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Exploring Elli's World: A case study on students' performance in media literacy tasks and teachers' perceptions

Esplorando il mondo degli Elli: uno studio di caso sulle performance degli studenti e le percezioni degli insegnanti in compiti di alfabetizzazione ai media

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ABSTRACT This study investigates a game-based learning approach to enhance reading comprehension through multiple texts, emphasizing the importance of critical media engagement for students' academic success. Involving 155 students (F=83, Mean age=10.8, SD=1.3) from 5th (n=44), 6th (n=44), and 7th grades (n=65), along with 33 teachers who participated in a voluntary survey, the research aimed to assess students' performance in Media Literacy tasks during four sessions of the videogame "Elli's World". Results indicated performance improvements from Session 1 to Session 3, followed by a decline in Session 4, suggesting potential fatigue. Although the class variable did not have a statistically significant impact on score increases, students' performance evolved differently over time depending on the class: younger students benefited from the game-based environment, whereas older students may respond better to shorter sessions. Although teachers expressed moderate satisfaction with the intervention, they reported no significant changes in students' behaviour, highlighting the need for diverse instructional strategies and ongoing professional development to better align educational initiatives with classroom realities.

KEYWORDS Game-Based Learning; Media Literacy; Intertextual Integration; Primary and Lower Secondary School; Serious Game.

SOMMARIO Questo studio indaga un approccio di apprendimento basato sul gioco per migliorare la comprensione della lettura attraverso testi multipli, sottolineando l'importanza di un coinvolgimento critico con i media per il successo accademico degli studenti. Coinvolgendo 155 studenti (F=83, età media=10,8, DS=1,3) delle classi 5^ primaria (n=44), 1^ (n=44) e 2^ secondaria primo grado (n=65), insieme a 33 insegnanti che hanno partecipato a un sondaggio volontario, la ricerca mirava a valutare le prestazioni degli studenti in compiti di alfabetizzazione ai media durante quattro sessioni del videogioco "Il mondo degli Elli." I risultati hanno mostrato un miglioramento delle prestazioni dalla Sessione 1 alla Sessione 3, seguito da un calo nella Sessione 4, suggerendo l'influenza di fattori motivazionali esterni e di fatica. Sebbene la variabile classe non

abbia avuto un impatto statisticamente significativo sull'aumento dei punteggi, le performance degli studenti si sono evolute in modo diverso nel tempo a seconda della classe: gli studenti più giovani hanno beneficiato dell'uso dell'app educativa, mentre gli studenti più grandi potrebbero necessitare di sessioni di gioco più brevi. Sebbene gli insegnanti abbiano espresso una soddisfazione moderata per l'intervento, non hanno riportato nessun cambiamento significativo nel comportamento degli studenti, evidenziando la necessità di strategie didattiche diversificate e di un continuo sviluppo professionale per allineare meglio gli interventi educativi con le realtà scolastiche.

PAROLE CHIAVE Apprendimento Basato sul Gioco; Alfabetizzazione ai Media; Integrazione Intertestuale; Scuola Primaria e Secondaria di Primo Grado; Serious Game.

1. Introduction

In an increasingly digital world, in which the advent of digital technologies has transformed how information flows and how people connect and interact among themselves (Castells, 2000), the ability to critically engage with media and information is essential for students' academic success and personal development as future citizens who need to understand how economic, political and cultural life work in a networked society (Castells, 2000; Hobbs, 2006). As educational institutions strive to prepare learners for the complexities of communication in our modern society, the integration of Media Literacy (ML) into school curricula has gained significant attention. In our societies digital and physical realities are intertwined, and information and knowledge are constantly generated, processed and exchanged through various media in the so called "infosphere" (Floridi, 2014). Thus, individuals are part of an information ecosystem in which boundaries between online and offline, virtual and real, are increasingly blurred in the so called "onlife" (Floridi, 2015). The integration of ML into curricular activities in schools could foster critical thinking skills and empower students to navigate diverse information sources effectively and responsibly. Concurrently, advancements in educational technology, particularly through digital game-based learning interventions, offer innovative methods for enhancing learning experiences and developing essential cognitive and affective-motivational skills. In this scenario, serious games have gained more attention: these tools are not designed primarily for fun or entertaining, whereas they aim to educate, train and support behavioural change (Michael & Chen, 2006).

This research study investigates an innovative approach to enhancing reading comprehension through the integration of multiple texts while playing a serious game. Recognizing the potential of this educational approach, the study explores the feasibility of a digital game-based intervention designed to foster students' ability to navigate and synthesize information from diverse sources. By examining the design elements of the game, teachers' perceptions and student outcomes, this study aims to contribute to the growing body of evidence supporting the use of game-based interventions for educational purposes.

2. State of the art

The integration of ML in schools is increasingly recognized as essential for preparing students to navigate a complex information landscape. ML encompasses the ability to access, analyse, evaluate, create, and act upon various forms of communication, equipping students with the skills necessary to discern credible sources from misinformation (Lipkin, 2021). ML can be integrated into educational curricula through three main approaches: as a disciplinary subject, a cross-curricular theme or a blended

model. As a standalone discipline, it emphasizes critical analysis, evaluation, and the creation of media texts, often focusing on media production skills and theoretical frameworks (Hobbs, 1998). Alternatively, a cross-curricular approach integrates ML concepts into subjects such as history, science, and literature, offering contextual diversity but potentially risking a loss of focus if not effectively managed (Kress, 1992). The blended model combines these strategies, integrating dedicated ML modules with cross-disciplinary applications to balance depth and practical relevance. This adaptable framework allows schools to align ML instruction with their educational objectives while addressing the complexities of a media-rich society (McDougall, 2010; Hobbs, 1998).

