Effects of digital game-based learning on students' digital etiquette literacy, learning motivations, and engagement

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ABSTRACT

Recent years have seen a substantial rise in the number of children and teenagers surfing the Internet; however, not all use this resource responsibly. Digital etiquette, a core element of digital citizenship, contributes to proper Internet adoption and reduces inappropriate behavior in cyberspace. To protect children and teenagers from harm online, it is essential to familiarize them with digital etiquette literacy and codes of Internet conduct from an early age. Digital citizenship education is relatively rare in Chinese primary schools. Research on student performance in this regard is also lacking. Digital game-based learning (DGBL) has demonstrated potential to enhance students' learning, motivations, and engagement. In this paper, we designed and implemented a digital game-based course intended to foster students' digital etiquette literacy. A quasi-experiment in a primary school in Guangzhou revealed that compared with conventional learning, DGBL improved students' digital etiquette literacy while positively influencing their learning-related motivations and engagement. This study can serve as a reference for primary or secondary schools interested in teaching digital etiquette to support global digital citizenship education.

1. Introduction

The term "digital natives" refers to individuals born in the digital age who rely heavily on the Internet for information and interaction. More than 5.07 billion people worldwide use this tool, totaling 63.5 % of the population [1]. A report from China Internet Network Information Center revealed that China has nearly 1.07 billion netizens; the country's Internet penetration has reached 75.6 % [2]. The Internet plays a central role in many people's lives. For example, it is an instrument through which children and teenagers can easily access information and communicate via mobile phones, tablets, or computers [3,4]. Online learning has accelerated Internet penetration among these groups during and after the COVID-19 pandemic. Even though 0.2 billion children and teenagers in China use the Internet (18.7 % of Chinese netizens) [2], spending excessive time online can be harmful [5,6]. Insufficient digital literacy and poor awareness of cyberspace etiquette have spawned problems such as cybercrime, cyberbullying, privacy leaks, and Internet addiction.

However, banishing technology from children's lives to mitigate risk is infeasible; people in this age group were born and raised in an era grounded in information technology [7,8]. Technology is a driving force in our globalized society. Children and teenagers

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should be taught to use it wisely [5,9–11]. The notion of digital citizenship reflects norms around using digital technology responsibly [12,13]. Relevant education requires students to recognize the opportunities and threats associated with the digital world and to understand their rights and responsibilities online [14,15]. Digital etiquette is a pillar of digital citizenship, describing an "electronic standard of conduct or procedure that has to do with the process of thinking about others when using digital devices" [16,17]. This type of etiquette guides one's use of technology and encompasses positive attitudes and actions meant to reduce wrongdoing in cyberspace [17,18]. Individuals possessing digital literacy are prepared to manage issues such as cyberbullying, cybersecurity, and digital footprints. Digital etiquette literacy should therefore be prioritized when educating youth.

Ideally, digital citizenship education should coincide with children's initial exposure to digital tools [5]. Ribble pointed out that students' technology-related habits tend to be set by age 12 [19]. Thus, teaching about digital citizenship in primary school would be preferable to waiting until adolescence [5,16]. Schools are responsible for helping students learn how to use technology in a smart, productive manner and to become qualified digital citizens [8,20,21]. Several researchers have promoted digital citizenship in K–12 education. For instance, Ohler [8] developed an Education Professional Learning Network (as part of the International Society for Technology in Education) for students to learn digital citizenship. Akhwani [5] proposed three frameworks to strengthen digital etiquette in primary schools: academic performance (i.e., student learning); the school environment and school behavior; and student life outside of school. Several organizations and institutions have also launched programs to supplement formal education. The International Society for Technology in Education Standards for Students offers guidance for students to become effective digital citizens and global collaborators [22]. Common Sense Media, an American nonprofit organization, has assembled a digital citizenship curriculum and robust resources for K–12 students [23]. Similarly, Facebook's global digital citizenship program features resources intended to empower students to think critically about their digital behavior [24].

Digital citizenship education in China lags behind that in developed countries [25,26]. Teaching practices have yet to be widely implemented in primary schools, and rigorous research on digital etiquette is thin. Related content is typically presented through academic lectures, topic-specific class meetings, or safety-oriented learning materials. These approaches limit learning and lead to low student motivation and interest. It is accordingly difficult to offer Chinese students digital citizenship education, especially when targeting children and teenagers.

Children in primary school today differ from those in the past; modern youth have been brought up in a world where digital devices are ubiquitous. Studies have indicated that using digital games in education can be more effective than conventional lecture-based strategies [27,28]. These games are seen as useful for facilitating situated learning and providing an enjoyable learning experience for students [29,30]. Digital game-based learning (DGBL) is an instructional strategy that merges digital games and educational design [27,31]. It has been shown to promote students' learning motivations and engagement. For example, Dele-Ajayi, Strachan, Pickard and Sanderson [32] discovered that using the SpeedyRocket game in a mathematics course boosted students' understanding of complex concepts and their learning engagement. Khan, Ahmad and Malik [33] suggested integrating a gamified learning approach in chemistry courses, arguing that this tactic can increase learning engagement and create a pleasant learning experience. DGBL has been used in several subject areas, such as science, mathematics, and chemistry, to enhance K–12 education [32–34].

However, it remains unclear exactly how DGBL affects students' learning performance, motivations, and engagement with respect to digital etiquette. We investigated this underexplored realm from a digital citizenship perspective. Specifically, we reconstructed and developed a digital game-based course in a primary school to improve students' digital etiquette literacy. We also examined DGBL's potential impacts on learners' motivations and engagement. The research questions (RQs) proposed in this study were as follows.

RQ1. Do students who learn through DGBL show better digital etiquette literacy than those who learn through traditional approaches?

RQ2. Does DGBL influence students' learning motivations?

RQ3. Does DGBL influence students' learning engagement?

2. Literature review

2.1. Digital citizenship and digital etiquette

As technology continues to permeate daily life, digital citizenship education is increasingly important [35]. Ribble [13] defined digital citizenship as "behavioral norms associated with the use of digital technology" and proposed three themes comprising nine elements: Respect (digital access, digital etiquette, digital law), Educate (digital literacy, digital communication, digital commerce), and Protect (digital rights and responsibilities, digital security, digital health and wellness). Martin et al. [11] framed digital citizenship from different perspectives, contending that such behavior reflects responsible digital habits needed to function in a digital world. Their viewpoint covered five aspects: cyberbullying, digital footprints, digital privacy, digital etiquette, and digital identity. Many researchers further elaborated the facets of digital citizenship. In one case, Yang, Xu and Zheng [36] outlined the standards, elements, and classification of digital citizenship education. By decomposing the factors that constitute digital citizenship, Zheng, Zhong, Huang and Yang [37] improved upon the aforementioned nine elements, which are generally accepted.

Digital etiquette encompasses norms of conduct for using digital technology, participating online, and interacting socially in the virtual world [13]. This cornerstone of digital citizenship applies to the Internet and other digital technologies. Students who display digital etiquette behave appropriately when using these tools [21]. This etiquette is also integral to ensuring that students use technology responsibly [38]. A lack of associated literacy may result in technology abuse, cyberbullying, and online harassment. Students

must learn about digital literacy in the classroom to prevent these types of situations. Adequate education will help youth realize the need to use technology respectfully, thereby avoiding potentially unpleasant circumstances [39].

2.2. Digital game-based learning

In addition to being entertaining, digital games have shown promise in educational settings. They can engage students in learning activities for an extended period [40,41]. Prensky [42] blended digital games with educational design in proposing DGBL theory, thus making the learning process more interesting [27,43]. This instructional strategy produces learning situations that encourage students to construct their own knowledge and solve authentic problems [44]. Researchers have also determined that DGBL can help students gain experience and make well-informed decisions when playing digital games [45,46]. DGBL hence represents a valuable means of nurturing students' abilities and attitudes.

