Exploring high school students' attitudes towards digital game-based learning: A perspective from Indonesia

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Abstract

Students' attitudes towards Digital Game-Based Learning (DGBL) in developing countries such as Indonesia are rarely investigated despite the fact that digital games are being used in secondary education increasingly. This research aims to explore students' attitudes towards DGBL in chemistry. We used a quantitative study method using a self-reported survey questionnaire. The study included 480 high school students (203 males and 277 females) from various public and private high schools in Indonesia. The present study employed a cross-sectional survey design to collect data in July and August 2023. The DGBL attitude scale was adapted to evaluate students' attitudes. The questionnaire comprised 22 items assessing students' attitudes towards digital game-based learning. The data obtained were analyzed using descriptive statistics as well as *t*-tests and a one-way Analysis of Variance (ANOVA). As a result, students expressed a slightly positive attitude towards digital games in chemistry learning particularly for learning opportunities. The results also showed that there was a significant gap in students' attitudes with regard to gender and the daily duration of smartphone use. However, there was no significant gap regarding students' attitudes towards digital game-based learning. The findings provide valuable insights for game designers and teachers to design and implement educational games that meet student needs and expectations in order to improve learning outcomes. The results are also useful for educators and educational researchers on how demographic factors influence students' DGBL attitudes in chemistry education in developing countries such as Indonesia.

Keywords: Attitudes, Digital games, Cross-sectional survey, Game-based learning, High school students, Indonesia.

Contents

Contribution of this paper to the literature
The results are useful for teachers and educational researchers regarding how demographic variables affect students' attitudes towards digital games in Indonesia and other developing countries. Policymakers, practitioners and educational managers can also use the research results to plan the effective use of digital games based on demographic factors.

1. Introduction

Nowadays, digital game-based learning (DGBL) is receiving attention from education researchers worldwide. The term DGBL refers to an effective pedagogical approach that incorporates digital games into the educational curriculum (Van Eck, 2015). This kind of approach is seen as a replacement for traditional methods (Gee, 2003). This research aims to explore students' search for information related to games and learning objectives. Students are expected to focus more on learning when learning activities are designed to allow them to learn while having fun because DGBL helps attract attention and provides enjoyment to students (Yang, Quadir, & Chen, 2016). In addition, digital games help students become active learners leading to an authentic learning environment (Ahmed et al., 2022). Existing studies report that DGBL provides opportunities for students to be actively involved in the classroom environment (Garris, Ahlers, & Driskell, 2002), encourages higher-order thinking skills (Dondlinger, 2007) and improves problem-solving and creative skills (Yang, 2015). Students who are more involved in games also show increased motivation and learning outcomes (Cornillie, Thorne, & Desmet, 2012).

Digital games are used for educational purposes apart from entertainment purposes. Students' attitudes towards DGBL in developing countries such as Indonesia are rarely explored despite the increasingly widespread use of digital games at the high school level. Previous studies focused on investigating the attitudes of lecturers (Noraddin & Kian, 2014), university students (Hainey et al., 2013), preservice teachers (Belda-Medina & Calvo-Ferrer, 2022) and elementary school students (Çankaya & Karamete, 2009). Thus, the current study seeks to determine the attitudes of Indonesian high school students towards digital games. The main research questions in this study were:
(1) What is the level of Indonesian high school students' DGBL attitudes?
(2) Do high school students' DGBL attitudes differ based on demographic factors namely gender, grade level and daily duration of smartphone use?