The ability to critically analyse, evaluate and create media are key components of ML and has become essential in today's digital age. To cultivate all these skills, Media Education (ME) provides a structured framework in schools to promote media competence, encouraging conscious and responsible media use and integrating media in teaching (Rivoltella, 2001). Scholars and media educators highlight the expansive scope of Media Literacy and Media Education, which extends beyond developing critical thinking skills to include a deeper commitment to fostering citizenship education. As Rivoltella (2001) and Buckingham (2006) point out, these fields empower individuals not only to analyse, evaluate, and create media but also to engage with its social, political, and cultural dimensions. By fostering digital literacy, ethical awareness, and critical autonomy, ME prepares students for active participation in democratic processes and encourages them to address contemporary societal challenges. Hobbs (2006) further underscores this connection, viewing ML as a pathway to cultivating reflective, informed citizens capable of contributing to a more equitable and participatory society. Research indicates that structured media literacy programs can positively impact students' critical analysis skills and attitudes toward media consumption (European Commission, 2022). Among interventions integrating ML into school curricula, the ones aimed at enhancing self-regulation in media and information literacy processes have shown promise. These programs often involve active teaching methods that engage students in evaluating media messages and understanding their implications (Sadeghi et al., 2015). Media literacy can be implemented through games (Pang & Pang, 2022), using either "game-based" or "gamified" approaches. Game-based learning (GBL) can be defined as a learning method which integrates actual games into the learning environment (Chang & Hwang, 2020), thus using games designed with educational purposes to facilitate learning through gameplay. Gamification can be defined as "the use of game design elements in non-game contexts", including elements that enable students' self-regulation as progress bars, badges and points that ensure monitoring progress (Deterding et al., 2011).

Studies have explored the perceptions of both students and teachers regarding gamified interventions, revealing challenges in implementing approaches that train Executive Functions (EF) as tools for managing media literacy tasks (Hakala et al., 2020). EF are top-down mental processes required in complex tasks to control the implementation of cognitive processes and training interventions adopt oftentimes a gamification approach, because gamification can help sustain students' cognitive efforts required by EF and motivate students (Pineda & Buensuceso, 2023). To strengthen students' self-regulation, game-based learning has emerged as a powerful strategy for enhancing educational outcomes (Barz et al. 2024; Mao et al., 2021). In particular, digital game-based learning (DGBL) interventions promote teaching and learning processes using digital games and apps on a computer or a mobile device. Effective game design elements – such as clear objectives, immediate feedback, and engaging narratives – are crucial for fostering student motivation and learning (Gee, 2013). The results of a meta-analysis by Barz et al. (2024) support the hypothesis that DGBL interventions lead to improved learning compared with traditional teaching methods, especially for cognitive and affective-motiva-

tional outcomes. Studies included in the meta-analysis showed that, for cognitive learning outcomes, DGBLs had a significant positive impact on knowledge acquisition and recall. Interventions utilizing game-based learning approaches have been studied for various educational aims, including improving engagement and critical thinking skills among students (Mao et al., 2021).

In this game-based learning scenario, teachers' perceptions of these tools also play a significant role; their values and beliefs about game-based learning can influence implementation success (Kapp, 2012).

The innovation of our approach lies in the use of an educational app (Elli's World) designed to train complex cognitive tasks in a digital environment, in which gamified elements sustain students' motivation and engagement, while also conducting a study to evaluate the efficacy of a game-based learning intervention from an evidence-based research perspective. Through an integrative approach, including media literacy, game-based learning intervention, gamification and self-regulation, we aim to enhance students' capabilities in managing information critically and effectively.

3. Design and development of a gamified app to train EF and Media Literacy

The app "Elli's World" follows the journey of a little Ello (it stands for "cervEllo" that it's "brain" in Italian), a young brain guided by Big Ello through various city districts, engaging players in activities that enhance EF through gamified coding and literacy tasks. Students navigate an urban environment completing tasks to earn star points based on success and time, motivating self-regulation. Daily sessions conclude with a points summary.

The game includes a Media Literacy (ML) district, aimed at enhancing students' ability to comprehend and integrate multiple texts by supporting the cognitive processes involved in the task. A video sets the context for writing an article on one of four themes (bottled versus tap water, animal versus lab-grown meat, electric versus gasoline-powered cars, and the use of robots in medicine), using preselected texts. The session kicks off with a coding activity, followed by questions aimed at assessing students' prior knowledge. Students are later asked to arrange ten steps of an article outline in the correct order (see Figure 1).

At this stage, students are presented with the titles, previews, and authors of eight texts developed ad hoc. Students are required to evaluate these previews (2 highly relevant, 2 moderately relevant, 4 irrelevant), assigning scores (2, 1, or 0). For this relevance judgement task, students should focus on the research topic and should identify the most relevant comprehensive titles. Irrelevant previews require justification (e.g., complex text, unhelpful preview). Final feedback compares their answers to correct scores.

For the following steps, student will use only texts from the four correct previews. Once this phase is completed, students are tasked with estimating the time, in minutes, required to complete the following activities.

The ability to make accurate time estimate is crucial in everyday life and aids students in self-regulating during tasks and daily activities. At the end, a countdown timer on the top of the screen allows students to monitor their activity. If time runs out, students can still finish their work but will lose the time estimate star. This affects only the total points shown at the end of the session, but without consequences for the course of the game.

Before viewing full texts, students predict how many snippets they will select from each text (out of a total of 20 snippets), while only showing the relevant previews. This expectation can be confirmed or adjusted when students access the complete documents. The goal of this phase is to encourage students

