and Software course curriculum updated in 2018 include the development of students' problem-solving and computational thinking skills (MEB, 2018). This situation clearly reveals the necessity of increasing the importance given to computational thinking, which is seen as a 21st century skill in educational environments. Because the computational thinking process includes many concepts and processes such as critical and creative thinking, abstraction, algorithm design, automation, data collection, data analysis, data presentation, parsing, pattern recognition, pattern generalization, collaboration and modeling (Gulbahar, Kert, & Kalelioglu, 2019; ISTE, 2011). In this respect, it is thought that it is important to actively integrate computational thinking into education systems. However, researchers emphasize that there are not enough resources and activities to carry computational thinking into the classroom environment (Barr & Stephenson, 2011). In addition, it is another problem that studies in the relevant literature tend to develop this skill before determining the computational thinking levels of individuals (Berikan, 2018; Gulbahar, Kert, & Kalelioglu, 2019). However, it is very important to determine the level of computational thinking that already exists in individuals, as well as to acquire computational thinking skills, or to evaluate to what extent individuals have acquired computational thinking skills as a result of the designed applications. Therefore, the process of determining the level of computational thinking in individuals, whose scope is extremely wide, should also be structured comprehensively, and computational thinking competencies should be carefully evaluated by considering knowledge, attitudes and skills (Snow, Katz, Elliott Tew, & Feldman, 2012). Student development files, multiple choice tests, computational thinking pattern graph, project and performance evaluation, computational thinking scale and rubrics can be used to evaluate computational thinking (Gouws, Bradshaw, & Wentworth, 2013; Grover, Pea, & Cooper, 2015). When the literature is examined, it is seen that there are limited studies on the measurement and evaluation of students' computational thinking level. Again, it is noteworthy that a very limited number of measurement and evaluation tools have been developed for the relevant subject in our country. When the measurement tools developed in our country are examined; there is a computational thinking skills scale for university students (Korkmaz, Cakir, & Ozden, 2017) and a computational thinking skills test for secondary school students (Ozmen, 2016). It is also seen that the computational thinking skill measurement tool (Yildiz, 2021) and the self-efficacy perception scale (Gulbahar, Kert, & Kalelioglu, 2019) for computational thinking skills have been developed for secondary schools. It is emphasized by researchers that there are not enough measurement tools to measure the level of computational thinking, especially in our country (Demir & Seferoglu, 2017). In addition, when the literature was reviewed, no measurement tool aimed at revealing the computational thinking levels of primary school students was found. Again, no other study has been found in the literature examining the computational thinking levels of primary school students according to different variables. At this point, this study aims to provide a valid and reliable computational thinking scale for primary school students to the relevant literature. Another aim of the study is to examine the computational thinking levels of primary school students, who are the sample group in which there are limited studies on computational thinking levels, according to various variables (grade level, daily computer use time) within the scope of this research.

Therefore, there are two main problem statements in this research. The first problem statement of the study was “What are the psychometric properties of the Computational Thinking Scale (CAI) that will be developed for primary school students?” has been determined.

The other problem statement of the research is “Do primary school students' computational thinking levels vary according to different variables (grade level, daily computer use time)?” is in the form.

METHOD

Research model

This study, which aimed to develop the computational thinking scale and to examine the computational thinking levels of primary school students according to different variables, was carried out in two stages. In the first stage of the study, a scale with appropriate psychometric properties was developed to measure computational thinking. In the scale development phase of the research, exploratory sequential mixed methods research design was used. In the other phase of the study, it was investigated whether the computational thinking levels of primary school students differed according to the grade level and daily computer usage time without

any intervention. For this reason, the research was carried out in accordance with the general survey model, which is one of the descriptive research types. Descriptive research is defined as research in which the current situation of the subject is examined and the relationship between the variables is revealed without changing (Buyukozturk, Akgun, Karadeniz, Demirel, & Kilic, 2016; Yildirim & Simsek, 2018). Survey models are studies in which research data are collected from a sample group representing the universe, rather than the entire universe, in order to reveal the views or characteristics adopted by large populations (Fraenkel & Wallen, 2009). The general screening model is defined as a model in which the researcher has no effect on the independent variable and includes studies conducted in the entire universe or in a smaller group to be taken from the universe in order to reach a general judgment about the universe (Karasar, 2017).

Working group

The study group of this research was determined by convenient sampling (Cohen, Manion & Morrison, 2007). In convenient sampling, the researcher or researchers conducting the study select the participants who will form the study group from volunteer individuals who are suitable for the research and easy to reach (Gravetter & Forzano, 2012). During the scale development process, which is the first stage of the research, the study group of the research consisted of 287 students studying in the 1st, 2nd, 3rd and 4th grades of primary schools in Golbasi district of Ankara in the second term of the 2021-2022 academic year. It is stated by Bryman and Cramer (2001) that the sample size reached in the scale development studies should be at least five times the number of items in the scale. Since the draft scale consists of 26 items, it is thought that the sample size of 287 students is sufficient.

In the process of examining the students' computational thinking levels according to the variables of grade level and daily computer usage time, the study group consisted of a total of 96 students attending the primary education classes of a private school in Ankara in the second term of the 2021-2022 academic year. Of the 96 students in the study group, 24 are 1st grade, 24 2nd grade, 24 3rd grade and 24 4th grade. The frequency distribution of the students in the study group according to the grade level and daily computer usage time is given in the table below (Table 1).

Table 1. Frequency distribution of the study group according to the variables of grade level and daily computer usage time

Variable		f	%
Grade level	1st grade	24	25
	2nd grade	24	25
	3rd grade	24	25
	4th grade	24	25
Daily computer usage time	Less than 2 hours	22	23
	2-4 hours	34	35
	4-6 hours	21	22
	More than 6 hours	19	20

Data collection tool

The data collection tool used in the research is the Computational Thinking Scale developed by the researchers. The development process of the scale and its psychometric properties are given below in detail.

Before starting the research, it was aimed to investigate whether the computational thinking levels of primary school students change according to different variables. When the relevant literature is reviewed, there are measurement tools that aim to determine the computational thinking levels of university (Korkmaz, Cakir, & Ozden, 2017) and secondary school students (Gulbahar, Kert, & Kalelioglu, 2019; Ozmen, 2016; Yildiz, 2021) in our country. However, it has been observed that there is no measurement tool to determine the computational thinking levels of primary school students. Therefore, with this study, it was decided to develop a scale that can reveal the computational thinking levels of primary school students.

In the first stage of the scale development process, information about computational thinking and the sub-dimensions of computational thinking was obtained by examining various sources (Barr & Stephenson, 2011; Grover & Pea, 2013; Kalelioglu, Gulbahar, & Kukul, 2016; Selby & Woollard, 2013; Wing , 2006; 2008; 2011). Based on the relevant literature and especially considering the classification of Wing (2008; 2011), who has many studies on computational thinking, the sub-dimensions of computational thinking were determined as abstraction, algorithm, automation, decomposition, generalization/evaluation. Then, an item pool of 33 items was created to include all these sub-dimensions and ensure content validity. While preparing the items in the item pool, attention was paid to write the items in accordance with the age group. In addition, all the items are written in a way that includes a single situation and is also clear and understandable. The scale was prepared in 3-point Likert type as “agree”, “no idea” and “disagree”. The scale was prepared in a triple Likert type because it is stated that scales with fewer choices are suitable for less educated or younger respondents (Koklu, 1995). Empirical studies reveal that participants do not perceive the difference between options equally in Likert-type questions (Hart, 1996). This situation causes a change in the number of participation levels and therefore affects the validity and reliability of the scale (Ozkan & Bindak, 2021).

Expert opinions were sought to ensure the content validity of the 33-item, 3-point Likert-type scale. The prepared scale was examined in terms of content validity by two faculty members working in the departments of computer and instructional technologies education and one faculty members working in the division of classroom instruction education. In addition, the scale was examined by 2 classroom teachers in terms of suitability for student level, language and intelligibility, and by an assessment

and evaluation expert in terms of compliance with assessment and evaluation criteria. In line with the suggestions from the experts, it was decided to remove some items from the scale because they were not suitable for the assessment and evaluation criteria and the level of primary school students. Again, the scope of some items in the scale was narrowed down and the items were corrected to be simpler and more understandable. After these regulations, a draft scale consisting of 26 items was created. Since the age group of the participants is small and especially the students who are just learning to read, such as the first graders, are also included in the participant group, the draft scale with 26 items was thought to be appropriate.

In the pilot study of the research, the draft scale was applied to a total of 20 primary school students. As a result of the feedback obtained by the students while answering the scale, the items that were difficult to understand were revised again. As a result of this preliminary application, the application time of the scale was determined as 25 minutes. After this stage, exploratory factor analysis was started.

The draft scale, which was prepared in line with the opinions obtained from the experts and the preliminary application made to primary school students, was applied to a total of 287 students studying in primary schools in Ankara province Golbasi district. During this practice, including 135 female and 152 male students; 69 students in the 1st grade, 71 students in the 2nd grade, 73 students in the 3rd grade and 74 students in the 4th grade were reached. The data obtained from the application were analyzed in the SPSS 21 package program and the findings related to the scale were reached.

As a result of the analysis of the data, the Kaiser-Meyer-Olkin (KMO) value of the draft scale consisting of 26 items was calculated as .88. In addition, a significant difference was found in the Bartlett Sphericity test result of the scale ($p < .05$). As a result of the analysis, the significant difference in the Bartlett Sphericity test and the KMO value greater than 70 revealed that the data were suitable for factor analysis (Leech, Barrett, & Morgan, 2005; Tavsancil, 2010).

After the scale was found to be suitable for factor analysis, factor analysis was applied to the scale and after the analysis of the main components of the scale, 7 factors with eigenvalues greater than 1.00 emerged. However, the fact that the eigenvalue of the first factor was significantly higher than the eigenvalues of the other factors indicated that the scale had a single-factor structure. At this point, in order to determine the factor number of the scale, Cattel's "scree" test was performed (Kline, 1994) and a graph as below was obtained (Figure 1).

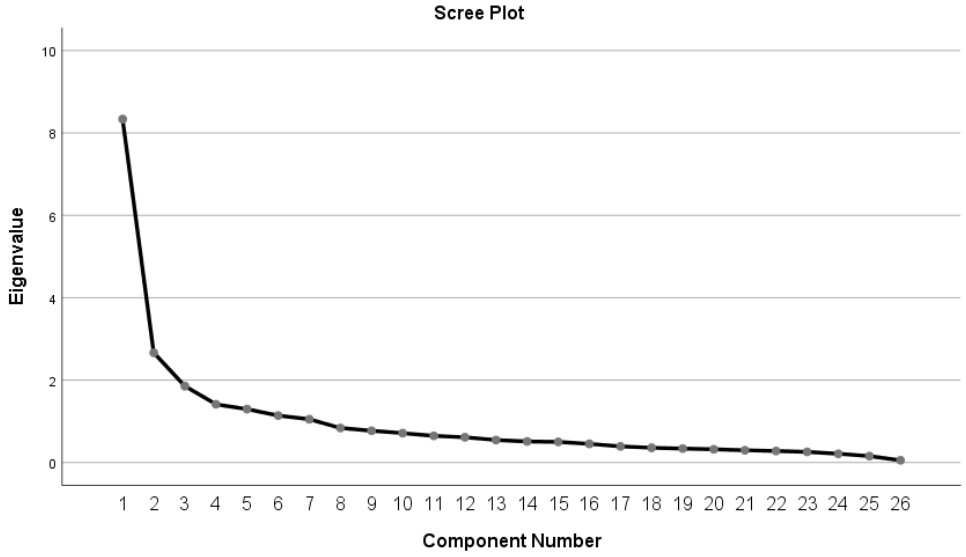

Figure 1. Computational Thinking Scale line chart

The sharp decline points in the graph determine the factor number of the scale (Singh, 2007). When the Scree plot graph in Figure 1 is examined, it is seen that there is only one sharp decline point. This showed that the scale measures a single factor structure and it was decided to have a single factor scale. The results obtained regarding the variance value of the single factor scale are given in the table below (Table 2).

Table 2. Findings related to a factor as a result of factor analysis

Factor	Eigenvalue	Percentage of Variance	Percentage of Total Variance
1	8.14	46.49	46.49

When Table 2 is examined, the eigenvalue of the single factor in the scale was found to be 8.14, and the total variance percentage of this factor was found to be 46.49. The single factor in the scale explains 46% of the total variance. According to Kline (1994), the acceptable rate is 41%. The fact that the value obtained from the relevant scale is above 41% allows the scale to be used as a scale consisting of a single factor. In scale development studies by researchers, it is considered sufficient that the variance explained,

especially in social sciences, is between 40% and 60%. The height of the explained variance is accepted as an indicator of how well the relevant structure is measured (Buyukozturk, 2012; Scherer, Wiebe, Luther, & Adams, 1988).

Factor analysis was also used to examine the factor structures measured by the scale items. At this stage, it is stated that the factor load values of the items in the scale should be above .30 and the difference between two high factor loads should be at least .10 in order to ensure the construct validity of the scale (Bryman & Cramer, 2001; Buyukozturk, 2012). At this point, experiments were carried out by removing scale items from the scale in order to ensure that the factor loads were in accordance with the referenced values. Items with a factor load less than .30 and under more than one factor at the same time were excluded from the scale (M4, M5, M6, M8, M9, M10, M12, M17, M19). As a result of the analyses, a total of 17 items remained in the scale. As a result of removing the relevant items from the scale, the factor loads of the items in the scale were found to be between .56 and .86. The factor load values of the remaining 17 items in the scale are given in Table 3.

Table 3. Factor loading values of the items in the scale

Item no	Factor load
M3	.86
M26	.83
M23	.81
M16	.79
M2	.79
M24	.71
M25	.69
M11	.65
M7	.65
M14	.61
M13	.61
M20	.59
M21	.59
M15	.58
M22	.58
M1	.57
M18	.56

In the next step, to determine the reliability of the scale, the internal consistency coefficient Cronbach alpha was calculated and found to be .92. A Cronbach alpha coefficient greater than .70 is considered sufficient, and greater than .90 is indicated as excellent. The scale was found to be highly reliable (Kilic, 2016.) After the validity and reliability analyzes, a 17-item scale was reached. The distribution of the items in the scale according to the computational thinking sub-dimensions is given in Table 4.

Table 4. Distribution of items according to computational thinking sub-dimensions

Sub-dimension	Sub-dimension
Abstraction	3, 8, 14, 17
Algorithm	4, 5, 11, 15
Automation	1, 10, 13
Decomposition	2, 9, 16
Generalization/ Evaluation	6, 7, 12

The lowest score that can be obtained from the scale is 0 and the highest score is 51. In the scale, reverse items were determined as M2, M5, M8, M10, M12 and M14 items. The response time of the scale is approximately 15 minutes.

Data Collection Process

Within the scope of this research, a valid and reliable computational thinking scale consisting of 17 items and one dimension was developed. After the development of the scale, an answer was sought for another problem statement of the research. At this stage the scale was applied to primary school learners and it was examined whether the computational thinking levels of primary school students changed according to the grade level and daily computer usage time. At this stage, the scale was applied to a total of 96 primary school students attending the primary school classes of a private school in order to investigate whether the computational thinking levels of primary school students differ according to the grade level and daily computer usage time variables.

Data Analysis

Microsoft Excel spreadsheet program and SPSS 21 statistical analysis program were used in the analysis of the data of the research. The Shapiro Wilk test was used to determine whether students' responses to the scale were normally distributed. One-Way ANOVA, one of the parametric analysis techniques, was used to determine whether there was a statistically significant difference between the

mean scores of the students in different groups. In case of significant difference as a result of the analysis, Bonferroni test, one of the multiple comparison tests, was used to determine between which groups the difference was. The significance level was accepted as .05 in all analyzes.

FINDINGS AND INTERPRETATION

Before proceeding to the analysis of the data, the statistical method to analyze the data collected through the Computational Thinking Scale was examined. In order for the data collected during the study to be analyzed with parametric tests, all of them should show a normal distribution. For this reason, first of all, the data should be analyzed by choosing the appropriate normal distribution test, and it should be decided whether the normality assumption is provided and parametric or non-parametric tests should be used in the analysis of the data (Ghasemi & Zahediasl, 2012; Sim & Wright, 2002). The Shapiro Wilk test was applied to all data obtained from the Computational Thinking Scale, which was also used as a data collection tool in this study. The Shapiro Wilk test is generally preferred in cases where the number of participants is less than 50 (n<50) (Ghasemi & Zahediasl, 2012). The Shapiro Wilk test results of the study group's Computational Thinking Scale scores according to grade level, daily computer use time and gender variables are given in Table 5.

Table 5. Shapiro Wilk Test results regarding grade level and daily computer use time variables

Variable	Group	statistics	df	p
Grade level	1st grade	,94	24	,13
	2nd grade	,94	24	,17
	3rd grade	,97	24	,66
	4th grade	,95	24	,33
Daily computer usage time	Less than 2 hours	,95	22	,26
	2-4 hours	,97	34	,55
	4-6 hours	,93	21	,15
	More than 6 hours	,96	19	,60

When the Shapiro Wilk test results in Table 1 are examined, it is seen that the significance level of the Computational Thinking Scale scores is greater than p > .05 according to the variables of class level and daily computer usage time of the study group. The p values obtained show that the scale scores show a normal distribution according to the variables of grade level and daily computer use time. Parametric tests were used in the analysis of the data obtained from the Computing Thinking Scale as a result of the normal distribution of the data obtained from the scale in terms of all variables. After the data showed normal distribution, One-Way ANOVA was applied to the data in order to determine whether there was a statistically significant difference between the scale mean scores of the students according to the grade level. The obtained results are given in Table 6.

Table 6. ANOVA results of Computing Thinking Scale scores according to grade level variable

Variable		Sum of Sq	df	Mean Sq	F	p
Grade level	Between groups	3860,12	3	1286,71	196,90	,00*
	Within groups	601,22	92	6,54		
	Total	4461,33	95			

*p < .05

When Table 6 showing the results of the ANOVA test according to the grade level variable of the scale scores is examined, it is seen that there is a statistically significant difference between the grade levels of the students and their computational thinking scores [$F_{(3, 92)}$= 196.90, p < .05] . Post-hoc test was needed in order to find out from which grade level or levels this statistical difference between grade levels originates. At this point, the Bonferroni Test was preferred because it is a multiple comparison test that does not require the principle of equal sample size (Miller, 1969). The Bonferroni Test results regarding the multiple comparison of scores are given in Table 7.

Table 7. Multiple comparison test results according to grade level variable

(I) group	(J) group	Mean difference (I-J)	Std error	p	95% Confidence interval	
					Lower bound	Upper bound
1st grade	2nd grade	-5,26	,72	,00*	-7,21	-3,31
	3rd grade	-6,42	,75	,00*	-8,45	-4,38
	4th grade	-17,42	,74	,00*	-19,41	-15,43
2nd grade	1st grade 3rd	5,26	,72	,00*	3,31	7,21
	grade	-1,15	,74	,74*	-3,15	,84
	4th grade	-12,15	,72	,00*	-14,11	-10,20
3rd grade	1st grade	6,42	,75	,00*	4,38	8,45
	2nd grade	1,15	,74	,74*	-,84	3,15
	4th grade	-11,00	,75	,00*	-13,03	-8,97

4th grade	1st grade	17,42	,74	,00*	15,43	19,41
	2nd grade	12,15	,72	,00*	10,20	14,11
	3rd grade	11,00	,75	,00*	8,97	13,03

*p < .05

The results of the Bonferroni Test, which was used to investigate the source of the significant difference between the grade levels of the students and the Computational Thinking Scale point averages, are given in Table 7. When the table is examined, it is seen that there is a significant difference between the mean scores of the 1st grades and the mean scores of the 2nd, 3rd and 4th grades in favor of the 2nd, 3rd and 4th grades (p < .05). There was no significant difference between the mean scores of the 2nd graders and the mean scores of the 3rd graders (p > .05). Again, looking at the data in the table, a significant difference was found between all grade levels and 4th graders in favor of 4th graders (p < .05).

In the study, it was also aimed to examine whether the Computational Thinking Scale scores of the students differ according to the daily computer use time. One-Way ANOVA was applied to the data in order to determine whether there is a statistically significant difference between the scale mean scores according to the daily computer usage time variable of the students. The obtained results are given in Table 8.