DGBL has started to be broadly employed thanks to its advantages over traditional learning. This approach enhances learning motivation, engagement, and performance among students. For example, Sabirli and Çoklar [47] conducted a comparative study of more than 2000 students and found that educational games significantly increased overall learning motivation and performance. Hartt, Hosseini and Mostafapour [48] highlighted DGBL's potential in promoting learning engagement and collaboration. Meanwhile, Ronimus, Eklund, Pesu and Lyytinen [49] used GraphoLearn in a 6-week intervention with second-graders and observed significant improvement in word-reading skills among children with dyslexia compared with traditional learning. Hwa [50] findings indicated that DGBL could help students acquire knowledge and better understand learning materials. Put simply, this learning mode is known to facilitate students' education.

2.3. Instructional design for DGBL

Although digital games are believed to be effective in education, limited empirical evidence exists to support this assumption [51]. Teachers must first consider whether using games could create cognitive barriers. Hofer [52] road-tested two information literacy games and noted that the relatively low-tech game was preferable. Consequently, game design should be carefully assessed so as not to amplify students' cognitive load.

It is also crucial to account for digital games' roles in the learning process [53,54]. Different games serve distinct purposes, which merit contemplation during design and use [27]. Behaviorist educational games, a replication of traditional learning, are knowledge-centered and usually applied in informal learning settings. Cognitivist educational games are meant to enhance conventional learning via certain aims: by (a) molding students' comprehension of learning objectives and conceptual knowledge and (b) prompting active participation in learning activities. Constructivist educational games complement traditional learning and normally revolve around mastery and interactive experiences to promote self-directed learning [55–57]. Additionally, a game's duration and the decision of when to implement it when teaching are important [58]. These factors can jointly affect students' acquisition and application of new knowledge.

2.4. Digital citizenship education practices

Digital citizenship is critical in K–12 education, particularly during primary school when children's consciousness and future development are being shaped [18]. Several digital citizenship education practices have emerged recently. Tapingkae, Panjaburee, Hwang and Srisawasdi [59] devised a formative assessment–based contextual gaming approach for middle school students in Thailand. Results showed that this technique could enhance students' digital citizenship behavior, most notably regarding online harassment victimization and perpetration. Bickham, Moukalled, Inyart and Zlokower [60] coordinated a cyber wellness curriculum to develop middle school students' positive digital social skills to improve their health and well-being. Likewise, Arachchilage, Love and Beznosov [61] designed a mobile game prototype as an educational tool to help students protect themselves from phishing attacks and enhance digital security literacy.

Moreover, several organizations and institutions have published online resources to supplement formal education. Common Sense Media [23] offers a digital citizenship curriculum with modules on topics such as "media balance and well-being," "privacy and security," and "relationships and communication." Facebook's global digital citizenship program called "We Think Digital" provides courses in digital foundations, digital wellness, and digital engagement [24]. Media Power Youth [62] is another educational nonprofit that offers curricula, trainings, and workshops to help students become responsible and respectful digital citizens as they navigate the pressures of the digital world. The importance of digital citizenship for students is therefore well recognized.

3. Course development integrated with digital games

Digital natives have grown up using the Internet to access information and interact with others [5,63]. However, not all members of this generation can use digital resources and devices correctly [17,64]. From an educational standpoint, teaching students about online etiquette and communication can help them become responsible digital citizens [21,64–66]. Instruction should address behavioral guidelines on the Internet, respecting others, and learning how to express oneself properly. Students should also be taught that people will hold different opinions; even so, individuals should interact with decency, explain their positions, and avoid online arguments [19, 64]. The goal of digital citizenship education is to train students to be qualified digital citizens. This endeavor represents a form of character education in the digital age [8], spanning one's personal life, interpersonal relationships, and social engagement when

teaching content [67].

Teaching students to use technology in a healthy and ethical manner is linked with moral education as well [68]. Harrison and Polizzi [68] stated that teenagers' morality influences their decisions when faced with uncivilized behavior on social media, such as cyberbullying. Moral education is essential in the real world and in cyberspace [15]; it can alleviate prevalent issues such as online harassment [69,70]. Combining digital citizenship education with moral education will aid students in becoming responsible digital citizens as they move from being mere "digital residents" to active participants in online communities [68,71].

Moral education plays a key part in Chinese elementary education by contributing to students' character and moral behavior [72]. As an example, an Ethics and the Rule of Law (ERL) course is required during compulsory education. This citizenship education course is designed to enhance students' morality, prompt legal awareness, and encourage them to pursue higher ideological and ethical standards [73,74]. The course also aims to improve students' moral dispositions and social responsibility, aligning with the objective of digital citizenship education (i.e., to foster moral behavior and values online) [74]. Many aspects of digital citizenship are covered in primary school ERL coursework. For instance, the third-grade textbook includes a unit titled "A Line Connects All." Students are expected to learn about the evolution of modern information technology in this unit. They should also come to appreciate the convenience of the Internet. In the fourth-grade unit "Cyberspace, a Connected New World," students learn how to use the Internet effectively as they familiarize themselves with online ethics and regulations. Another fourth-grade unit, "The Art of Shopping," teaches students about online shopping and how to make rational purchase decisions. The primary school ERL course mirrors digital citizenship education in both learning objectives and content. As such, incorporating this form of education into ERL courses reflects a new attempt to cultivate digital citizenship.

Integrating digital citizenship education in ERL courses can also enhance students' proficiency in navigating the digital world while fostering personal values. In essence, this type of education should focus on literacy in the digital age by drawing on students' real-life experiences. It should specifically emphasize thinking patterns, behavioral habits, and moral intentions in digital life. These factors are vital to one's digital identity and abilities to manage emotions in cyberspace, display empathy, build positive relationships with others, and uphold civic responsibilities.

3.1. Design principles

3.1.1. Course design principles

3.1.1.1. Real-life relevance. Learning content related to digital citizenship should approximate the real-life experiences of Chinese children and teenagers. Zhang [75] noted that students do not develop virtues from preaching or instilling moral norms. Rather, students are inspired when moral education addresses real-world situations; only when students view morality as relevant to their own lives will they be driven to learn more [74,76]. Moral norms can only be deemed a virtue when students fully accept them. Common Sense Media conducted long-term, in-depth research on children's and teenagers' digital lives. Results revealed that children often encounter digital life dilemmas when interacting online. These conundrums are related to technology or social media use and do not always have clear right or wrong answers [67]. Students often have no idea how to respond properly, even when they are hurt or aggrieved [67,77]. Thus, to help students grasp the value of digital citizenship, it is recommended to connect learning material with their personal Internet experiences and the problems they may encounter online. This content will prepare students to address moral dilemmas that arise in digital life and to actively contribute to online communities.

3.1.1.2. Guidance in correct values. Moral education seeks to promote students' moral development and character [78]. This facet of education is rooted in the education of the soul, which shapes one's behavior in addition to evoking noble sentiments, positive emotions, and sound mental health [74]. Educators typically focus on skills that students need to learn but pay less attention to the character required to apply those skills [67]. Students must obtain practical knowledge to navigate the digital world; however, character development is equally important. One's character guides their thoughts and actions throughout life [68]. Digital citizenship education is strongly related to moral education. Students should be led to establish appropriate values when integrating the two. For instance, when teachers emphasize respect and inclusivity, students should be advised to respect others' privacy and opinions, to acknowledge potential consequences when posting information online, and to avoid being impolite.

3.1.1.3. Information technology support. Numerous practical activities have been introduced into moral education to improve students' learning engagement [72]. Generally, however, such education remains traditional and has not yielded desired impacts for students. Teachers can leverage information technologies to capture students' attention and improve teaching success. Carstens, Mallon, Bataineh and Al-Bataineh [79] argued that using information technology to support teaching and learning enables courses to function more effectively. Instructors can then present material in an engaging way and foster student interaction [79]. For instance, teachers may wish to use online question-and-answer sessions or games to prompt interaction and assess students' understanding of digital citizenship. Today's students are well acquainted with technology, and using it is likely to make them more comfortable. Heafner [80] showed that technology helps students search for information and comprehend course material. Using technology to learn and complete tasks can also boost students' confidence, resulting in greater learning motivation. These strategies collectively enrich knowledge construction and student-centered learning.