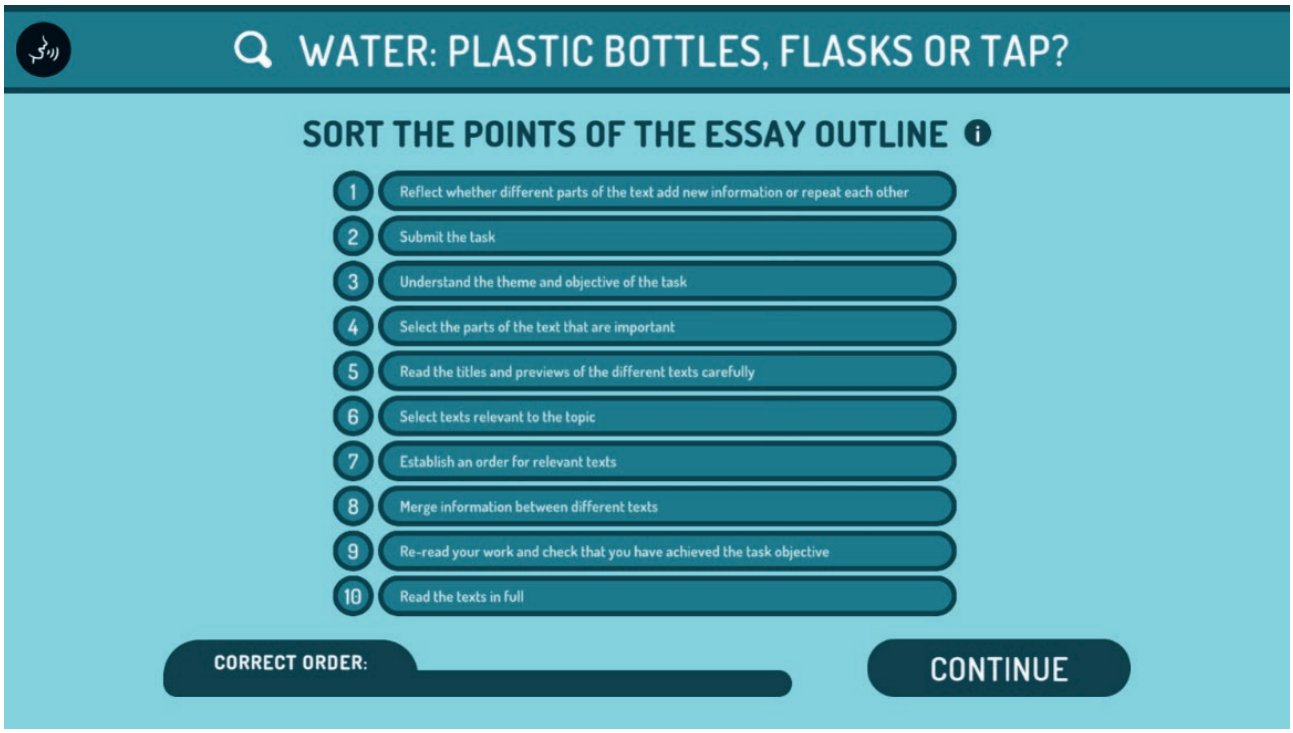

Figure 1. Screenshot of the essay outline task.

Figure 2. Screenshot of the relevance judgment task.

Figure 3. Screenshot of the production task.

to anticipate what they will find as they approach various sources of information, knowing only some features but not all content.

Once the complete texts with their relevance scores are displayed, students should identify the most relevant and informative snippets from each text to compile in their virtual notebooks. Each text has been specifically designed to contain two highly relevant snippets that yield maximum points if selected, along with two non-relevant snippets worth 0 points and other moderately relevant snippets with a score of 1.

During the article production phase, students rearrange their selected snippets within their virtual notebooks. They can connect these text snippets using cards featuring various types of conjunctions (coordinating, adversative, correlative, causal, temporal, conditional, consecutive, concluding). Additionally, during the revision, students can leverage superpowers gained while playing Elli's World for drafting assistance. Specifically, the interference control and response inhibition button suggest removing repeated or irrelevant parts; the working memory button helps ensure no important information is overlooked; and the cognitive flexibility button encourages students to verify the order of snippets for coherence.

Next, from a list of proposed keywords, students must select three that best represent their article's theme and identify the most fitting title. In the final stage, they are asked metacognitive questions designed to explore their personal perception of task difficulty. They will also choose one or more pieces of advice to share with future young Elli who may face similar challenges in article writing.

4. Aims

The present study aims at exploring the feasibility of a game-based training to understand and train processes that are needed in media and information literacy. Moreover, the study aims to inves-

tigate the perceptions of teachers regarding implementing a complex ML task through an educational app. We aim to assess:

RQ1) How do students perform on the gamified media learning activities?

RQ2) How do teachers perceive the game-based intervention and what are the challenges from their points of view?

This study has exploratory and descriptive aims, and the methodology section provides context by detailing the larger study from which these data were derived.

5. Methodology

5.1. The context

The subgroups of participants (teachers and students) described in this reported research is part of a larger population of 528 students and 14 teachers which were involved in the EMILE (Empowering schools in self-regulation of Media and Information Literacy processes) project, funded by the European Media and Information Fund, managed by the Calouste Gulbenkian Foundation and coordinated by the University of Florence with partners Anastasis Social Cooperative, Tampere University, and the Romanian-American University. The EMILE project was designed to empower adolescents' critical (digital) reading competence by supporting the underlying cognitive processes and to provide professional development to support teachers' competence in critical reading education. The University of Florence was responsible for the design and implementation of "Elli's World-Media Literacy", an update of the previous validated educational intervention through the "Elli's World" app. The EMILE project involved two comprehensive schools in Tuscany, working with primary and secondary schools, and in this study, we described sociodemographic data from one of the two schools. Feasibility and satisfaction data from teachers from the other school were incomplete and could not be considered for an integrated analysis of students' performance and teachers' perceptions. The larger intervention was a randomized control trial aimed at verifying the efficacy of an adaption of the game to train cognitive functions that are needed in critical reading and therefore support students' self-regulation of media and information literacy processes.

5.2. Participants

In September 2023, 2 schools were recruited to participate in the project. After obtaining authorization from the school administrators and informed consent from the parents, the intervention began in October 2023 and concluded in December 2023.

Participants in this restricted population were 155 (F=83, Mean age=10.8, DS=1.3), attending 5th grade (2 classes, n=44), 6th grade (2 classes, n=44) and 7th grade (2 classes, n=65)[1]. Teachers involved in the feasibility and satisfaction survey were 33, as answers were given on a voluntary basis by all teachers, across subject areas and special education, at both primary and secondary school, teaching in the classrooms involved with the game-based training.

[1] In the Italian school system, 5th grade corresponds to the final class of primary school, while 6th and 7th grades are the first two classes of middle school.

5.3. Materials

5.3.1. Students' performance in the Elli's World app

To describe a more complete picture of students' engagement with the app, in the larger project students' satisfaction and enjoyment in the training and feedback of feasibility were assessed through a survey designed *ad hoc* with 11 statements, using a 5-point Likert scale (1= not all; 5= very much). The reliability of the scale was assessed using Cronbach's alpha. The analysis yielded a Cronbach's alpha of 0.667, indicating an acceptable but moderate level of internal consistency. Although this value is below the commonly accepted threshold of 0.70, it may still be considered adequate for exploratory research (Hair et al., 2010).

The app allows to collect data through learning analytics techniques referring to students' performances in several ML tasks. For this study, we were interested into describing two specific tasks: the production task and the title selection task.