Table 8. ANOVA results of Computing Thinking Scale scores according to daily computer use time variable

Variable		Sum of Sq	df	Mean Sq	F	p
Daily computer usage time	Between groups	1353,19	3	451,07	68,24	,00*
	Within groups	608,14	92	6,61		
	Total	1961,33	95			

*p < .05

The ANOVA test results according to the daily computer use time variable of the Computing Thinking Scale scores are given in Table 8. A statistically significant difference was found between the time spent in front of the computer during the day and the computational thinking scores of the students in the study group [$F_{(3, 92)}$= 68.24, p < .05]. The Bonferroni Test was applied to the data in order to determine between which hour intervals the significant difference found in the daily computer usage time of the students was. The results of the multiple comparison of the scores are given in Table 9.

Table 9. Multiple comparison test results according to daily computer usage time variable

(I) group	(J) group	Mean difference (I-J)	Std error	p	95% Confidence interval	
					Lower bound	Upper bound
Less than 2 hours	2-4 hours	-4,71	,70	,00*	-6,61	-2,81
	4-6 hours	-7,66	,78	,00*	-9,77	-5,54
	More than 6 hours	-10,97	,81	,00*	-13,14	-8,80
2-4 saat	Less than 2 hours	4,71	,70	,00*	2,81	6,61
	4-6 hours	-2,95	,71	,00*	-4,87	-1,02
	More than 6 hours	-6,26	,74	,00*	-8,25	-4,27
4-6 saat	Less than 2 hours	7,66	,78	,00*	5,54	9,77
	2-4 hours	2,95	,71	,00*	1,02	4,87
	More than 6 hours	-3,31	,81	,00*	-5,51	-1,12
Morethan 6 hours	Less than 2 hours	10,97	,81	,00*	8,80	13,14
	2-4 hours	6,26	,74	,00*	4,27	8,25
	4-6 hours	3,31	,81	,00*	1,12	5,51

*p < .05

When the data in Table 9 were examined, it was observed that there were significant differences in daily computer usage times between all time zones (p < .05). Computational thinking mean scores of students who spend less than 2 hours a day at the computer and 2-4 hours, 4-6 hours and more than 6 hours in front of the computer show a significant difference in favor of increasing the time spent in front of the computer (p < .05). Again, there is a significant difference between the mean scores of the students who spend 2-4 hours in front of the computer and those who spend less than 2 hours in front of the computer in favor of the students who spend 2-4 hours in front of the computer (p < .05). The mean scores of students who spend 2-4 hours on the computer and those who spend 4-6 hours or more than 6 hours a day differ in favor of students who spend 2-4 hours (p < .05). Similarly, the average score of the students who spent 4-6 hours on the computer and the averages of the students who spent more than 6 hours in front of the computer differ in favor of the students who spent more than 6 hours (p < .05). Finally, there is a significant difference between the mean scores of the students who spend more than 6 hours a day at the computer and the mean scores of the students who spend less than 2 hours, 2-4 hours and 4-6 hours in favor of the students who spend more than 6 hours on the computer (p < .05).

DISCUSSION AND CONCLUSION

With this research, it was primarily aimed to develop a valid and reliable Computational Thinking Scale for primary school students. When the measurement tools developed in our country on the subject are examined; it is seen that there is a computational thinking

skills scale for university students (Korkmaz, Cakir, & Ozden, 2017). In addition, there are computational thinking skills test (Ozmen, 2016), computational thinking skills measurement tool (Yildiz, 2021) and self-efficacy perception scale for computational thinking skills (Gulbahar, Kert, & Kalelioglu, 2019) for secondary school students in the literature. However, as it was emphasized before, no measurement tool aimed at revealing the computational thinking levels of primary school students was found. However, it is stated by the researchers that there are problems in the acquisition of computational thinking skills by the students since there is no measurement tool to evaluate computational thinking skills. Therefore, it is emphasized that evaluation tools that can measure computational thinking skills should be developed without losing much time (Werner et al. 2012). In this context, a valid and reliable measurement tool for primary school students has been brought to the literature with this study.

The developed Computational Thinking Scale was then applied to primary school students and it was investigated whether students' computational thinking levels differ according to the grade level variable. As a result of the analyzes made, it was found that the computational thinking levels of the students differed according to the grade level variable. In general, it was found that as the grade level increased, the computational thinking levels of the students also increased. When the literature on the subject was examined, few studies were found that investigated the computational thinking level of learners, especially in terms of different variables. It has been seen that the results of the limited number of studies also support the result obtained from this study. Examining the computational thinking skills of secondary school students in terms of various demographic characteristics, Korucu et al. (2017), as a result of their studies, found that there is a difference between the students' computational thinking levels in terms of the grade level variable. The researchers stated that the computational thinking skill levels of the participants differed significantly according to their grade levels. Again, Seiter and Foreman (2013) aimed to determine the differences between the computational thinking skills of students of different ages in their studies and stated that it is necessary to create a research-based and age-appropriate curriculum for primary school students as a result of the study. In another study, Catana Kuleli (2018) examined the computational thinking skills of pre-service teachers according to grade level and found that there was a significant difference between the 4th grade and 1st grade pre-service teachers in favor of the 4th grade level. Contrary to the result obtained from this study, Korkmaz et al. (2015) concluded in their study that while the increase in the grade level is expected to increase along with the computational thinking skills, this skill gradually decreases with the increase in the grade level. As a result of the study, it was revealed that the level of computational thinking of individuals who are active in business life is high.

In the study, it was also aimed to examine whether the students' computational thinking levels differ according to the daily computer use time. The findings revealed that the mean score of the scale differed depending on the daily computer usage time. As students' daily computer use time increases, their computational thinking mean scores also increase. In the literature on the subject, it has been seen that there are a very limited number of studies investigating the effect of daily computer use time on computational thinking. The results obtained from these studies show parallelism with the results of this study. For example, Saritepeci (2017) found that participants with easy computer access had higher computational thinking scores than those without computer access. Again, in the research conducted by Yildiz Durak and Saritepeci (2018), it was found that computational thinking skills were predicted by the variables of information technology use experience and daily internet use time. In another study conducted by Qualls and Sherrell (2010), it was suggested that computational thinking is a problem-solving approach that consolidates logical skills with computer concepts. According to the researchers, computational thinking should be included in primary and secondary education programs, and pre-service teachers who will teach in these fields should be familiarized with computational thinking skills. Contrary to the results obtained from this study, Korucu et al. (2017) suggested in their study that there was no significant difference in computational thinking skills in terms of the variables of weekly internet usage time and mobile device usage abilities, however, their computational thinking skills differed in terms of having mobile technology. In another study conducted by Oluk and Korkmaz (2016), it was revealed that there was no significant difference in the level of computational thinking skills of the students according to the variables of computer usage time, but there was a significant relationship between the students' Scratch programming skills and their computational thinking skills.

Recent reports published in Europe reveal that children should be familiar with computer science concepts from the beginning of their education and gain computational thinking skills (Ozbey & Kucukoglu, 2018). For this reason, computational thinking skills should be taught to students from the earliest ages possible (Wing, 2006). In other studies, to be conducted on the subject, activities that will enable young age groups to acquire computational thinking skills can be developed. Again, it can be examined whether computational thinking skills vary in terms of different variables that were not studied in this study.

Limitations

This study has several limitations that should be addressed. First of all, only primary school students constitute the participant group of this study. Secondly, it is focused only on students' computational thinking levels according to different variables, and in this respect, it is quite difficult to reveal the causal relationships between the relationships. Finally, the data collection tool of the study is only the computational thinking scale.

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Computational Thinking Scale Final Form: The final version of the developed scale in Turkish is presented in APPENDIX-1.

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APPENDIX-1: Computational Thinking Scale Final Form

BİLGİ İŞLEMSEL DÜŞÜNME ÖLÇEĞİ			
İfadeler	**Katılıyorum**	**Fikrim Yok**	**Katılmıyorum**
1. Bir problemle karşılaştığımda çözüm yolunu bilgisayarda ararım.			
2. Problem çözerken arkadaşlarımla görev paylaşımı yapamam.			
3. Problemi her zaman doğru tanımlarım.			
4. Çözüm için yapılması gerekenleri listelerim.			
5. Çözüm için gerekli adımları takip edemem.			
6. Benzer problemleri çözerken aynı çözüm yolunu denerim.			
7. Çözüm yolları içerisinden en pratik olanı seçerim.			
8. Problem çözerken tüm çözüm yollarını gözden geçiremem.			
9. Hafta sonu ödevlerimi günlere bölerim.			
10. Ödevlerimi bilgisayarda yazmakta zorlanırım.			
11. Problemin çözümü için uygun adımları oluştururum.			
12. Problemi çözdükten sonra sağlamasını yapamam.			
13. Dört işlemi hesap makinesinde yapmayı tercih ederim.			
14. Problem çözerken en uygun çözüm yolunu bulamam.			
15. Problem çözme basamaklarındaki hataları tespit ederim.			
16. Problemin hepsini tek seferde değil parça parça çözerim.			
17. Problem içerisinde verilenleri ve istenenleri bulurum.			

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Review Paper

Impact of Vocabulary Teaching Approach in Turkish Curriculum on Turkish Textbooks and Use of Technology in Vocabulary Teaching

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ABSTRACT

Knowing a word means knowing its pronunciation, spelling, concept area, and meaning layers. Vocabulary is never an area that can be learned completely by individuals; rather it is a field that expands and deepens throughout life. Vocabulary teaching requires much more than just looking up words in a dictionary or using them in a sentence. Vocabulary is formed either by coincidence through indirect exposure to words or by deliberate and planned acquisition of certain words with vocabulary learning strategies. In this respect, the materials and lesson plans for teaching vocabulary should be prepared to enable the individual to comprehend words with multiple meanings and to use them effectively. Because the vocabulary of an individual will directly have an impact on effective use of four basic skills of the language (listening, reading, speaking, and writing). In this study, the approach of the Turkish curriculum and Turkish textbooks to vocabulary teaching is examined and the areas of utilisation of web 2.0 tools in vocabulary teaching are exemplified within the scope of technological development. This research is a qualitative study using the data which were collected through document analysis. Data collection sources are Turkish course curricula and secondary school Turkish textbooks. Results of the study show that, there is a conflict between the curriculum and the textbook in terms of vocabulary teaching; the vocabulary teaching activities are monotonous and are predominantly associated with the reading skill which is just one of the four basic language skills; Turkish textbooks lack addressing to related technological tools. Moreover, the planning of vocabulary teaching in the Turkish curriculum is not clear enough. In this context, the present study introduces various web 2.0 tools for the interest of curriculum developers, textbook authors, and Turkish teachers to effectively teach vocabulary.

INTRODUCTION

Having high-level language skills is one of the most important criteria for being a modern and developed society. Human, as a social being, interacts with their environment and can express their ideas, feelings, and thoughts through language (Lüle Mert, 2013). In this context, an individual's capacity of comprehension and narrative skills is related to how effectively he or she uses the language. One of the most important factors that provide and strengthen this activity is the vocabulary of the individual. When the relationship between language and thought is considered, the effect of having a rich vocabulary on the richness of thought will be understood.

Nation (1990) defines knowing a word as knowing its spelling, pronunciation, derivations, syntactic features, collocations (concurrent words), frequency and appropriateness, meaning, and tones of meaning. Based on this definition, it is seen that knowing a word is a much more comprehensive task than knowing the dictionary meaning of that word.

According to Karadağ and Maden (2014), vocabulary is divided into two; receptive vocabulary and productive vocabulary. Receptive vocabulary is used during comprehension activity (listening, reading), while productive vocabulary during one's narration (speaking) and writing activity. In other words, learning a new word or concept activates the receptive vocabulary, while producing an oral or written context with learned words activates the productive vocabulary.

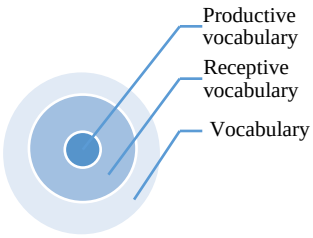

Figure 1. Vocabulary types (Onan, 2020)

As understood from Figure 1, vocabulary set includes receptive and productive vocabulary as the most comprehensive among the vocabulary types. Reseptive vocabulary includes productive vocabulary as the number of words acquired during listening and reading is higher than that of words produced during speaking and writing. According to Onan (2020), productive vocabulary can never reach the same number of words as receptive vocabulary. Vocabulary teaching aims to reduce this difference between receptive and productive vocabulary as much as possible.

An individual's vocabulary is formed either through indirect exposure to a word by coincidence or by acquisition directly (intentionally) through various strategies and practices (Hiebert, 2005). Incidental learning by exposure includes the language and its words that the individual acquires from his/her family and environment, starting from the moment of birth until the school-age when the formal education starts. Direct vocabulary teaching, on the other hand, is performed intentionally based on a curriculum and therefore takes place during the education process in schools.

The curriculum guides teachers in ensuring that the teaching of a course is carried out in a planned and systematic way (Ceran, 2015). In addition, curricula have an important place in the preparation of textbooks, which are the primary source of Turkish teaching. The element that has an important place in the planning of vocabulary teaching in schools is the curriculum. Therefore, curricula should have a specific approach as they both guide the teacher and shape the teaching materials.

The general perspective of the Turkish curriculum is to raise individuals with knowledge, skills, competencies and behaviors integrated with our values. The values in the program are justice, friendship, honesty, self-control, patience, respect, love, responsibility, patriotism, and benevolence, while the competencies included in the program are: communication in the mother tongue, communication in foreign languages, mathematical competence, and basic competences in science/technology, digital competence, learning to learn, competencies related to social citizenship, taking initiative and entrepreneurship, cultural awareness and expression (MEB, 2019). As stated in the Turkish curriculum, students are expected to be individuals who have 21st-century skills, to think, question, have effective communication skills, use technology actively, gain awareness of their learning, respect their essence and culture, and develop their moral and conscientious responsibilities.

Nowadays, as in many fields, the rate of using new technologies in the field of education is increasing rapidly (Çelik, 2021). Therefore, using technology is another factor that needs to be taken into consideration for effective vocabulary teaching. For instance, web 2.0 tools offer second-generation web environments that allow both students and teachers to learn and teach regardless of time and place (Hung & Yuen, 2010).

In this study, the approach of the Turkish curriculum and Turkish textbooks to vocabulary teaching is examined and the usage areas of web 2.0 tools in vocabulary teaching are exemplified within the scope of developing technology. In this respect, the study aims to investigate how the programs and textbooks deal with vocabulary teaching and whether there is attribution to technological tools and to give effective examples of web 0.2 tools that can be used in vocabulary teaching.

For this purpose, answers to the following problems were sought:
1. What is the vocabulary teaching approach in the 2019 Turkish Curriculum?
2. What are the strategies used in vocabulary teaching?
3. Which vocabulary teaching strategies were used in the activities included in the vocabulary teaching in the textbooks?
4. Is there a common approach between the curriculum and textbooks in terms of teaching vocabulary and directing to technological tools?
5. What are the web 2.0 tools that can be used in vocabulary teaching?

METHOD

This study, which aims to determine to what extent the activities prepared for teaching vocabulary in Turkish textbooks used in secondary and imam-hatip secondary schools overlap with the vocabulary teaching approach in the Turkish Lesson Curriculum (2019), was designed with an analytical research model. In analytical research, events, ideas, concepts, and works are analyzed with the document analysis method. In analytical research models without active communication, the data collection and analysis process is generally based on documents (McMillan, 2004; McMillan & Schumacher, 2014; Burkett, 1990 cited in Boyacı, Güner, & Babadağ, 2017). In this study, the 5th Grade Turkish Textbook (Anıttepe Publishing), 6th Grade Turkish Textbook (Ministry of Education), 7th Grade Turkish Textbook (Ozgun Publishing), and 8th Grade Turkish Textbook (Ministry of Education) used in the 2020-2021 academic year were examined as documents, and the data obtained from them were analyzed with content analysis method.

Table 1. Examined textbooks

Grade	Publisher
5th Grade Turkish Textbook	Anıttepe Publishing
6th Grade Turkish Textbook	Ministry of Education Publishing
7th Grade Turkish Textbook	Ozgun Publishing
8th Grade Turkish Textbook	Ministry of Education Publishing

RESULTS

Vocabulary Teaching in the 2019 Turkish Curriculum

Vocabulary teaching in the 2019 Turkish Curriculum was implicitly indicated for the first time under the title of "Individual development and curricula":

"The curricula have acted on the principle that takes a holistic approach to human development. The characteristics of human beings in different developmental areas are in interaction with each other. ***For instance, language development affects intellectual development and is affected by intellectual development****."*

With this expression, emphasis is placed on the relationship between language and speech. The first direct emphasis on vocabulary teaching in the 2019 Turkish Curriculum is under the heading "Special purposes". The 3rd special purpose given in the curriculum is as follows:

"Accessing language pleasure and consciousness by enriching the vocabulary based on what they read, listen/watch; thus enabling them to develop their feelings, thoughts, and imaginations"

With this expression, the importance of vocabulary in Turkish teaching has been directly emphasized. Apart from this, no emphasis was placed on teaching vocabulary until the part of the program that included the achievements and explanations (MEB, 2019).

Acquisitions and Vocabulary Teaching

The first acquisition that can be considered within the scope of vocabulary teaching, which is classified under the "Listening Skill" section and common with the 5th, 6th, 7th, and 8th-grade levels is that: "*Guesses the meaning of unfamiliar words, when they listen/watch. Students are instructed to compare their predictions to the dictionary meanings of the words."* Moreover, this acquisition is the only one that establishes a relationship between listening skills and vocabulary teaching.
Vocabulary learning outcomes described under "Speaking Skill" section are also common at all grade levels. *"Uses words in accordance with their meanings."* and *"In speeches, uses the Turkish equivalents of the foreign words that are unsettled in our language."* These two acquisitions aim to establish a relationship between speaking skills and vocabulary teaching.
The sub-title of "Vocabulary" under the title of "Reading Skill" focuses on teaching vocabulary and grammar. The acquisition of *"Guesses the meaning of unfamiliar words and phrases by using the context"* is common at all grade levels. Under this acquisition, it is emphasized that tools such as using a dictionary, making use of visuals, and creating a dictionary should be used within the scope of vocabulary teaching. Also under this heading, the acquisition of *"Explains the contribution of idioms and proverbs to the text"* is common at all grade levels and points to vocabulary teaching.
Vocabulary learning outcomes under "Writing Skill" are also common at all grade levels: *"Uses proverbs, idioms, and aphorisms to enrich their writings"* and *"Uses Turkish equalance for words taken from foreign languages and unsettled in our language".*

Attributions to Technology in the Turkish Curriculum

The importance of using technology is emphasized for the first time under the title of "competencies" in the Turkish curriculum.
"Digital competence: It covers the safe and critical use of information and communication technologies for business, daily life, and communication. This competence is supported through basic skills such as using computers to access and evaluate information, storing, producing, presenting, and exchanging information, as well as participating in common networks and communicating via the Internet."
The expression of "accessing information from printed materials and multimedia resources, organizing information, questioning, using and producing skills" under the title of "special purposes" in the Turkish curriculum is a guidance in terms of increasing the technological competence of the individual.
With the statements *"Information and communication technologies should be used as much as possible in the learning-teaching process… Visual communication tools should be included in teaching and practical applications of the course; slide, computer, television, interactive whiteboard, internet, EBA contents, etc. should be used effectively…"*, teachers are directed to use technological tools for teaching Turkish lesson.

Vocabulary Teaching Strategies

Vocabulary teaching strategies are presented under six headings in a study called "Vocabulary Teaching in English Language Teaching" by Pan and Xu (2011). When the study is examined, the contents of these six basic titles are explained by taking into account the meaning and structural features of Turkish language:

Teaching Vocabulary in Context

Teaching vocabulary from context means finding expressions that help you capture the meaning of the word before and after the unknown word or phrase. When word lists are isolated from the context, this prevents students from activating some sub-strategies

such as guessing, making inferences, and establishing relationships, whereas teaching vocabulary from context supports the active use of all these strategies.

Teaching Vocabulary with Semantic Field Theory

According to the semantic field theory, no word exists on its own. For example, the words summer, winter, spring, and autumn belong to the field of meaning called "season". Therefore, the meaning of a word is determined by its relationship with other words in the semantic field it belongs.
There are various types of relationships established in this way: homophony, part/whole relationships, synonymy, and contrast are some of them. For example, let's take the word "yaş", the meaning of this word is determined by its semantic field. When the meaning of this word is asked, the student can determine the meaning in two ways:

1. The duration of the existence of a living thing or object in the world.
2. The state of being wet.

However, when the word is associated with its concept area, the meaning will become clear. In the first case, the semantic field to which the word is related can be called: duration, year, time, etc. In the second case, the semantic field with which the word is associated can be called: dry, moist, wet, etc. Therefore, the meaning of the word “yaş” will only be revealed by determining the meaning areas it is related to.