3.1.2. Digital game design principles

3.1.2.1. Alignment with students' characteristics. To ensure learning engagement while lightning students' cognitive load, games should be designed to match users' developmental characteristics [81]. Games that are too easy can become boring and cause players to quit, whereas games that are too difficult can elicit frustration and also lead to quitting [82]. Essentially, when a game exceeds one's problem-solving capacity, the person may lose interest [83]. Educational content geared towards young children should be cleverly presented and embedded in game mechanics; college students may benefit from games that use professional vocabulary to present scientific information [84,85]. Accordingly, for primary school students, games with storylines can be designed around learning objectives. Students in lower grades should be given game-based tips and instructions to help them complete missions [86]. These approaches will foster a sense of achievement and enable young students to remain focused on the game.

3.1.2.2. Contextual learning. Constructivist theory holds authentic learning scenarios as the heart of educational game design. This approach allows students to interact in real-life situations, connect prior knowledge to new information, and construct meaning while improving their understanding of complex concepts [87]. Thus, digital citizenship games should include realistic scenarios and immersive experiences to help students acknowledge games' salience. Students will also be better able to recognize the value of digital citizenship in everyday life [59]. For example, a game may simulate social media use to help students see how to use technology safely. Students can then translate abstract concepts into concrete actions and link their prior knowledge of digital citizenship with novel contexts.

3.1.2.3. Instantaneous feedback. The learning environment should suit each student's skill level and include tasks with unambiguous objectives and immediate support [88]. Feedback can update players on their performance and their progress towards a goal [89]. This information can also help players identify how their behavior enables them to achieve objectives. Feedback should be positive and constructive—particularly for inexperienced players who may struggle to complete certain actions [84,90]. Instant feedback can help players stay focused as well [91]. If players must wait a long time to realize the impacts of their actions, they will become distracted and lose focus on the game mission. Common forms of game-based feedback include scores, leaderboards, pop-ups, and hints. For low-grade players, feedback can be delivered as visual or auditory cues to increase content-related understanding [90], maintain players' interest in the game, and enhance positive perceptions [92].

3.2. Course content

Etiquette education is the foundation of daily moral education and is an essential element of traditional childrearing [10]. Students need to receive training on appropriate technology use at an early age; every click or tap creates a digital footprint with potentially enduring effects [66]. Students who are taught about digital etiquette and online communication are better equipped to be responsible digital citizens [64,65]. This transformation can reduce both conventional bullying and cyberbullying [70].

In this vein, Hollandsworth et al. [19] investigated the state of digital citizenship education for K–12 learning. The authors especially stressed the role of this type of education in early grades. Based on their recommendations, digital citizenship education should begin in either 1st and 2nd grade (33 %) or in 3rd and 4th grade (32 %). The *Curriculum Standards for Ethics and the Rule of Law*

Table 1
Learning objectives and activities for the digital etiquette course.

Lesson	Learning objectives	Learning activities
Lesson 1. Proper understanding of digital etiquette	◆ Know the concept of digital etiquette ◆ Understand the impacts of digital etiquette on individuals, society, and our country	◆ Group singing: A four-character song "Be polite online" ◆ Introduction: Traditional etiquette and digital etiquette ◆ Interactive digital game: Matching real-life scenarios and netiquette rules ◆ Summary: The impacts of digital etiquette on individuals, society, and our country
Lesson 2. Polite words	◆ Master the rules of using words and emojis on online social platforms ◆ Learn how to be an "online social expert" in actual situations	◆ Exploring: The use of words in online socializing ◆ Exploring: The use of emojis in online socializing ◆ Digital game: Be an "online socialite" when chatting with people of different identities
Lesson 3. Digital etiquette on the Internet	◆ Explore and discuss how to behave properly during online socializing and learning ◆ Know the laws and regulations of digital etiquette	◆ Exploring: Etiquette in online socializing ◆ Discussion: Etiquette in online learning ◆ Introduction: Laws and regulations on digital etiquette
Lesson 4. Proper participation in online games	◆ Learn about verbal violence in online games and how to deal with it correctly ◆ Learn how to treat others with respect and friendliness and how to deal with online verbal violence	◆ Scenario: Pay attention to verbal violence in online games ◆ Analysis: How to deal with verbal violence in online games ◆ Digital game: An alien called "QI" learns about Earth ◆ Summary: To be a qualified digital citizen

in Compulsory Education (2022 Edition) released by the Chinese Ministry of Education indicates that students in 3rd and 4th grade are expected to acquire basic social etiquette (e.g., understanding the fundamentals of interaction), foster a sense of equality among people, and respect each other online. These principles are tightly linked with digital etiquette, a main aspect of digital citizenship. It is accordingly logical to integrate digital citizenship in ERL courses; doing so will enhance students' morality and responsibility in cyberspace.

By carefully inspecting learning materials, we found that the learning objectives in Unit 3 of the 4th-grade ERL course, titled "Cyberspace, a Connected New World," were closely related to digital etiquette. This unit requires students to develop a proper understanding of online socialization and to demonstrate basic etiquette and ethics in cyberspace. They can then cultivate moral behavior and a positive attitude on the Internet. We combined Unit 3 with digital etiquette by reconstructing the content as described below.

Fourth-grade students can communicate online independently. However, because they may not pay attention to specific standards of online interaction, improper wording or misunderstandings can occur when socializing in digital spaces. This unit is designed to assist students in mastering digital etiquette and enhancing their online morality through four lessons. The first lesson concentrates on Internet etiquette, bringing students into a connected new world. In the second lesson, students complete two exploratory activities to learn rules about using words and emojis when socializing online. Lesson 3 discusses how students can behave properly when interacting and learning online. In the fourth lesson, students learn about verbal violence in online games and how to navigate it. The course essentially instructs students on how to become qualified digital citizens in terms of Internet etiquette. Specific course activities are detailed in Table 1.
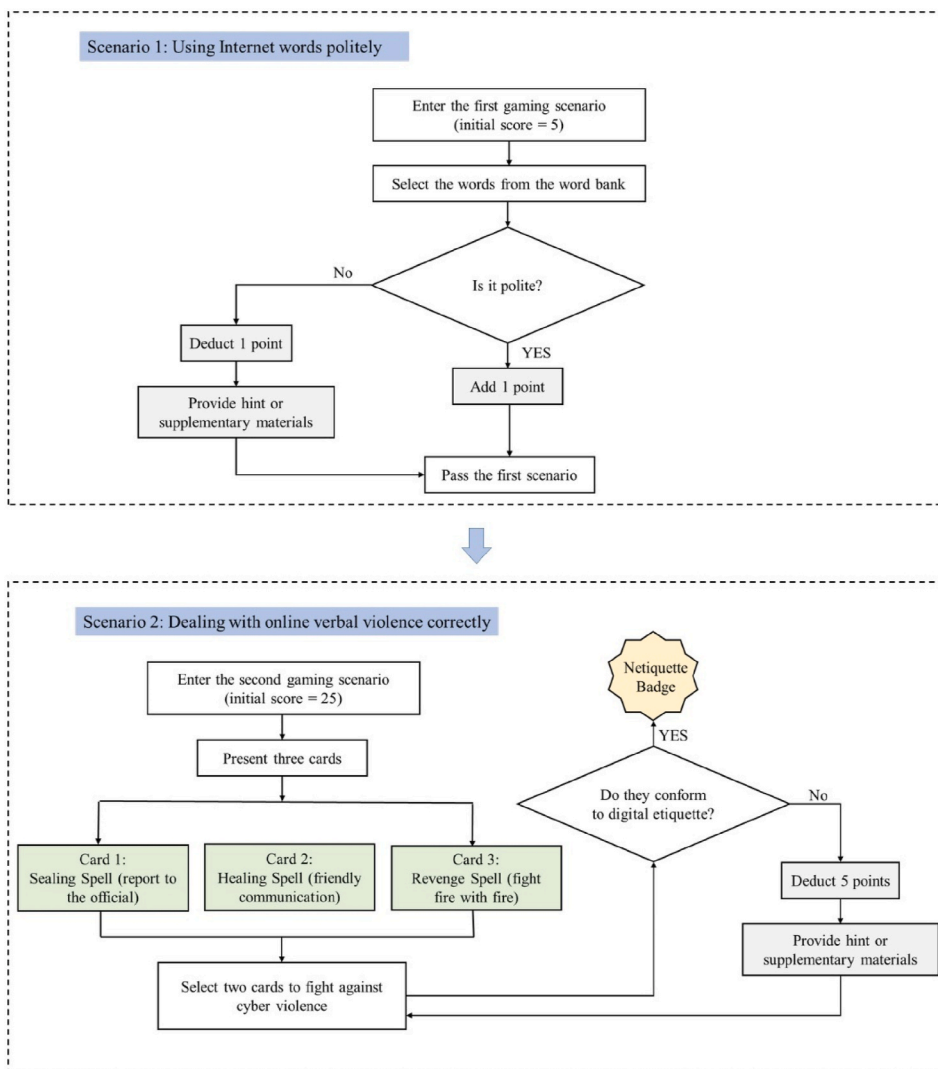

