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Gamification in Cybersecurity Education: Leveraging Google's Interland for Elementary Students

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Abstract

This study explores the role of gamification in cybersecurity education for elementary students, focusing on Google's Interland game within the Be Internet Awesome initiative. By reviewing existing literature and analyzing Interland's design, the study highlights how gamified approaches can enhance digital citizenship and cybersecurity awareness among young learners. Grounded in Self-Determination Theory and Flow Theory, the article examines Interland's interactive mechanics, which teach concepts like password security and responsible online behavior. Research suggests that gamification increases engagement, but evidence on long-term behavioral impact remains limited. Visual aids, such as screenshots of Interland's sections, illustrate its educational potential. The study advocates integrating gamified tools into curricula, supported by teacher training and policy development, to foster safe digital practices. Recommendations include empirical studies to assess Interland's effectiveness and cross-cultural comparisons to enhance global applicability.

Keywords: Cybersecurity Education, Gamification, Interland, Digital Citizenship, Elementary Education, Self-Determination Theory, Flow Theory, Be Internet Awesome

1. Introduction

The digital age has transformed education, with children as young as four engaging with online platforms, necessitating early cybersecurity education (Livingstone et al., 2017). Cybersecurity, encompassing the protection of digital systems from threats like hacking and phishing, is critical in an era where 65% of children aged 3–17 are exposed to online risks (UNICEF, 2021). Traditional teaching methods often fail to engage young learners, prompting exploration of innovative approaches like gamification (Deterding et al., 2011). Gamification, the integration of game-like elements into non-game contexts, enhances motivation and learning outcomes (Hamari et al., 2014).

Google's Interland, part of the Be Internet Awesome initiative, is a web-based game designed to teach elementary students cybersecurity and digital citizenship through interactive adventures (Google, 2018). This study examines Interland's potential to foster cybersecurity awareness, drawing on theoretical frameworks and existing research to propose its integration into educational settings. Visual representations of Interland's interface and gameplay, as shown in Figure 1, provide a glimpse into its engaging design.

Figure 1: Screenshot of Interland's starting screen, accessed via a browser search, featuring the "Let's Get Started" button and options to select one of four sections. *Source*: Google Be Internet Awesome (2018).

The objectives are to review gamification's role in cybersecurity education, analyze Interland's design, and provide recommendations for educators and policymakers.

2. Literature Review

2.1. Gamification in Education

Gamification leverages game mechanics like points, badges, and challenges to enhance engagement (Deterding et al., 2011). Studies show it improves motivation and retention in educational settings (Hamari et al., 2014). For elementary students, gamified learning aligns with developmental needs, fostering active participation (Nicholson, 2015). Research by Sailer et al. (2017) found that gamification increases intrinsic motivation when tasks are meaningful and interactive.

2.2. Cybersecurity Education and Digital Citizenship

Cybersecurity education aims to equip individuals with skills to navigate digital risks (Goodrich & Tamassia, 2011). For young learners, this includes understanding password security, recognizing phishing, and practicing responsible online behavior (Alruwaili & Alotabi, 2023). Digital citizenship, encompassing ethical technology use, is critical for fostering safe online communities (Ribble, 2015). Studies indicate that early education reduces cyber vulnerabilities (Livingstone et al., 2017).

2.3. Gamification in Cybersecurity Education

Gamified cybersecurity tools, such as Space Shelter and CyberCIEGE, have shown promise in engaging learners (Coenraad et al., 2020). A survey by Tioh et al. (2022) highlights games like Interland as effective for teaching digital safety. Alruwaili and Alotabi (2023) found that Be Internet Awesome significantly improved digital citizenship awareness among middle school students, suggesting potential for younger learners. However, evidence on long-term behavioral change is limited (Giannakas et al., 2016).

2.4. Global and Local Contexts

Globally, countries like the USA and South Korea integrate cybersecurity into curricula, while Turkey lags in structured programs (Aslay, 2017). The EU's fragmented approach highlights the need for unified strategies (ENISA, 2020). In Turkey, low cybersecurity awareness underscores the urgency of innovative educational tools (Çetin, 2014).

3. Theoretical Framework

Gamification's effectiveness is grounded in Self-Determination Theory (SDT), which posits that motivation stems from autonomy, competence, and relatedness (Ryan & Deci, 2000). Interland's interactive tasks foster autonomy, while rewards enhance competence. Flow Theory (Csikszentmihalyi, 1990) explains engagement through balanced challenge and skill levels, evident in Interland's game design. These theories frame how gamification can make cybersecurity education engaging for young learners.