Expanding Vocabulary by Word Formation

The strategy of forming words and expanding vocabulary requires making the student realize the effect of the morphological features of a word on its meaning. Although this method does not guarantee students to determine the meaning of the word exactly, it enables them to make much stronger predictions about the meaning of a word they do not know by following the figural clues. For example, a student who encounters the words "Ankaralı, İstanbullu, Ordulu" and realizes that the suffix -lı must indicate where the person is from, can guess that the word is a place name even if it is an (imaginary) place that he has never heard of, thanks to the suffix feature.

Creating Mental Linkages by Associating

While teaching vocabulary, the atmosphere of the classroom environment should be active, a natural learning environment should be provided in the course and student motivation should be increased with various activities to expand the vocabulary of the students. For example, teachers can write a word in the middle of the board and then ask students to brainstorm all the words they can think of related to that word and then form a tree of words. In the use of this strategy, support can be obtained from many teaching methods and techniques in which the student is active.

Teaching Cultural Connotations and Differences

Turkish is a deep-rooted language with a long history. The centuries-old role of Turkish on the stage of history has caused our language to be influenced by many cultures and languages. Therefore, Turkish teachers should benefit from this cultural accumulation and richness while teaching vocabulary. For instance, if we take the word "wolf", which is a very important symbol for Turks, represents rebirth, courage, warrior spirit, and sanctity in Turkish literature, while it represents cunning, danger, and deceit in the literature of some European countries. Turkish is also a rich language in terms of vocabulary elements such as proverbs and idioms. Although these word groups are mostly used metaphorically today, it should not be forgotten that they may have arisen from a real event or situation at the time they were spoken. Take, for example, the phrase " kozunu paylaşmak". This idiom is used in today's Turkish to mean "to resolve a conflict by resorting to force". However, the word “koz” in the idiom has passed into our language from Persian and has the meaning of walnut. The idiom emerged when villagers who could not share the walnuts they collected and had a disagreement, found the solution by resorting to force. Therefore, the use of cultural connotations in vocabulary teaching is very important.

The Use of Dictionaries

Students may want to learn much more than the words their teachers plan to teach them. At this point, the most effective and accessible resource that can help them will be dictionaries. Here, the task of the teacher is to introduce the students to the methods of choosing and using a suitable dictionary.
Karadağ (2019) discussed the vocabulary teaching strategies under 3 groups, and these 3 groups are then divided into sub-categories within themselves. Descriptions of these headings are as follows:

A. Strategies Used to Decipher The Meaning of The Word When Faced with an Unknown Word

a. Referring the context the word is in: Although words can convey meaning on their own, they can establish meaning relations with other words at the time of communication. A word that is seen as independent when reading, it has meaningful relationships with

the sentences before and after its use. Therefore, referring to the context in reaching the meaning of a word helps decipher the meanings of the words.
b. Searching for the word in the context of another phrase, sentence, and text: The meaning of a word may not be inferred from the text in which it is used. In this case, seeing the word in different contexts of different expressions, sentences, and texts will help to decipher the meaning.
c. Gaining morphological awareness: Reaching the meaning of the word based on the morphological features of Turkish. This strategy applies to both the derivation and inflection functions of the language.
d. Guessing: Predicting the meaning of words by using context and morphology clues.
e. Using a dictionary: It is an important strategy in terms of gaining the habit of using a dictionary. After guessing the word, looking at the dictionary and checking the meaning is also important in terms of confirmation.
f. Using visuals: It is a strategy based on establishing a relationship between visuals and words.

B. Strategies to Clarify the Meaning Words and Deepen Vocabulary

a. Generating context: It is the reutilization of a newly learned word in relation with other words. This is an important strategy in confirming the meaning of the newly learned word.
b. Intertextual reading: Words can acquire different meanings in different contexts. In this respect, meanings can be deepen by reaching different uses of a word with intertextual reading.
c. Creating a dictionary: Creating a personal dictionary from newly learned words has an important place in terms of clarifying the meaning and permanent learning.
d. Creating a concept map: This strategy facilitates vocabulary learning in terms of revealing the concept features and the meaning relations collectively.

C. Strategies to Teach New Words and Concepts
a. Gaining language awareness: It means understanding the importance of language in human life and being conscious and sensitive to language. In this way, students can make special efforts to expand their vocabulary.
b. Being open to communication: Students' opennes to communication with their peers and other people helps to structure the words in the mind by using words to convey their thoughts and creates the opportunity to encounter new words and concepts.
c. Listening and reading habits: While having the habit of reading and listening creates a rich vocabulary, a rich vocabulary will also give the habit of reading and listening (Çeçen, 2007).

Classification of Vocabulary Teaching Activities in Textbooks According to Strategies

In this study, while examining the activities for teaching vocabulary in Turkish textbooks, the classification of Karadağ (2019) was taken as a basis. When the activities were examined, it was necessary to add two more strategies to these strategies. These strategies are:
1. Making use of the meaning with the context of the word
2. Using a dictionary after guessing.

The first strategy was added since almost all of the context-based activities in textbooks were asked to match the meaning of the words in the text. Since using a dictionary and guessing strategies are used together, the second strategy has been added. The 3rd item, "Strategies to used to teach new words and concepts" has not been included in our strategy classification. The reason for this is that the strategies given under this heading do not have any equivalents in the textbooks and these strategies are mostly strategies that one can use to control their own learning.

The strategy of using visuals were included in the classification since the acquisition of "*Guesses the meaning of unfamiliar words and phrases by using the context*" was included in the explanation part of the Turkish curriculum (2019).

Table 2. Classification of Vocabulary Teaching Activities According to Strategies

Strategies	Frequency				
	5th grade	6th grade	7th grade	8th grade	Total
Referencing the context the word is in	5	1	1	1	8
Making use of the meaning with the context of the word	19	12	19	20	70
Searching for the word in the context of another phrase, sentence, and text	0	0	0	0	0
Gaining morphological awareness	2	0	0	0	2
Guessing	1	1	1	0	3
Using a dictionary	6	13	0	2	21
Using a dictionary after guessing	11	8	12	12	43
Using visuals	0	0	0	0	0
Generating context	29	13	7	8	57
Intertextual reading	0	0	0	0	0

Creating a dictionary	0	0	1	0	1
Creating a concept map	0	1	0	0	1
Total	73	48	40	43	203

According to the findings obtained from Table 2, the most used strategy (f=70) for vocabulary teaching in secondary school Turkish textbooks is “making use of the meaning with the context of the word”. This strategy is not included in any classification in the literature. The reason why this strategy is not evaluated within the scope of the strategy of " Referencing the context the word is in " in the classification of Karadağ (2019) is that the words in the text are given with their dictionary meanings and word-meaning matching is expected from the student. At this point, the student can recognize the word based on the given dictionary definition and complete the activity without the need to refer to the context. Therefore, a new classification has been made for this activity type.

The second most used vocabulary teaching strategy in textbooks was determined as” “generating context”. Generating context strategy is rarely included as a separate activity in all textbooks. This strategy was mostly used as a sub-item in the activities. However, it was added to the frequency due to its intense presence in the books.

The third most used vocabulary teaching strategy in textbooks is “using a dictionary after guessing”. Again, this strategy was not included in Karadağ's (2019) classification and was added later. The reason for this addition is that, unlike Karadağ's classification in textbooks, two strategies are used together in many activities.

Using a dictionary is the fourth strategy among the strategies in the textbook, which has a considerable frequency of use (f=20). The strategy of “referring to the context the word is in” was used directly in 8 activities. The strategies of estimating, lexicography, morphology awareness, and concept mapping were not used in textbooks with a remarkable frequency.

Using visuals, searching the word in the context of other expressions, sentences, and texts, and intertextual reading strategies are not included in secondary school textbooks.

Approach Compatibility Between the Curriculum and Textbooks

This study aims to examine the situation of having a common understanding of the Turkish curriculum and Turkish textbooks within the scope of vocabulary teaching. The findings obtained for this purpose are as follows.

The fact that the emphasis on vocabulary teaching in the Turkish Curriculum is insufficient and not associated with basic language skills is also reflected in the vocabulary teaching activities in the textbooks. Vocabulary teaching activities mostly remained as independent activities limited to the text, detached from the four basic skills.

One of the limited vocabulary teaching achievements in the Turkish Curriculum is "*Explains the contribution of idioms and proverbs to the text*". However, although this achievement is emphasized repeatedly at every grade level, the activities for proverbs and idioms in the textbooks are both insufficient in number, out of context, and artificial.

There is no strategy classification for vocabulary teaching in the Turkish Curriculum. According to the results of the research, it has been observed that this classification deficiency in the curriculum is also reflected in the textbooks. The use of strategy in the activities in the textbooks is entirely left to the initiative of the textbook authors. This has caused an unbalanced strategy distribution in the activities.

Although the emphasis is placed on the importance of technology use and orientation to technological tools under the headings of special purposes, competencies, learning, and teaching approaches in the Turkish Curriculum, when the vocabulary teaching activities in the textbooks are examined, no interactive activities or web tools are offered to correspond to this guidance. In this respect, the emphasis on technology made by the curriculum could not be found in the textbooks in the context of vocabulary teaching.

Web 2.0 Tools That Can Be Used in Vocabulary Teaching

In this part of the research, some of the web 2.0 tools that Turkish teachers can use within the scope of vocabulary teaching will be introduced in light of the findings in the previous titles.

Instructional Activity	Web 2.0 Category	Web 2.0 Tool	Instructional Method
Description	Presentation/ Podcast Tools	PowerPoint Prezi iTalk	Students are introduced to terms using a multimodal representation
Restating	Mind Maps/ Screen Capture	Popplet Jing Wonderopolis	Students are to demonstrate word understanding through multimodal representations
Graphic Representation	Word Clouds/ Virtual Posters	Tagul Easel.ly ThingLink	Students construct pictures, pictograph or symbolic representation of images related to terms
Academic Notebooks	eBinders/ Annotation	Livebinders Google Docs	Students create personalized e-notebooks to organize and anchor and study vocabulary
Discussion	eBoards/ Forums	Padlet Blogger Edmodal	Students are able to engage in discussion using these online collaboration resources
Games	Games/ Quizzes	Kahoot.it Quizlet FreeRice	Students are able to reinforce word learning through interactive games and activities

Figure 2. Web tools for teaching vocabulary (Sharma & Unger, 2016)

Sharma & Unger (2016) stated in their study "Employing Web 2.0 Technologies to Support Students' Academic Vocabulary Acquisition" that web 2.0 technologies have the potential to provide students with the opportunity to promote vocabulary learning in engaging, meaningful, and collaborative ways. In the figure above, they introduced some web 2.0 tools that can be used to increase students' academic vocabulary acquisition.

Web 2.0 tools that can be used in vocabulary teaching within the scope of Turkish lesson:

Mindomo

Link address: https://www.mindomo.com/dashboard

Mindomo, a free diagramming tool, has hundreds of different diagram templates. Mindomo has different interfaces for students and teachers. This tool can be used in teaching vocabulary words, words with more than one meaning, layers of meaning, semantic relations between words, and words belonging to the same concept area. It is a suitable tool for producing activities for strategies such as semantic field theory and concept map creation strategies.

Figure 3. Mindomo Program Interface

Pixton

Link address: https://app.pixton.com/#/

Pixton is an engaging comic design tool. It has many characteristics and location templates. Pixton has a wide variety of templates available for free. In terms of vocabulary teaching, teachers can use this program to narrate words, idioms, and proverbs. Students, on the other hand, can create a comic book series using newly learned words and phrases. . It is a suitable tool for producing activities for strategies such as using visuals, generating context, teaching cultural connotations, and cultural differences.

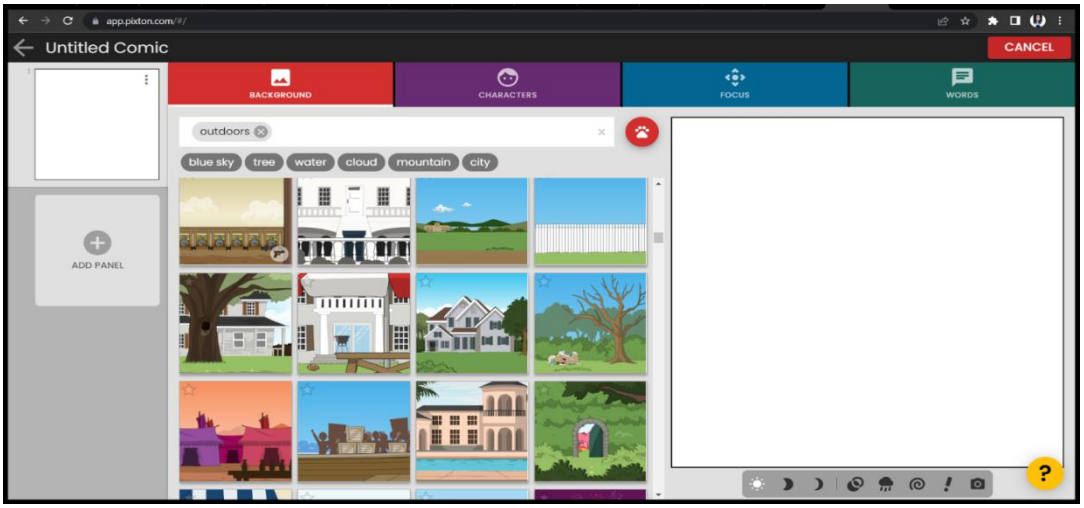

Figure 4. Pixton Program Interface

WordCloud Generator

Link address: https://monkeylearn.com/word-cloud/

WordCloud Generator is a very simple-to-use Web 2.0 tool. To use the program, the target text is loaded, and the program automatically creates a word cloud showing the most frequently used words in the text. This tool is highly effective in vocabulary teaching and grammar teaching in common subject areas. For example, it provides a relationship between the different functions and meanings of the word "one" in a text. It is a suitable tool for producing activities for strategies such as searching the word in the context of another expression, sentence, and text, gaining morphology awareness, and expanding vocabulary by word formation.

Figure 5. WordCloud Generator Program Interface

Wordmint

Link address: https://wordmint.com/puzzles/5009395

Wordmint is a free tool with which you can create different types of puzzles. The program allows users to create 5 unique puzzles. However, to create more puzzles, you need to delete the ones you have already created. Puzzles can be used effectively in vocabulary teaching. The point to be considered here is that the puzzle clues are chosen from contexts appropriate for the student's level, rather

than the exact dictionary definition. It is a suitable tool for producing activities for the strategies such as guessing, generating context, and creating mental linkages by association.

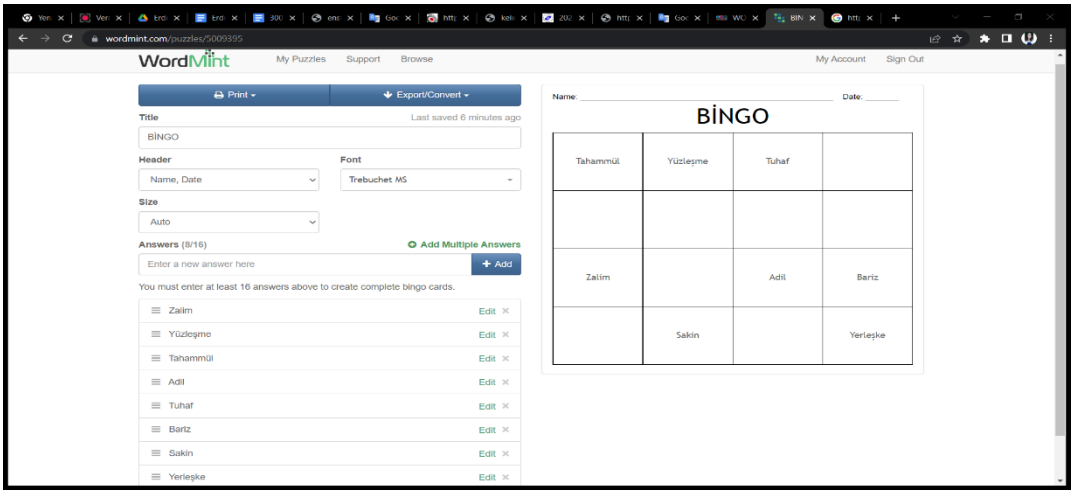

Figure 6. Wordmint Program Interface

Scrumblr (collaborative digital board)

Link address: http://scrumblr.ca/soz-luk

Scrumblr is a collaborative digital board tool that can be used in partnership with students. Students access the content with the name given to the clipboard by the teacher. In addition, students have the right to contribute to this board. This tool can help students create a digital context dictionary in vocabulary teaching. Students can share the words they learned in the lesson on this board, using them in context. Thus, the same word can be used in different contexts. It is a suitable tool for producing activities for the strategies such as creating a dictionary, generating context, and the use of dictionaries.

Figure 7. Scrumblr Program Interface

Wheel of Names

Link address: https://wheelofnames.com/

Wheel of names is an easy-to-use wheel of fortune tool. The program has Turkish support. It can be used as an in-class game tool in terms of teaching vocabulary. Teachers can use the program as a selection tool by typing student names on the wheel, or as a context generation tool by typing words or phrases. In addition, the program has the feature of adding images. It is a helpful tool for using vocabulary teaching strategies.

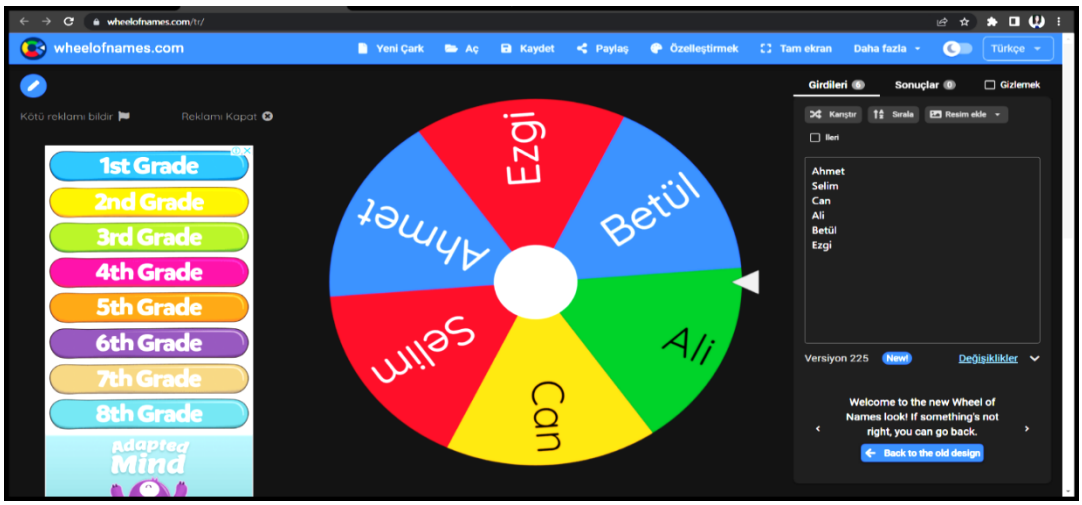

Figure 8. Wheel of names Program Interface

Zoompad

Link address: https://zumpad.zum.de/p/btDbexZKZaLQElkAgGT9

It is a web 2.0 tool where you can write collaborative writing, poetry, and article. Students can enter the application from the common link and edit the articles. It is a convenient tool for producing stories in groups with newly learned words. It supports students to work actively with each other as there are chat and comment features. It is a suitable tool for producing activities for the strategies such as generating context and creating mental linkages by association.