For the production task, the app calculates a relevance score based on the cumulative relevance scores of each snippet used in the text. During the production phase, students are presented with the four most relevant texts pertaining to the overall topic and may select their preferred snippets from each of these sources, with a maximum limit of 20 snippets in total. Each snippet has an assigned score already established. Consequently, when students make their selections, the system automatically records the corresponding relevance scores (2, 1, or 0). This approach allows for a measurement of relevance for each written text produced. Each relevant text has a maximum relevance score of 8, derived from the inclusion of 2 highly relevant snippets (total score of 4), 4 relevant snippets (total score of 4), and 2 irrelevant snippets (total score of 0). Consequently, the maximum score for the production task for each research topic is 32 points (8 points multiplied by 4 texts).

For the title selection task, students should select the most appropriate title for their written text, choosing from four options, where only one is the most suitable, as it represents the comparisons of different opinions. Two of the other options don't refer to the research topic, while one title focuses only on one side of the comparison. For the coding system, 1 point is assigned for the correct title. The maximum score a student can reach after the four sessions is 4 points.

5.3.2. Teachers' perceptions

Teachers' feasibility and satisfaction survey was structured in two parts and administered at different times.

Section 1 was administered to one teacher for each class involved in the training, at the final session of the game. Answers to the following statements, using a 5-point Likert scale (1= not all; 5= very much), were collected from 7 teachers.

Question number 11 was open-ended and ask for teachers' opinion on the app: "Now we ask you to kindly provide us with some information for the improvement of the app. If you could change anything, what changes would you suggest?"

Section 2 of the questionnaire was administered 5 months after the conclusion of the intervention to all the teachers working in the classrooms involved in the training. Answers from 33 teachers were collected. The questions (Yes/No, judgment on a 10-points Likert scale and justification open-ended) are shown in table 2.

Table 1. Items of Section 1 from teachers' feasibility and satisfaction's survey.

Items
1. I am satisfied to have taken part in the enhancement project.
2. I would recommend this training to other teachers.
3. I would do this training again if there was a chance.
4. I have noticed improvements in pupils' behaviour after the training.
5. I have noticed improvements in the pupils' academic performance after the course.
6. It was difficult to find 30 min per week to devote to the weekly training session.
7. It was difficult to find 30 minutes twice a week to devote to the weekly training session.
8. It was difficult to find 1 hour twice a week to devote to the ML training session.
9. I would have liked to be more involved in the students' video game sessions.
10. I would like to receive specific training in the use of the app "Elli's world" to propose it independently to my students.

Table 2. Items of Section 2 from teachers' feasibility and satisfaction's survey

Items
1. Do you find the project interesting?
2. Briefly justify your previous answer.
3. Do you think the project is useful from an educational perspective?
4. Would you use an app like "Elli's world" in class with your pupils?
5. How do you assess your level of knowledge of Executive Functions prior to the training?
6. How do you assess your level of knowledge of Executive Functions after participating in the training?
7. Do you think you are aware of the levels of your pupils' EF skills?
8. Do you think it is useful from an educational perspective to be aware of the levels of your pupils' EF skills?
9. Briefly justify your previous answer.
10. At the end of the training, did you notice any behavioral changes in your pupils?
11. If you have detected changes, please give some examples.
12. Has this experience changed something in your way of teaching?
13. Which critical issues and challenges did you notice within the training?
14. Would you like to add some suggestions to improve the activity and the training?

5.4. Procedure

Before the start of the training with the app, teachers of Intervention Group participated in two meetings with the researchers, where they were instructed on the objectives, purposes, structure and methods of the intervention.

Regarding the larger project's objective to assess training's efficacy, pre- and post-training assessments of Executive Functions and Reading Comprehension (standardized tests) and Intertextual Integration (test designed ad hoc based on previous research) were conducted in the first and last weeks for both Intervention and Control Group.

The project was conducted entirely during school hours with the support of researchers and was designed to be highly inclusive, allowing all students in the class to participate, including those with neurodevelopmental disorders or disabilities. During the first four weeks, the videogame sections focused on EF training were covered in two 30-minute sessions per week. The final two weeks of train-

ing in the ML district involved two 1-hour sessions per week. At the end of the training, students' questionnaire and teachers' survey were administered, paper-and-pencil and digital way respectively.

5.5. Data analysis

Data from teachers' survey (both sections) and learning analytics data from two tasks (production and selection of correct title) from 102 sessions with the app (the incomplete game sessions were not included in the analysis for this case study) were processed and analysed (RQ1). The analysis of descriptive statistics aims to compare maximum scores to assess performances in two tasks, as well as to evaluate descriptive performances across different school levels. In addition, a content analysis was employed to classify the qualitative data from open-ended questions within the teachers' survey to quantitative data. This systematic process produced a numerical summary of the answers set for RQ2.

6. Results

6.1. Research Question 1: How do students' performance on Media Literacy tasks evolve over time?

Initial descriptive statistics were conducted and analysis of the normality of the distribution showed that the production index for all the four sessions was normally distributed (skewness [-.59; 0.17]; kurtosis [-.09; 1.15]), while 3 out of 4 choose of correct title variables were normally distributed (skewness [.3; 0.12]; kurtosis [-1,93; 0.08]).

The following figures show how performances on the two variables (Production and Title selection tasks) changes over time. Estimated marginal means , including 95% confidence interval for each session, are shown. As Figure 4 suggests, in the production task students perform progressively better through Session 1 to 3, showing higher points of production, suggesting that they become more aware in the selection of relevant snippets. From Session 3 to 4 points of production slightly drop, but per-

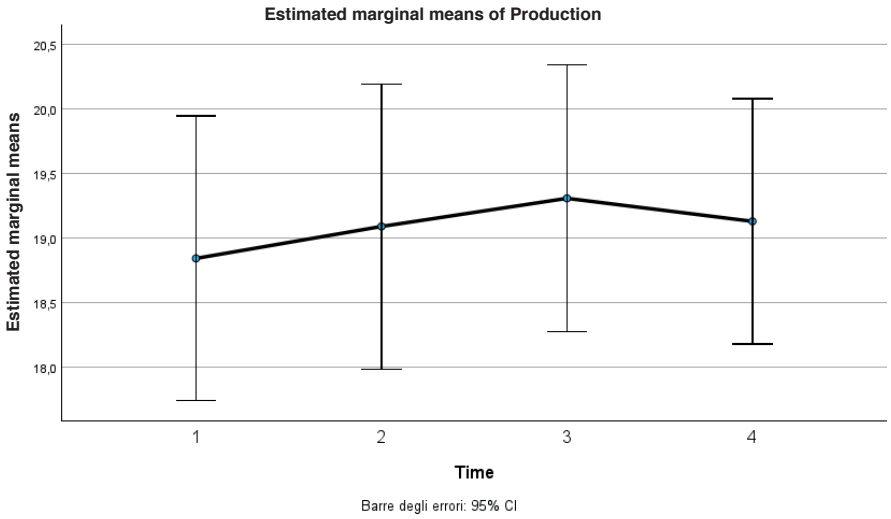

Figure 4. Students' performance data on the **Production task** over time (estimated marginal means; 95% CI).

