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HEALTH EDUCATION: TOWARDS THE AGE OF THE METAVERSE, HEALTH LITERACY GAME

SAĞLIK EĞİTİMİ: METAVERSE ÇAĞINA DOĞRU, SAĞLIK OKURYAZARLIĞI OYUNU

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ABSTRACT

Objective: The World Health Organization recommends people engage in settings where they can actively engage and take advantage of novel ideas and approaches in education to enhance their health literacy. Gamified systems are one of them. Also, The Metaverse concept has become widely popular, particularly amid the pandemic, as individuals resorted to virtual platforms for tasks such as work, education, shopping, and other pursuits. The opportunities presented by Metaverse are thrilling for both education and gamification, and they similarly apply to the improvement of health literacy. In this context, the present study was conducted to examine the effects of individuals with different demographic characteristics receiving education on health literacy in a game.

Material and Method: This study is a pre-test, post-test quasi-experimental study. Individuals over the age of 18 were included in the study with the convenience sampling method (n=199). A pre-test was given via Google Forms, and post-test data was obtained from a game.

Results: A statistically significant difference was detected between participants' post-test and pre-test scores ($p<0.001$). The findings revealed that the participant's level of education and age caused differences in the post-test scores ($p<0.001$). Finally, a statistically significant correlation was detected between body mass index (BMI) and post-test scores ($p<0.001$).

Conclusion: This study demonstrates that a game-based approach improves health literacy. The impact of the game varies across age groups and educational levels, indicating a need for customized strategies. A negative correlation between post-test scores and BMI suggests a potential link between health literacy and health outcomes.

Keywords: Gamification, health literacy, metaverse, health education

ÖZ

Amaç: Dünya Sağlık Örgütü, insanların sağlık okuryazarlıklarını artırmak için yeni fikirlerden ve yaklaşımlardan faydalanabilecekleri kapsayıcı eğitim ortamlarında aktif olarak yer almalarını önermektedir. Bu yaklaşımlara örnek olarak, oyunlaştırılmış sistemler gösterilebilir. Öte yandan, özellikle pandemi döneminde insanlar iş, eğitim, alışveriş ve diğer uğraşlar için sanal platformlara başvurduğundan, Metaverse kavramı geniş çapta popüler hale gelmiştir. Metaverse tarafından sunulan fırsatlar, eğitim ve oyunlaştırma için heyecan verici olmanın yanı sıra, sağlık okuryazarlığının geliştirilmesinde de benzer şekilde geçerlidir. Bu bağlamda, ilgili çalışma farklı demografik özelliklerdeki bireylerin sağlık okuryazarlığı konusunda eğitim aldıkları oyundaki etkilerini belirlemek için yapılmıştır.

Gereç ve Yöntem: Çalışma ön-test, son-test yarı deneysel bir çalışmadır. Çalışmaya 18 yaş üstü bireyler uygun örnekleme yöntemi ile dahil edilmiştir (n=199). Ön-test Google form aracılığıyla verilip son-test oyun içerisinde verilmiştir.

Bulgular: Araştırma katılımcılarının sağlık okuryazarlığı oyunu sonrasında post-test skorlarında ön-test skorlarına oranla istatistiksel olarak fark tespit edildi ($p<0,001$). Katılımcıların eğitim seviyelerinin ve yaşlarının son-test sonucu elde ettikleri skorlarda farklılıklara sebep olduğu bulundu ($p<0,001$). Son olarak da vücut kitle indeksi ile son-test skorları arasında istatiksel olarak anlamlı bir korelayson tespit edildi ($p<0,001$).

Sonuç: Bu çalışma, oyun temelli bir yaklaşımın sağlık okuryazarlığını geliştirmedeki etkinliğini göstermektedir, önemli ölçüde post-test gelişmeleri belirlenmiştir. Oyunun etkisi, yaş grupları ve eğitim seviyeleri arasında değişiklik gösterir, bu da özelleştirilmiş stratejilere ihtiyaç olduğunu gösterir. Post-test puanları ile BMI arasındaki negatif korelasyon, sağlık okuryazarlığı ile sağlık sonuçları arasında potansiyel bir bağlantıyı önermektedir.