2. Literature Review
2.1. Digital Game-Based Learning (DGBL)

DGBL has received attention in education as technology advances. Recently, educational digital games has emerged as an emerging tool to support the teaching process (Lampropoulos, 2023). It is widely recognized that DGBL is a smart pedagogical method that uses educational digital games or learning by solving problems through digital devices (e.g., smartphones, personal computers or tablets). Van Eck (2015) proposes three strategies in the literature to use digital games in an educational context: first, integrating students in the development of digital games to satisfy their needs, next developing digital games to practice skills and improve knowledge and finally, using educational commercial games in the classroom. DGBL has been a prominent pedagogical method in secondary education due to its many benefits for students. Previous research highlights the reasons why teachers use digital games in the classroom. In research conducted by Huizenga, Ten Dam, Voogt, and Admiraal (2017), teachers agreed that in DGBL students can learn in a safe environment, become active learners and receive feedback on their actions. In addition, most teachers believe that when students are engaged in games, they will focus on one thing at a time and take responsibility for their academics (Kokandy, 2021). It should be noted that teachers, students and digital games are essential elements for the effective implementation of DGBL. More importantly, students' perceptions of digital games can be influenced by several factors such as their usefulness, learning opportunities, experience with games and preference for digital games (Bourgonjon, Valcke, Soetaert, & Schellens, 2010). When teachers successfully use educational games in the classroom, students' attitudes and academic performance will improve (Cagiltay, Ozcelik, & Ozcelik, 2015). Thus, evaluating students' attitudes towards DGBL is crucial in order to promote their performance.

2.2. Research on DGBL

Previous studies exploring students' attitudes and perceptions towards digital games have been documented. For instance, Hainey et al. (2013) studied Scottish and Dutch students' attitudes towards playing games concluding that most participants agreed that computer games can be used for educational purposes at the higher education level. In addition, Noraddin and Kian (2014) focused on the perceptions of Malaysian university teachers about using video games in the classroom and reported that most participants have a positive attitude towards using video games in their educational practices. Furthermore, Sardone (2018) performed a study with 102 preservice teachers and revealed that the participants saw benefits in using educational games to teach specific content to their students. Licorish, Owen, Daniel, and George (2018) conducted a qualitative study to evaluate university students' experiences with Kahoot (a game-based learning platform in New Zealand). As a result, they highlighted that the use of educational games is useful for improving the quality of student learning in the classroom. The current literature looks at the attitudes and views of preservice teachers and university students about the use of video games in education. In contrast, our study focuses on high school students' perceptions of DGBL.

3. Methods
3.1. Research Design

This cross-sectional study was performed from July 2023 to August 2023. In this study, we gathered data through a one-time self-administered survey. Thus, it can provide valuable information in a short period of time about students' attitudes towards DGBL (Creswell, 2012).

3.2. Participants

Table 1 provides demographic information about respondents. The study included 480 participants with 57.71% of them being female and 42.29% being male. A majority of the participants were eleventh-grade students (48.54%) followed by twelfth-grade students (45.00%) and tenth-grade students (6.46%). In terms of daily duration of smartphone use, 7.08 percent of students used smartphones for less than 1 hour per day, 54.58 percent were between 1 and 6 hours and 38.33 percent were more than 6 hours. They were between the ages of 14 and 19.

Table 1. Demographic characteristics of participants in the present study.

Variable	Frequency	%
Gender		
Male	203	42.29
Female	277	57.71
Grade		
10	31	6.46
11	233	48.54
12	216	45.00
Daily duration of smartphone use		
Less than 1 hour	34	7.08
1–6 hours	262	54.58
More than 6 hours	184	38.33

3.3. Instrument

The attitude of students towards Digital Game-Based Learning (DGBL) was evaluated using the DGBL attitude scale constructed by Bourgonjon et al. (2010). The questionnaire is a 22-item 5-point rating scale with choices ranging from strongly agrees at point 5 to strongly disagree at point 1, all of which are positive. The questionnaire consisted of five dimensions as listed in Table 2.

Table 2. Dimensions and examples of items in the DGBL attitude scale.

Dimension	Item	α	Example
Usefulness	4	0.93	Using digital games in the classroom would help me achieve better grades.
Ease of use	3	0.83	My interaction with digital games in the classroom would be clear and understandable.
Learning opportunities	7	0.90	Digital games offer opportunities to stimulate transfer between various subjects.
Experience with games	5	0.90	I like playing digital games.
Preference for digital games	3	0.91	I would support the use of digital games in the classroom if I had to vote.

Total scores varied from 22 to 110 in all dimensions. Higher scores represent higher attitudes towards the use of digital games in chemistry learning. In the current study, the value of Cronbach α (alpha) reliability for the DGBL attitude scale was 0.96 which indicated that the questionnaire is reliable (Taber, 2018). Students answered the attitude scale in about 15 minutes.