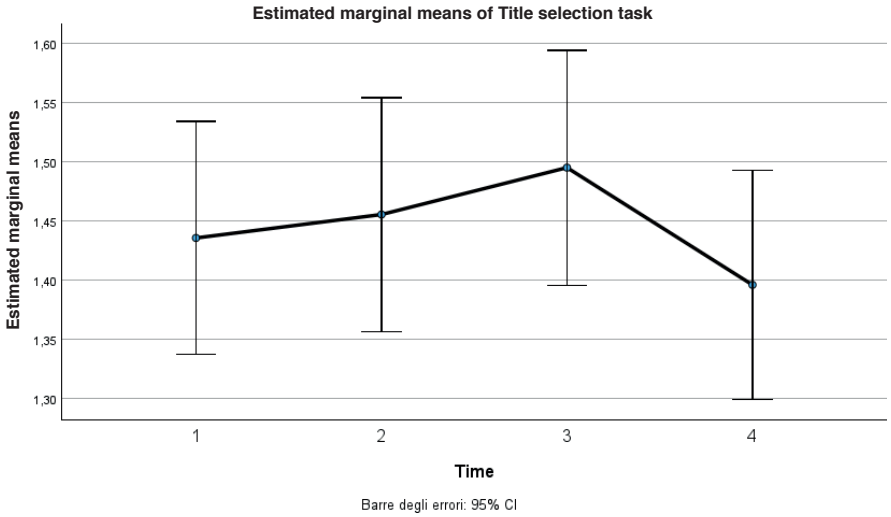

Figure 5. Students' performances on the **Title selection task** over time (estimated marginal means; 95% CI).

formances from the beginning of the training (M=18.84; DS=5.59) towards the final session (M=19.13; DS=4.81) register higher scores. Comparing to the maximum score for this task (32 points), estimated marginal means over the four sessions were significantly below, slightly above the half score.

Moreover, as Figure 5 suggests, initially there is a gradual increase in the marginal means from Session 1 to Session 2, followed by a more pronounced rise that peaks in Session 3. A higher estimated marginal means suggests that more students perform better on the task, as the coding system assigned 1 point for incorrect title and 2 for correct title. However, after reaching this peak, there is a significant decline between Sessions 3 and 4, with the marginal means falling below the levels observed in Session 1, indicating less students correctly selected the title in the last sessions. This pattern, with a final decline, may suggest factors such as participant fatigue, reduced efficiency, or alterations in task conditions affecting the performances of students towards the end of the training.

To compare the estimated marginal means in relation to Production and Title selection tasks' performances across three distinct class, a hierarchical linear regression was conducted, showing that the grade variable did not have a statistically significant impact on growth in production across the four time points (Wilks'λ= .95, F= .84, df= 6, 196; p= .54, η2= .03) neither in title selection across the four time points (Wilks'λ= .97, F= .48, df= 6, 196; p= .82, η2= .02). As no significant differences attributable to the class were found, the following differences across grades are presented descriptively.

Figures 6 illustrates the estimated marginal means of Production task over four sessions across three distinct classes (5^{th-} 6^{th}-7^{th} grades). As Figure 6 suggests, 6^{th} grade begins at the highest level (M=19.18; DS=4.78) and demonstrates a steady increase, peaking in Session 3 (M=20.27; DS=4.02) before experiencing a slight decline in Session 4. In contrast, 7^{th} grade shows greater stability, maintaining marginal means around 19 throughout the sessions, with a gradual increase leading to Session 3 (M=19.40; DS= 5.76) followed by a decrease in Session 4 (M= 18.55; DS=5.59). 5^{th} grade starts at a lower level (M=18.50; DS=6.19), experiences a dip between Sessions 1 and 2 (M=17.77; DS= 6.77), but recovers by Session 4. These patterns suggest that 6^{th} grade consistently performs the best, while 5^{th} grade exhibits the most variability in performance.

Figure 7 illustrates the estimated marginal means for the Title selection task. In this analysis, a higher estimated marginal means suggests that more students perform better on the task, as the cod-

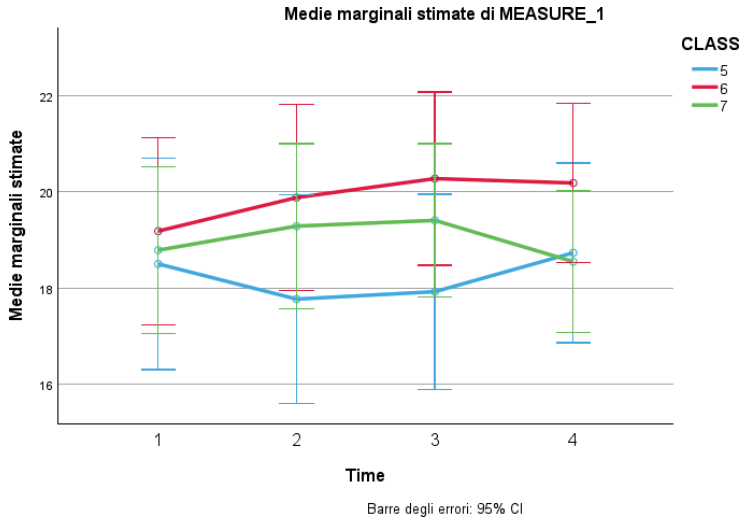

Figure 6. Students' performance in time and between class on the Production task (estimated marginal means; 95% CI).