Anahtar Kelimeler: Oyunlaştırma, sağlık okuryazarlığı, metaverse, sağlık eğitimi

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INTRODUCTION

Health education can improve communication between healthcare providers and recipients, promote correct resource utilization, and reduce health disparities, while also enhancing personal development, self-confidence, and social skills. Health literacy pertains to an individual's ability to understand grasp, utilize, and apply health-related information to make informed and suitable choices regarding their well-being. It encompasses having the necessary knowledge, competence, and social skills to navigate the healthcare decision-making process and make appropriate selections.

The World Health Organization (WHO) has defined health literacy as the cognitive and social skills that determine an individual's ability to access, understand, and use information in a way that contributes to maintaining good health. To increase the levels of health literacy in society, organizations, social associations, and individuals, the WHO has recommended specific actions, especially in the field of education (1). These encompass actions such as delivering crucial health information in early childhood, implementing rules in schools to foster positive behavior and attitudes toward health, engaging adult learners in health literacy education by igniting motivation and interest, utilizing multimedia resources that can captivate a broad audience, facilitating interactions and knowledge-sharing among individuals, and incorporating innovative approaches and techniques in health education. Adopting innovative and efficient learning tools, such as gamified systems, can also be beneficial for health literacy education and awareness.

Gamification is a method that employs digital game design strategies to enhance the effectiveness of the learning experience. It incorporates elements such as rewarding systems and competitive features commonly found in games. While there are various definitions of gamification, the concise definition proposed by Deterding and his team is widely acknowledged in academic literature. They define gamification as the integration of game elements into non-game contexts (2).

According to Sardi, Idri, and Fernández-Alemán gamified systems utilize core game elements like feedback, progression, social interaction, and incentives (3). These key features are further explained by Palmer, Lunceford, and Patton (4). Progress is based on completing achievements and missions with clear rules and visible stages, leading to an increase in gains and motivation for both expert and novice players. Reward and feedback are important indicators of success and failure that must be given promptly to motivate players. In contrast, socialization entails engaging with fellow users, which not only enhances communication but also boosts game competition and support, leading to a more fulfilling and enthusiastic gaming experience for players. Finally, the interface and user experience must be aesthetic, useful, and fun, and advancements in technology allow for the development of high-quality games through the internet, sensors, mobile devices, virtual reality, and augmented reality.

In the second half of 2010, gamification began to be used in various fields, particularly in industry and education. On the other hand, its adoption in the health sector has increased since 2014. Several scientific studies have been conducted on gamification in health, mainly in Canada, England, Finland, the Netherlands, Portugal, and the United States with very few studies in other countries (3).

Gamification is a technique that can enhance learners' motivation and focus during e-learning activities. By employing strategies that boost motivation, gamification can create valuable learning experiences that contribute to improved health literacy. A study conducted by Alahäivälä and Oinas-Kukkonen demonstrated the positive impact of "gamification in health behavior change support systems" (hBCSSs) for individuals with diverse health conditions (5). However, our research indicates a lack of serious games or gamified systems specifically designed for health literacy.

The literature contains many systematic reviews demonstrating that serious games and gamification elements can effectively induce changes in certain health behaviors by providing motivation, entertainment, and focus (6, 7). Johnson and his colleagues outlined seven potential advantages that can be derived from implementing gamification in the field of health, including the support of internal motivation, adaptation to mobile technologies and sensor-based data collection, the potential for widespread use, adaptability to various health domains, the ability to develop gamified systems, integration with existing activities, and the provision of positive experiences for users (8).

Davaris and colleagues conducted a literature review and came to similar conclusions (9). They found that digital health resources and gamification can enhance health literacy and support patients in preparing for surgery, as well as promote positive shifts in their perspectives regarding health issues. They suggest that gamified health care, which is a novel approach, has the potential to be a vital addition to patient-centered care.