4. Case Study: Interland

4.1. Overview of Interland

Google's Interland, part of the Be Internet Awesome initiative, is a free, web-based game targeting children aged 4–12 (Google, 2018). It features four interactive "lands," each designed to teach specific cybersecurity and digital citizenship skills, as illustrated in Figures 2–5:

Kindness Kingdom: Teaches empathy and strategies to combat cyberbullying through scenarios where players respond to virtual bullying situations, fostering positive online interactions..

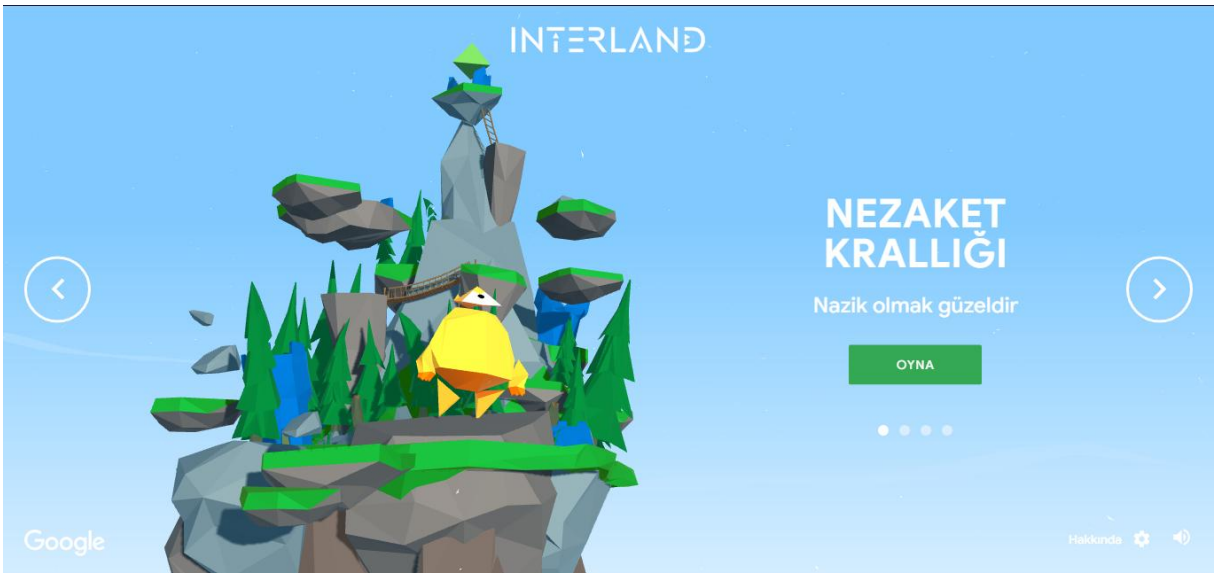

Figure 2: Screenshot of Kindness Kingdom in Interland, illustrating cyberbullying prevention education.

Source: Google Be Internet Awesome (2018).

Reality River: Focuses on identifying misinformation and avoiding deceptive content, encouraging critical evaluation of online sources.