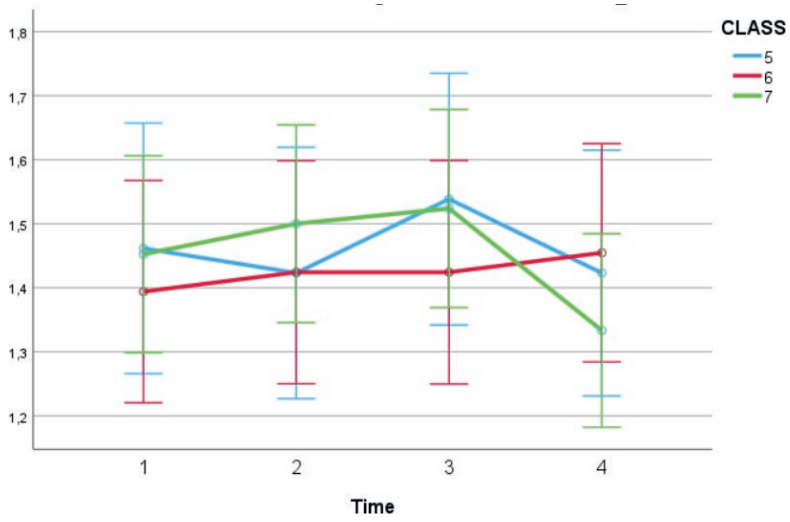

Figure 7. Students' performance in time and between classes on the Title selection task (estimated marginal means; 95% CI).

ing system assigned 1 point for incorrect title and 2 for correct title. 5th grade demonstrates significant fluctuations, experiencing a decline from Time 1 (M=1.46; DS=0.51) to Time 2 (M=1.42; DS=0.50), followed by a sharp increase that peaks in Session 3 (M=1.54; DS=0.51), and then a steep drop in Session 4 (M=1.42; DS= 0.50). In contrast, 6th grade maintains a more stable pattern, exhibiting a gradual increase in means across the four sessions, which suggests consistent performance. 7th grade shows an upward trend from Session 1 (M=1.45; DS= 0.51) to Session 3(M= 1.52; 0.51), peaking in Session 3 before experiencing a sharp decline by Session 4. These patterns indicate variability in performance across the classes, with 6th grade exhibiting the most stability and an increase from session 1 to 4 in the number of students who performed well on the task, while grades 5th and 7th display more dynamic changes, particularly notable declines following their peaks in Session 3. This suggests that

towards the final session, more students of 5th and 7th grades perform worse on the task than in the first session.

6.2. Research Question 2: How do teachers perceive the gamified intervention and what are the challenges from their points of view?

For the first section of the survey, answers to 10 items using a 5-point Likert scale were collected from 7 teachers and means and standard deviations for each item were calculated to create the following graph in figure 8. Teachers were satisfied to have taken part in the training (M=3.4, DS=0.5), would suggest other colleagues to participate (M=3, DS=0.6) and would do the intervention again (M=3, DS=0.8), even if they didn't notice any changes in their students' behaviours or academic performances after the training.

Answers to the open-ended question (Item 11) were 2 out of 7 and were referred to the need of paper and pencil material ("*I'd like to add some non-computerised activities to work with in class")* and to the need of more clarity to explain how the production phase works ("*I think more clarity is needed in the part concerning the composition of a text with sentences extrapolated from other texts with the same subject matter*").

Regarding the second section of the survey administered 6 months after the conclusion of the training, answers from 33 teachers were collected and frequencies were calculated for Yes or No questions and judgments on a 10-points Likert scale. For this study, only frequencies to a few items are shown in Figure 9 (Items 1,2,3,4).

For the analysis of the open-ended questions in the delayed survey, answers were read, and clusters of topics were identified, to calculate the frequency of each cluster. When teachers were asked to justify their answers to why they found or didn't find the project interesting, they valued it positively because they thought it stimulated students' motivation (30%) and students' participation and interest (30%), also because they gave importance to research assumptions and methodology (25%), and the innova-

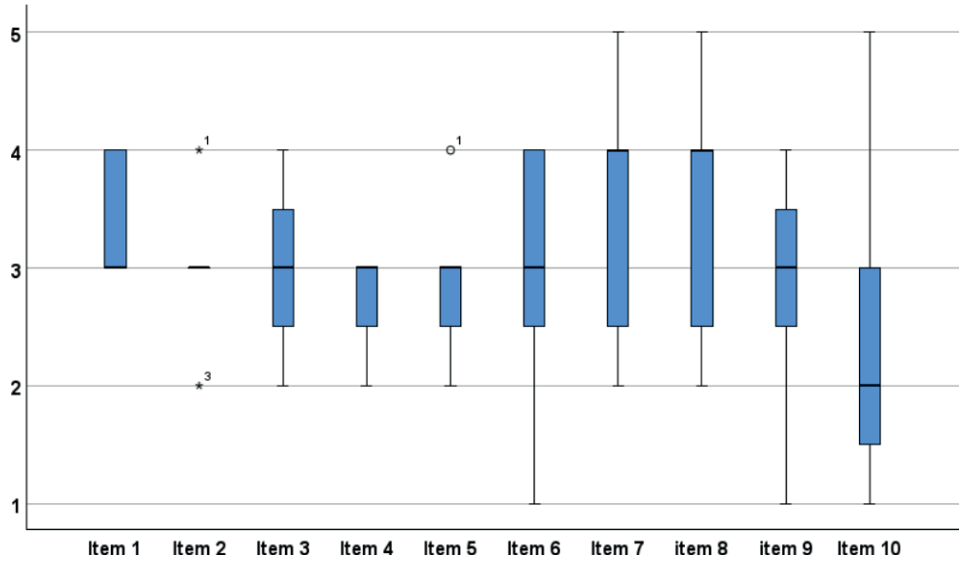

Figure 8. Boxplot of responses to Likert scale, highlighting the median, interquartile range, and the presence of outliers.