Fig. 1. Procedure of digital game.

3.3. Development of the digital game

We developed a 2D digital game called "An alien named QI learns about Earth" based on the aforementioned game design principles. This web-based game was developed using Articulate Storyline3, supporting both computers and mobile devices. The game's objective is to help students understand concepts in digital etiquette and to reinforce responsible online behavior. The game scenes blend text and animation, accompanied by background music and sound effects. Fig. 1 shows the game process. Fig. 2(a) presents the game's background: the main character, an alien named QI, comes to Earth to learn about Internet etiquette. The game includes a pair of scenarios, "Using Internet words politely" and "Dealing with online verbal violence correctly." Players complete tasks in each scene by obtaining feedback through clicking and dragging. Students' individual scores are displayed at the end of the game as pictured in Fig. 2(b).

The game features a flat cartoon style with rich and harmonious colors. The rules are simple to understand and have user-friendly manipulation. Instant feedback in various forms, such as hints or encouragement, guides students towards correct decisions. Students can empathize with the game's characters through the two scenarios while developing problem-solving skills. This game is universally applicable given its modest network requirements, compatibility with multiple devices (e.g., smartphones, tablets, computers), and suitability for online and offline teaching.

The first scenario is related to using polite words in cyberspace. All students enter with an initial score of 5 points. The alien QI visits this digital world for the first time and discovers many blocks showing popular Internet words. The player's task is to maneuver the spaceship to crash into or avoid these blocks, as displayed in Fig. 2(c). When the spaceship collides with a polite word (e.g., "Hello," "Sorry," "Thank you"), the player receives 1 point. Conversely, if the spaceship hits an impolite word (e.g., "Stupid," "Shut up"), a point will be deducted from the student's score as shown in Fig. 2(d). This scenario is meant to help players distinguish different types of Internet words, prepare students for online life, and enable them to interact with others in a friendly and polite manner.

The second scene involves online verbal violence. In this scenario, QI loses an online game and is insulted by other players, as in Fig. 3(a). This scene is meant to inspire players to consider what to do upon encountering cyberbullying. The card game depicted in Fig. 3(b) follows. In this game, players must select three "spell" cards (one at a time) to be paired with "online verbal violence." Each card represents a strategy to cope with online verbal violence. The Sealing Spell refers to "reporting to police or a certain authority," the Healing Spell involves "communicating with others in a kind and friendly manner," and the Revenge Spell entails "fighting back with verbal violence" (see Fig. 3[c]–[e]). Three new cards are respectively generated after pairing: "Report to the Official" (Card 1), "Friendly Communication" (Card 2), and "Fight Fire with Fire" (Card 3) (see Fig. 3(f)). Finally, players are required to choose two cards from among these three to fight against cyber violence (see Fig. 3(g)). If they make the correct decision that conforms to digital etiquette (Cards 1 and 2), they receive a Netiquette Badge, as displayed in Fig. 3(h); otherwise, they lose 5 points and receive a "Please reconsider" prompt on the screen. They must then continue choosing cards until the correct answer is selected. This task can help players realize the significance of treating others in a respectful, friendly fashion online. The game also teaches individuals ways to protect themselves in digital spaces.
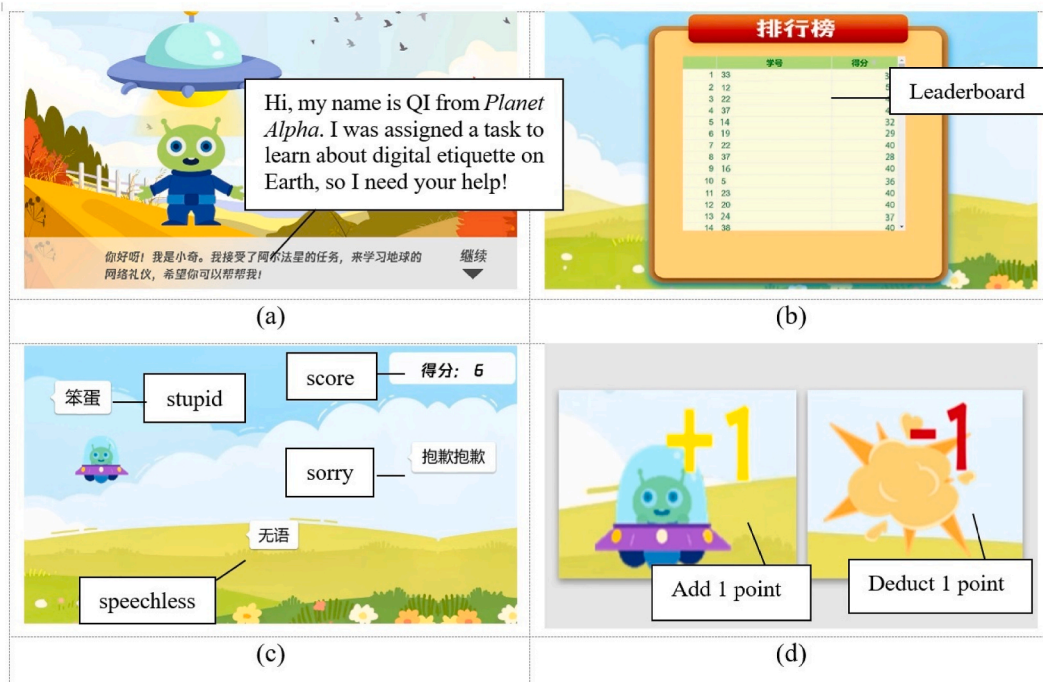