The pandemic has accelerated the adoption of Metaverse platform applications, reigniting interest in gamification for online education. Furthermore, health literacy and gamification can facilitate the integration of personalized medicine and telemedicine applications supported by wearable technology. These advancements represent a significant shift in the current healthcare landscape, as highlighted by Bozbuğa (10). The concept of the "Metaverse" was initially coined by Neal Stephenson in his science fiction novel Snow Crash in 1992. In the book, Stephenson defines the Metaverse as a large virtual environment (11). Today, the term Metaverse generally refers to an online virtual world that enables users to connect and establish social and business relationships with a sense of immersion in a feeling of naturalness, both in online and offline contexts (12). The concept of the Metaverse has experienced a significant surge in popularity, particularly amid the pandemic, as individuals increasingly relied on online platforms for work, education, shopping, and various other activities (13). The Metaverse concept

is based on the idea of blending virtual and physical worlds to create unique interactions and experiences.

Schoenfeld claimed that using augmented reality in education can enhance students' analytical skills and performance (14). Furthermore, new models of Metaverse-powered distance education, such as 3D virtual campuses, can offer hybrid formal and informal educational opportunities (15). Some Metaverse-based virtual education sites have utilized gamification to teach about future social issues like climate change, low fertility, and aging, and even allowed officials to design a virtual smart city to address these issues (16).

Butt and colleagues argue that virtual reality, especially when combined with haptic technology and game-based learning, can revolutionize learning and retention (17). Considering the demand for more authentic distance learning settings in the aftermath of COVID-19, Metaverse platforms incorporating VR and AR technologies seem to be well-suited. While the Metaverse phenomenon may present potential problems, it is expected to become more prevalent, particularly in areas like education and health.

Metaverse can be used for laboratory applications, procedural skills development, and STEM education, and gamification can offer significant benefits by providing an immersive and engaging environment (18, 19). Metaverse is more flexible than traditional games and can provide global systems without user limits (20). The integration of gamification within the Metaverse has the potential to establish broader and enduring virtual environments that attract a larger user base, primarily focusing on fostering social interactions (21).

Metaverse has exciting opportunities in education and gamification, and the same applies to health literacy, which is the focus of this study. The Metaverse platform can offer users a more realistic and tangible experience, leading to possible gains in health literacy. The goal is to bring people a better life through the conveniences and opportunities offered by Metaverse environments while considering possible drawbacks.

Given all these, this study examines the gains of players with different demographic characteristics from a game designed for health literacy education. Additionally, it would be beneficial to look at the book chapter by the authors of the relevant study for a more comprehensive literature review (22).

MATERIAL and METHOD

Design and participants

A pre-test and post-test, quasi-experimental study was employed, as described by Creswell (23). The study examined the impact of the health literacy game on health literacy learning, with participants' age range, body mass index (BMI), and education level serving as independent variables. Convenience sampling was used due to the difficulty of obtaining random participants. Participants volunteered and had not previously played the health literacy game. A total of 225 participants were included in the data collection. 26 participants were excluded from the study for not having post-test scores.

Educational game

There were three different types of game versions prepared by using Unity. The only difference between the versions is that each one targets a specific age group: 18-25 for university, 25-65 for the workplace, and over 65 for home situations related to health literacy and media use. However, all versions have common situations, which aim to achieve the same learning objectives about health literacy. The learning material was reviewed for validity by Prof. Dr. Nilgün Bozbuğa. The game's instruction language is Turkish.

The intended learning outcomes for participants in the game are as follows: They can find information about the symptoms of commonly encountered diseases, know what to do in a medical emergency, understand at a basic level what the doctor says about the disease and its treatment, comprehend information given in the media about being healthier, find information about the treatment of mental health issues, and understand the importance of participating in physical activities, and so on.

Each version of the game is divided into six segments, modeling 3D environments of places people commonly encounter in their daily lives, such as homes, workplaces, schools, restaurants, markets, and hospitals. The game's scenario was designed to attract participants' attention to the learning materials by considering their age and background knowledge.