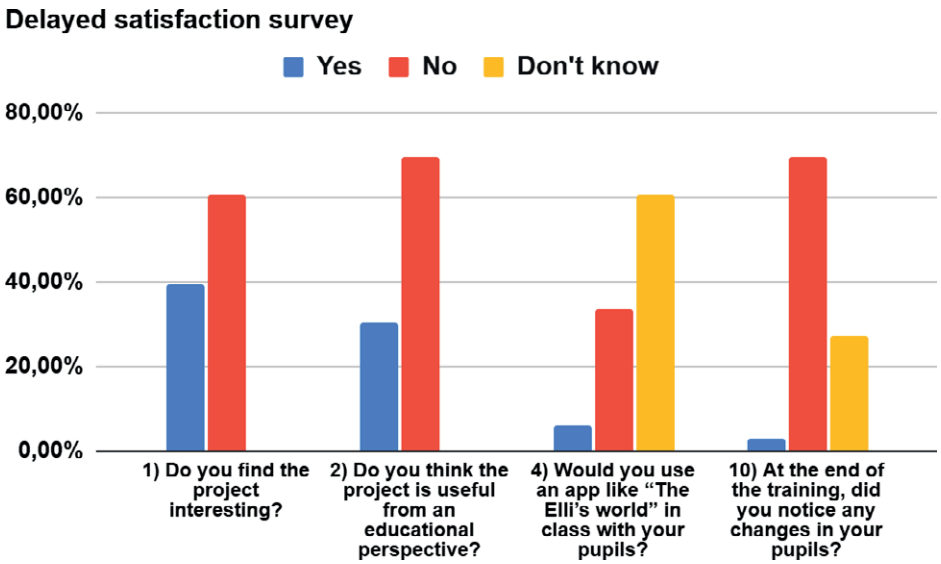

Figure 9. Bar plot of teachers' answers on items 1,2,4 and 10.

tive methodology used with the gamified app (15%). Teachers which found the project not interesting didn't justify their answer.

Regarding the question "Please identify which critical issues you may have encounter", most of them identified multiple reasons, including lack of teacher training (42.4%), excessive duration of training (30.3%) and excessive use of technology (18.2%). The most critical answers are the ones referring to a disbelief in the project's usefulness (33.3%).

7. Discussion

In our digital world, the ability to critically engage with media and information is essential for students' academic success and personal development. This research study investigates an innovative approach to enhancing reading comprehension through the integration of multiple texts within a digital game-based learning environment.

The first research question examined student performance in Media Literacy (ML) tasks – text production and title selection – across four sessions of the serious game Elli's World. Analysis revealed progressive improvement from Session 1 to Session 3, indicating increased awareness in selecting relevant snippets. However, a slight decline in Session 4 raises questions about factors like fatigue, task conditions, or motivational influences. Despite progress, performance remained below the maximum score in the production task, highlighting students' difficulty identifying the most relevant text parts for research-related tasks.

Performance trends varied by grade. Sixth graders showed steady improvement, while seventh graders initially improved but experienced a sharp decline. Fifth graders performed best initially but exhibited the most significant drop-off by Session 4. These results suggest younger students initially struggle with intertextual integration but benefit from gamified environments that sustain motivation throughout training. In contrast, older students may require shorter sessions to mitigate fatigue or external distractions. Findings align with research framing ML as an adaptive dynamic process rather

than a static skill (Potter, 2004; McDougall, 2010). In a media-saturated society, individuals must continually develop critical and creative media engagement skills responsive to diverse contexts. Students need training tailored to their cognitive abilities, age, and capacity for active participation to foster creativity and adaptability.

The second research question explored teacher perceptions of the intervention and training challenges. Survey responses from seven teachers reflected moderate satisfaction but revealed no observed changes in student behaviour or academic performance post-intervention. This disconnect suggests gaps between training content and practical classroom application. Teachers expressed a need for more hands-on, non-computerized activities and clearer production phase guidance. Teacher beliefs significantly influence instructional practices and outcomes (Pajares, 1992), yet barriers like their beliefs on insufficient training, excessive program duration, and over-reliance on technology hinder implementation (Loperfido et al., 2019). Teachers' scepticism about the program's utility highlights the importance of sustained support and professional development to build confidence in innovative methods. Addressing these challenges can bridge the gap between theoretical intervention design and practical classroom success.

Overall, these findings highlight the necessity to maintain continuous dialogue between educators and program developers to ensure that training initiatives, also with digital games, are aligned with classroom realities and effectively address teachers' concerns and students' needs.

8. Conclusions and Future directions

The aims of this case study were (1) to highlight how students' performances on media literacy tasks evolve over time, (2) to evaluate how teachers perceive the game-based intervention and what challenges do they experience.

Findings of the study underscore the importance of game-based learning in enhancing media literacy and reading comprehension. While student performance remained stable across sessions, further research is needed to explore factors affecting engagement and skill application. Gamified learning proves effective for cognitive and motivational outcomes, but tailoring interventions to diverse learners is crucial. Future research should integrate advanced tools like AI and mobile learning to personalize experiences (Cotton & Patel, 2019). Broader approaches addressing not only cognitive skills, but also societal challenges are necessary to cultivate informed citizens for democratic participation (Hobb, 2006).

Teacher engagement challenges, linked to limited knowledge and self-efficacy, highlight the need for professional development on integrating digital and serious games into curricula (Sailer & Homner, 2019). Research should explore leveraging app data to inform teaching and optimize strategies for diverse demographics (Barz et al., 2023; Koivisto & Hamari, 2019). Longitudinal studies are essential to examine the impact of game types, elements, and moderating factors on learning outcomes (Nicolaidou et al., 2019). Collaboration among educators, researchers, and developers can ensure innovative, evidence-based interventions (Fang et al., 2019; Zainuddin et al., 2020).

Furthermore, emphasizing intertextual integration early in education fosters critical skills for navigating complex information. Findings reveal students' difficulty in identifying relevant text sections, stressing the need for interventions that train them in relevance assessment (McCrudden & Schraw, 2007). Game-based learning effectively engages younger students in complex tasks, such as judging relevance across texts, but explicit instruction on criteria is essential for improving outcomes in digital environments.

9. Author contributions

CT and CP contributed to the conception of the study and organization of the database. AS contributed to the organization of the database and the intervention in schools. CB contributed to the conception and design of the intervention. SDR contributed to the organization of the database, the intervention in school and the writing of the manuscript. CT contributed to the writing of the manuscript. All author contributed to manuscript revision, read, and approved the submitted version.

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12. References

Barz, N., Benick, M., Dörrenbächer-Ulrich, L., & Perels, F. (2024). The effect of digital game-based learning interventions on cognitive, metacognitive, and affective-motivational learning outcomes in school: A meta-analysis. *Review of Educational Research, 94*(2), 193–227. https://doi.org/10.3102/00346543231167795

Buckingham, D. (2006). *Media education. Alfabetizzazione, apprendimento e cultura contemporanea*. Erickson.