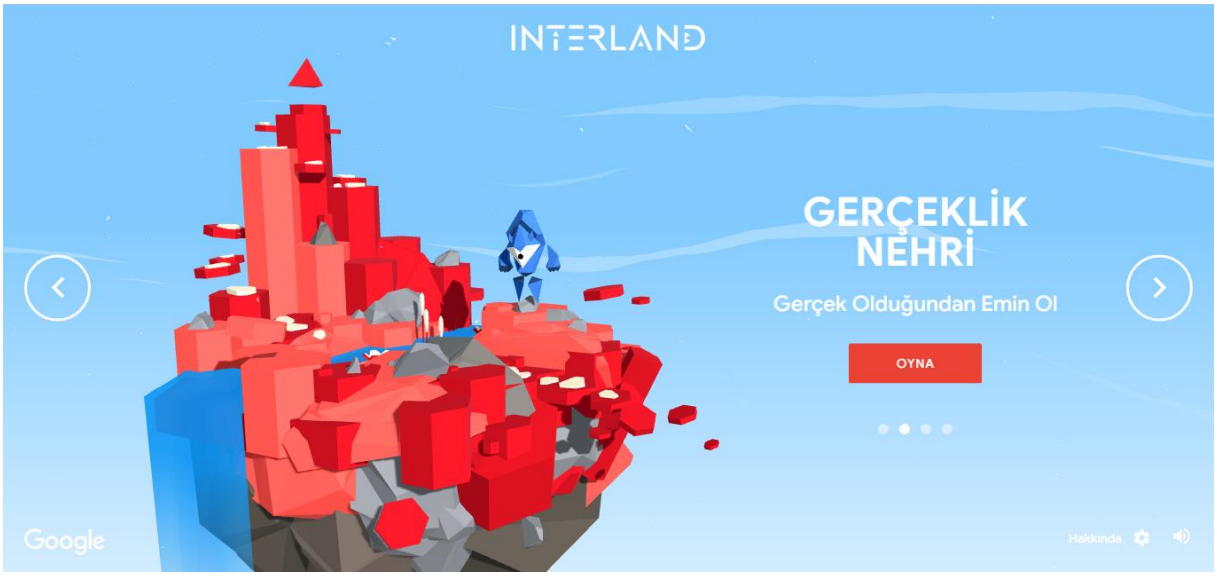

Figure 3: Screenshot of Reality River in Interland, teaching players to distinguish accurate online information.

Source: Google Be Internet Awesome (2018).

Mindful Mountain: Emphasizes responsible data sharing and online privacy awareness, guiding players to make cautious decisions about personal information.

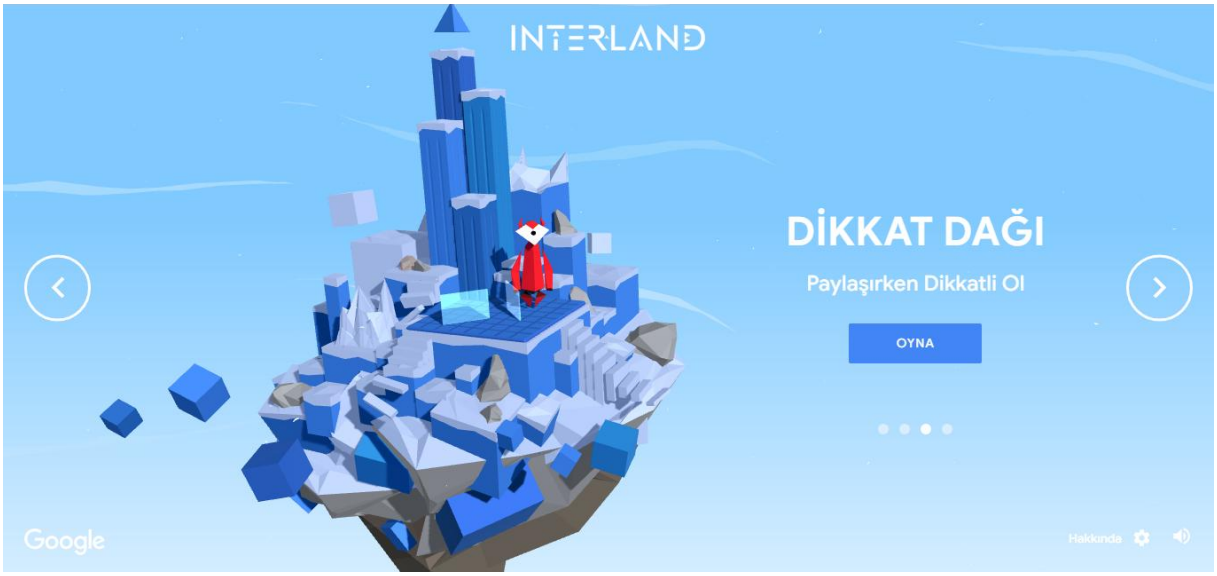

Figure 4: Screenshot of Mindful Mountain in Interland, promoting careful information sharing and privacy protection.

Source: Google Be Internet Awesome (2018).

Tower of Treasure: Guides players in creating secure passwords to protect accounts, reinforcing cybersecurity practices through interactive challenges.