Fig. 2. Screenshots from digital game: (a) story background; (b) leaderboard; (c) game activities; (d) feedback.
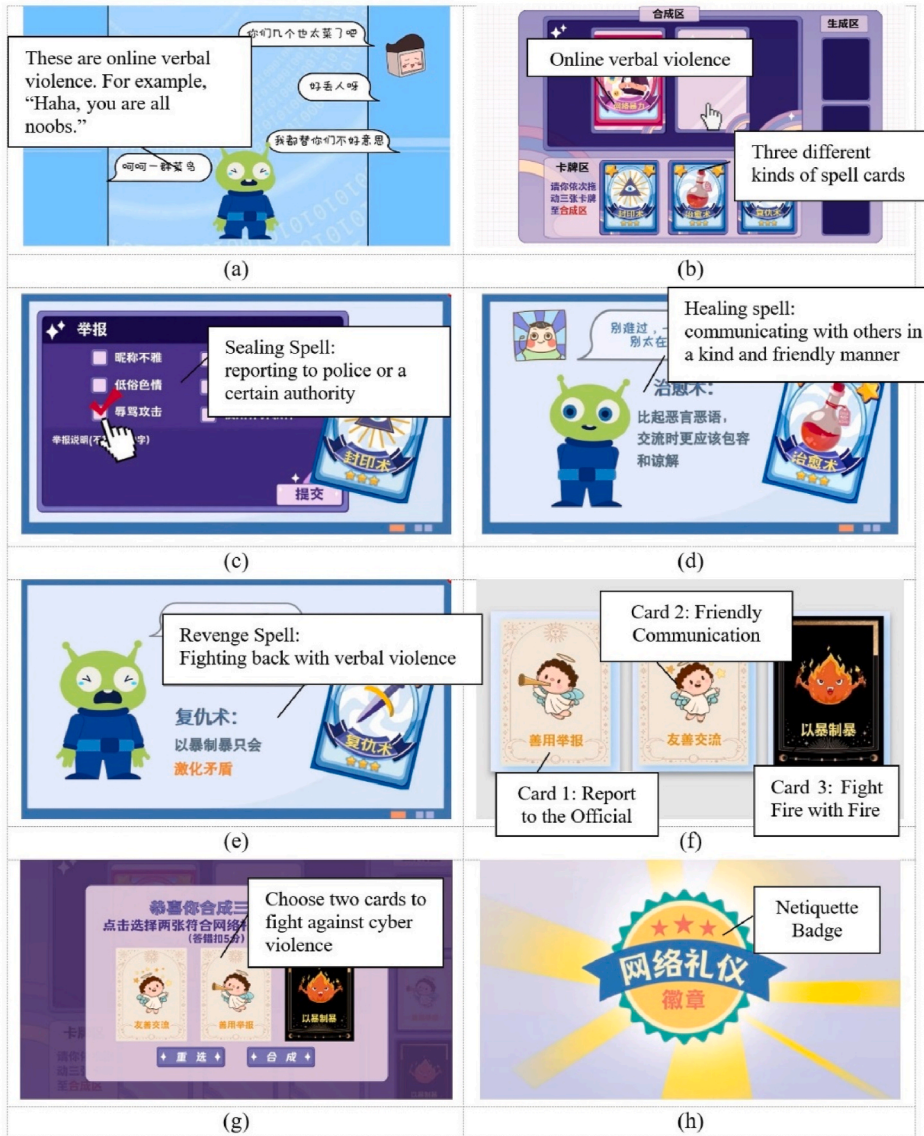
Fig. 3. Screenshots from digital game (the second scene): (a) story background; (b) card game; (c) description of Sealing Spell card; (d) description of Healing Spell card; (e) description of Revenge Spell card; (f) screenshot of the new cards; (g) selecting cards; (h) netiquette badge.

4. Research method

4.1. Experimental participants

A quasi-experimental design was used in this study. Participants consisted of 80 fourth-graders (age 9) from Yunshan Primary School in Yuexiu, Guangzhou, China, who were selected through random sampling. The experimental and control groups each contained 40 students (experimental: 23 boys and 17 girls; control: 20 boys and 20 girls). The experimental group participated in digital etiquette learning activities with DGBL, and the control group completed activities based on conventional learning. All students were informed that their participation was voluntary and anonymous.

4.2. Experimental procedure

The experiment was carried out in November 2022. At the beginning of the first lesson, the experimental and control groups completed a digital etiquette literacy questionnaire to evaluate their prior level. Afterwards, students attended four lessons (totaling 160 min) over the following 4 weeks. The learning objectives and activities for the course can be found in Table 1. Details of the course

content are available in Appendix A. Throughout the course, one teacher serves as the primary instructor, while another teaching assistant maintains classroom order. In the experimental group, students acquired knowledge about digital etiquette through a digital game-based approach. They accessed the game on iPads using Google Chrome, while the backend automatically collected game data. Meanwhile, students in the control group learned the same content in the traditional way (without digital game). After completing the course, participants from both groups filled out a post-digital etiquette literacy questionnaire, learning motivations questionnaire, and learning engagement questionnaire. Finally, comparisons were made between the pre- and post-questionnaires of the two groups. The experimental procedure is illustrated in Fig. 4.

4.3. Measurement tools

The study included a digital etiquette literacy questionnaire, learning motivations questionnaire, and learning engagement questionnaire. Details are listed in Appendix B. Experts reviewed these tools to ensure the measures' effectiveness. Experienced teachers also checked all questionnaires to determine their suitability for primary students.

4.3.1. Digital etiquette literacy questionnaire
The digital etiquette literacy questionnaire was adapted from Jones and Mitchell [12] scale and Pector and Hsiung's [93] learning objectives for digital etiquette. The full digital etiquette scale (DES) focuses on whether students can (a) apply different strategies in different situations and (b) treat others with respect and kindness. The instrument covers four dimensions, namely etiquette awareness (EA), polite words (PW), respectful behavior (RB), and active participation (AP). The EA construct centers on students' adherence to rules, norms, and expectations in the digital world (e.g., "I should learn how to communicate appropriately when I join a new online community"). PW guides students in interacting politely online to prevent misunderstandings and cyberbullying (e.g., "I should be very cautious when posting comments online so that people won't misunderstand me"). RB refers to respecting online privacy and others' behavior (e.g., "When chatting online, I will avoid getting into arguments and conflicts with others"). AP requires students to actively participate in cyberspace to create a harmonious online environment (e.g., "When there are malicious comments or bullet-screen comments, I will respond rationally or intervene"). The questionnaire includes 17 items scored on a 5-point Likert scale ranging from (1) *strongly disagree* to (5) *strongly agree*. Statistical results showed that this tool had adequate reliability (Cronbach's α = 0.889) and validity (Kaiser–Meyer–Olkin [KMO] value = 0.858).

4.3.2. Learning motivations questionnaire
The learning motivations questionnaire was modified from Wang and Chen's [94] Motivation Scale. It contains two dimensions, namely intrinsic and extrinsic motivation. Intrinsic motivation (IM) reflects students' needs or interests, representing an internal
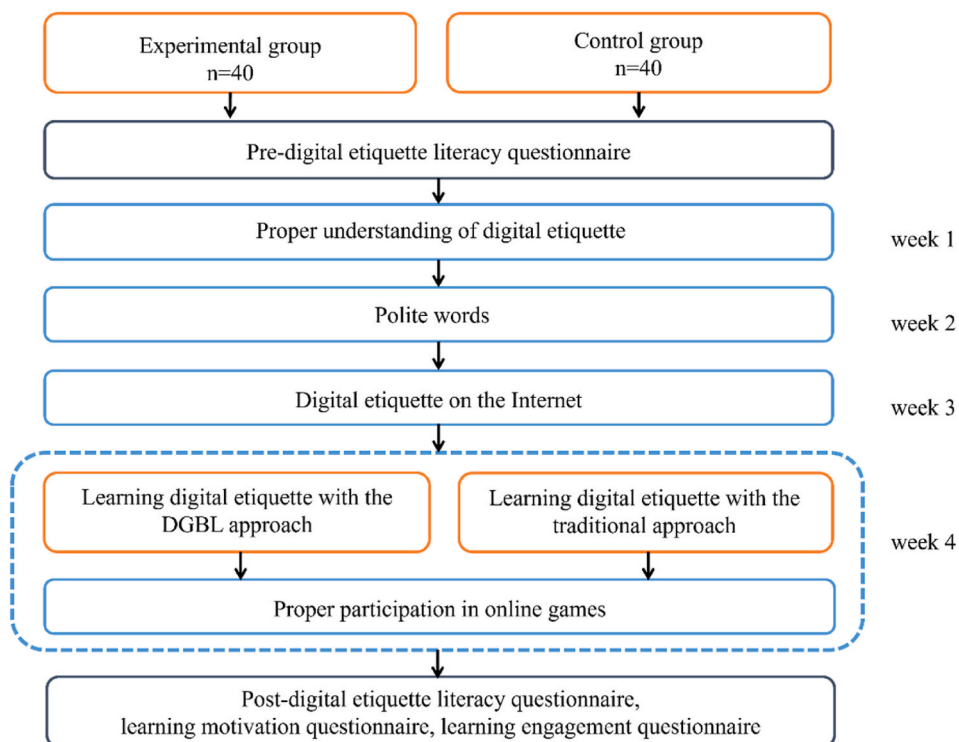
Fig. 4. Experimental procedure.

driving force that external factors do not directly influence. IM is also related to one's identity and well-being (e.g., "I prefer course material that really challenges me so I can learn new things."). Extrinsic motivation (EM) manifests from external facets that can modify one's behavior. Learning that is driven by rewards (e.g., grades or praise) is an example of EM (e.g., "If I can, I want to get better grades in this class than most of the other students."). This questionnaire contains six items scored on a 5-point Likert scale. It was found to possess strong reliability (Cronbach's ɑ = 0.912) and validity (KMO value = 0.892).