3.4. Procedure

After the study received ethical approval, the researchers contacted chemistry teachers at public and private high schools in Jakarta, Indonesia. We explained the purpose of the research. An online survey using Google Forms was distributed to students in order to assess students' attitudes towards digital games. Data collection was carried out from July 25 to August 9, 2023. Students could fill out the questionnaire at any time either inside or outside of class. The researchers sent a survey link to teachers through WhatsApp to facilitate data collection. The chemistry teachers were then requested to forward the link to their students. Since it was voluntary, students were given the right to refuse to participate. At the end of data collection, 480 students filled out the questionnaire. All responses were declared valid because all items in the instrument had to be answered. Usable responses were then imported into SPSS (Statistical Package for the Social Sciences) version 25 for analysis.

3.5. Data Analysis

In this study, we used SPSS Statistics 25.0 for statistical analysis. The kurtosis and skewness values were calculated to check the normal distribution of the data. After calculations, it was found that the values ranged from ±1, namely −0.305 to 0.236 for skewness and −0.312 to 0.632 for kurtosis. This indicates that the data was normally distributed (Tabachnick & Fidell, 2019). Then, the data were analyzed using descriptive statistics including percentages (%), mean scores (M), and standard deviations (SD). In addition, the t-test was also adopted to check whether there was a gap caused by gender while a one-way Analysis of Variance (ANOVA) was performed to identify whether there was a gap caused by grade level and frequency of daily smartphone use. Tukey's post-hoc test was then executed to check for gaps between groups. A p-value < 0.05 was interpreted as statistically significant.

4. Results and Discussion

In the present study, the researchers focused on students' attitudes towards digital game-based learning (DGBL). The results of the descriptive statistics are summarized in Table 3. According to Table 3, the highest and lowest attitude scores were found in learning opportunities ($M = 3.735$, $SD = 0.694$) and experience with games ($M = 3.186$, $SD = 0.854$) respectively. According to the results, attitudes towards digital games were above the middle point. This value can be expressed as $M = 3.520$ on a 5-point scale which is nearly the option "agree". It can be

stated that students had a slightly positive attitude about the use of digital games in teaching and learning practices. In other words, students considered themselves sufficient for digital games.

This result is consistent with Çankaya and Karamete's (2009) findings. They surveyed 176 elementary school students in Turkey on whether educational games influenced students' attitudes towards computer games and found that they were positive. Similarly, Pastore and Falvo (2010) examined preservice teachers' perceptions of video games in the classroom environment and reported that all participants felt that gaming was appropriate for promoting learning and motivating students in the classroom. The findings also highlight the study of Chen, Chen, Chen, and Yang (2012) and Kuru Gönen (2019) which shows that learners have a positive attitude towards the use of games. Moreover, Vogel et al. (2006) systematically reviewed 32 articles and reported that students showed significantly more positive attitudes towards DGBL compared to traditional lecture-like instruction. A possible explanation for this finding may be that students perceive educational games as an effective and valuable tool to promote their learning. According to Gibson, Halverson, and Riedel (2007), out of 228 pre-service teachers, a total of 65% of participants agreed that digital games can be useful as an educational tool. They are more motivated to learn which in turn promotes their attitude towards digital games in the presence of visual representations. In other words, digital games are seen as having a positive effect on students' learning attitudes.

Table 3. Descriptive statistics of DGBL attitudes.

Dimension	Min.	Max.	Mean	SD
Usefulness (U)	1	5	3.563	0.856
Ease of use (EOU)	1	5	3.597	0.759
Learning opportunities (LO)	1	5	3.735	0.694
Experience with games (EWG)	1	5	3.186	0.854
Preference for digital games (PDG)	1	5	3.444	0.845
All dimensions	1	5	3.520	0.678

Students' attitudes towards DGBL were analyzed based on their gender, grade level and daily duration of smartphone use. Table 4 presents the results of the *t*-tests conducted considering gender. As clearly seen in Table 4, male students showed more positive attitudes towards digital games than their female counterparts in almost all dimensions except learning opportunities ($p > 0.05$). In general, there were statistically significant gaps in the attitude scores between male and female students ($p < 0.05$).

Table 4. *T*-test results by gender.