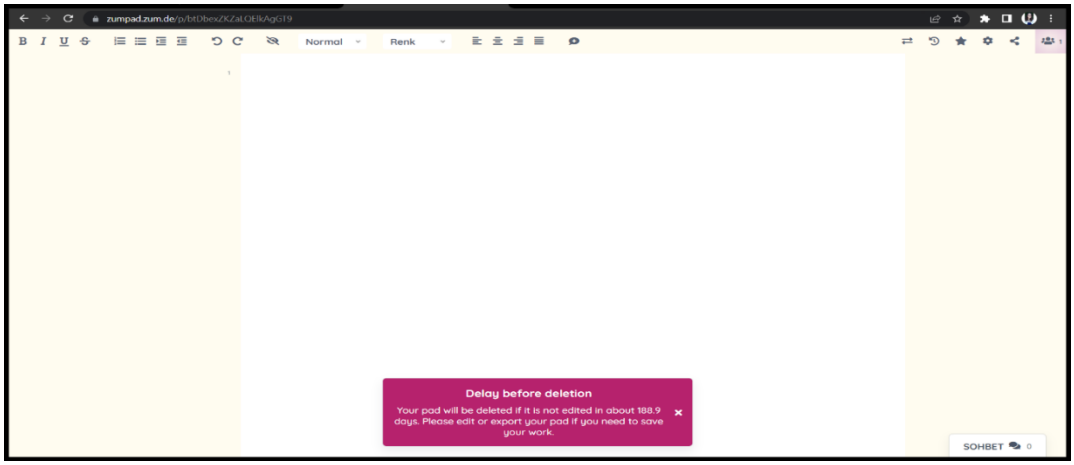

Figure 9. Zoompad Program Interface

Giphy

Link address: https://giphy.com/

Giphy is a tool where you can find motion pictures. It is a fun tool that can be used in teaching especially verbs and word groups. For example, it can be used to make students realize whether idioms and proverbs, which have an important place in Turkish, have literal or figurative meanings. It is a suitable tool for producing activities for the strategy of using visuals.

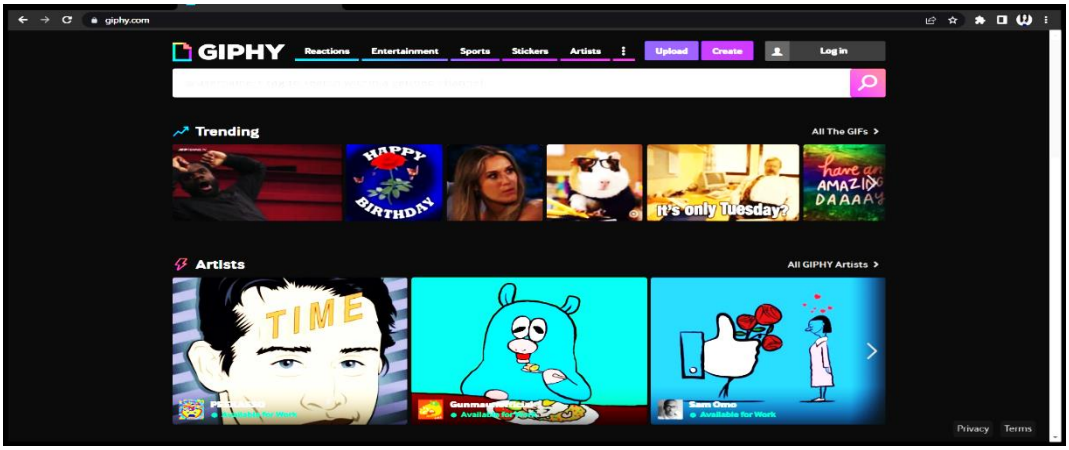

Figure 10. Giphy Program Interface

CONCLUSION

The conclusions obtained in line with the above-mentioned purposes are given in order.

When the distribution of the activities in the examined textbooks to the vocabulary teaching strategies was examined, it was concluded that there was an unbalanced distribution.

Most of the textbook activities for the generating context strategy ask the student to use a few of the unknown words in the text in context. In this case, the choice of words is left entirely to the initiative of the student. At that point, the student can choose the words that can produce the easiest context and show an attitude of omitting the others. This is a negative situation in terms of vocabulary teaching.

According to a finding in the study by Ömeroğlu and Hakkoymaz (2022), the most used vocabulary teaching strategy was determined as "creating a dictionary". However, in the textbooks examined, only one 7th-grade activity was found for creating a dictionary. Although the emphasis is frequently on creating a vocabulary book or dictionary in the textbooks, no examples are given of what the content of a vocabulary book/dictionary is. This emphasis remained as a suggestion that the student is expected to make separately of the textbook.

In light of the findings obtained from the study, it was concluded that the scope of the vocabulary teaching achievements in the Turkish Curriculum is very limited and it is lacking in association with the four basic skills. This result was also reflected in the textbook activities. The vocabulary teaching activities in the textbooks were mostly limited to reading skills. This can be interpreted that the development of students' receptive vocabulary is given more importance in textbooks than the development of productive vocabulary.

Although the importance and necessity of technology use in the Turkish curriculum is sufficiently emphasized, when the Turkish textbooks are examined, it has been concluded that the guidance on technological tools is insufficient and therefore the use of technology-based tools is left entirely to the competence of the teacher.

As a result, it has been determined that there is a conflict between the curriculum and the textbook in terms of both teaching vocabulary and directing the use of technological tools.

Ethics and Consent: Ethical approval was not sought for the present study because data set has not been used. Ethics committee permission is not applicable because this article does not contain any studies with human or animal subjects.

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Research Paper

Examination of the Effect of Using Web 2.0 Tools in Environmental Education on Preschool Children's Attitudes Towards the Environment*

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ABSTRACT

In this study, it was aimed to examine the effects of using Web 2.0 tools in environmental education on the attitudes of preschool children towards the environment. The research used a combination of quantitative and qualitative data. Quantitative data were collected through the "Attitudes Toward the Environment Scale: Children's Attitudes Toward the Environment Scale-Preschool Version (CATES-PV)", and the qualitative data were collected through the "Interview Form" created by the researcher. A total of 38 children, 18 of them in the experimental group and 20 of them in the control group, aged between 60-72 month old attending a public day care center, participated in the study group of the research. One of the parents (mother or father) of the experimental group, which is the group where qualitative data were collected, participated in the research with 18 participants. Attitude towards the environment constitute dependent variable in the research. Independent variable is environments with and without Web 2.0 tools are used. In this research, two-factor ANOVA analysis for repeated measurements used for independent samples of the quantitative data obtained, descriptive analysis was applied to qualitative data. As a result of the research, a significant difference was determined between the average scores of children's attitudes towards the environment after the experimental procedure in the environment where Web 2.0 tools were used in environmental education. It was determined that the changes in the mean scores of attitudes towards the environment of the two groups before the experimental procedure were significantly higher in favor of the group in the environment where Web 2.0 tools were used in environmental education. In this study, it was concluded that the environment in which Web 2.0 tools are used in environmental education is effective in developing children's attitudes towards the environment. According to the qualitative findings, the parents in the experimental group stated that these tools made learning interesting, memorable and facilitating, provided continuity and permanence in learning, and were effective in developing correct attitudes.

INTRODUCTION

In the 21st century, Prensky (2001), who emphasizes the impact of social and communal differences created by technological development on people, talks about a generation born into digital technology and states that this generation differs from previous generations in this purport. Prensky defined this generation as "digital native". The current generation spends time with smart devices starting from early childhood or even infancy through educational or entertaining games chosen by their parents (Mete and Batıbay, 2019). The technologies used for educational purposes in the preschool period are digital painting, digital books, gamifications and mobile applications. In the past, educational activities with paper and pencil were considered sufficient in the education of preschool children, but today, multimedia software is also used to meet the needs of children (Konstantinidis, Theodosiadou, and Pappos, 2013). It has been stated that more research is needed to see the development of language and vocabulary, logic and mathematical understanding, problem solving skills, self-regulation and social skills in preschool children with the use of technology tools (Radich, 2013).

It has been determined that the efficient use of technological tools used for educational purposes in preschool period increases children's motivation towards activities. It is stated that the reason for this may be children's interest in technology (Kal, 2012; As cited in: Bulut, 2018). Preschool children can develop learning experiences with every tool in their environment. The rich experiences offered during this period positively affect children's development. It is an important need to see technological tools and computers as a learning tool that provides information communication in the classroom environment (Sayan, 2016). In order to use these technologies in the classroom environment, electronic content appropriate to the developmental levels of preschool children is needed.

*This study belongs to the master's thesis entitled "Investigation of the Effect of Using Web 2.0 Tools in Environmental Education on Preschool Children's Attitudes Towards the Environment" completed in 2022 by Canan Özçelik AKAY under the supervision of Associate Professor Özlem Çakır.

The freedom to develop content in Web 2.0 tools gives the opportunity to produce content suitable for the developmental levels of preschool children. Web 2.0 tools can be defined as online environments where users can interact and develop content and share these developed contents on different platforms (Grosseck, 2009; Yazıcı, Ocak and Bozkurt, 2021).

As a result of the pandemic that started in China and spread all over the world, face-to-face education was suspended. In order not to disrupt education, distance education was urgently introduced at all levels, from higher education to pre-school. Thus, the use of technology in education has become a necessity for teachers and students at all levels, and even for parents. Television and web-based technologies were used in the emergency distance education process. The importance of interaction in the distance education process during the pandemic period has emerged with the start of distance education activities at all levels from pre-school to higher education.

Significant research on the use of Web 2.0 tools in education has increased during the Covid-19 pandemic. Başaran and Kılınçarslan (2021) conducted a study in a quasi-experimental model with a pre-test, post-test control group using Web 2.0 tools in literacy education for children attending distance education during the pandemic process. The findings of the study showed that the experimental group, in which the games prepared using Web 2.0 tools were applied, improved the skills of teaching first reading and writing, distinguishing the letter, spelling, and reading the letter in the text compared to the control group. Türker and Dündar (2020) examined the views of students receiving distance education at the secondary education level and 565 secondary school students participated in the study. When the findings of the research are examined, it is seen that EBA (Educational Information Network) application alone is not sufficient and that they can receive feedback effectively in live lessons. In a study conducted by Türker and Dündar (2020) examining the opinions of high school teachers in distance education, it was stated that there were difficulties in technical issues in distance education, but it was also stated that EBA has some strengths, such as its rich content and the possibility of sharing questions and live lessons. In a study conducted by Keskin and Özer (2020) in higher education, it was stated that they did not see web-based learning as effective as face-to-face education, but it gave them the opportunity to learn at their own pace. Yürek (2021) examined the opinions of academicians in the field regarding the implementation of distance education in preschool period. It was stated that the participants expressed a common opinion that the cognitive development area of the child could be supported through distance education, but that the child may not be adequately supported in the field of social-emotional development and therefore would experience limitations.

It was determined that the studies conducted with Web 2.0 tools in the preschool period were quite limited and the existing studies were conducted during the pandemic period. However, Web 2.0 tools offer easy access, the opportunity to produce and share content according to children's developmental level-interest-needs (Atıcı and Yıldırım, 2010). With the content produced through Web 2.0, it may be possible to acquire the knowledge and skills needed in daily life and transform these knowledge and skills into positive attitudes. Web 2.0 tools, which play a major role in raising individuals who will meet the requirements of the age with their potential contributions to attitude and learning and other aspects, are becoming one of the indispensable elements of 21. century education (Dere, Yücel and Yalçınalp, 2016; Gündoğdu, 2017).

The attitudes that individuals exhibit in daily life develop starting in the first years of life. Attitudes, which are enriched by learning and experiences and transform into the identity of individuals over the years, can be supported positively with appropriate training starting from early periods. The attitudes and behaviors acquired by the child in the preschool period form the permanent personality structure of the future adult (Gülay-Ogelman and Güngör, 2015). In this study, the effect of using Web 2.0 tools in environmental education on preschool children's attitudes towards the environment was examined. In the preschool period, the formation of knowledge about the environment, the correct perception of the environment and its components, and the development of behavioral changes and positive attitudes in the desired direction are too important to be ignored. Because every child born today is born into the climate crisis and environmental problems. With an appropriate environmental education in the preschool period, it is possible to ensure that children become adults who are sensitive to the environment they live in and to contribute by supporting their developmental areas (Kınık, Okyay and Aydoğan, 2016).

In a study by Shin (2008), many environmental educators in Korea and other countries agreed that environmental education should begin at a young age and that environmental experiences at a young age are essential for developing children's attitudes, curiosity, sense of respect and responsibility to care for the environment. Similarly, Shepardson et al. (2007) stated that children may have deficiencies in defining the environment. In the study, it was emphasized that while children could define the environment as nature, forests, living and non-living things, they mostly did not mention the urban environment. In this case, introducing the environment to children through environmental education in the preschool period gains importance in terms of developing the right attitudes.

It is known that learning is intertwined with play in accordance with the developmental characteristics of preschool children and that audiovisual elements positively affect learning. Videos, audio studies, visual text reading studies, interactive presentations, concept games created using Web 2.0 tools prepared within the scope of environmental education for preschool children can make learning interesting and permanent. This can help children develop positive attitudes towards the environment.

When the literature is examined, there are a limited number of studies in which environmental education is provided with technological tools in preschool period; studies conducted specifically on Web 2.0 tools are even more limited. However, teachers working with preschool children also need examples of successful practices to improve their technology knowledge, skills and experience (Radich, 2013).

In today's conditions where we are faced with the environmental problems mentioned above and technology has become a part of life, the problem of this study is to what extent environmental activities developed with Web 2.0 tools and environmental activities prepared using traditional materials will be effective on children's attitudes towards the environment, taking into account the developmental characteristics of 60–72-month-old preschool children.
In this study, it is aimed to examine whether the use of Web 2.0 tools in environmental education has an effect on preschool children's attitudes towards the environment and to examine the views of parents on the use of technology at home. In line with this general objective, answers to the following questions were sought:

1. Is there a significant difference between repeated measures (pre-test-post-test) of preschool children regardless of which group they are in (as a single group)?
2. Is there a significant difference between the attitude towards the environment scores obtained from the repeated measurements of the groups of preschool children who received and did not receive environmental education prepared using Web 2.0 tools, regardless of the change between pre-test and post-test?
3. Does the change observed in the repeated measurements of preschool children's attitude towards the environment variable show a significant difference between the groups that received and did not receive environmental education prepared using Web 2.0 tools (experimental-control)?
4. For the parents of the experimental group, what are the technological tools used by children at home and for what purpose?
5. For the parents of the experimental group, were there/are there any changes in the children's home environment for the implementation process?
6. What are the views of the experimental group's parents on the use of Web 2.0 tools for educational purposes in early childhood?

METHOD

Research Design

In this study, both quantitative and qualitative methods were used together. The combination of different methods is important in determining the validity and reliability of the data collected. Both research methods have advantages for the field of education. Of course, qualitative methods cannot be used as a substitute for quantitative methods, but both forms of research can be used together to support each other. For this reason, it is becoming increasingly important for researchers in the field of education to acquire the necessary knowledge and skills in quantitative and qualitative methods (Yıldırım, 1999).

The research was planned in two phases. In the first stage, a quasi-experimental design with pre-test-post-test control group was used to examine the effect of using Web 2.0 tools in environmental education on preschool children's attitudes towards the environment. The aim of research using experimental design is to discover the cause and effect relationship between variables. In the study, the research design was determined as a quasi-experimental design since two groups were randomly selected from the groups that were ready to be used in determining the experimental groups and experimental and control groups were formed accordingly (Büyüköztürk, Kılıç-Çakmak, Akgün, Karadeniz and Demirel, 2017).

Independent variable is environments with and without Web 2.0 tools are used. While one of the independent variables is the randomization of the groups, i.e. being in the experimental and control groups, another variable is the measurements of the dependent variable made at different times (pre-test, post-test measurements) (Büyüköztürk, 2011). The dependent variable is attitude towards the environment.
In the second stage of the study, parents' views on the use of technology at home were collected through an interview form.

Working Group

The research was carried out in a pre-school institution located in the Çankaya district of Ankara province in the 2021-2022 academic year. The experimental group consisted of 18 children, the control group consisted of 20 children, and a total of 38 children between the ages of 60-72 months. Qualitative data were collected from 18 participants who were either mothers or fathers.

Data Collection Tools

In the study, the Attitude Towards Environment Scale was used to collect quantitative data: The Children's Environmental Attitude Scale Preschool Version (CATES-PV) was used. An interview form prepared by the researcher was used to collect qualitative data.

Environmental Attitude Scale: Children's Environmental Attitude Scale Preschool Version (CATES-PV)

The CATES-PV scale was developed by Musser and Diamond (1999) to measure preschool children's attitudes towards the environment (As cited in: Erol, 2016). Gülay (2011) conducted a study on the adaptation of CATES-PV into Turkish. There are 15 items in the scale. Each article has an image that points to a specific environmental issue. Children should choose their favorite picture from the pictures. Then point to the big and small circles and ask whether there is more or less and mark the answer. Each item in the scale is scored between 1-4. In this measurement tool, which has no subscales, total scores are calculated. The highest and lowest score that can be obtained from the scale is 60 and 15. Scores close to full points in the scale are interpreted as high

levels of environmental behaviors (Gülay, 2011). In the study, the Cronbach's alpha value of the scale was determined as .826; highly reliable.

Semi-structured Interview Form for Families on Process Evaluation and Learning Children's Transfers

It was prepared by the researcher in order to obtain the evaluations of the parents regarding the process experienced at school, the transfers of the experimental group children in the home environment regarding the implementation of the activities prepared using Web 2.0 tools, the technological tools used by the children at home, and the evaluations of the parents regarding the family involvement activities. The form was reviewed and finalized by two academicians working in the field of educational technology and a master's graduate preschool teacher with 5 years of teaching experience who worked with the researcher. The semi-structured interview form was sent to the families of the children included in the experimental group.

Preparations Before Experimental Application

Material Development Suitable for Preschool Period Development within the Scope of Experimental Application with Powtoon Tool

In the study, the activities applied to the experimental and control groups were prepared by the researcher. Instructional materials prepared with Powtoon and Wordwall tools, which are Web 2.0 tools, were applied to the experimental group. Expert opinion was obtained from pre-school teachers before the implementation of the activities prepared for the experimental group. Necessary arrangements were made in line with expert opinions. The fact that children heard the voices of people they recognized in the video was a facilitating factor for them to pay attention to the video or presentation in Powtoon. The duration of the videos produced on Powtoon did not exceed 3 minutes. In the preschool period, play is seen as an integral part of learning. For this reason, even if a Web 2.0 tool is used in part of the activity, it is important to establish a relationship between this tool and a game or a post-video activity and to maintain the context. For this reason, the end of each video prepared with Powtoon in the context of environmental education included in the activities in this study usually ends by explaining the work to be done after the video and giving the necessary guidance.

In the theoretical framework, it is stated that the important element that distinguishes Web 2.0 tools from others is interaction. In this study, in the fiction included in the videos prepared with Powtoon, children were addressed by their names in the voiceover made by the researcher and asked questions, received ideas, asked to complete the story, etc. The children directly followed the instructions given in the Powtoon video without the intervention of the teachers in the classroom or the researcher. In this way, the children in the experimental group were able to interact with Powtoon.

Development of Developmentally Appropriate Materials in Preschool Period within the Scope of Experimental Application with Wordwall

Before starting the experimental implementation process, the researcher prepared various games with Wordwall to be used in family participation or in the learning process to be applied to the experimental group.

In this study, Wordwall was mostly used in the learning process for gamification or assessment purposes or in family engagement activities as a support. The games prepared with Wordwall facilitated the diversification of learning strategies in the activities. Brainstorming technique was used through question-and-answer activities that included suggestions for solutions to environmental problems, and learning by discovery strategy was used through gamification of visuals related to environmental problems.

In order for the games prepared in Wordwall to be suitable for the development of preschool children, the questions included were reduced and the duration was extended. It is made up entirely of visuals. We tried to increase children's readiness for the games by ensuring that the visuals included in the family involvement activities were selected from those that were also used at school that day.

Implementation and Data Collection

Experimental Implementation Process

Within the scope of the research, activities related to environmental education for both the experimental and control groups are included in the Preschool Education Program (MEB, 2013). It was prepared to include the outcomes and indicators, vocabulary and concepts, specific days and weeks, family participation and learning process in the Monthly Education Plan for the month of implementation. In both the experimental and control groups, an 8-week experimental application consisting of environmental education activities was conducted 3 times a week. The activity prepared for the experimental and control groups included the same outcomes and indicators. Outdoor activities were included in both the experimental and control groups. The main difference between the groups was that the experimental group interacted with Web 2.0 tools in some parts of the activity plan, while the control group interacted with traditional materials.

In the planning phase of the activities, some themes related to the environment were identified by the researcher. These can be listed as climate change, water resources and the reason/importance of saving, life in soil, life in water, energy resources and the reason/importance of energy conservation, air-water-soil pollution, recycling and upcycling, paper consumption, respect for wildlife. Whichever theme was studied in the experimental group, the same theme was studied in the control group. Before the application, the themes that could be applied for the next day's application were shared with the children and the activity they chose from the options given was applied. It was observed that this situation positively affected children's participation in the activity.

Data Analysis

The quantitative data collected within the scope of the research were found to be normally distributed. Two-factor ANOVA test for repeated measures was applied to analyze the quantitative data. Two-factor ANOVA is used to test whether there are significant main effects for each of the independent variables and whether the interaction between two variables is significant. It is used in studies where both between-group design and within-group repeated measures design are used together (Pallant, 2016). The distribution of the qualitative data of the study, the views of the families' data, was also evaluated with descriptive analysis.