In the game, the player navigates these environments through the eyes of an avatar and encounters situations related to health literacy, prompting them to make choices based on these situations. Positive points are given for each correct decision and negative points for incorrect choices. Players also receive appropriate feedback for their decisions. The game records the players' total points on a health literacy certificate, along with the time spent playing the game, which is displayed in real-time. Another feature is that the game tracks the player's decisions during gameplay and presents them as a test at the end of the game for any incorrect decisions made, making the game personalized to each player.

Data collection and instruments

Before gathering and processing the data, ethical clearance was secured from the İstanbul University's Ethics Committee for Social and Human Sciences Research (Date: 24.04.2023, No: 1735456). 225 people participated in the study. Data from 199 people were taken into account. The research was carried out in two separate sessions; google Forms and Game. The research employed two data collection tools: (1) a pre-test administered through Google Form to assess participants' initial health literacy knowledge and (2) a post-test (corresponding to the pre-test) that evaluated students' understanding of health literacy through a game. Both tests featured 25 multiple-choice questions, with options ranging from two to four alternatives.

Statistical analyses

To address the research inquiries, a variety of statistical tests were performed. The data underwent a verification process to ensure that each participant had complete data for all four measurements, including age level, BMI, education level, pre-test score, and post-test score. Participants who were missing any of these data points were excluded from the study, resulting in the removal of twenty-six participants. IBM SPSS statistical software (Version 27) was utilized for all statistical analyses.

Initially, the data were checked for normality. The Kolmogorov-Smirnov test was employed to evaluate the normality of the quantitative data. The study utilized the Wilcoxon signed-rank test to analyze and compare the average scores of the participants' pre-test and post-test results. To compare data from three groups, the Kruskal-Wallis H test was employed for non-normally distributed variables. Spearman's correlation analysis was utilized to determine the level of correlation between quantitative variables, between non-normally distributed variables. A significance level of $p<0.05$ was accepted.

RESULTS

Differences between pre-test and post-test

Table 1 presents the demographic information of the participants included in the study. To examine whether the pre-test and post-test scores of the participants followed a normal distribution, the Kolmogorov-Smirnov test was employed. The results indicated that the data for both the pre-test and post-test scores in the current study ($p>0.05$) deviated from a normal distribution, as shown in Table 2.

Table 1: Demographic data of participants

	N (%)
Age	
18-25	59 (29.65)
25-65	60 (30.15)
65-65+	80 (40.20)
Education	
Primary Education	58 (29.14)
High School	77 (38.70)
University/Undergraduate	64 (32.16)
Body Mass Index	
Underweight (below 18.5)	2 (1.01)
Normal weight (18.5-24.9)	83 (41.70)
Pre-obesity (25.0-29.9)	65 (32.67)
Obesity class I (30.0-34.9)	34 (17.08)
Obesity class II (35.0-39.9)	12 (6.04)
Obesity class III (above 40.0)	3 (1.50)

N: Number

Table 2: Tests of normality (pre-test, post-test)

	Statistic	df	Sig.
Pre-test	.091	199	<.0001
Post-test	.155	199	<.0001

df: Degree of freedom, Sig.: Significance

The Wilcoxon signed-rank test was conducted to compare the means of the pre-test and post-test scores among the participants. The results of this test revealed that there was a statistically significant difference observed in the scores of participants between the pre-test and post-test phases who engaged in the health literacy game ($Z=-12.212$, $p<0.001$). Descriptive statistics of the pre-test and post-test scores of the participants are presented in Table 3.

Table 3: Descriptive statistics of pre-test and post-test

	N	Mean	SD	Minimum	Maximum
Pre-test	199	15.88	4.175	8	25
Post-test	199	22.30	2.249	18	25

N: Number, SD: Standard deviation

Post-test scores of groups formed according to educational levels.

To examine the normal distribution of the post-test scores among the groups, the Kolmogorov-Smirnov test was conducted. However, the results indicated that the post-test scores for all educational groups ($p>.05$) did not follow a normal distribution, as presented in Table 4 based on the analysis.

The Kruskal-Wallis H test was utilized to compare the average post-test scores among the different groups. The results of this test indicated a statistically significant difference among the post-test scores of the groups, $\chi2\ (2)=84.989$, $p<0.001$. The mean rank post-test score was 49.78 for the primary education group, 100.49 for the high school education group, and 144.93 for the university education group, as presented in Table 4.