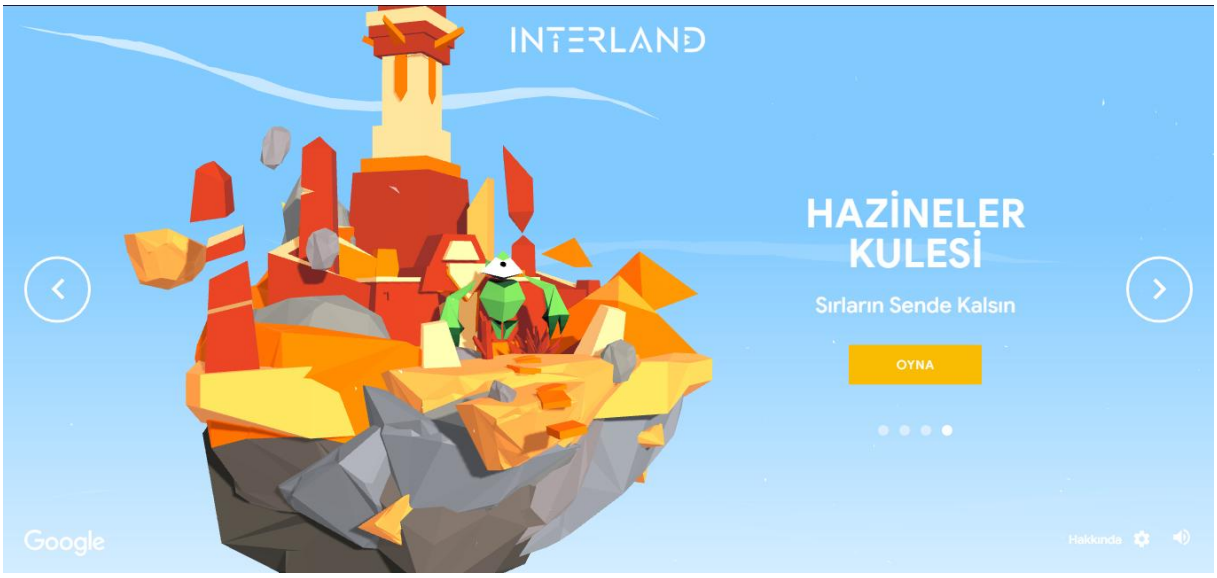

Figure 5: Screenshot of Tower of Treasure in Interland, guiding players on strong password practices.

Source: Google Be Internet Awesome (2018).

Each land uses mini-games to reinforce cybersecurity concepts, culminating in a certificate for completion, enhancing motivation (Jin et al., 2020).

4.2. Game Mechanics and Educational Value

Interland's design aligns with educational psychology, using rewards and challenges to engage players (Nicholson, 2015). For example, in Tower of Treasure, players create strong passwords to protect treasures, reinforcing security practices. Alruwaili and Alotabi (2023) found that such interactive elements increased awareness among middle school students, suggesting applicability to younger learners. The game's narrative-driven approach, where players navigate virtual worlds, mirrors real-world digital challenges, making abstract concepts tangible (Werbach & Hunter, 2012).

4.2.1. Gameplay Dynamics

Interland's gameplay is structured around tasks that require players to follow instructions, complete challenges, and answer questions to progress. At the start of each section, players receive clear guidance on objectives, such as navigating obstacles or collecting items, which reinforces engagement through structured yet autonomous play (Ryan & Deci, 2000). For example, in Kindness Kingdom, players are tasked with avoiding negative interactions, learning to identify and mitigate cyberbullying behaviors. Upon completing tasks, players answer questions to reinforce learning, receiving immediate feedback and tips to guide their progress. This question-and-answer mechanism ensures comprehension and encourages critical thinking.

Players use directional keys to control in-game actions, collecting symbols to achieve goals, as seen in tasks requiring strategic navigation to avoid "bad characters" (e.g., virtual representations of cyber threats). Successful completion of tasks earns praise and rewards, enhancing motivation (Sailer et al., 2017). In Tower of Treasure, players fortify their tower against adversaries by answering security-related questions correctly, directly applying cybersecurity knowledge. These mechanics, combining challenge and reward, align with Flow Theory's principles of optimal engagement (Csikszentmihalyi, 1990).

4.3. Implementation in Classrooms

Interland's accessibility, requiring only a web browser, makes it suitable for diverse educational settings. Google's accompanying curriculum provides lesson plans tailored for elementary classrooms, guiding teachers on integrating the game into subjects like social studies or technology (Google, 2022). For instance, Kindness Kingdom can be paired with lessons on empathy, while Reality River supports media literacy education. The game's age-appropriate design (4–12 years) ensures relevance for elementary students, though teachers must be trained to align gameplay with learning objectives (Yılmaz et al., 2016). Challenges include ensuring equitable access to technology and addressing varying digital literacy levels among students (Chigona et al., 2016). Schools can implement Interland in computer labs or as part of blended learning, with teachers facilitating discussions to reinforce concepts learned during gameplay.