The significance level was taken as 0.05 in analyzing all the data obtained through the research. SPSS 23.0 package program was used for data analysis

FINDINGS

Findings Related to Quantitative Data

Environmental Attitude Scale: Findings and Comments Regarding the Children's Environmental Attitude Scale Preschool Version (CATES-PV)

Environmental Attitude Scale for Students: Children's Environmental Attitude Scale for Children Preschool Version (CATES-PV) was given to both groups as pre-test and post-test. Analyses were made by taking the total score from the data obtained. The descriptive statistics of the CATES-PV scores of the students in the experimental and control groups in the pre-test and post-test are shown in Table 1.

Table 1. Cates-PV Scale Scores of the Experimental and Control Groups Participating in the Study

Group	**Cates-PV Pre-Test**			**Cates-PV Post-Test**		
	n	**X̄**	**Sd.**	**n**	**X̄**	**Sd.**
Experimental Group	18	40,72	6,07	18	57,83	3,90
Control Group	20	41,60	7,35	20	47,75	4,39
Total	38	41.16	6,71	38	52,79	4,15

According to the results given in Table 1, the mean score of the experimental group students on the pre-test Cates-PV scale was 40.72, while the mean score of the control group students on the pre-test Cates-PV scale was 41.60. The mean score of the experimental group students on the Cates-PV scale in the post-test was 57.83, while the mean score of the control group students on the Cates-PV scale in the post-test was 47.75. The reason for this difference in the post-test scores of the experimental and control groups may be that the children in the experimental group were more interested in the activities carried out using Web 2.0 tools compared to the activities carried out with other materials in the control group.

Two-factor ANOVA results for repeated measures are given in Table 2.

Table 2. Repeated Measures ANOVA Results for Cates-PV Scale Test Scores in Experimental and Control Groups

Source of Variance	**Sum of Squares**	**Sd**	**Mean Squares**	**F**	**p***
Between Subjects	2814,55	18			
Group (Experimental/Control)	1138,23	1	1138,23	24,44	**,000**
Error	1676,33	17	46,57		
Within Subjects	84545,34	18			
Measurement (Pre-test- Post-test)	83625,39	1	83625,39	4185,64	**,000**
Group*Measurement	200,71	1	200,71	10,05	**,003**
Error	719,25	16	19,98		
Total	87359,90	38			

According to the data in Table 2, there was a significant difference between the repeated measurements (pre-test and post-test scores) of 38 students as a single group, regardless of which group the students were in [$F(1,16) = 4185.64$, $p < .05$].

According to the data in Table 2, when the "measurement" value for the groups taken into consideration, it is seen that the children in two different groups, the experimental and control groups, have a significant change from the pre-test to the post-test [F(1,16) =4185.64, p < .05].

Regardless of the inter-measurement variation in Table 2, a significant difference was found between the CATES-PV scores obtained from repeated measurements of the two groups using and not using Web 2.0 tools in environmental education [F(1, 17) =24.44, p < .05]. That is, the increase in the CATES-PV attitude scores of the two groups shows a significant difference.

The change observed in repeated measurements regarding the CATES-PV attitudes scores of the students in Table 2 shows a significant difference between the groups using and not using Web 2.0 tools in environmental education [F(1,17) = 10.05, p <.05]. In other words, it was seen that the common effects of the experimental conditions applied with repeated measurements of the students in two different groups were significant.

The joint effects of being in different treatment groups (experimental and control groups) and repeated measures (pre-test-post-test) factors on children's attitudes towards the environment were statistically significant [F(1-16)= 4185.638; p<.05]. The significant difference in the joint effect of the common interaction factor of Measurement and Group shows that the difference between the pre-test and post-test mean scores also differed significantly. In the experimental group, the Cates-PV post-test mean score of 57.83±6.06 was significantly higher than the pre-test mean score of 40.72±3.89. In the control group, the Cates-PV post-test mean score of 47.75±4.38 was significantly higher than the pre-test mean score of 41.60±7.35. That is, the post-test environmental attitude scores of the two groups increased. Accordingly, as a result of the experimental procedure, children's attitudes towards the environment improved. It can be said that the environmental education activities conducted in the experimental group using Web 2.0 tools were more effective than the environmental education activities conducted in the control group using traditional materials. It can be said that the activities implemented in the experimental and control groups positively affected the attitudes towards the environment in both groups. This finding shows that using Web 2.0 tools in environmental education is effective in increasing children's attitude scores towards the environment.

Findings and Comments on Qualitative Data

Table 3. "Which technological tools does your child use at home?" Distribution of Responses to the Question

		n	**%**
Which technological tools does your child use at home?	Television	11	20,8%
	Tablet	14	26,4%
	Telephone	16	30,2%
	Computer	10	18,9%
	Smart Watch	1	1,9%
	Playstation	1	1,9%

When the distribution of the answers given by the families participating in the study to the question "Which technological tools does your child use at home?" was evaluated, it was determined that 30.2% used phones, 26.4% used tablets, 20.8% used televisions, 18.9% used computers, 1.9% used smart watches, and 1.9% used playstations. The reason for the high rate of use of the telephone among other technological tools may be that it is accessible and available to every parent. Therefore, it can be said that the use of Web 2.0 tools in this study was an appropriate decision in terms of children's technological tool preferences. From another perspective, it can be said that Web 2.0 tools, whose interface can be experienced on tablets and phones, can enable children of this period to meet the right tools on the internet and to have the right learning experience with these tools. In the meeting held with the parents of the experimental group before the start of the experimental implementation process, it was requested to carry out family involvement activities through the computer as much as possible, but this process did not seem to prevent children from preferring the phone in the first place. Based on this finding, it can be said that the phone or tablet is one of the tools that can be used in technology studies in preschool period.

Table 4. "For what purpose does your child use these technological tools?" Distribution of Responses to the Question

		n	**%**
For what purpose does your child use these technological tools?	Watch movie video	17	39,5%
	Educational application research	9	20,9%
	Recreational play	10	23,3%
	Music	3	7,0%
	Painting and Coloring	2	4,7%
	Other	2	4,7%

When the distribution of the answers given by the families participating in the study to the question "For what purpose does your child use these technological tools?" was evaluated, it was found that 39.5% of the families used them for watching movies and videos, 23.3% for entertainment, 20.9% for educational application research, 7% for music, 4.7% for painting, and 4.7% for other purposes.

When Table 4 is examined, it is seen that children mostly use technological tools for entertainment activities such as watching movies and videos and playing games for entertainment purposes. From this point of view, it can be said that children perceive technological tools as entertainment tools rather than learning tools. According to the findings, while examining children's early use of technological tools, it can be said that video design and gamification tools can be emphasized. These tools can overlap with children's interests reflected in the findings and allow for more efficient use of technology in the learning environment. From another perspective, this finding supports the fact that during the experimental implementation process, Powtoon was mostly used for monitoring and question-answer (interaction) and Wordwall was used for gamification.

Table 5. The Families Participating in the Study were asked, "Did your child tell you about his/her experiences at school during the education program? How did it happen?" Distribution of Responses to the Question

		n	**%**
Did your child tell you about his/her experiences at school during the education program? How did it happen?	Learning Act.	10	33,3%
	Enjoyment Act.	2	6,7%
	Play Act.	2	6,7%
	Environmental Edu. Act.	6	20,0%
	Better utilization Act.	1	3,3%
	Other	9	30,0%

When the distribution of the answers given by the families participating in the study to the question "Did your child transfer any information to you about his/her experiences at school during the education program?" is examined; 33.3% transferred learning, 30% transferred other, 20% transferred environmental education, 6.7% transferred having fun, 6.7% transferred playing, and 3.3% transferred better use. In particular, family involvement activities prepared using Web 2.0 tools and sent to families after the implementation of the activities at school may have been effective in helping parents to have an idea about the activities and to interpret children's transmissions at home. These activities provided families with the opportunity to support their children's learning experiences in environmental education.

P8, one of the experimental group parents, answered the question as follows: "Yes, she taught every lesson of the education program at home. He explained the importance of water, the importance of recycling, not harming the environment and carbon footprint at home. She herself responded to the family participation activities prepared with Web 2.0 tools. He explained the importance of not harming nature and not consuming too much.
He explained which materials do not dissolve in nature. We were able to observe the benefits of the education my daughter received, especially with the sensitivity she showed when garbage was thrown on the ground. I think he started to become environmentally literate."

P14 said, "As a result of the experiments and explanations at school, we think they made great contributions to environmental education. We pay attention to our excessive use of paper, water consumption, napkin use, and our children warn us if they observe that we are being careless."

P17 "We realized that environmental awareness has improved, he talks about recycling, tries to throw plastic and glass bottles in separate boxes, etc."

The above-mentioned experimental group parents stated that their children exhibited better behaviors about the environment after the environmental education activities. It is found in the literature that family participation activities support children's skills. Supporting what is learned at school with family involvement activities at home is important in terms of ensuring integrity in education. In this direction, family involvement activities prepared with Web 2.0 tools can be effective in reinforcing what children learn during the experiment process and returning to parents as various transfers by supporting them in the home environment, ensuring continuity and permanence in learning and developing correct attitudes.

The finding on better use of Web 2.0 tools (3.3%), which was obtained in the qualitative data although it was included at a low rate, is one of the important results considering the age group of the children.

P12, in relation to the question "It surprises me that he can clearly access what he is looking for on the internet." It expressed his opinion as follows.

As a result of this study, although not all parents have observed it at the moment, the readiness levels of the experimental group in the use of Web 2.0 tools in their later educational life will not be the same as the children who have not experienced this learning experience.

Table 6. "What are your views on the use of Web 2.0 tools in early childhood?" Distribution of Responses to the Question

		n	%
What are your views of the use of educational web 2.0 tools in early childhood education?	True and Positive	13	34,2%
	Should be Limited	4	10,5%
	Not Effective	3	7,9%
	The Child Must Explore	1	2,6%
	Enduring engaging facilitative play	5	13,2%
	Primary School Preparation	1	2,6%
	Technology Age	6	15,8%
	Other	5	13,2%

“Education in early childhood Web 2.0 are you positive?” components of answers to questions when evaluated; 34.2% of them are correct and positive, 15.8% are of their age, 13.2% are other, 132% old attractive, simplifying, 10.5% should be, 7% effective 2.6% of them had children, 2.6% of them were interviewed in pre-primary school preparation. kept it. When Table 6 is examined, it is seen that parents mostly believe that the use of Web 2.0 tools in preschool period is correct and positive.

P4, one of the parents of the experimental group, said, "As a teacher myself, I believe that the education and training of children of the digital age should also be digital. Within certain limitations, the sooner the better." Opinions were expressed as follows.

P6 said, "In order to keep up with the age, I find it right to utilize technology and such educational tools in accordance with the age of children." It expressed his opinion as follows.

One of the factors causing this may be the belief that distance education trials were conducted during the pandemic process in the preschool period and that children should get used to this process.

In their responses, families stated that these tools make learning interesting, memorable and facilitate learning.

Regarding the question, P13 of the parents said, "It allows children to learn while having fun. The efficient use of Web 2.0 tools can bring children into learning and offer them a different understanding of education and training." It stated.

P9 said, "With Web 2.0 tools, the educational environment becomes more fun and permanent"; P10 said for the related question, "Having the visuals of the information learned at school in these tools and supporting it with games that my daughter likes was useful. I think it also contributed to their responsibilities in the future, such as homework. Thank you."

This finding may have been influenced by the family involvement activities prepared with Wordwall sent to the experimental group parents during the research process. It is seen that 7.9% of the responses indicate that the use of Web 2.0 tools in early childhood is not effective. Regarding question P2, "I think that technological tools in early childhood lead to conditions such as attention deficit and hyperactivity in children." P7 said, "I do not think that the web tools applied in this period have much effect on children. In my opinion, there is not yet a tool that can replace face-to-face training activities."

This may be because the implementation process was not implemented efficiently at home, in the school environment, or family involvement activities were not implemented at home or the child did not provide information.

CONCLUSION, DISCUSSION AND RECOMMENDATIONS

This study was carried out to examine whether the use of Web 2.0 tools in environmental education has an effect on attitudes towards the environment compared to traditional materials and to examine the views of parents on the use of technology at home. In this context, during the 8-week implementation process, activities were created for the experimental group using Wordwall and Powtoon, which are Web 2.0 tools, while activities were created for the control group using materials that can be provided in the classroom environment, cut from magazines, newspapers or made by teachers. The activities of both groups were prepared in accordance with the MEB Preschool Education Program. Based on the findings of the study, the conclusions are as follows:

1- Regardless of which group the students were in, a significant difference was found between the repeated measurements (pre-test and post-test scores) of 38 students as a single group. It was concluded that the increase in attitude scores was significant regardless of the groups.

2- When the "measurement" value for the groups is taken into consideration, it is seen that the children in two different groups, the experimental and the control group, had a significant change from the pre-test to the post-test. There was a significant effect on the post-test scores of the group receiving training with Web 2.0 tools.
3- A significant difference was found between the CATES-PV scores obtained from repeated measures of the two groups using and not using Web 2.0 tools in environmental education, regardless of the change between measurements. That is, the increase in the CATES-PV attitude scores of the two groups had a significant difference. The change observed in repeated measures of students' CATES-PV attitude scores showed a significant difference between the groups that used Web 2.0 tools in environmental education and those that did not.
4- When asked which tools their children use the most at home, parents stated that they used phones or tablets; when asked for what purpose, they stated that they used them for entertainment purposes.
5- In response to the question of whether there were any transfers from the home environment regarding the implementation process, it was stated that 33.3% of the parents provided learning, 30% other, 20% environmental education, 6.7% having fun, 6.7% playing, and 3.3% technology use experience.
6- Regarding the use of Web 2.0 tools for educational purposes in early childhood, it was determined that 34.2% of the parents found it correct and positive, 15.8% were technology age, 13.2% were other, 13.2% were permanent, interesting and facilitating, 10.5% were limited, 7.9% were not effective, 2.6% were children should discover, and 2.6% were preparation for primary school.

Based on the increase in the post-test scores of both groups, it can be said that there was an improvement in the attitudes of the experimental and control groups towards the environment. However, when the difference between the recovery scores of the experimental group and the control group was examined, it was observed that there was an increase in favor of the experimental group. Accordingly, it can be said that the use of Web 2.0 tools within the scope of environmental education has a positive effect on preschool children's attitudes towards the environment. It is also similar to the research findings conducted by Kahriman-Öztürk, Olgan and Güler (2012), Erol (2016) and Akkaya Alıcı (2022). It can be stated that the environmental education conducted in both groups positively affected children's attitudes towards the environment. When the findings of the study conducted by Kahriman and other (2012) were analyzed, it was found that the children participating in the study respected animals, plants, nature and people. In addition, children talked about reducing water, paper and electricity consumption to protect the environment. When the findings of the experimental study conducted by Erol (2016), in which Cates-PV was one of the data collection tools, statistically significant differences were found between the children in experimental group 1, experimental group 2, experimental group 3 and control group, and it was stated that all of the education programs applied to the experimental groups had positive effects on children's attitudes and awareness towards the environment. Akkaya Alıcı (2022) implemented a sustainability education program with digital books using one of the quasi-experimental models with pre-test-post-test unequalized control group.

Regardless of which group the preschool children were in, a significant difference was found between the repeated measures (pre-test and post-test scores) of 38 children as a single group [$F(1,17) = 4185,63,71$, $p < .05$]. The use and non-use of Web 2.0 tools in environmental education shows a significant change from pre-test to post-test within two different groups. This change has been in favor of using Web 2.0 tools in environmental education. A study conducted with science teachers was worked out by Elgün (2021). The study investigates the sustainability of online environmental education. When the findings of the study are analyzed, the majority of the teachers stated that they needed in-service training on online education and the use of Web 2.0 tools. It is thought that the use of Web 2.0 tools has become more visible especially during the pandemic process and that some, if not all, of the teachers may have had difficulties in the use and integration of Web 2.0 tools that they met with the distance education process. Similarly, Akın and Aslan (2021) conducted a study on the distance education process of preschool children in the Covid-19 Pandemic. When the findings of the study were examined, it was stated that they liked the activities such as coding with Web 2.0 tools in the live lesson, examining different objects (motorcycle helmet, etc.), finding a material from home (lemon, orange, etc.), dancing, and that they liked the coding done with Web 2.0 tools very much and wanted coding game tasks and kept their attention span longer in these studies. The findings obtained from the above-mentioned studies are consistent with the findings obtained from this study.

When the distribution of the answers given by the families participating in the study to the question "Which technological tools does your child use at home?" was evaluated, it was determined that the most common technological tools used by the families participating in the study were telephone, tablet, television, computer, smart watch and playstation. Jafari (2021) examined the relationship between children's intelligence levels and social skills and digital parenting attitudes in early childhood and asked parents about the technological tools used by their children. Smartphones, televisions and tablets were the most frequently mentioned. Similarly, in the study conducted by Ergüney (2017), the internet access device of the 16 preschool children constituting the sample was asked. Tablet, phone, computer or phone belonging to parents were most frequently mentioned. The reason for this, which may also be noted in other studies, may be that the phone and the tablet, which have similar features, are easier for children to learn, are less complex than the computer, require less hand-eye coordination and less cognitive processing. Another approach may be that since one of the technological devices that parents frequently use is the telephone, children are first curious about these devices from infancy and are motivated to use them. Accordingly, Web 2.0 tools are suitable tools to be selected among technological tools for preschool children because they can be easily applied via phones and tablets.

When the distribution of the answers given by the families participating in the study to the question "For what purpose does your child use these technological tools?" was evaluated, it was found that they mostly used them for watching movies and videos, playing games for entertainment, researching educational applications, listening to music, and painting pictures. Supporting these

findings, Ergüney (2017) also emphasized that children prefer cartoons, games and video content. All of the children participating in the study watch cartoons online. 4 children use it for playing games in addition to cartoons. It was stated that 8 of the children watched videos prepared by Youtubers, usually toy promotions or videos with content featuring children. 3 children preferred both cartoons, games and video content. The children in the sample of this study use technological tools mostly for entertainment purposes. In a study conducted by Kayış (2022), children intensively use technological tools for watching videos, movies or playing games alone or with one of their parents. At this point, the findings obtained in this study are similar to the literature. The reason why technological devices are preferred for entertainment purposes may be related to the fact that children are not aware of the different Web 2.0 tools that they can do with these devices and learn while having fun. At this point, teachers can use such sites with children in the school environment and prepare games to be played at home and deliver them to parents. The preschool period is a time when developmental support is prioritized over academic concerns. From this point of view, it can be said that the learning experiences of children who start primary school as graduates have an important place and shed light on primary school life.

When the distribution of the responses of the families participating in the study to the question "Did your child transfer any information to you about his/her experiences at school during the implemented education program?" was evaluated, the most common responses were learning transfer, other, environmental education transfer, having fun transfer, playing transfer, and better use transfer. The fact that children make various transfers in the home environment may be a result of family involvement activities. These efforts have also made families a part of the process. In general, the transfers on learning and environmental education serve the aims of this study.

When the distribution of the answers given by the families participating in the study to the question "What are your opinions on the use of Web 2.0 tools in early childhood education?" was evaluated, it was determined that the most common opinions were correct and positive, technology age, other, permanent interesting facilitating game, should be limited, not effective, child should discover, preparation for primary school. It is observed that families have a generally positive approach to the use of Web 2.0 tools in this period and focus on their benefits. According to the findings of the study conducted by Kılınç (2015), it was concluded that parents were united in the view that the use of technology by preschool children would not benefit them much and that parents did not use technological tools in teaching sounds and words, shapes, numbers and numbers with their preschool children.

For researchers who want to conduct research on similar topics or methods, and for parents who want to provide more qualified guidance to their children about technology, the following suggestions are given.

For researchers,

- Web 2.0 tools are being updated and new tools are being developed every day. Studies on the use of Web 2.0 tools in education can be conducted as they will benefit the literature and especially preschool educators.
- Based on the findings of this study, not only environmental education, but also different educational programs can be prepared by planning different activities that develop self-care skills, social skills, motor skills in preschool period with Web 2.0 tools. It would be useful to test these and share the results.
- Since the majority of Web 2.0 tools are paid applications, researchers may have difficulty in conducting their research. For this reason, before starting the research, it should be planned in advance whether the tools can be charged or whether access to the user account, which is not charged, can be accessed and whether enough content can be produced for the research.