Castells, M. (2000). *The rise of the networked society* (2nd ed.). Blackwell.

Chang, C.-Y., & Hwang, G.-J. (2020). Trends in digital game-based learning in the mobile era: A systematic review of journal publications from 2007 to 2016. *International Journal of Mobile Learning and Organisation, 14*(1), 68–90. https://doi.org/10.1504/IJMLO.2019.096468

Cotton, S., & Patel, D. (2019). *Gamification in education: What, how, why bother?* IGI Global. https://doi.org/10.4018/978-1-7998-0365-6

Deterding, S., Sicart, M., Nacke, L., O'Hara, K., & Dixon, D. (2011). Gamification. Using game-design elements in non-gaming contexts. *CHI'11 Extended Abstracts on Human Factors in Computing Systems*, 2425–2428. https://doi.org/10.1145/1979742.1979575

European Commission. (2022). *Teaching media literacy in Europe: Evidence of effective school practices in primary and secondary education*. https://doi.org/10.2766/5609

Fang, Y., Wang, Y., & Zhang, Y. (2019). Understanding the effects of gamification on learning outcomes: A meta-analysis. *Educational Technology & Society, 22*(1), 1–11. https://doi.org/10.1007/s10639-018-09840-5

Floridi, L. (2014). *The fourth revolution: How the infosphere is reshaping human reality*. Oxford University Press.

Floridi, L. (2015). *Onlife: Being human in a hyperconnected era*. Springer.

Gee, J. P. (2013). What video games have to teach us about learning and literacy. *Computers in Human Behavior, 29*(1), 1–5. https://doi.org/10.1016/j.chb.2012.08.007

Hair, J. F., Black, W. C., Babin, B. J., & Anderson, R. E. (2010). *Multivariate data analysis* (7th ed.). Pearson.

Hakala, T., et al. (2020). The relationship between cognitive skills and reading comprehension of narrative and expos-

itory texts: A longitudinal study from Grade 1 to Grade 4. *Learning and Individual Differences, 80*, 101–110. https://doi.org/10.1016/j.lindif.2020.101110

Hobbs, R. (1998). Media education in Massachusetts. In A. Hart (Ed.), *Teaching the media worldwide* (pp. 127–144). Erlbaum.

Hobbs, R. (2006). The state of media literacy education. *Journal of Communication, 55*(4), 865–871. https://doi.org/10.1111/j.1460-2466.2005.tb03027.x

Hobbs, R., & Moore, D. C. (2013). *Discovering media literacy: Teaching digital media and popular culture in elementary school*. Corwin Press.

Kapp, K. M. (2012). *The gamification of learning and instruction: Game-based methods and strategies for training and education*. Wiley.

Koivisto, J., & Hamari, J. (2019). The rise of motivational technology: A review of gamification research. *International Journal of Information Management, 45*, 191–210. https://doi.org/10.1016/j.ijinfomgt.2018.10.007

Kress, G. (1992). Media literacy as cultural technology in the age of transcultural media. In C. Bazalgette, E. Bevort, & J. Savino (Eds.), *New directions: Media education worldwide* (pp. 190–202). British Film Institute.

Lipkin, M. (2021). Building media literacy into school curriculums worldwide. *News Decoder*. https://newsdecoder.com/2021/09/20/media-literacy-curriculum/

Loperfido, F. F., Dipace, A., & Scarinci, A. (2019). To play or not to play? A case study of teachers' confidence and perception with regard to digital games at school. *Italian Journal of Educational Technology, 27*(2), 121–138. https://doi.org/10.17471/2499-4324/1062

Mao, W., Cui, Y., Chiu, M. M., & Lei, H. (2022). Effects of game-based learning on students' critical thinking: A meta-analysis. *Journal of Educational Computing Research, 59*(8), 1682–1708. https://doi.org/10.1177/07356331211007098

McCrudden, M. T., & Schraw, G. (2007). Relevance and goal-focusing in text processing. *Educational Psychology Review, 19*(2), 113–139. https://doi.org/10.1007/s10648-006-9010-7

McDougall, J. (2010). *Media literacy and the digital society: Learning, democracy and technology*. Routledge.

Michael, D., & Chen, S. (2006). *Serious games: Games that educate, train and inform*. Thomson Course Technology.

Nicolaidou, I., Tozzi, F., Kindynis, P., Panayiotou, M., & Antoniades, A. (2019). Development and usability of a gamified app to help children manage stress: An evaluation study. *Italian Journal of Educational Technology, 27*(2), 105–120. https://doi.org/10.17471/2499-4324/1050

Pang, Y. (2022). The effects of location-based mobile games on media literacy education in schools based on the case study of Pokémon Go. In *Proceedings of the 2022 8th International Conference on Humanities and Social Science Research (ICHSSR 2022)* (pp. 917–922). Atlantis Press. https://doi.org/10.2991/assehr.k.220504.168

Pajares, M. F. (1992). Teachers' beliefs and educational research: Cleaning up a messy construct. *Review of Educational Research, 62*(3), 307–332. https://doi.org/10.3102/00346543062003307

Pineda, K. G., & Buensuceso, D. B. (2023). Using gamification technique in the assessment of executive function of kindergarten pupils. *International Journal of Research and Innovation in Social Science, 7*(9), 2186–2209. https://dx.doi.org/10.47772/IJRISS.2023.71078

Potter, W. J. (2004). *Theory of media literacy: A cognitive approach*. Sage Publications.

Rivoltella, P. C. (2001). *Media education. Modelli, esperienze, profilo disciplinare*. Carocci.

Sadeghi, N., et al. (2015). Impact of media literacy education on knowledge and behavioral intention. *Journal of Media Literacy Education, 7*(2), 1–12. https://doi.org/10.23860/JMLE-2015-07-02-01

Sailer, M., & Homner, L. (2019). The gamification of learning: A meta-analysis. *Educational Psychology Review, 32*(1), 77–112. https://doi.org/10.1007/s10648-019-09498-w

Zainuddin, Z., et al. (2020). The impact of gamification on student engagement: A systematic review. *Educational Technology Research and Development, 68*(4), 1005–1032. https://doi.org/10.1007/s11423-020-09716-y