Dimension	Gender	N	Mean	SD	t	p
U	Male	203	3.720	0.854	3.500	0.001*
	Female	277	3.447	0.840		
EOU	Male	203	3.732	0.794	3.376	0.001*
	Female	277	3.498	0.718		
LO	Male	203	3.793	0.748	1.569	0.117
	Female	277	3.693	0.650		
EWG	Male	203	3.529	0.822	8.022	0.000*
	Female	277	2.934	0.788		
PDG	Male	203	3.647	0.881	4.604	0.000*
	Female	277	3.295	0.786		
All dimensions	Male	203	3.691	0.718	4.847	0.000*
	Female	277	3.395	0.619		

Note: * *p*-value < 0.05.

This finding is consistent with earlier research (e.g., Bertozzi and Lee (2007)). Similarly, Martín del Pozo, Basilotta Gómez-Pablos, and García-Valcárcel Muñoz-Repiso (2017) explored prospective Spanish teachers' attitudes towards video game-assisted learning. Ismail and Mohammad (2017) carried out a survey of 113 1st-year students in Malaysia. The findings showed that there was a significant gap in perception scores between female and male students. Male students were more inclined than female students to use Kahoot and they thought Kahoot had a superior approach to help with information retention. A possible reason for this finding may be related to the historical gender gap in exposure to video games. In the existing literature, the number of female students who play video games is less than that of their male counterparts (Ferguson, 2015). In the study by Admiraal et al. (2014), they revealed that male students are more interested in digital games than female students. Similarly, Wang and Wang (2008) also reported that males were more willing to use online games than their female counterparts. Another reason may be that male students tend to set higher learning goals, preferences, motivation, learning performance and engagement in DGBL environments than female students (Chung & Chang, 2017; Papastergiou, 2008). This might be a logical explanation for the attitude scores of male students being higher than those of female students.

Table 5 reveals the ANOVA results regarding the disparity of attitude scores based on grade level. According to Table 5, there was no significant gap between students in grades 10, 11 and 12 in terms of attitudes towards DGBL ($p > 0.05$). Similarly, Altawalbeh and Irwanto (2023) investigated the perceptions of 72 Jordanian students concerning the use of Kahoot in a game-based learning environment. They also reported that there were no significant differences in perceptions of game-based learning based on grade level. When tested by dimension, differences in attitudes appeared only on the ease of use dimension. Grade 11 students were found to have greater attitude scores than their grade 10 counterparts ($p < 0.05$) based on Tukey's post-hoc analysis. This means that students increase their interest in using digital games as their grade level increases. It may be stated that students' digital literacy skills improve as they grow (Keane, Linden, Hernandez-Martinez, Molnar, & Blicblau, 2023). This may be a possible reason why the attitude scores of Indonesian high school students in higher grades were greater than their counterparts in lower grades.

Table 5. ANOVA results by grade level.

Dimension	Grade	N	Mean	SD	F	p
U	10	31	3.492	0.810	0.156	0.855
	11	233	3.556	0.804		
	12	216	3.580	0.918		
EOU	10	31	3.312	0.739	3.244	0.040*
	11	233	3.662	0.730		
	12	216	3.568	0.784		
LO	10	31	3.540	0.678	1.333	0.265
	11	233	3.755	0.686		
	12	216	3.741	0.704		
EWG	10	31	3.032	0.962	0.699	0.498
	11	233	3.174	0.806		
	12	216	3.220	0.889		
PDG	10	31	3.205	0.758	1.446	0.236
	11	233	3.442	0.800		
	12	216	3.480	0.900		
All dimensions	10	31	3.339	0.681	1.183	0.307
	11	233	3.531	0.633		
	12	216	3.534	0.723		

Note: * p-value < 0.05.

Furthermore, Table 6 displays the findings of the ANOVA on the students' DGBL attitude with respect to their daily smartphone use.

Table 6. ANOVA results by daily duration of smartphone use.

Dimension	Smartphone use	N	Mean	SD	F	p
U	Less than 1 hour	34	3.353	1.077	4.369	0.013*
	1–6 hours	262	3.492	0.800		
	More than 6 hours	184	3.701	0.872		
EOU	Less than 1 hour	34	3.461	0.833	2.067	0.128
	1–6 hours	262	3.556	0.715		
	More than 6 hours	184	3.681	0.800		
LO	Less than 1 hour	34	3.559	0.781	2.781	0.063
	1–6 hours	262	3.700	0.656		
	More than 6 hours	184	3.818	0.723		
EWG	Less than 1 hour	34	3.053	0.865	3.148	0.044
	1–6 hours	262	3.118	0.818		
	More than 6 hours	184	3.308	0.891		
PDG	Less than 1 hour	34	3.334	0.884	2.296	0.102
	1–6 hours	262	3.386	0.781		
	More than 6 hours	184	3.547	0.917		
All dimensions	Less than 1 hour	34	3.362	0.780	3.982	0.019*
	1–6 hours	262	3.467	0.629		
	More than 6 hours	184	3.625	0.714		

Note: * p-value < 0.05.