5. Discussion

5.1. Effectiveness of Gamification

Gamification enhances engagement by leveraging intrinsic motivators like autonomy and competence (Ryan & Deci, 2000). Interland's interactive tasks, such as answering questions to progress or collecting symbols to fortify a tower, create an immersive learning experience (Kapp, 2012). Studies suggest that gamified tools improve knowledge retention, but their impact on long-term behavioral change remains underexplored (Giannakas et al., 2016). For example, while Interland's question-and-answer system reinforces cybersecurity concepts, empirical evidence on whether students apply these lessons in real-world settings is limited (Coenraad et al., 2020). The game's feedback mechanisms, providing tips and praise, align with Landers' (2014) findings that immediate feedback enhances learning outcomes. Werbach and Hunter (2012) argue that gamification's success depends on meaningful challenges, which Interland achieves through scenario-based tasks like identifying misinformation in Reality River.

5.2. Educational Implications

Integrating Interland into elementary curricula can address cybersecurity education gaps, particularly in Turkey, where structured programs are limited (Aslay, 2017). The game's tasks, such as avoiding deceptive content in Reality River or protecting data in Mindful Mountain, align with digital citizenship goals (Ribble, 2015). Teachers can use Interland to teach cross-curricular skills, such as critical thinking in social studies or problem-solving in technology classes. In Turkey, where digital literacy levels vary, Interland's intuitive design can bridge gaps for students with limited prior exposure to technology (Çetin, 2014). However, effective implementation requires teacher training to ensure alignment with educational standards and to facilitate post-game discussions that reinforce learning (Çakır & Uzun, 2021). Policymakers should develop national strategies to support gamified tools, including funding for technology access, teacher professional development, and curriculum integration.

5.3. Limitations

The lack of empirical data on Interland's effectiveness for elementary students limits conclusions. While Alruwaili and Alotabi (2023) demonstrated its impact on middle school students, younger learners' developmental differences may affect outcomes. For instance, younger children may

struggle with abstract concepts like misinformation, requiring teacher guidance (Jin et al., 2020). Cultural factors, such as varying attitudes toward technology in Turkey, may influence adoption (Chigona et al., 2016). Additionally, access to reliable internet and devices remains a barrier in some regions, potentially exacerbating educational inequities (UNICEF, 2021). The game's reliance on immediate feedback may not guarantee long-term retention of cybersecurity practices without reinforcement through follow-up activities.

5.4. Future Research

Future studies should:

Conduct pre-and post-tests to measure Interland's impact on elementary students' cybersecurity knowledge and behavior.

Compare gamified and traditional methods to assess relative effectiveness.

Explore cross-cultural applications, examining how cultural contexts influence Interland's efficacy.

Investigate the role of teacher facilitation in maximizing learning outcomes.

Examine long-term behavioral impacts, such as whether students apply learned skills in real-world digital interactions.

Assess the scalability of Interland in low-resource settings, addressing technological barriers.

6. Conclusion and Recommendations

Google's Interland, as part of the Be Internet Awesome initiative, offers a promising approach to cybersecurity education for elementary students. Its engaging design, as depicted in Figures 1–5, fosters awareness of digital citizenship and cybersecurity principles through interactive tasks and rewards. The game's mechanics, such as answering questions to progress and receiving a personalized certificate upon completion (see Figure 5), enhance motivation and reinforce learning (Sailer et al., 2017). For instance, tasks requiring players to avoid virtual adversaries or collect symbols to achieve goals mirror real-world cybersecurity challenges, making abstract concepts tangible (Kapp, 2012).

To maximize Interland's impact, the following recommendations are proposed:

Curriculum Integration: Embed Interland in elementary curricula, aligning it with subjects like social studies and technology to teach digital citizenship.

Teacher Training: Develop professional development programs to equip teachers with skills to facilitate gamified learning and lead post-game discussions.

Policy Development: Advocate for national cybersecurity education strategies, including funding for technology infrastructure, curriculum development, and teacher training.

Empirical Research: Conduct longitudinal studies to assess Interland's effectiveness in fostering long-term cybersecurity behaviors, particularly in diverse cultural and socioeconomic contexts.

Community Engagement: Launch awareness campaigns to involve parents and communities in promoting safe digital practices, reinforcing Interland's lessons outside the classroom.

Cross-Sector Collaboration: Encourage partnerships between schools, technology companies, and policymakers to develop scalable gamified tools for cybersecurity education.

By integrating gamified tools like Interland, educators can cultivate a generation of digitally literate and responsible citizens, addressing the evolving demands of the information society.

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