4.3.3. Learning engagement questionnaire

The learning engagement questionnaire was adapted from the Utrecht Work Engagement Scale–Student [95] and has three dimensions: cognitive engagement (CE), behavioral engagement (BE), and emotional engagement (EE). CE captures one's willingness to strive to learn complex ideas and master difficult skills (e.g., "After completing all the activities, I have a clear understanding of the course content."). BE refers to one's extent of engagement in learning activities and assignments (e.g., "I carefully take notes in learning each lesson."). EE covers positive and negative reactions towards teachers and classmates, which are thought to influence one's willingness to learn (e.g., "I think the course is interesting and helps me understand netiquette"). The questionnaire's six items are measured on a 5-point Likert scale. This measure was deemed reliable (Cronbach's ɑ = 0.954) and valid (KMO value = 0.871).

4.4. Data collection and analysis procedure

The questionnaires were translated from English to Chinese to ensure they could be administered in the participants' native language. These paper-based questionnaires were filled out by the participants both at the beginning of the first lesson and at the end of the final lesson. All collected responses were entered into Microsoft Excel and then imported into IBM SPSS Statistics version 26.0 for statistical analysis. The Kolmogorov-Smirnov test was used to inspect the normality and homogeneity of variance of all the data. Values are presented as the mean ± standard deviation for data that were normally distributed or median and interquartile range for data that were not normally distributed for continuous variables. Initially, an independent samples *t*-test was performed to investigate differences between the two groups in terms of digital etiquette literacy to eliminate the influence of prior experience. Then, we employed a one-way analysis of covariance test and an independent samples *t*-test to compare students' changes in digital etiquette literacy in the two groups, both between the two groups and within the two groups. Finally, we employed nonparametric Mann-Whitney U tests to compare students' learning motivation and engagement between the two groups. Furthermore, Spearman correlation analyses were conducted to examine the relationships between game scores and both learning motivation and learning engagement, respectively. The statistical significance was set at $p < 0.05$.

5. Experimental results

5.1. Digital etiquette literacy

5.1.1. Analysis of the two groups

To eliminate the impact of prior experience, we conducted a pre-test by administering the digital etiquette literacy questionnaire before our experiment. An independent samples *t*-test was used to examine their scores on digital etiquette literacy across the two groups. No significant difference emerged ($t = 0.44$, $p = 0.97 > 0.05$); that is, both groups demonstrated similar digital etiquette literacy before the experiment (see Table 2).

A one-way analysis of covariance (ANCOVA) was used to evaluate students' post-digital etiquette literacy in the two groups. The pre-digital etiquette literacy questionnaire served as a covariate, and Levene's test for homogeneity of variance was not violated. Table 3 lists significant differences between both groups on post-digital etiquette in terms of DES [$F(1,77) = 7.434, p = 0.008 < 0.05$],

Table 2
Independent samples *t*-test results for two groups' pre-digital etiquette.
Levene's Test for Equality of Variances.

Dimension		F			Sig.
Digital Etiquette Scale (DES)		0.557			0.114
Etiquette Awareness (EA)		1.215			0.274
Polite Words (PW)		1.730			0.192
Respectful Behavior (RB)		0.624			0.432
Active Participation (AP)		1.699			0.196

Dimension	Mean (SD)		SE		*t*
	EG ($n = 40$)	CG ($n = 40$)	EG ($n = 40$)	CG ($n = 40$)	
Digital Etiquette Scale (DES)	3.83 (0.47)	3.82 (0.72)	0.07	0.11	0.44
Etiquette Awareness (EA)	3.87 (0.61)	3.93 (0.81)	0.10	0.13	−0.35
Polite Words (PW)	3.93 (0.58)	3.25 (0.77)	0.09	0.12	0.95
Respectful Behavior (RB)	4.07 (0.73)	4.02 (0.93)	0.12	0.15	0.29
Active Participation (AP)	3.96 (0.60)	4.09 (0.84)	0.09	0.13	−0.73

t-test for Equality of Means.

Table 3

Analysis of covariance results for two groups' post-digital etiquette.

Dimension	Group	Mean (SD)	Adjusted mean	SE	$F(1,77)$
Digital Etiquette Scale (DES)	EG ($n = 40$)	4.45 (0.42)	75.64	0.421	7.434*
	CG ($n = 40$)	4.17 (0.50)	70.96	0.497	
Etiquette Awareness (EA)	EG ($n = 40$)	4.48 (0.46)	4.48	0.463	3.677
	CG ($n = 40$)	4.25 (0.59)	4.25	0.586	
Polite Words (PW)	EG ($n = 40$)	4.29 (0.61)	4.28	0.608	4.194*
	CG ($n = 40$)	3.98 (0.63)	3.99	0.630	
Respectful Behavior (RB)	EG ($n = 40$)	4.67 (0.45)	4.66	0.454	4.204*
	CG ($n = 40$)	4.43 (0.54)	4.44	0.536	
Active Participation (AP)	EG ($n = 40$)	4.32 (0.63)	4.34	0.625	7.446*
	CG ($n = 40$)	3.96 (0.71)	3.94	0.709	

*$p < 0.05$.

PW [$F(1,77) = 4.194$, $p = 0.044 < 0.05$], RB [$F(1,77) = 4.204$, $p = 0.044 < 0.05$], and AP [$F(1,77) = 7.446$, $p = 0.008 < 0.05$]. No significant between-group differences were observed for EA. In sum, the experimental group's DES, PW, RB, and AP were significantly better than those of the control group. The DGBL approach thus appeared more effective than the traditional method in enhancing students' digital etiquette literacy.

5.1.2. Analysis within the two groups

A paired-sample *t*-test was carried out to analyze students' changes in digital etiquette literacy (pre-vs. post-digital etiquette scores), as displayed in Table 4. Both groups' post-digital etiquette literacy significantly exceeded their pre-digital etiquette literacy in terms of DES ($p = 0.000 < 0.01$), PW ($p = 0.000 < 0.01$), and RB ($p = 0.000 < 0.01$). These students therefore engaged appropriately in cyberspace. Interestingly, regarding EA, only students in the experimental group showed significantly higher digital etiquette literacy than before ($p = 0.000 < 0.01$). This outcome conveyed the positive impact of DGBL. Surprisingly, neither group's AP varied significantly after taking the course.

5.2. Learning motivations

A nonparametric Mann–Whitney *U* test was performed to determine students' learning motivations in the experimental and control groups. Table 5 indicates that students in the experimental group scored significantly higher than those in the control group on EM ($p = 0.012 < 0.05$). IM did not differ significantly between these groups.

A Spearman correlation analysis between game scores and learning motivation was completed as well. Table 6 reveals that students' game scores were significantly and positively correlated with both IM ($p = 0.002 < 0.01$) and EM ($p = 0.000 < 0.01$). Students who were more motivated to learn hence appeared to earn higher scores in the game.