The mean total attitude score and the "Usefulness" component of the DGBL attitude scale showed a statistically significant difference with respect to the daily duration of smartphone use. In general, the results of Tukey's post-hoc test reflected that students who used smartphones for more than 6 hours showed significantly higher attitude scores than their counterparts who used them between 1 and 6 hours ($p < 0.05$). This shows that students' attitudes towards digital games increase as the frequency of daily smartphone use increases. In the study by Krist et al. (2020), older students tend to spend more time using Information and Communications Technology (ICT) than younger students. Our finding is consistent with the study of Martín del Pozo et al. (2017) who reported that students who spent more time playing educational games had more positive attitudes towards using games in a collaborative learning environment.

5. Conclusion

In this study, students' attitudes towards digital game-based learning (DGBL) were analyzed based on several variables. A statistically significant gap was found in attitudes towards DGBL in terms of gender in favor of male students. On the other hand, no significant gaps were found between students in grades 10, 11 and 12 in terms of DGBL attitudes. Specifically, a significant gap was only found in the "Ease of use" dimension in favor of grade 11 students. Furthermore, it was determined that students with the highest DGBL attitude scores were those who used smartphones for more than 6 hours followed by those who used smartphones between 1 and 6 hours and less than 1 hour. This gap was found to be statistically significant. The results obtained in the current study provide valuable information regarding various factors influencing students' attitudes towards the use of digital games in secondary education. Our study shows that digital games are a promising tool for enhancing the educational experience of high school students. As technology continues to improve students' attitudes and abilities to learn, it can be assumed that there will be a greater impact of digital games on the learning environment. This study provides valuable insights into the use of digital games for academic purposes in order to enhance teacher and student interactions and strengthen their learning process. Accordingly, teachers should be willing to use digital games in their classrooms to support learning objectives. In other words, teachers should implement educational games to elevate student engagement and academic performance in the classroom.

6. Implications

According to the results of the analysis, it appears that high school students have a positive attitude towards digital games. It can be concluded that there is a statistically significant gap in the variables of gender and daily duration of smartphone use. In contrast, if grade-level variables were examined, students' attitudes towards digital games did not differ significantly. This indicates that more attention should be paid to both male and female students using digital games to support learning goals in the classroom. In addition, teachers should ensure that students' use of smartphones is for educational purposes. Students can achieve specific objectives in dynamic, student-centered learning environments such as game-based learning (Erhel & Jamet, 2013). The current study's findings suggest that teachers develop and incorporate more gender-neutral digital educational games into the teaching and learning process. The present study also has important implications for encouraging students to play instructional games outside of the classroom. It seeks to inspire students to learn more and advance their chemistry proficiency.

References

Admiraal, W., Huizenga, J., Heemskerk, I., Kuiper, E., Volman, M., & Dam, G. T. (2014). Gender-inclusive game-based learning in secondary education. *International Journal of Inclusive Education, 18*(11), 1208–1218. https://doi.org/10.1080/13603116.2014.885592

Ahmed, A. A. A., Ampry, E. S., Komariah, A., Hassan, I., Thahir, I., Hussein Ali, M., . . . Zafarani, P. (2022). Investigating the effect of using game-based learning on EFL learners' motivation and anxiety. *Education Research International*, 1–9. https://doi.org/10.1155/2022/6503139

Altawalbeh, K., & Irwanto, I. (2023). Game-based learning: The impact of Kahoot on a higher education online classroom. *Journal of Educational Technology and Instruction, 2*(1), 30-49.