For parents;

- The fact that children's use of technology is focused on watching and playing is observed both in this study and in different studies in the literature. It is recommended that they get to know Web 2.0 tools closely as one of the grounds on which children perform their watching and playing activities and encourage them to use them correctly.

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Research Paper

Development and Validation of the Teachers' Digital Competence Scale (TDiCoS)

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ABSTRACT
The competences expected from teachers are described in several international reports. An investigation of teacher competences has a potential to analyze and delineate the current situation. Assessment of any construct necessitates utilization of appropriate scales with established validity and reliability. Currently available validated digital competence scales have examined digital competences of citizens, teachers, students, but most are based on only one digital competence framework. In this study a valid, reliable, and comprehensive scale entitled "Teachers' Digital Competence Scale" (TDiCoS) for teachers of different subjects has been obtained by relying on standards/policy reports from several countries. TDiCoS items measure teachers' self-assessment and report of their use of digital technologies in their classrooms. TDiCoS was validated on a sample of 288 in-service teachers. In the final form TDiCoS is unidimensional and composed of 19 items. The model fit criteria, factor loadings, internal validity, and reliability of TDiCoS were examined and found to be good. Hence, it can inform design of new policies and teacher professional development programs targeting digital competences.

INTRODUCTION

Classrooms in all levels are now hosting the generation Z and students who were born later. These students are often called "digital natives" (Prensky, 2001) and from birth they are immersed in ever developing, state of the art digital technologies and the opportunities they offer (Twenge, 2017). For anyone it is now possible to access information quickly and easily via the internet in the forms of digital books, educational videos, or animations/simulations, etc. from anywhere and anytime. As a result, expectations from educators have also undergone transformations. Teachers are no longer expected to be the authority persons who possess and transfer information to students, but to be a guide for them to make sense of the knowledge they have acquired, to realize what is essential and what is unimportant, and to use the information they have acquired for their benefit in their lives (Kuran, 2018, p. 113). For this reason, teachers and students must know how to use digital technology to understand and interpret the world in which they live (NETS-S, 2007; NETS-T, 2008). Learning a new skill or coming to terms with a different perspective is challenging and time-consuming. For teachers, adapting to an approach they are not accustomed to in their classrooms is indeed a complex and gradually developing process (Guskey, 2002; Van Driel, Beijaard, & Verloop, 2001).

Students need learning environments in which they can collaborate with their peers and develop critical thinking and creativity skills while using digital opportunities to acquire information/knowledge (Harari, 2018, p. 241). Accordingly, teachers should design learning environments where students can use digital technologies and these skills.

The construct "Digital Competence" has been a topic that has attracted much attention and has been frequently researched recently due to the COVID-19 pandemic experienced worldwide beginning early in 2020 (TEDMEM, 2021). The forcedly widespread use of online teaching environments and learning management systems during the pandemic has revealed the importance of teachers' ability to use digital tools (OECD, 2022). It is asserted that teachers with a high level of digital competence will assist their students in learning more efficiently and enjoy their schoolwork more in the digital environment (Caena & Redecker, 2019; Redecker, 2017). Ilomäki, Paavola, Lakkala, and Kantosalo (2016) underlined that the idea of digital competence incorporates elements from other disciplines and that it first emerged in education policy reports. Digital competence has dimensions of knowledge, skills, and attitude to use information and communication technologies (ICT) and digital media in a creative, critical, and efficient way for various purposes (work, participation, learning, socializing, etc.) (Ferrari, 2012, p. 3; Oberländer, Beinicke, & Bipp, 2020). Due to its characteristics, digital competence is difficult to define by a few words. The reason lies in its multidimensional, complex, and interconnected in nature (Calvani, Cartelli, Fini, & Ranieri, 2008). Therefore, it is said to be a "pluralist concept" (Janssen, Stoyanov, Ferrari, Punie, Pannekeet, & Sloep, 2013).

Digital competences are also defined in various policy reports created by national and international organizations (Carretero, Vuorikari, & Punie, 2017; Ferrari 2012; etc.). In these reports, the competences required by the new century were defined and the digital competences expected from the citizens were specified. Additionally, there exist particular definitions for educators (Redecker, 2017), citizens (Carretero et al., 2017), consumers (Brecko & Ferrari, 2016), entrepreneurs and virtual office workers (Bartolomé et al, 2018).

Digital competences for teachers in reports include profession-specific features (e.g., UNESCO, 2011; ISTE, 2000; ISTE, 2017; Redecker, 2017). When addressing the digital competence of teachers, various factors must be considered, including their social, cultural, educational, and ethical natures. Many scales have also been developed to measure teachers' digital competences (Alarcón, Jimenez, & Vicente-Yagüe, 2020; Gümüş & Kukul, 2022; Lucas, Bem-Haja, Siddiq, Moreira, & Redecker, 2021; Toker, Akgün, Cömert, & Edip, 2021). It is suggested that future research should determine the similarities and differences among the digital competence models, frameworks, and strategies (Sillat, Tammets, & Laanpere, 2021). Although the competences expected from teachers agree with the requirements of the age, they can still differ due to the cultural, social and economic characteristics of the country (He & Li, 2019; Ilomäki et al., 2016; Skantz-Åberg, Lantz-Andersson, Lundin, & Williams, 2022). Infrastructure, access to technology, and facilitation are all positively related to digital competence; however, individual factors appear more pivotal (Lucas et al., 2021). This situation can change the way teachers evaluate their desired and expected characteristics (Lucas et al., 2021).

By qualitatively analyzing digital competence indicators in various standards/policy reports in different countries the "Teachers' Digital Competence Scale" (TDiCoS) has been developed in this study. A strength of TDiCoS is that it is informed by teacher competence documents of different countries and incorporates their common aspects. Potentially, researchers and institutions/organizations can use TDiCoS to investigate/assess teachers' digital technology competences. On the other hand, teachers can use it for self-evaluation purposes as well.

Teachers' Digital Competences

The Organisation for Economic Co-operation and Development (OECD) conducts large scale surveys of teachers called The Teaching and Learning International Survey (TALIS). The most recent one was conducted in 2018 and revealed some striking results. For the purposes of the current study, it is noteworthy that in the 2018 TALIS survey (Schleicher, 2020, p. 21) teachers reported that they highly prioritized professional development in the use of information and communication technologies (ICT) for teaching. This can be attributed to the finding that the frequency of student use of ICT for projects or class work has been increasing continuously and has become very common.

The adaptation of digital technologies in classrooms recently has revealed the need for teachers to use them effectively and efficiently to enhance student learning (Redecker, 2017; Turkish Education Association, 2009, p. 176). In Turkey, the FATIH (Movement to Increase Opportunities and Improve Technology) project was launched in 2010 to increase technology use in the classroom and provide necessary technical equipment to all schools. However, providing the necessary technical infrastructure is insufficient for integrating technology into teaching as emphasized by the 2018 TALIS report. Teachers may experience various problems and difficulties regarding when and how to integrate new educational technologies into the learning-teaching environment (Niess, 2011, p. 299). It would be beneficial to examine the standards of the teaching profession to overcome these difficulties and learn what is expected from teachers.

Various international standards describe the digital competences expected from teachers. Although there is no digital competence framework in Turkey, they were included in the "General Competences of the Teaching Profession" (Ministry of National Education [MNE], 2006). In the updated 2017 version emphasizes that teachers should use digital technologies effectively in their classrooms (MNE, 2017). The "Turkish Qualifications Framework" was developed in accordance with the European Qualifications Framework and published in 2016. It brings together all learning paths and competence principles. "Digital Literacy Competence Framework" has been explained in the Digital Literacy Teacher's Guide created by the Ministry of National Education for current needs during the pandemic process (MNE, 2020). In this framework, competence areas consisting of sub-titles such as communication, cooperation, security, and problem-solving are defined in addition to basic technology usage skills.

The "Digital Competences for Educators (DigCompEdu) Framework" has defined the profession-specific digital competences that educators should capture the potential digital technologies offer to enhance and reform education in many European Member States. This framework also allows educators to develop and evaluate their digital competences (Redecker, 2017, p. 9). The first spark for the DigCompEdu framework was ignited by Ferrari (2012), who provided a comprehensive definition of digital competence by analyzing 15 different digital literacy and competence frameworks. The framework (titled DigComp 1.0), which received an update in 2013, consists of constructs in five competence areas (information, communication, content creation, security, and problem solving). In this framework, it suggests definitions of relevant competences, not of desired citizen behavior (Ferrari & Punie, 2013, p. 12). It has been updated due to the incorporation of new technologies and the use of distinct terminology. The digital competence framework for citizens called DigComp 2.0 has received new word updates to its previous version (Vuorikari, Punie, Carretero Gomez, Van den Brande, 2016). DigComp 2.1 (Carretero et al., 2017) defines eight proficiency levels for twenty-one proficiency indicators. Each of these levels contains descriptive information in considerable detail. The European Framework for Digital Competence of Educators (DigCompEdu) provides a holistic framework for teachers' digital competence (Redecker, 2017, p. 19):

1. Professional engagement (organizational communication, professional collaboration, reflective practices)
2. Digital resources (selecting, creating & modifying, managing-protecting-sharing)
3. Teaching and learning (teaching, guidance, collaborative learning, self-regulated learning)
4. Assessment (assessment strategies, analyzing evidence, feedback & planning)
5. Empowering Learners (differentiation & personalization, accessibility & inclusion, actively engaging learners
6. Facilitating learners' digital competence (information & media literacy, communication, content creation, responsible use, problem solving)

Assessment of Teachers' Digital Competences

There is a rising interest to improve and assess pre-service and in-service teachers' digital competences (Revuelta-Domínguez, Guerra-Antequera, González-Pérez, Pedrera-Rodríguez, & González-Fernández, 2022). Kluzer and Pujol Priego (2018, p. 35) defined four different approaches for assessing digital competences: self-assessment questions, knowledge-based tests, and performance-based evaluation, a mix of these methods. Self-assessment approach helps encourage respondents to think critically about their own levels of digital competence and to evaluate their own perceived strengths and weaknesses. The self-assessment of teachers' digital competences has been the subject of a significant number of studies (e.g., Scherer, Siddiq, & Tondeur, 2017; Tondeur, Aesaert, Pynoo, van Braak, Fraeyman, & Erstad, 2017). A knowledge-based test approach can more accurately describe a user's digital competence as it measures both factual and procedural knowledge. In the performance-based assessment approach, where users are asked to solve various problem situations that reflect the real situations they may encounter, a far more accurate evaluation of their digital competence is possible.

Cartelli (2010), who presented a digital competence assessment framework, suggested that cognitive, affective, and social-relational dimensions are related to each other in the evaluation process. In the cognitive dimension, technological, verbal-linguistic, and logical-mathematical features are measured. In the social dimension, characteristics such as the use of self-reflective skills and capacities, the ability to interact with others and be sensitive to their needs, and the ability to work in a group are highlighted.
DigCompEdu also suggests a multi-stage, six-level assessment model of digital competence proficiency: beginner (A1) and explorer (A2), integrator (B1) and expert (B2), and leader (C1) and Pioneer (C2) (Redecker, 2017, p. 31). Several studies have used the DigComp framework to develop scales. With teachers from various disciplines in Turkey (Gümüş & Kukul, 2022; Toker et al., 2021) and Spain (Alarcón et al., 2020). The digital competence level can be determined based on the overall score gained on this scale. Other scales were prepared to measure the importance that teachers attach to the status and development of their students' digital knowledge and skills rather than their own competences (Kim & Choi, 2018; Kuzminska, Mazorchuk, Morze, Pavlenko, & Prokhorov, 2018; Siddiq, Scherer, & Tondeur, 2016; Sillat et al., 2021). There are also scales for measuring the digital competences of higher education students as adult learners (e. g., Tzafilkou, Perifanou, & Economides, 2022). These scales are in the self-assessment category. Measurement tools using DigComp-related frameworks are usually multiple-choice format (Mattar, Ramos, & Lucas, 2022). This framework can be used for knowledge-based assessment and in the preparation and definition of authentic tasks for performance-based assessment (Alarcón, et al., 2020).

METHOD

Procedure

Scale development procedures have been the subject of various studies (Boateng, Neilands, Frongillo, Melgar-Quiñonez, & Young, 2018; Cohen & Swerdlik, 2009). The stages indicated by Cohen and Swerdlik (2009, p. 245) were followed throughout the TDiCoS's development. TDiCoS is aimed to measure teachers' self-assessment of using digital technologies for educational purposes.

Content Analysis for Item Generation

In the TDiCoS development process, we first determined the domain in accordance with the purpose of the scale. We explained what we mean by the expression of a teacher with digital technology competence. We defined it as follows: a teacher who uses digital technology in her/his classroom to ensure active student participation, use it to ensure professional development and cooperation with colleagues, and knows about moral and ethical use of digital technologies. Based on this definition, we benefited from the related English and Turkish standards and frameworks. To accomplish this, we searched the Google Academic database for the terms "digital yeter(li)lik " in Turkish and "digital competence" in English. The exclusion criteria were considered during this process, including 1) research articles and book chapters, and 2) documents written in languages other than English and Turkish. Then, we reached the following standards/policy reports: National Educational Technology Standards for Teachers (NETS-T, 2008), European Framework for the Digital Competence of Educators (Redecker, 2017), General Competences of the Teaching Profession MNE (2006), and UNESCO ICT Competency Framework for Teachers (UNESCO, 2018). A professional translation company translated these documents from English into Turkish. Then, we brought together these standards created for different countries and institutions in the MAXQDA 2018 qualitative analysis program and made content analysis of competence indicators. Because of the content analysis, we merged the common points of these frameworks and reached the following areas the digital technology competences of teachers: 1) learning-teaching process, 2) selecting and using digital resources, 3) assessment, 4) digital technologies, 5) professional learning, and 6) ethical use of resources. The descriptions of these six different areas are in Table 1.

Generating Scale Items and Expert Reviews for Revision

Fowler (1995, p. 103) and Clark and Watson (1995) defined the characteristics that items should have. Some of them are as follows: the items contain what people have experienced firsthand, the items consist of a single judgment, all the words chosen in the items mean the same thing for the respondents, the items are not complex, and so on. We ensure sure the scale's items aligned with these requirements. We collected statements that met similar competences and then developed new competence items in Turkish that could correspond to these statements. The size of the starting pool of items should be at least double that of the final scale (Kline, 1993, p. 162). We created a pool of 56 items from the competence statements we obtained. The results of the content analysis were collected from six distinct areas. The item pool created according to the proficiency areas because of the content analysis and the item numbers in the final scale is given in Table 1.

Table 1. TDiCoS scale's defined teacher competence areas and item-related explanations

Competence areas	Descriptions	Item number in the pool	Final scale item numbers
Learning-teaching process	Including technology in the lesson plan, using technology in a way that enables students to use their creativity and working collaboratively, ensuring active participation of students in the environment where technology is used, identifying learner characteristics using technologies and developing materials using technologies	1–2 (lesson plan)	17
		3–4 (developing materials)	8
		5–7 (enables students to use their creativity	2
		11 enables students to work collaboratively)	19
		12–14 (active participation)	15
		21–26 (identifying learner characteristics)	4
Selecting and using digital resources	This takes into account the students' knowledge level, subject area, and capabilities during the teaching-learning process.	8–10	1 14 16
Assessment	To enable students to evaluate their own knowledge, and their learning,	16–20	18 11 7
Digital technologies	Aware of the specific characteristics of technologies and employing compatible technologies	37–46	9 10
	Willingness to learn how to use various technologies and to engage in online groups for self-improvement	27–38 47–51	5 6 12
Ethical use of resources	Verifying information sources and educating students about copyright	52–56 15	3 13

To ensure content validity of the TDiCoS items, we received expert opinions from four people from the measuring, science, computer/instructional technology, and Turkish department. Experts (such as colleagues who have substantial experience and expertise with the construct in issue or related phenomena) might be asked to score the items' relevance to the construct or phenomenon being measured (DeVellis, 2017). We received their opinions in terms of the domain suitability of the items, clarity of the article, and compliance with the item writing rules. Finally, teachers' opinions were also sought to check the comprehensibility of the items on the TDiCoS. Finally, items were accepted, rejected, or modified based on the experts' views. By considering into account the feedback of several pre-service teachers who read the entire scale, we refined the accuracy, clarity, and parsimony of each item. After all the steps, we created a 20-item form. The last form of the scale has two items for each competence area of having technological knowledge and ethical use of resources, and three or more items for other competence areas.

We developed the TDiCoS as a Likert-type scale to measure teachers' digital competences. The scale we developed in this study was graded into 5 categories (Table 2). The teachers taking the scale will rate how often they make the statements in the items. Since our items contain some technological tools, equipment, or material information, the category of "Not Appropriate" has been added to the frequency statements. If the teachers did not know/experience the given item, they chose the NA category. In this way, we have distinguished between the teacher who does not know the technology in that article and the teacher who does but never uses it in her lessons.

Table 2. 5-point Likert scale response options

Point	How often does it use	Description of the category
[NA]	Not Appropriate	If you are not familiar with the substance.
(1)	Never	If you know and never use it.
(2)	Rarely	If you know it, but rarely apply it.
(3)	Sometimes	If you know and sometimes, apply it.
(4)	Generally	If you know and usually apply it.
(5)	Always	If you know and always apply it.

Sample Characteristics and Data Collection

DeVellis (2017) prefers a sample size as large as possible to ensure factor stability. Comrey and Lee (1992, p. 217) indicate the adequacy of a sample with the following scale: 50 —very weak; 100 — poor; 200 — fair; 300—good; 500 — very good; and 1000 or more—perfect. However, the sample size fulfills the recommendation that there be a minimum of 10 participants for each relevant item evaluated (Guadagnoli & Velicer, 1988). The final version of the TDiCoS, returned by the experts, consists of 20 items. For this reason, applying EFA to nearly 200 participants can be considered an appropriate value. However, if the results contain relatively few factors and the amount of variance explained by the factor is large, the investigator can be confident that the factors obtained represent a close match to the population factors, even at medium to small sample sizes (MacCallum, Widaman, Zhang, & Hong, 1999). Generally, CFA/SEM requires large samples (Kline, 2016, p. 15), A lower sample size is appropriate if there are substantial correlations and few, distinct components (Tabachnick & Fidell, 2013, p. 666). Moreover, a simple model can be analyzed with 100 and less (Kline, 2016, p. 16).

The TDiCoS was applied to the teachers working in different regions of Turkey with a 5-point Likert-type scale. The descriptive statistics of the study groups in which the scale was applied to exploratory factor analysis and confirmatory factor analyzes are given in Table 3.

Table 3. Demographics of the participants

Respondents Characteristics	Exploratory Factor Analysis Sample % (N)	Confirmatory Factor Analysis Sample % (N)
Gender		
Female	79.2% (95)	71.4% (120)
Male	20.8% (25)	28.6% (48)
Experience		
1–5 years	48.3% (58)	29.2% (49)
6–10 years	31.7% (38)	35.2% (59)
11–15 years	8.3% (10)	13.7% (23)
16–20 years	1.17% (14)	21.4% (36)
Area		
Science education	83.3% (100)	91.1% (153)
Physics	5% (6)	1.8% (3)
Chemistry	6.7% (8)	4.8% (8)
Biology	5% (6)	2.4% (4)
Total	100% (120)	100% (168)

Although this scale was designed to be applicable to all teachers, only teachers from different science fields completed it. The great majority of participants in both analyses are involved in science education. In Turkey, science education teachers teach science to students between the ages of 10–14. Physics, chemistry, and biology teachers work at the high school level. Most respondents were women. In both groups, those with less than 10 years of experience constituted the majority. The total number of participants invited to participate in TDiCoS voluntarily and anonymously is 357 teachers.

We assigned 162 responses randomly to the exploratory factor analysis (EFA) group. With advice from two experts, 42 participants' responses were excluded from the data list since they included at least one "Not Appropriate [NA]" item response. Thus, 120 of these participants constituted the EFA sample. For model-fit calculations, the sample was separated from the EFA sample (Schumacker & Lomax, 2010, p. 224). Similarly, we assigned the remaining 195 respondents to the confirmatory factor analysis (CFA) group randomly. Twenty-six respondents were dropped due to missing value items. Thus, 168 of them constituted the CFA sample.

Analysis of Data

We used exploratory and confirmatory factor analyzes to reveal the TDiCoS's validity (Hurley, Scandura, Schriesheim, Brannick, Seers, Vandenberg, & Williams, 1997). For the TDiCoS's reliability, we calculated the Cronbach's Alpha value.
Factor analysis is used in scales calculated based on the total for features that cannot be measured directly. This analysis is about constructing validity. The pattern of correlations (or covariances) between the observed measures is examined in factor analyses (DeCoster, 1998). Factor analysis consists of two main topics. While exploratory factor analysis helps us understand the structure to be measured, confirmatory factor analysis allows for testing the revealed structure (Costello & Osborne, 2005).