Table 4: Tests of normality and ranks of post-test (group by educational level)

Education level	Statistic	df	Sig.	N	Mean Rank
Primary education	.191	58	<.0001	58	49.78
High school	.190	77	<.0001	77	100.49
University	.289	64	<.0001	64	144.93

df: Degree of freedom, Sig.: Significance, N: Number

Post-test scores of groups formed according to age levels.

To assess the normal distribution of the post-test scores among the groups, the Kolmogorov-Smirnov test was conducted. However, the results indicated that the data of post-test scores for all age groups ($p>.05$) did not demonstrate a normal distribution, as presented in Table 5 based on the analysis.

The Kruskal-Wallis H test was utilized to compare the average post-test scores among the different groups. The results of this test indicated a statistically significant difference among the post-test scores of the groups, $\chi2\ (2)=40.702$, $p<0.001$. The mean rank post-test score was 115.79 for the 18-25 age group, 125.87 for

the 25-65 age group, and 68.98 for the 65-65+ age group, as presented in Table 5.

Table 5: Tests of normality ranks of post-test (group by age level)

Age	Statistic	df	Sig.	N	Mean Rank
18-25	.204	59	<.0001	59	115.79
25-65	.213	60	<.0001	60	125.87
65-65+	.146	80	<.0001	80	68.96

df: Degree of freedom, Sig.: Significance, N: Number

Correlation between BMI and post-test scores

To examine whether the BMI scores and post-test scores of the participants followed a normal distribution, the Kolmogorov-Smirnov test was employed. The results indicated that the data for both the BMI scores and post-test scores in the current study ($p>0.05$) deviated from a normal distribution, as shown in Table 6.

Table 6: Tests of normality (post-test and BMI)

	Statistic	df	Sig.
Post-test	.155	199	<.0001
BMI	.074	199	.011

BMI: Body Mass Index, df: Degree of freedom, Sig.: Significance

The Spearman's rank-order correlation test was run to determine the relationship between participants' BMI scores and their post-test scores. There was a strong, negative correlation between participants' BMI scores and their post-test scores, which was statistically significant ($r_s(197)=-.306$, $p<0.001$), as presented in Table 7.

Table 7: Correlations between BMI and post-test

		Post-test	BMI
Post-test	Correlation Coefficient	1.000	-.306[a]
	Sig. (2-tailed)	.	<.001
	N	199	199
BMI	Correlation Coefficient	-.306[a]	1.000
	Sig. (2-tailed)	<.001	.
	N	199	199

BMI: Body Mass Index, Sig.: Significance, N: Number, [a]: Spearman's Rank-Order Correlation

DISCUSSION

In the study, we tested users before and after playing the game developed to enhance health literacy. Using a predefined treatment protocol, we evaluated users' levels of health literacy. We found a statistically significant difference between users' pre-test scores and post-test scores ($p<0.05$). These results indicate the potential of game-based approaches in improving health literacy. This finding is parallel with Alahäivälä and Oinas-Kukkonen's assertion that gamification positively contributes to making correct decisions about health (5). These findings may stem from some potential benefits of gamification as suggested by Johnson and colleagues (8). Firstly, the game provides users with interactive experiences while presenting health-related information. This interactive experience captures users' attention and encourages the learning process. Additionally, the competitive and enjoyable nature of the game may motivate users to spend more time and learn the information within the game more effectively. This research encompasses a study conducted to evaluate the influence of a game developed on health literacy. Davaris and colleagues also suggested in their 2021 literature review study that gamification would increase the level of health literacy (9). These results are supportive of their claims. It can also be seen as one of the potential actions to increase the level of health literacy in the community, an issue that Kickbusch and colleagues have emphasized (1).