Belda-Medina, J., & Calvo-Ferrer, J. R. (2022). Preservice teachers' knowledge and attitudes toward digital-game-based language learning. *Education Sciences, 12*(3), 1-16. https://doi.org/10.3390/educsci12030182

Bertozzi, E., & Lee, S. (2007). Not just fun and games: Digital play, gender and attitudes towards technology. *Women's Studies in Communication, 30*(2), 179–204. https://doi.org/10.1080/07491409.2007.10162512

Bourgonjon, J., Valcke, M., Soetaert, R., & Schellens, T. (2010). Students' perceptions about the use of video games in the classroom. *Computers & Education, 54*(4), 1145-1156. https://doi.org/10.1016/j.compedu.2009.10.022

Cagiltay, N. E., Ozcelik, E., & Ozcelik, N. S. (2015). The effect of competition on learning in games. *Computers & Education, 87*, 35-41. https://doi.org/10.1016/j.compedu.2015.04.001

Çankaya, S., & Karamete, A. (2009). The effects of educational computer games on students' attitudes towards mathematics course and educational computer games. *Procedia-Social and Behavioral Sciences, 1*(1), 145-149. https://doi.org/10.1016/j.sbspro.2009.01.027

Chen, H. H.-J., Chen, M.-P., Chen, N.-S., & Yang, C. (2012). *Pre-service teachers' views on using adventure video games for language learning.* Paper presented at the In Proceedings of the 6th European Conference on Games Based Learning, Cork, Ireland, 4–5 October 2012.

Chung, L.-Y., & Chang, R.-C. (2017). The effect of gender on motivation and student achievement in digital game-based learning: A case study of a contented-based classroom. *Eurasia Journal of Mathematics, Science and Technology Education, 13*(6), 2309–2327. https://doi.org/10.12973/eurasia.2017.01227a

Cornillie, F., Thorne, S. L., & Desmet, P. (2012). ReCALL special issue: Digital games for language learning: Challenges and opportunities: Editorial digital games for language learning: from hype to insight? *ReCALL, 24*(3), 243-256. https://doi.org/10.1017/s0958344012000134

Creswell, J. W. (2012). *Educational research: Planning, conducting, and evaluating quantitative and qualitative research.* Boston: Pearson Education.

Dondlinger, M. J. (2007). Educational video game design: A review of the literature. *Journal of Applied Educational Technology, 4*(1), 21-31.

Erhel, S., & Jamet, E. (2013). Digital game-based learning: Impact of instructions and feedback on motivation and learning effectiveness. *Computers & Education, 67*, 156–167. https://doi.org/10.1016/j.compedu.2013.02.019

Ferguson, C. J. (2015). Clinicians' attitudes toward video games vary as a function of age, gender and negative beliefs about youth: A sociology of media research approach. *Computers in Human Behavior, 52*, 379–386. https://doi.org/10.1016/j.chb.2015.06.016

Garris, R., Ahlers, R., & Driskell, J. E. (2002). Games, motivation, and learning: A research and practice model. *Simulation & Gaming, 33*(4), 441-467.

Gee, J. P. (2003). What video games have to teach us about learning and literacy. *Computers in Entertainment, 1*(1), 20-20.

Gibson, D., Halverson, W., & Riedel, E. (2007). Gamer teachers in D. Gibson, C. Aldrich & M. Prensky (Eds.), Games and simulations in online learning: Research and development frameworks. In (pp. 175-188). Hershey, PA: Information Science Publishing.

Hainey, T., Westera, W., Connolly, T. M., Boyle, L., Baxter, G., Beeby, R. B., & Soflano, M. (2013). Students' attitudes toward playing games and using games in education: Comparing Scotland and the Netherlands. *Computers & Education, 69*, 474-484. https://doi.org/10.1016/j.compedu.2013.07.023

Huizenga, J. C., Ten Dam, G. T. M., Voogt, J. M., & Admiraal, W. F. (2017). Teacher perceptions of the value of game-based learning in secondary education. *Computers and Education, 10*, 105–115. https://doi.org/10.1016/j.compedu.2017.03.008

Ismail, M. A.-A., & Mohammad, J. A.-M. (2017). Kahoot: A promising tool for formative assessment in medical education. *Education in Medicine Journal, 9*(2), 19-26. https://doi.org/10.21315/eimj2017.9.2.2