With the data we obtained for the validity analysis of the scale, we first performed exploratory factor analysis, then reliability analysis, and finally confirmatory factor analysis.

RESULTS

Exploratory Factor Analysis (EFA)

To ensure construct validity with the remaining 120 people, we conducted exploratory factor analysis using the SPSS 25 program with the principal components analysis method.

Evaluation of The Suitability of Data for Factor Analysis

We performed the KaiserMeyer-Olkin test and the Bartlett test for the suitability of the dataset for the study group for principal component analysis. Kaiser-Mayer-Olkin (KMO value) value of .930 indicates that the sample size is sufficient for factor analysis (it should be greater than .80). This value indicated that the sample size was perfect. This because according to the literature review, the KMO value is 0.60 moderate, 0.70 good, 0.80 very good, and 0.90 excellent (Bryman & Cramer, 1999). According to the KMO value obtained, it can be evaluated whether the data structure is sufficient for factor analysis.

It is determined by the "Bartlett Test of Sphericity" that the data come from a multivariate normal distribution. The p-value (p=0.000) obtained from the Bartlett test is less than the 0.05 significance level. This results in a clear rejection of the independence hypothesis, indicating that the matrix may be suitable for analysis (Dziuban & Shirkey, 1974). Since the Bartlett Test of Sphericity is less than .05, it shows that at least one significant factor can be formed from these items.

Determining The Number of Factors

In factor analysis, the lowest factor loadings of the items were .571. We did not do rotations because the load given to the different factor was higher than that for the other. Because “if the correlation patterns in the data are clear, different rotation methods tend to give similar results” (Tabachnick & Fidell, 2013, p. 690). Even though there was no rotation, we excluded the 16th item from the analysis because an item alone loaded a factor, and there could not be a factor from a single item in that factor. Finally, the TDiCoS consists of 19 items, and the eigenvalues and variance explanation percentages of the factors are presented in Table 4.

Table 4. Total variance explained

Component	Initial Eigenvalues			Extraction Sums of Squared Loadings		
	Total	% Variance	Cumulative%	Total	%Variance	Cumulative %
1	10.198	53.675	53.675	10.198	53.675	53.675
2	1.736	9.135	62.811	1.736	9.135	62.811
3	.954	5.021	67.831			

After the 16th item was removed, the single factor structure (eigenvalue 10,198) explained 53.68% of the variance. Bryman and Cramer (1999) stated that factors with an eigenvalue of 1 or greater than 1 can be considered important factors. When the total explained variance is examined, two factors with an eigenvalue greater than 1 are seen in the scale. This scale is unidimensional because the first eigenvalue is much bigger than the second (Hambleton & Traub, 1973). The eigenvalue of the first factor is more than 3 times the nearest eigenvalue of the other. Simultaneously, when their contribution to the total variance is examined, the second factor's contribution is relatively low. Using Cattell's (1966) Scree test, researchers chose to retain one component. It was thought that testing and examining the Scree plot, another criterion used in determining the number of factors, would be effective in making the final decision (Tabachnick & Fidell, 2013, p. 697). Scree plot is presented in Figure 1.

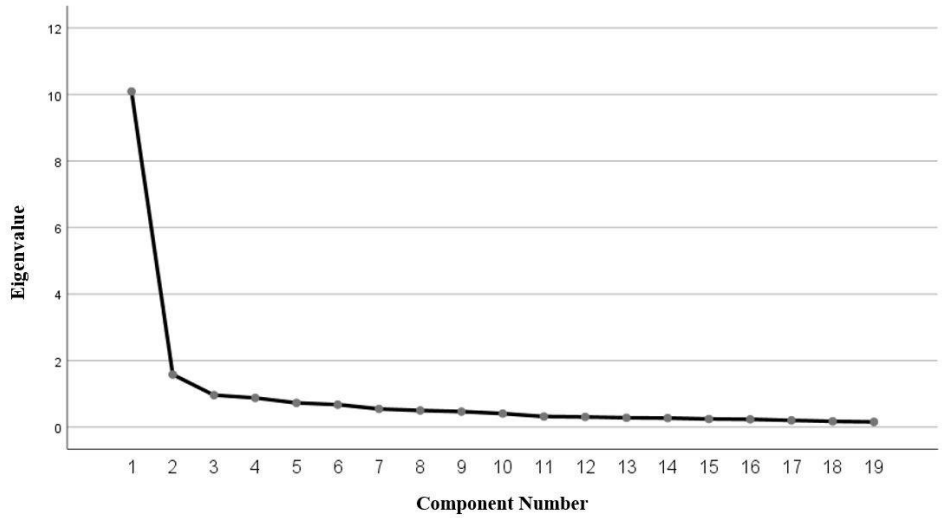

Figure 1. Scree plot

While interpreting the Scree plot, "it is necessary to pay attention to the places where the slope of the line formed by the combination of points changes" (Tabachnick & Fidell, 2013, p. 697). When the graph in Figure 1 is examined, it is seen that the slope of the line has changed since the second component. Therefore, according to the explained variance distributions and Scree plot data, it has been determined that this 19-item scale has a single factor structure.

Determination of Factor Variables

After determining the factor number of the scale and removing the 16th item, the factor loads of the scale were determined. The factor loads of 19 items in the TDiCoS are presented in Table 5. Since variables with factor loadings of .32 and higher were interpreted, those below this value are not included in the table (Tabachnick & Fidell, 2013, p. 702).

Table 5. Component matrix

Items	Component	
	1	2
Item 1	.765	
Item 2	.777	
Item 3	.657	
Item 4	.781	
Item 5	.786	
Item 6	.653	-.357
Item 7	.695	.363
Item 8	.593	
Item 9	.777	
Item 10	.790	
Item 11	.696	.364
Item 12	.776	
Item 13	.672	-.499
Item 14	.726	-.423
Item 15	.782	
Item 16	.822	
Item 17	.759	
Item 18	.684	.542
Item 19	.683	.452

When Table 5 is examined, it is seen that all items give a more significant load to the 1st factor. Considering the variance explanation value, it was determined that the scale had a single factor structure. However, some items' loads given to the second factor should not be ignored. The 6th, 7th, 11th, 13th, 14th, 18th, and 19th items are evaluated as explaining the variance very well in the first factor with factor loadings above .63 (Comrey & Lee, 1992, p. 243).

Reliability Measure of TDICoS

We chose the most widely used "internal consistency reliability" method, which can be easily detected by software, to determine the reliability of a scale. Internal consistency measures item homogeneity, or how well test items measure the same construct (Henson, 2001). The Cronbach Alpha coefficient was calculated to determine the reliability of the scale. The Cronbach's Alpha value of this 19-item TDiCoS was determined as .949. Alpha values were excellent when 0.93–0.94 (Taber, 2018). Therefore, it can be said that the TDiCoS, which consists of a single factor, is a reliable measurement tool.

Confirmatory Factor Analysis

Confirmatory Factor Analysis (CFA) offers a measurement based on the structural equation model (Fontaine, 2005). We performed confirmatory factor analysis to test whether the 19-item TDiCoS, which was determined as a single factor, was validated as a model. We used confirmatory factor analysis for the remaining 168 people using the Lisrel 8.80 program. To determine the model compatibility of the scale, we reached the standardized values in Figure 2.

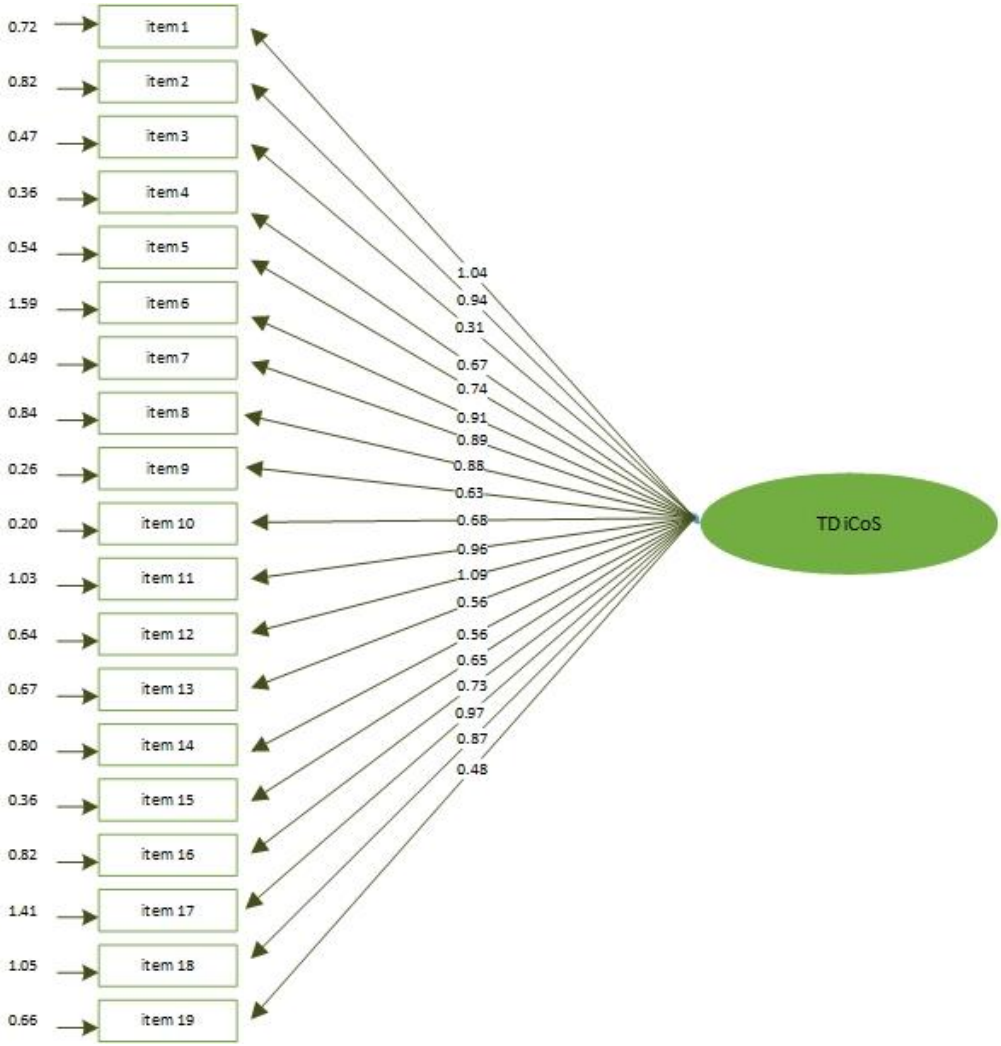

Figure 2. Path diagram

In the confirmatory factor analysis, a strong structure was obtained due to the single factor structure's variance explanation rate and the single factor's very high eigenvalue.

The standardized estimates of all items is shows that the value of the ratio of Chi square (χ^2) to degree of freedom (*df*) is 1.94, and at a significant level (p<0.000) and the root mean square error of approximation (RMSEA) value is .075. If the RMSEA values are less than .05, the model fit is good; a value of .08 shows that it is an acceptable limit (Schermelleh-Engel, Moosbrugger, & Muller, 2003). The RMSEA value found because of the analysis shows that the model fit is within the reference range of acceptable fit values.

The model's goodness of fit index (GFI) was found to be .74. The GFI value is not within the acceptable limit. Normed fit index (NFI) .95, non-normed fit index (NNFI) .97; comparative fit index (CFI) .98; incremental fit index (IFI) was found to be .98. These values show that the model fit is within the reference range of good fit values (Schermelleh-Engel, Moosbrugger, & Muller, 2003).

DISCUSSION

This study aims to develop a valid and reliable scale to determine teachers' digital competences. The exploratory factor analysis shows that TDiCoS consists of a single factor with 19 items. This unidimensional structure shows that the digital competence items on the scale are not significantly different from each other and that each one coexists and measures the same feature. The confirmatory factor analysis yielded that the fit indices obtained are at an acceptable level. The Cronbach Alpha reliability coefficient for TDiCoS is .949. These results show that in its final version TDiCoS is a scale that enables teachers to determine their digital competences. However, different factors have emerged in the scales that tried measuring teachers' digital competences in the literature. For example, TDiCoS has items that include the ability of teachers to collaborate using digital tools and use them with their students. In this regard, it has been determined that items prepared for similar characteristics on different scales constitute different factors. Although the factor names are different, they mean the same thing: "sharing and communicating" (Siddiq, et al., 2016), "social/cultural engagement" (Kim & Choi, 2018), and "professional engagement" (Toker, et al., 2021). The items measuring this feature on TDiCoS did unload a different factor. Similarly, there are competence items on the safe use of digital resources. It has been determined that these items are involved in different factors on various scales (Siddiq, et al., 2016; Toker et al., 2021; Yılmaz, Aktürk, & Çapuk, 2021). Additionally, there is an item on TDiCoS that includes teachers' digital material development competences. Similar items are also found in the Turkish adaptation scale of the DigCompEdu standards (Toker et al., 2021). These items are included in the factor called "professional engagement." The items in this factor relate to teachers' digital teaching skills and communication with colleagues and students.

Many types of measurement tools based on different theoretical frameworks can be found in the literature. This is partly because there is currently no agreed-upon method for measuring digital competence (Sillat et al., 2021). The multi-faced nature of this concept (Oberländer et al., 2020) can be shown as a reason for differentiating the frameworks created. Different countries' definitions and indicators of competences may diverge because of cultural differences in how this concept is perceived (He & Li, 2019; Ilomäki et al., 2016; Skantz-Åberg et al., 2022). For example, The DigComp 2.0 competence framework targets high-income and technologically-advanced European countries (Law, Woo, de la Torre, & Wong, 2018, p. 28). This framework's competence indicators are thus not transferable to a country with different demographics and socioeconomic conditions.

Furthermore, contrary to previous studies that suggested quite long (e.g., Alarcón et al., 2020; Gümüş & Kukul, 2022) instruments, the TDiCoS proposes a comprehensive model of unidimensional and 19 items, providing a practical and easy-to-use instrument for future research on teachers' digital competence. The person who will administer TDiCoS does not need any training. Instead, the scale will be administered individually. The original items in the TDiCoS were prepared in Turkish and included in the doctoral dissertation (Author, 2020) of the first author. It can be created in paper format or online via Google Forms. An English translation is presented in the appendix.

In its final form TDiCoS has content validity to identify teachers with digital technology competence. In this scale, respondents indicate how and how often they use digital technologies in instruction. Thus, those who administer the TDiCoS can determine the digital technology competences of the practitioners and teachers. TDiCoS assesses teachers' capacity to use digital technologies in the classroom environment. This situation will be beneficial for both practitioners and teachers. TDiCoS helps to highlight teachers' strengths and weaknesses across digital competences. Teachers can be aware of their digital literacy and can critically question and develop themselves (Roberts & Kruse, 2021). Using TDiCoS, practitioners can conduct needs assessments to design programs and create relevant materials for teacher education and professional development. Teachers are more likely to adopt a more constructivist technology pedagogy if they see examples of effective mastery, mentoring, and technology integration throughout their education and career (Rowston, Bower, & Woodcock, 2021). In this way, teacher education can be redesigned to equip educators with digital technology-related skills.

Limitations

One of the main limitations of this study is its sample size at the lower limit recommended for EFA and CFA. In this scale development process, the recommended number of respondents could not be reached due to time constraints and difficulty in accessing teachers. Therefore, further research on larger populations is recommended in the future. Another limitation of our study is that we investigated TDiCoS based on teachers' self-reports. These reports reflect teachers' perceptions of their digital competence. Therefore, it may not reflect the actual classroom environment. Qualitative data collection tools (such as observation, reflective journals, and video) can be used to learn more about teachers' practices in the classroom (Calvani, et al., 2008; Revuelta-Domínguez et al., 2022; Sillat et al., 2021). Most of the data were gathered using a web-based google form. This could mean teachers who are already engaged with digital technologies answer this scale. Although data were collected online and science teachers were not targeted specifically it has become the case that only science teachers participated. Also, the sample is mostly middle school science teachers, so the results cannot be generalized to teachers of other subjects. It is recommended that the validity and reliability measures of this scale be established with participation of teachers of other subjects.

Conclusion

This study established the internal and external validities of TDiCoS and its reliability. We report that teachers' digital competence is best represented by a single factor scale with congruent exploratory and confirmatory factor analysis. We consider TDiCoS as a construct that can identify teachers' use of ICT in future research on technology acceptance and integration. Here we show the suitability of the construct for teachers to self-evaluate their classroom practices and for teacher educators to examine the current situation.

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APPENDIX

Read each of the following statements and mark as X in the box next to the statement in the column that shows how often you do / do not do this statement in the learning-teaching environment or have no knowledge at all.	NA (Not Appropriate)	Never (1)	Rarely (2)	Sometimes (3)	Generally (4)	Always (5)
1. I choose digital technologies suitable for the subject.						
2. I use digital technologies to develop students' creative thinking skills.						
3. I inform students about the copyrights of digital materials.						
4. I create learning environments suitable for students' individual differences by using digital technologies.						
5. I learn to use new digital technologies that support students' learning.						
6. I join communities in social networks about innovative digital technology applications that support student learning.						
7. I enable students to evaluate their own learning processes using digital technologies (educational software, virtual classroom, etc.).						
8. I create learning materials with digital content for students.						
9. I design rich learning environments using digital technologies.						
10. I use different Digital technologies in a way to complement each other.						
11. I evaluate students' learning processes by using various digital technologies (e-portfolio, excel, etc.).						
12. I closely follow new digital technologies that support students' learning.						
13. While searching for a subject on the Internet, I evaluate the information I get from different sources according to the reliability of the source.						
14. I consider the relevant learning outcome when choosing digital technologies.						
15. I use digital technologies in a way that ensures active participation of students in the lesson.						
16. I consider students' individual differences when choosing digital technologies.						
17. I incorporate digital technologies into the lesson plan.						
18. I provide instant feedback to students during the lesson using various digital technologies (audio or video response, cloud applications, etc.).						
19. I use a digital technology to enhance student collaboration.						

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Research Paper

Examination of Variables Affecting the Perceptions of Academic Performance of Higher Education Students during the Distance Education Process

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ABSTRACT

Covid-19 has had serious consequences in all areas of social life, including education. In this period, distance education appeared as an inevitable solution. Even today, when the pandemic process is over and re-normalization has begun, online teaching environments have become such an indispensable part of education systems that it has been decided that a certain proportion of the courses will be conducted online in universities. For this reason, determining student experiences in online courses is important in planning the future of distance education. Since academic performance is the output of the teaching process, students' academic performance is one of the topics of interest in higher education research. There may be different factors affecting the academic performance of students in the distance education process, which imposes more responsibility on students and requires self-control. This study aimed to examine the relationship of academic performance in the distance education with home infrastructure, student interaction, computer skills, academic satisfaction. This research is based on a large-scale study, "The impact of the Covid-19 pandemic on the lives of higher education students", examining the pandemic's impact on higher education student perceptions in 2020. It has been observed that home infrastructure has a significant impact on the student's academic performance. The infrastructure increases the interaction of the student. When home infrastructure is taken as a control variable, students' computer skills are the highest predictor of their perception of academic performance, followed by their online interactions and, finally, perceived satisfaction. Today, pandemic conditions are still ongoing. In addition, even as the pandemic ends, online education has become an indispensable part of our education system. Therefore, the findings of the research would be beneficial for the ongoing planning process.

INTRODUCTION

Covid-19, which caused the global pandemic, has caused serious negative consequences in all areas of social life, including education. In the face of the pandemic process, which has not ended after two years, countries are trying to normalize within certain limits and ensure the maintenance of the production and service sectors. Education, which affects the future and the current conditions of the citizens of the country, is a priority area that is tried to be maintained both during the pandemic and normalization. In order to prevent the spread of the virus during the pandemic process, higher education continued with distance education after a mandatory break. During this period, this compulsory preference was the most effective way for students to attend the classes. Today, online teaching environments have become such an inevitable part of education systems during the normalization process that even when the pandemic is over, it has been decided that a certain proportion of the courses will be conducted online in universities.

According to the International Association of Universities (IAU), more than one and a half billion students worldwide have been affected by the suspension of higher education courses due to the pandemic (IAU, 2020). With the help of online technologies to ensure continuity of learning, there has been a large transition to distance education. Higher education institutions in Turkey switched to distance education three weeks after a one-week break. 121 (64%) of higher education institutions started their education by distance education on 23 March 2020; 41 (21.6%) of them on 30 March 2020 and 25 (13.2%) on 6 April 2020 (Turkish Higher Education Board, 2020).