5.3. Learning engagement

A nonparametric Mann–Whitney *U* test was also used to measure students' learning engagement. Table 7 presents significant differences between the experimental and control groups with respect to LE ($p = 0.035 < 0.05$), BE ($p = 0.015 < 0.05$), and EE ($p = 0.020 < 0.05$). No significant difference applied to CE. This shows that students participating in DGBL were ultimately more active than those who learned in the traditional way.

We performed a correlation analysis to further explore the relationship between game scores and learning engagement. Table 8 shows that students' game scores were significantly positively correlated with LE ($p = 0.012 < 0.05$), CE ($p = 0.003 < 0.01$), and BE ($p = 0.041 < 0.05$) but had no significant association with EE. As such, EE could not predict students' game scores.

Table 4

Independent samples *t*-test results for two groups' digital etiquette.

Dimensions	EG ($n = 40$) Mean (SD)		t	CG ($n = 40$) Mean (SD)		t
	Pre	Post		Pre	Post	
Digital Etiquette Scale (DES)	3.82 (0.60)	4.31 (0.48)	6.38**	3.82 (0.72)	4.17 (0.50)	2.78*
Etiquette Awareness (EA)	3.90 (0.71)	4.36 (0.54)	4.78**	3.93 (0.15)	4.25 (0.59)	1.88
Polite Words (PW)	3.32 (0.68)	4.14 (0.63)	8.44**	3.25 (0.77)	3.99 (0.63)	4.86**
Respectful Behavior (RB)	4.04 (0.83)	4.55 (0.51)	5.29**	4.02 (0.94)	4.43 (0.54)	2.68*
Active Participation (AP)	4.04 (0.73)	4.14 (0.69)	1.07	3.96(0.71)	4.09 (0.84)	0.96

*$p < 0.05$, **$p < 0.01$.

Table 5
Mann–Whitney *U* test results for two groups' learning motivations.

Dimension	EG (*n* = 40)	CG (*n* = 40)	*z*	*p*
Learning Motivation (LM)	4.00(3.38,4.63)	3.58(3.33,4.00)	−2.267	.023*
Intrinsic Motivation (IM)	3.88(3.50,4.75)	3.75(3.25,4.19)	−1.876	.061
Extrinsic Motivation (EM)	4.25(3.50,4.88)	3.50(3.00,4.00)	−2.502	.012*

*p < 0.05.

Table 6
Correlation analysis between learning motivations and game scores.

Dimension	Game Score (GS)
Learning Motivation (LM)	0.558**
Intrinsic Motivation (IM)	0.480**
Extrinsic Motivation (EM)	0.609**

**$p < 0.01$.

Table 7
Mann–Whitney *U* test results for two groups' learning engagement.

Dimension	EG (*n* = 40)	CG (*n* = 40)	*z*	*p*
Learning Engagement (LE)	4.40 (4.00, 5.00)	4.30 (3.70, 4.60)	583.00	0.035*
Cognitive Engagement (CE)	4.50 (4.00, 5.00)	4.50 (4.00, 4.50)	663.50	0.174
Behavioral Engagement (BE)	4.00 (4.00, 5.00)	4.00 (3.00, 4.00)	564.00	0.015*
Emotional Engagement (EE)	4.50 (4.50, 5.00)	4.00 (4.00, 4.50)	566.50	0.020*

*$p < 0.05$.

Table 8
Correlation analysis between learning engagement and game scores.

Dimension	Game Score (GS)
Learning Engagement (LE)	0.395*
Cognitive Engagement (CE)	0.456**
Behavioral Engagement (BE)	0.324*
Emotional Engagement (EE)	0.289

*$p < 0.05$, **$p < 0.01$.

6. Discussion

6.1. Digital etiquette literacy of the two groups

Regarding RQ1, it was found that students who learned through the digital game had better digital etiquette literacy than those who learned traditionally. This outcome highlights digital games' positive impacts in the context of education [44,83,96]. Specifically, significant differences were found in DES (digital etiquette scale), PW (polite words), RB (respectful behavior), and AP (active participation). These results imply that the proposed approach improved students' behavior in cyberspace, enabling them to communicate more politely and raising awareness of how one's behavior affects others. These results are consistent with those of Tapingkae et al. [59], who also studied DGBL and found it to decrease students' online harassment. It seems possible that these results are due to the fact that digital games afford students the chance to cultivate skills through practice without feeling as though the involved tasks are insurmountable [97,98]. Students can reinforce their skills or achieve specific learning aims while engaging in an enjoyable activity [99]. At the same time, DGBL additionally echoes Vygotsky's notion of the zone of proximal development: effective learning occurs when students receive appropriate support to succeed but must still navigate challenges within their skill range [100]. Although no significant difference applied in this case between the two groups' EA (etiquette awareness), the experimental group scored higher on this construct than the control group.

Furthermore, we analyzed digital etiquette literacy questionnaire scores within the two groups. Students' scores of digital etiquette literacy improved after the experiment based on DES, PW, and RB. It implies that students who learned via both DGBL and traditional learning displayed more suitable actions in cyberspace, corroborating earlier findings [59,101]. As for EA, the experimental group had higher post-test scores (vs. pre-test scores) whereas the control group did not. A possible reason for this may be that the provided game has allowed students to develop and verify their understanding of digital etiquette through gameplay [102,103]. More precisely, students' encounters with authentic gaming scenarios facilitated sound decisions [104]. Yet strong EA tends to be cultivated over time [5]; digital games may only have an immediate effect on students' awareness. Therefore, schools have a responsibility to create a

digitally friendly atmosphere and to carefully arrange learning materials on digital etiquette [105] to improve students' further awareness of this concept.

6.2. Learning motivations of the two groups

With respect to RQ2, our findings regarding learning motivations corroborate work from Erhel and Jamet. The results showed that students who participated in DGBL demonstrated greater learning motivations compared with students taught via traditional methods [106], especially in terms of EM (extrinsic motivation). Prior research has noted the importance of in-game rewards, such as scoreboards or leaderboards, which are sometimes used to promote players' EM and encourage learning [84]. Meanwhile, we found no significant differences manifested in our two groups' IM (intrinsic motivation). This result is likely to be related to the fact that the focal school strictly limited students' use of digital devices, and the game was designed to last about 13 min. Extending this duration could potentially strengthen students' motivations [107,108]. Moreover, it has previously been observed that enhancing players' identification with digital characters in games can foster IM [109]. Allowing players to customize their characters' appearance (e.g., by choosing clothing, hair color, skin tone, or spaceship model) may increase students' identification with the game [84,88]. Furthermore, we examined the experimental group's learning motivations and game scores in depth and unearthed a significant positive correlation between game scores and intrinsic and extrinsic motivations. This finding aligns with research demonstrating the utility of competitive game elements (e.g., scores or leaderboards) in promoting students' learning motivations [110].

6.3. Learning engagement of the two groups

For RQ3, the results indicated that students who played the digital game showed better learning engagement as indicated by BE (behavioral engagement) and EE (emotional engagement). Khan et al. [33] similarly discovered that incorporating digital games into a course can create a pleasant learning experience. Different from other educational resources, digital games obligate students to react to events in a virtual world, which is naturally more interactive than conventional learning. DGBL is hence apt to pique students' interest [111] and increase their behavioral and emotional engagement. In addition, in-game challenges, scoreboards, and leaderboards can also inspire students to achieve learning objectives while boosting learning engagement [110,112]. Dynamic educational activities fit well with the motivation psychology [51]. Conversely, we did not discern significant differences in the two groups' CE (cognitive engagement). Whitton [113] reported similar results. Greene [114] observed that self-report instruments cannot fully capture the nuances of cognitive engagement in learning tasks. The brief duration of games [115] and students' distinct cognitive needs [116] may further explain the lack of significant differences in this regard.