Keane, T., Linden, T., Hernandez-Martinez, P., Molnar, A., & Blicblau, A. (2023). Digital technologies: Students' expectations and experiences during their transition from high school to university. *Education and Information Technologies, 28*(1), 857-877. https://doi.org/10.1007/s10639-022-11184-4

Kokandy, R. (2021). Teachers' perceptions of using digital gaming in classrooms. *International Journal of Educational Technology and Learning, 11*(1), 6-13. https://doi.org/10.20448/2003.111.6.13

Krist, L., Roll, S., Stroebele-Benschop, N., Rieckmann, N., Müller-Nordhorn, J., Bürger, C., . . . Müller-Riemenschneider, F. (2020). Determinants of physical activity and screen time trajectories in 7th to 9th grade adolescents—a longitudinal study. *International Journal of Environmental Research and Public Health, 17*(4), 1-15. https://doi.org/10.3390/ijerph17041401

Kuru Gönen, S. İ. (2019). A qualitative study on a situated experience of technology integration: Reflections from pre-service teachers and students. *Computer Assisted Language Learning, 32*(3), 163-189. https://doi.org/10.1080/09588221.2018.1552974

Lampropoulos, G. (2023). Educational benefits of digital game-based learning: K-12 teachers' perspectives and attitudes. *Advances in Mobile Learning Educational Research, 3*(2), 805-817. https://doi.org/10.25082/amler.2023.02.008

Licorish, S. A., Owen, H. E., Daniel, B., & George, J. L. (2018). Students' perception of Kahoot!'s influence on teaching and learning. *Research and Practice in Technology Enhanced Learning, 13*(1), 1-23. https://doi.org/10.1186/s41039-018-0078-8

Martín del Pozo, M., Basilotta Gómez-Pablos, V., & García-Valcárcel Muñoz-Repiso, A. (2017). A quantitative approach to pre-service primary school teachers' attitudes towards collaborative learning with video games: Previous experience with video games can make the difference. *International Journal of Educational Technology in Higher Education, 14*(1), 1–18. https://doi.org/10.1186/s41239-017-0050-5

Noraddin, E. M., & Kian, N. T. (2014). Academics' attitudes toward using digital games for learning & teaching in Malaysia. *Malaysian Online Journal of Educational Technology, 2*(4), 1-21.

Papastergiou, M. (2008). Digital game-based learning in high school computer science education: Impact on educational effectiveness and student motivation. *Computers & Education, 52*(1), 1–12. https://doi.org/10.1016/j.compedu.2008.06.004

Pastore, R. S., & Falvo, D. A. (2010). Video games in the classroom: Pre-and in-service teachers' perceptions of games in the K-12 classroom. *International Journal of Instructional Technology and Distance Learning, 7*(12), 49-57.

Sardone, N. B. (2018). Attitudes toward game adoption: Preservice teachers consider game-based teaching and learning. *International Journal of Game-Based Learning, 8*(3), 1-14.

Tabachnick, B. G., & Fidell, L. (2019). *Using multivariate statistics* (7th ed.). Upper Saddle River: Pearson Education.

Taber, K. S. (2018). The use of cronbach's alpha when developing and reporting research instruments in science education. *Research in Science Education, 48*(6), 1273-1296.

Van Eck, R. (2015). Digital game-based learning: Still restless, after all these years. *Educause Review, 50*(6), 13-28.

Vogel, J. J., Vogel, D. S., Cannon-Bowers, J., Bowers, C. A., Muse, K., & Wright, M. (2006). Computer gaming and interactive simulations for learning: A meta-analysis. *Journal of Educational Computing Research, 34*(3), 229-243.

Wang, H. Y., & Wang, Y. S. (2008). Gender differences in the perception and acceptance of online games. *British Journal of Educational Technology, 39*(5), 787–806. https://doi.org/10.1111/j.1467-8535.2007.00773.x

Yang, J. C., Quadir, B., & Chen, N.-S. (2016). Effects of the badge mechanism on self-efficacy and learning performance in a game-based English learning environment. *Journal of Educational Computing Research, 54*(3), 371-394. https://doi.org/10.1177/0735633115620433

Yang, Y.-T. C. (2015). Virtual CEOs: A blended approach to digital gaming for enhancing higher order thinking and academic achievement among vocational high school students. *Computers & Education, 81*, 281-295. https://doi.org/10.1016/j.compedu.2014.10.004