Before the pandemic, distance education or online learning platforms were used as a pillar of blended learning. The distance education process, which uses applications based on online interaction such as Microsoft Teams, google classroom, zoom, and blackboard, requires systematic planning and preparation. Because distance education is more than uploading learning resources to the system and presenting them to students, it is a learning process that gives students more autonomy, responsibility, flexibility, and choice. For this reason, the pandemic and the compulsory transition process, and distance education cannot be considered in the same context. It seems more appropriate to call this system, in which universities have made a compulsory transition as emergency

distance education or critical distance education (Hodges, Moore, Lockee, Trust & Bond, 2020; Sümer & Yüner, 2021). In this study, what distance education means is compulsory distance education.

The transition to distance education due to the pandemic caught most institutions unprepared. Both the lack of infrastructure of higher education institutions and the inexperience and unpreparedness of the instructors made the process difficult (Osman, 2020). In addition, the process necessitated a significant change in terms of students as well. While students attend classes from their homes, their interactions with their social environment have decreased, and their learning responsibilities have increased to a higher level (Aytaç, 2021). All these changes will affect students' experiences in the teaching process, their perceptions of the process, and ultimately their academic performance.

Students' academic performance is one of the subjects of interest in studies on higher education because academic performance is the output of the teaching process. In this direction, many studies have been conducted to explore the factors affecting the academic performance of university students. Among these studies, Hanson (2000) reported that student performance is affected by different factors such as learning abilities, gender, and race. Furthermore, Mckenzie and Schweitzer (2001) found that pre-university academic performance is the most important predictor of university performance. On the other hand, Hijazi and Naqvi (2006) reported that the attitude towards attending classes, the time allocated to the lessons, the parent's income level, the mother's age, and the mother's educational status are the main factors affecting the performance. Although it serves a common purpose, face-to-face and distance education teaching environments are different. Therefore, in these processes, the behaviors expected from the students also change. There may be different factors affecting students' academic performance in the distance education process, which imposes more responsibilities on students and requires self-control. The arrangement of educational environments is effective on learning outcomes. This also applies to online learning. How the education process is carried out affects the success of distance learning (Puljak, Čivljak, Haramina, Malisˇa, Čavić, Klinec, et al., 2020).

Many factors affecting learning performance in the distance education process have been studied in the literature. These studies show that online interactions (Kuo, Walker, Schroder, & Belland, 2014; Sher, 2009) the ability to use the computer effectively (Cidral, Oliveira, Di Felice & Aparicio, 2018; Wu, Tennyson & Hsia, 2010), teaching staff support (Cidral et al., 2018; Chopra, Madan, Jaisingh & Bhaskar, 2019; Joo, Lim& Kim, 2011), providing feedback (Chen, Breslow & DeBoer, 2018), technical support (Al -Fraihat, Joy & Sinclair, 2020; Cidral et al., 2018; Zhang & Goel, 2011) affect learning performance in distance education.
Participation affects learning, and effective institutions focus on students' participation. (Akpur, 2021; Astin, 1984; Lim & Fraser, 2018) The primary actors in ensuring student participation are the instructors. Academic counseling increases students' engagement with school and their resilience in the face of difficulties (Shahzadi, Erum & Ahmad, Z, 2011). Interactions with instructors, mainly focusing on intellectual or career-related issues, increase student participation and motivation (Astin, 1984; Pascarella, 1980; 1985; Terenzini, Pascarella& Lorang, 1982; Tinto, 1987). Another influential factor on student performance is the student's perceptions. If the student is satisfied with the learning environment and process and feels academic satisfaction, it will positively affect performance. Research in the literature reveals that there is a strong relationship between students' satisfaction with distance learning environments and their perceptions of academic performance (Sun, Tsai, Finger, Chen& Yeh, 2008; Eom, Wen& Ashill, 2006; Marks, Sibley & Arbaugh, 2005).

One of the factors affecting students' satisfaction in distance education is their computer skills. Cidral et al. (2018) revealed that students' ability to use digital learning platforms affects their distance education process. Similarly, Wu, Tennyson and Hsia (2010) emphasized computer skills in effective distance learning. Another critical factor affecting the distance education process is whether or not students have the necessary infrastructure and equipment for the course. The required infrastructure may differ according to the development level of the countries. Students' satisfaction with the distance education process is higher in developed countries than in developing countries (Abbasi, Ahmed, Sajjad, Alshahrani, Saeed& Sarfaraz et al., 2020). The main difference is the opportunities that can be had according to the level of development. In countries with shortages of financial resource, limited internet access, slow internet speed, high internet fees, and impaired functioning of digital platforms pose problems (Dutta & Smita, 2020). This leads to a decrease in student participation and performance. Similarly, Aung and Khaing (2018) revealed that compared the developing countries and developed countries, and active participation is low in developing countries due to the inadequacy of technological infrastructure and the inadequacy of information technology literacy of teachers and students.

Based on the results of the studies in the literature, in this study, it is assumed that the home infrastructure, student interaction, computer skills, and academic satisfaction will impact the perception of academic performance in the distance education process. Determining student experiences in online courses is important in planning the future. In this context, the current study aimed to examine the academic performance perceptions of higher education students in the distance education process. Answers to the following research questions were sought:

According to student opinions on the distance education process,

1. What is the level of students' home infrastructure, online interactions, informatics skills, academic satisfaction, and academic performance?
2. Is there a significant relationship between students' academic performance and their home infrastructure, online interactions, informatics skills, academic satisfaction?
3. Do home infrastructure, online interactions, informatics skills, and academic satisfaction significantly predict students' academic performance?

METHOD

The research is a correlational study designed in the descriptive model. The research aims to examine the changes affecting the perceptions of academic performance of higher education students. The dependent variable of this study is the perceptions of academic performance of higher education students in the distance education process. The independent variables of the research are home infrastructure, online interaction, computer skills, and perceptions of satisfaction.

Workgroup

This research is based on a large-scale study examining the pandemic's impact on higher education student perceptions in 2020. This research, "The impact of the Covid-19 pandemic on the lives of higher education students", has been applied worldwide. The research was prepared for all higher education students over 18. However, since it is aimed at students who can be reached through social media aged 18 and over around the world, the simple random sampling method has been preferred. The study was responded to by 10092 high school students from 130 countries. In the current study, 1049 Turkish students who participated in the study were included in the study group, and the data on the participants were presented in Table 1.

Table 1. Participant data

Variable		N	%
Level of education	License	902	86
	Master	110	11
	Doctor	31	3
Field	Arts and humanities	29	20
	Social sciences	699	68
	Applied sciences	95	9.3
	Nature and life sciences	23	2.2
Gender	Male	298	28
	Female	743	71
	Preferred not to say	6	.06
Total		1049	100

Data collection tools

As a data collection tool, the online scale applied within the scope of the research titled "The impact of the Covid-19 pandemic on the lives of higher education students" was used. The scales were developed using the European Students' Union. The scale, which contains 39 items, was initially prepared in English. Later, it was adapted into Italian, Northern Macedonian, Portuguese, Roman, Spanish, and Turkish. Linguists carried out the adaptation process in the relevant languages who have a high level of proficiency in English. The data set of the study was first analyzed by Aristovnik, Kerži˘c, Ravšelj, Tomaževi˘c & Umek (2020). Within the scope of the current research, home infrastructure, online interaction, computer skills, satisfaction perceptions, and academic performance perception scales were used. Scales are five-point Likert where 5 represents the highest and 1 represents the lowest.

Home infrastructure

It contains provisions for the equipment students need to be involved in the distance education process. In addition, it contains items related to access to the computer, the necessary software, programs. Scale reliability is reported as .89 by calculating Omega (Aristovnik, et a., 2020). In this research, reliability analyses of the scales were calculated as .84 Cronbach alpha.

Online interaction

The scale consists of 3 items regarding the interaction of students with friends, faculty, and administrators. The scale's reliability is .72.3 Omega (Aristovnik, et a., 2020). As part of the current research, reliability analyses of the scales were replicated and calculated as .66 Cronbach alpha. According to Kılıç (2019), .60 to .70 is acceptable. The low number of scale items can cause this condition.

Computer skills

The scale consists of 5 items related to the student's access to online information and their use of online communication platforms. The reliability of the scale was reported as .913 Omega (Aristovnik, et a., 2020). As part of the current research, reliability analyses of the scales were replicated and calculated as .91 Cronbach alpha.

Perceived student satisfaction

It includes the perceptions of students in the distance education process. It expresses satisfaction with online courses, faculty members, consultancy services provided. Scale reliability was reported as .852 Omega (Aristovnik, et a., 2020). As part of the current research, reliability analyses of the scales were replicated and calculated .80 Cronbach alpha.

Perceived student performance

The scale consists of 4 items, including sentences like *I have improved my performance and adapted to new learning teaching techniques.* The reliability of the scale is .845 Omega (Aristovnik, et a., 2020). In this research, it was calculated.81 Cronbach alpha.

All participants read an informative confirmation page about the purpose and details of the research prior to the research. Before the scale is implemented, it passes to the scale items by approving the information page. This study is in line with the Helsinki Declaration for human participants. Ethical permissions have been obtained from various higher education institutions for the research (Yozgat Bozok University, no:31/21).

Data analysis

This research was carried out in 2020 with Turkish higher education students who participated in the research titled "The impact of the Covid-19 pandemic on the lives of higher education students" implemented worldwide. It is aimed to examine the variables affecting the perceptions of academic performance of higher education students. The predictive effects of home infrastructure, online interaction, computer skills, and academic satisfaction perception variables on higher education students' academic performance perceptions in the distance education process were examined. Before the analysis, missing data and extreme values were determined. Mahalanobis distances were compared with the critical chi-square value ($p<.001$). 12 scales were excluded, and the analysis was conducted with 1037 scales. Skewness and kurtosis values were examined to control the normal distribution of the data. It was determined that the skewness and kurtosis values of the variables were within the acceptance limits (Tabachnick & Fidell, 2013).

To investigate the multicollinearity problem VIF and tolerance values were examined. In the current research, the VIF value of home infrastructure, online interaction, computer skills, satisfaction perception and academic performance perception variables (1.338; 1.052; 1.421; 1.080; 1.206 respectively) and tolerance values (.747; .950; .704; .926; .829 respectively) were found to be in the acceptance range. It was also found that the intervariate correlations were positive but valued below.80 and did not show multicollinarity spelling problems (Table 3).

During the analysis phase, the data were examined using descriptive statistics. In addition, hierarchical multiple regression analysis was used for intervariate relationships, Pearson correlation analysis, and determining predictors of academic performance perceptions. In the first step, the predictive value of home infrastructure on the perception of academic performance was examined. In the second step, home infrastructure was kept as a control variable. Finally, the predictive value of computing skills, online interaction, and satisfaction perception on the perception of academic performance were examined. A packaged program (SPSS) was used in the analysis of the data.

RESULTS

This section presents findings on the relationships between home infrastructure, online interaction, computer skills, and perceptions of satisfaction and academic performance according to higher education student opinions during the distance education process. In Table 2, descriptive analysis results of higher education student opinions are presented.

Table 2. *Descriptive analysis results of higher education student views*

	N	Average	Sd	Skewness	Curtosis
1. Home infrastructure	1037	3,75	1,20	-.628	-.794
2. Computer skills	1037	3,76	.87	.506	-.062
3. Perceived satisfaction	1037	2,98	.41	-.736	.595
4. Online interaction	1037	2,24	.92	-.133	-.216
5.Perception of academic performance	1037	2.83	.93	.025	-.525

As can be viewed from Table 2, home infrastructure, in other words, having the necessary equipment for distance education in the distance education process ($\tilde{x}$ =3.75) and computer skills ($\tilde{x}$ =3.76) had a higher average than other variables. On the other hand, the lowest average was determined on the scale of online interaction ($\tilde{x}$ =2.24). In Table 3, correlation analysis results of variables are presented.

Table 3. Correlation analysis results of variables

Factors	1	2	3	4	5
1. Home infrastructure	1				
2. Computer skills	.492**	1			
3. Perceived satisfaction	.173**	.180**	1		
4. Online interaction	.075*	.116**	.086**	1	
5. Perception of academic performance	.228**	.331**	.232**	.216**	1

*p<.05; **p<.01

As can be viewed from Table 3, home infrastructure had a positive, *moderate* and significant relationship with computer skills (r=.492; p<. 01). This finding reveals that students who have computer access at home define themselves “better” in computer skills. It was found that computer skills had positive *moderate* significant relation with the perceived academic performance,

(r=.331; p<. 01), which underlines the relationship between students' perception of being academically successful and having computer skills in the distance education process. As seen in Table 3, there are significant low-level positive relations between other variables. Table 4 presents hierarchical multiple regression analysis results

Table 4. Hierarchical multiple regression analysis results

Variables	**R**	**R^2**	**ΔR^2**	**B**	**Standard Error**	β	**t**
Step 1							
Home infrastructure	.228	.052	.052	.117	.023	.228	7.542*
Step 2							
Computer skills	.414	.171	.119	.269	.035	.250	7.611*
Perceived satisfaction				.360	.065	.161	5.563*
Online interaction				.170	.029	.168	5.865*

R=. 414; $R2$=.171; F= 53,261; p=.000
Dependent variable: academic performance perception

When the data in table 4 are examined, it is seen that the home infrastructure variable in the first step is a significant predictor of academic performance perception (R=.228, R^2=.05, ΔR^2=.05). In the second step of the analysis, when home infrastructure is kept under control, it was determined that computer skills, perceived satisfaction, and online interaction variables were significantly predictive on the perception of academic performance (R=.414, R^2=.17, ΔR^2=.119). According to standardized regression coefficients *(β),* the importance order of variables in explaining the academic performance perception is listed as computer skills (β=.250), online interaction (β=.168), and perceived satisfaction (β=.161). The fact that the variables in the second step of the analysis the explained variance increased (ΔR^2=.119) revealed that the variables of computer skills, online interaction, and satisfaction perception contribute to academic performance. As a result, home infrastructure, computer skills, online interactions, and students' academic satisfaction in the distance education process explain 17% of academic performance perceptions.

DISCUSSION, RESULTS AND RECOMMENDATIONS

Within the scope of this study, which aims to examine the relationship between the perceptions of academic performance of higher education students and their home infrastructure, computer skills, online interactions, and perceptions of academic satisfaction, firstly the levels of variables according to student opinions were examined. It was determined that home infrastructure and computer skills variables had the highest average among the variables. In parallel with the developing technology since the 1990s, young people have become the most intensive users of various communication and information technologies (Sağır & Eraslan, 2019). In addition, in the 21st century, smartphones have become a symbol for young people to reflect "identity and style/style" (Ling, 2004). According to the results of the Turkish Statistical Institute's (TUIK) Household Information Technology Usage Survey, 92.0% of households will have access to the internet from home in 2021; It was revealed that 80.5% of all individuals aged 16-74 used the internet regularly (almost every day or at least once a week) during the period covering the first three months of 2021 (TUIK, 2021). Today, the age of having a phone has decreased to the level of primary education. Therefore, in today's technology age, it is understandable that home infrastructure is high. In addition, the higher average of computer skills may be explained by the adaptation of children and young adults to the developing technology.

Satisfaction perception, perception of academic performance, and online interaction are averaged below mid-level ($\tilde{x}$ =3). Among the variables, the lowest average is in the online interaction variable. Education is a process based on mutual interaction. However, due to the pandemic, interaction was limited to online platforms. Being away from traditional face-to-face interaction opportunities and being limited to certain communication technologies have made the teaching-learning process difficult. It was more difficult especially in areas that require application. Even before pandemic conditions, the report by Industry Expansion Solutions (2015) revealed that in distance education, academic and social relations decreases. It is difficult to develop relationships with classmates, there is limited personalized attention from instructor and there is no campus atmosphere to create social interaction. Similarly, Nambiar (2020) found that instructor-student interaction decreased during the distance education process.

Within the scope of the second question of the study, the relationships between variables were examined. It was observed that there was a significant positive relationship between all variables and academic performance perception. The highest relationship was determined between computer skills and academic performance perception. This finding suggests that students who have acquired the skills to access information and know-how to research, perceive themselves as more successful. The distance education process requires students to have high self-regulation and self-control skills. They need to take more responsibility in their learning process. They have to be aware of their individual knowledge needs and skills and improve themselves constantly. In other words, they need to be conscious information consumers as Eryılmaz (2018) defines them. In this direction, students' competence and skills in every respect, especially in computers, allow students to participate in courses actively and do the assignments better. The research of Wu et al. (2010), which noted ineffective computer skills as an essential factor that hinders the effective distance education process, supports that. Similarly, Ezziane (2007) states computer literacy is one of the most important skills for individuals to possess in today's competitive environment. It can be stated that students with knowledge and experience in digital media are more easily adapted to distance learning.

The other variable positively related to students' perception of academic performance is home infrastructure. In the distance education process, students who have equipment such as computers, necessary software, cameras, and microphones have a higher perception of academic performance. Having the necessary equipment is a prerequisite for using computer skills at home. Therefore, it can be stated that the relationship between academic performance perception and home infrastructure is parallel to the relationship between academic performance and computer skills. Dinçer (2011) stated that the use of technological tools in the distance education process has become such a prerequisite for access to information that development is possible with computer literacy.

Within the framework of the current research, it has been determined that students' online interaction positively affects their perception of academic performance. Therefore, faculty members play an active role in executing educational processes. Within the scope of distance education, when an interaction is reduced, faculty members must guide students and provide timely feedback besides instruction of course contents. Because one of the main problems raised about the distance education process is the decrease in interaction (Nambiar, 2020), therefore, increasing interaction can also be effective in increasing the perception of academic performance.

Another variable positively related to the perception of academic performance is academic satisfaction. Students with higher satisfaction with the learning process expressed a more favorable opinion of their academic performance. In other words, students who feel academically satisfied in the distance education process perform better. The relationship between academic satisfaction and performance in literature is noted in the face-to-face education process (Dhaqane & Afraf, 2021) and the distance education process (Kerzˇič, Alex, Pamela Balbontı's Alvarado, Bezerra Dd, Cheraghi, Dobrowolska, et al, 2021).

The positive relationship between all variables reveals that all variables in the education system are interconnected. Therefore, to achieve the desired outputs, all variables must be processed effectively at the same time. As a result, students' having the necessary equipment increases their computer skills, and the students with good computer skills also achieve higher satisfaction with the process and perform better academically with a higher level of interaction.

Finally, the study's findings on the prediction of academic performance perceptions of higher education students were obtained. It has been observed that home infrastructure has a significant impact on the student's academic performance. During distance education, technological equipment and connection have become the only means of connecting students with the educational environment and teachers. It has been not possible for the students who do not have the necessary materials and connection opportunities to be involved in the education process. Therefore, it may be concluded that the infrastructure increases the interaction of the student, which increase their performance. This finding is consistent with other research results associated with the distance learning process (Wu et al., 2010).

Thanks to smartphones, nearly all higher education students have the necessary material to participate in the course. In addition, in Turkey, students who do not have the opportunity to access have been designated by the university rectorates, and necessary initiatives have been made to make use of the facilities in the public institutions in the city where the students live. Considering these conditions, home infrastructure is taken as a control variable and the effects of computer skills, perceived academic satisfaction, and online interaction on academic performance are examined. As a result of this review, students' computer skills are the highest predictor of their perception of academic performance, followed by their online interactions and, finally, perceived satisfaction. In the 21st century, information technology literacy has become a key competence in recognizing the information needed and making the necessary research for it. Students are no longer expected to memorize information, but to access information through information technologies, to analyze and use the information they need. In this direction, the importance of computer skills in the education process has increased. Especially in the distance education process, computer skills have an indispensable role.

This study is limited to Turkish Higher Education students who participated in the research titled "The impact of the Covid-19 pandemic on the lives of higher education students". This result may not reflect the overall view of higher education students in Turkey. Reconducting the study in certain regions of Turkey and handling it on the basis of different universities may produce significant results. Also, investigation of the relationships with different variables will contribute to the field. Today, pandemic conditions are still ongoing. In addition, even as the pandemic ends, online education has become an indispensable part of our education system. The study revealed that s students' computer skills increase, their sociability on the internet and their communication with their teachers increase. This significant relation consequently influences their satisfaction and academic performance. Considering these situations, it is useful to evaluate the results of the current study, carrying out studies for students to gain computer skills should be a priority in educational planning.

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