We again analyzed the experimental group to thoroughly explore the relationship between learning engagement and game scores. Further analysis showed that students' scores were significantly related to LE (learning engagement), CE, and BE. Digital games can therefore promote student engagement as documented elsewhere [116–118]. The results showed that there was no significant correlation existed between students' EE and game scores. This pattern coincides with that of Sagayadevan and Jeyaraj [119], who discovered that EE failed to predict academic achievement. Hidi and Renninger's four-phase model of interest development provides some support for these findings [120]. The authors described the concepts of situational interest (which is typically externally supported) and individual interest (characterized by positive feelings, stored knowledge, and stored value). In our study, the digital game may have only triggered situational interest among students in the experimental group because the game was too short to elicit more enduring personal interest [120].

7. Conclusions and limitations

Technological advances have brought sweeping changes to social interaction, leading to increased dependence on the Internet [121]. People need to use this tool responsibly, abide by online ethics, and protect their personal information [15,114]. Researchers have begun to acknowledge the power of digital citizenship and to examine its effectiveness in schools [59,60,101,122]. Although some previous studies have attempted to integrate digital citizenship education into formal learning through digital game-based learning, such as a course to promote good digital citizenship behaviors in real-world situations [59], a digital health education course for reducing cyberbullying and interrupting negative peer pressure [60], a cybersecurity course to protect ourselves from phishing attacks [61], and a library course to help younger students foster digital citizenship and information literacy [123], the influence of digital games on students' learning outcomes, learning motivation, and engagement in the field of digital etiquette has not been fully explored. We accordingly reconstructed and implemented a digital game-based course to cultivate students' digital etiquette literacy, aiming to improve their understanding and behavior on the Internet. It is believed that when students use polite words on online social media platforms and learn how to deal with verbal violence in online games by using the proposed game, they not only improve digital etiquette awareness, but also develop good online behavior. Through an experiment within the primary ERL course, we compared this approach with conventional learning. Statistical results from 80 students revealed that DGBL increased students' digital etiquette literacy and online ethics. Students who engaged in DGBL showed better digital etiquette literacy than those who learned through traditional modes, especially in terms of PW (polite words), RB (respectful behavior), and AP (active participation). That is, students who learned with the DGBL method showed better digital behaviors. At the same time, the DGBL method positively influenced students' learning motivations and engagement as well. In sum, this approach can demonstrably improve students' learning performance and digital etiquette literacy. Compared to previous research, the major contribution of this study is that it takes the initiative to focus on students' digital etiquette literacy (one of the most important elements of digital citizenship) and improves it through

education practice by proposing a digital game-based learning strategy to developing digital citizenship courses to provide students with more immersive learning experiences. Our study can serve as a reference for primary or secondary schools interested in teaching digital etiquette to support global digital citizenship education.

Although the findings show that the digital game-based learning facilitated the improvement of students' digital etiquette literacy, learning motivation and engagement, there are certain limitations that call for further investigation. First, these results were derived from a single school, which implies that the findings may change in other samples with different backgrounds or of different ages. To draw more comprehensive conclusions, experiments should be conducted that include more participants from different schools and longer-term studies. Second, student data were collected using self-report measures. Scholars should incorporate formative evaluation into future studies to uncover additional factors shaping the effectiveness of DGBL. Lastly, network capacities (e.g., bandwidth, speed, etc.) can also influence the effectiveness of DGBL. When a large number of students log into the game server, excessive Internet connections and slow responses may lead to game delay, thereby affecting students' learning experience. Therefore, further studies are needed to collect data from students with different schools (e.g., urban schools and rural schools) and of different grades, to collect more formative data from teaching practice, and to provide technical support for reliable infrastructure.

Ethics statement

This study was reviewed and approved by the Institutional Review Board (IRB) of the South China Normal University, with the approval number: SCNU-JX-2022078. Written informed consent was obtained from all the participants. The questionnaires were anonymized, and patients were free to opt out of participation in the study whenever they were uncomfortable.

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Data availability statement

Data will be made available on request by contacting the author.

Additional information

No additional information is available for this paper.

CRediT authorship contribution statement

Yunxiang Zheng: Writing – original draft, Supervision, Methodology, Funding acquisition, Conceptualization. **Junyi Zhang:** Writing – original draft, Resources, Methodology, Investigation, Data curation. **Yumeng Li:** Writing – original draft, Software, Resources, Investigation, Data curation. **Xiaomin Wu:** Writing – original draft, Software, Data curation. **Ruofei Ding:** Software, Resources. **Xianfei Luo:** Software, Resources. **Panpan Liu:** Software, Resources. **Jingxiu Huang:** Supervision, Funding acquisition, Conceptualization.

Declaration of competing interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

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Appendix A. Learning content for the digital etiquette course

Lesson	Content
Lesson 1. Proper understanding of digital etiquette	Introduction to digital etiquette.
	The impacts of digital etiquette on individuals, society, and our country

(*continued*)

Lesson	Content
Lesson 2. Polite words	Rules for using words politely when communicating with others online.
	Rules for using emojis properly on social media platform.
Lesson 3. Digital etiquette on the Internet	Digital etiquette in online socializing and online learning.
	Rules and regulations related to digital etiquette.
Lesson 4. Proper participation in online games	Verbal violence in online games.
	Treating others with respect and friendliness in online games.
	Ways to deal with online verbal violence in online games.
	An alien named QI learns about Earth (Gameplay).

Appendix B. Questionnaires

Digital etiquette literacy questionnaire

Dimensions	Items
Etiquette awareness (EA)	1. My favorite place to be online is where people are respectful toward each other.
	2. I should learn how to communicate appropriately when I join a new online community.
	3. I can freely express myself online without any concerns.
	4. Neglecting our online behavior can equally have legal consequences.
	5. The conduct of individuals on the Internet can exert a profound influence on the societal and even national image.
Polite words (PW)	6. When chatting online through WeChat, TikTok, or in game chatroom, I will pay attention to the accuracy of punctuation and wording.
	7. I should be very cautious when posting comments online so that people won't misunderstand me.
	8. When chatting online, I tend to employ polite words more often than Internet buzzwords, abbreviations, and the like.
	9. I'll blame my teammate in the chatroom vocally or textually for making a mistake in the game.
	10. When chatting online, I hate seeing vulgar things, even though some of them make sense.
Respectful behavior (RB)	11. I won't send duplicate comments in live broadcasts or bullet-screen to avoid disturbing others.
	12. Even if I disagree with someone online, I still pay attention to my wording so it doesn't come across as mean.
	13. When I post or send someone's photos online, I am very cautious to avoid making him (her) fell embarrassed or in trouble.
	14. When communicating online with teachers or elders, I use formal language.
	15. When chatting online, I will avoid getting into arguments and conflicts with others.
Active participation (AP)	16. When someone offends me online, I'll fight back in the same way (i.e., to fight fire with fire).
	17. When I see someone forwarding harmful images or spreading fake information about others, I will remind these parties.
	18. When there are malicious comments or bullet-screen comments, I will respond rationally or intervene.
	19. I believe that learning how to communicate politely online is more conducive to network harmony than issuing more regulations.

Learning motivations questionnaire

Dimensions	Items
Intrinsic motivation (IM)	1. I prefer course material that really challenges me so I can learn new things.
	2. I prefer courses that spark my curiosity, even if they are difficult to learn.
	3. When I have the opportunity, I choose course assignments that I can learn from even if they don't guarantee a good grade.
Extrinsic motivation (EM)	4. Getting a good grade in this class is the most satisfying thing to me.
	5. If I can, I want to get better grades in this class than most of the other students.
	6. I want to do well in this class because it is important to show my ability to my family, friends, teachers, or others.

Learning engagement questionnaire

Dimensions	Items
Cognitive engagement (CE)	1. After completing all the activities, I have a clear understanding of the course content.
	2. When I finish my assignment, I reflect on what I've learned in the course.
Behavioral engagement (BE)	3. I carefully take notes in learning each lesson.
	4. I can actively interact and discuss with teachers and classmates.
Emotional engagement (EE)	5. I think the course is interesting and help me understand netiquette.
	6. If there are similar courses, I'm willing to actively participate in learning.

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