In the study, we aimed to evaluate the effects of a game developed for health literacy by examining differences among young, middle-aged, and elderly individuals. When analyzing pre-test and post-test scores, we observed a significant difference among these three age groups. These results indicate that the impact of the game on health literacy levels may vary across different age groups. Older individuals scored lower on the post-test. This result supports the claim of the metric analysis conducted by Qi and colleagues on studies between the years 1995-2020 (24). One primary factor may be the variation in technology use and digital literacy levels among different age groups. The younger generation is generally more familiar with digital technologies and may engage with the game more easily, while older individuals may have limited digital skills and access to technology. These disparities can influence the effect of the game across age groups. However, it is important to note that the differences among age groups may also be associated with other factors. Health literacy can be influenced by factors such as experience, education, and the development of health awareness, which can vary with age.

In addition, we examined the differences among different groups based on educational levels to evaluate the impact of a game developed for health literacy. When analyzing pre-test and post-test scores, we observed a significant difference among the groups with different educational levels. These results indicate that educational level plays a role in health literacy levels and that the effect of the game may vary depending on the educational level. Likewise, in a survey study conducted by Frıis and colleagues in 2016 on 29,473 Danish citizens over the age of 25, they also concluded that health literacy was indirectly positively affected by the level of education (25). We can provide some explanations for the differences among groups with different educational levels. Individuals with higher educational levels often possess better reading, research, and information-processing skills. This can make it easier for them to adapt to the provided health literacy information and achieve the objectives of the game more effectively. On the other hand, individuals with lower educational levels may have limited access to information and a lower capacity for understan-

ding, which can reduce the impact of the game. In addition to educational level differences, it is important to consider other variables such as socioeconomic status, language skills, and cultural factors that can also influence health literacy.

Finally, we aimed to evaluate the impact of the health literacy game developed by examining the relationship between users' post-test scores and their BMI. The analysis revealed a negative correlation between users' post-test scores and their BMI, indicating that as BMI increased, their health literacy scores tended to decrease. Similarly, Toçi and his colleagues conducted a study in 2019, in which they examined the relationship between health literacy and BMI in Tirana, Albania (26). The study included 1154 participants aged 18 and above. According to the data they gathered, they found a strong negative correlation between health literacy and BMI. It could be attributed to several factors. Firstly, individuals with higher BMIs may be more prone to health-related issues and may have limited access to health information or face challenges in understanding and interpreting health-related content. This could result in lower health literacy scores. Conversely, individuals with lower BMIs may exhibit higher health literacy scores, potentially due to their proactive approach to maintaining a healthy lifestyle and seeking health-related knowledge. Other factors such as socioeconomic status, cultural influences, and education can also contribute to the relationship between BMI and health literacy.

However, this study has some limitations relating to its sampling and methodological approach. The findings should be prudently extrapolated to a broader participant population. It employed a convenience sampling technique. Therefore, to enhance the applicability of these findings, it is advisable to repeat the present study using a genuinely experimental design. On the other hand, conducting further subgroup analyses can provide a better understanding of specific differences within the age groups. For instance, the impact of factors such as gender, educational level, health status, socioeconomic status, or access to technology on the differences among age groups could be explored. Finally, conducting the same research with a professional game development team to create a more realistic and technically comprehensive game could provide more diverse and profound findings.

CONCLUSION

In conclusion, this study provides compelling evidence for the effectiveness of a game-based approach in enhancing health literacy. The significant improvement in post-test scores compared to pre-test scores underscores the potential of gamification in health literacy education. The study also highlights the differential impact of the game across various age groups and educational levels, suggesting the need for tailored strategies in promoting health literacy. Furthermore, the observed negative correlation between users' post-test scores and their BMI provides an intriguing avenue for future research, potentially linking health literacy to health outcomes. As we enter the Metaverse era, the development and presence of health literacy games in this environment will greatly contribute to individuals' educational development in health. Particularly, their existence in other health-related topics can significantly enhance individuals' understanding and knowledge about health. However, it is crucial to acknowledge that this study is not without limitations, including its sampling method and the need for a more comprehensive game development process. Future research should aim to address these limitations and further explore the potential of gamification in health education. Ultimately, this study adds to the expanding body of evidence that endorses the utilization of innovative, technology-driven approaches in health education and promotion.

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