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PAPER

Improving Security and Environmental Awareness through Game-Based Learning with Minecraft

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ABSTRACT

This paper presents an innovative educational approach centered on the use of the game Minecraft to shape attitudes and develop knowledge in young people. The Children's University summer camps, although they revolve around various subjects, share a common goal: to enhance environmental and safety awareness and foster technological interest among younger generations. These camps enable students from participating elementary schools to learn interactively about key areas such as sustainable energy sources, information protection, and security in buildings. In the virtual realm of Minecraft, players encounter real-life challenges that demand the utilisation of their creativity and problem-solving abilities. The effectiveness of the camps was measured through questionnaire surveys. 33.3% of participants felt the knowledge acquired at the camp was very useful, and 38.9% felt it was useful for their future studies or careers. 55.6% of the participants felt that their problem-solving skills and creativity had greatly improved during the camp, while 27.8% noticed a less significant improvement in these skills. The camps were characterised by an atmosphere of cooperation and openness. The results of questionnaire surveys confirmed the effectiveness of the camps, not only in terms of improving environmental and safety awareness but also in terms of fostering creative work through cooperation.

KEYWORDS

environmental and security awareness, game-based learning (GBL), Minecraft

1 INTRODUCTION

Environmental and security awareness play an increasingly important role in European and national education policies [1]. As part of environmental education, students in lower grades are introduced to concepts related to renewable energies, energy conservation, energy consumption, energy crises, geothermal energy, and hydroelectric power. Today's generation places great importance on climate protection and the direct preservation of the environment. Their openness to renewable energy sources underscores the importance of a mindful approach to energy consumption and energy efficiency issues.

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Despite the importance of environmental sustainability and safety awareness, they are often not given sufficient emphasis in education [2]. This is a serious omission, as the utilisation of renewable energy sources and the implementation of environmentally friendly energy technologies are essential for sustainable development. These advances contribute to the quality of life and well-being of future generations [3].

The development of digital skills is particularly crucial in elementary and high schools [4]. Security technology represents an area of digital competence where a multifaceted set of knowledge and skills can be applied and developed. It is important to note that the rapid evolution of scientific fields poses challenges to curricula, educational institutions, teachers, and parents.

The rapid pace of technological change demands the mastery of new knowledge and skills through adaptable methods and innovative educational approaches. In the summer of 2023, we implemented game-based learning (GBL) by utilising a modified version of Minecraft to teach children about renewable energy sources and safety technologies at three different children's camps. One of our academic camps aimed to engage participants in creating and implementing a model green city on an island, with a focus on climate protection. Another camp focused on repairing objects that require security, with an emphasis on civil protection and security requirements, including aspects of cyber defense. Through these specialised camps, we actively involved young individuals in technological and environmental challenges.

Our programmes in the public education sector can play a key role in shaping the career choices of future generations. This is why we believe it is essential to introduce simplified forms of thought formation into higher education disciplines at an early stage. An inter- and multi-disciplinary approach should be readily available in higher education to prepare students for the challenges of the future. By modifying the Minecraft software, our goal is to enhance participants' skills, including problem-solving, algorithmic thinking, systems approach, creativity, self-confidence, and concentration. These skills empower them to gain a deeper understanding and knowledge of physics, mathematics, electrical engineering, computer science, and security technology.

This paper is organised as follows: In Section 2, we explain how learning through the Minecraft game can significantly contribute to shaping mindsets, supported by a comprehensive literature review. Section 3 describes the objectives, methods, and themes of our three children's summer camps, as well as the results of our camper questionnaire survey. The main challenge is to evaluate the effectiveness of the camps in terms of the knowledge acquired, collaboration during tasks, and the creative atmosphere of the camps. Section 4 discusses the results. Section 5 draws conclusions.

2 HOW MINECRAFT GAME-BASED LEARNING HELP SHAPE MINDSETS

In contemporary education, GBL is becoming increasingly prevalent and popular, with the aim of enhancing the learning experience [5]. The utilisation of game content and processes contributes to more efficient knowledge mastery and skill development [6–7]. The experience of GBL not only provides students with valuable experiences but also stimulates and sustains their interest and motivation [8–9]. In science education, a negative attitude towards subjects and a lack of interest can be problematic. GBL also enhances student engagement and motivation in the sciences by incorporating game elements that actively involve students in the teaching-learning process for extended periods, thus sustaining their attention and interest [10].

Digital game-based learning (DGBL) involves the use of player-developer applications displayed on devices during the learning process [6], [9]. These games create an engaging learning environment, actively involving students in the learning

process [11]. In virtual spaces [12] created by these games, students can explore, experiment, and enjoy themselves [13]. Given the significant popularity of video games, especially among children and teenagers, their educational applications in natural sciences, such as mathematics, biology, and chemistry, are effective [14–16]. Moreover, they extend to other areas, such as history, language education, and civic knowledge [17].

Minecraft, as a sandbox video game, offers a versatile platform for learning due to its user-friendly nature [18]. Sandbox games are characterised by non-linear structures, providing players with the freedom to build and create according to their ideas. In Minecraft, players can create new 3D worlds using blocks, construct buildings, and shape virtual animal and plant environments. Minecraft offers both single-player and multiplayer modes, including creative mode, where players have access to almost all blocks and items for unrestricted creation. Survival mode involves resource exploitation and dealing with various creatures, which resemble real-life scenarios. Hardcore mode is an intensified version where players face increased challenges. Once they die, they cannot respawn, thus ending the game. There is also an educational version called Minecraft Education Edition, which is equipped with tutorials and a colorful interface. While it serves as a valuable tool for bringing natural sciences closer to students, it does not allow for extensive software development. The integration of Minecraft in education fosters the development of 21st-century competencies, such as communication, cooperation, social skills, algorithmic and logical thinking, critical thinking, design thinking, creativity, openness, innovation, problem-solving, and spatial orientation [19–22].

Short [23] outlines various applications of Minecraft in education, such as biology students learning about forest species and tree levels. Virtual excursions to deserts, jungles, and the North Pole can be conducted to demonstrate the impact of deforestation and the formation of deserts. In chemistry classes, Minecraft can illustrate the TNT explosion process, and molecular models can be built using blocks [24]. Mathematics classes can incorporate Minecraft for calculating area and perimeter, identifying the required elements to enclose imaginary flower gardens, and investigating various geometric shapes and their properties.

2.1 Summer Minecraft University: crafting intelligent, secure buildings

In the summer of 2023, the university organised three children's camps that featured a modified version of Minecraft Java Edition. This version utilised modifications to make the game more realistic. Currently, there are no modifications that realistically model the scientific fields that the university aims to teach. Therefore, they configured and parameterized 60 mods to align more closely with reality, integrating these modifications into the game to enhance the educational experience. The camp titled "Developing Smart and Secure Buildings in the World of Minecraft" attracted the participation of 12 students. In the first session, the camp focused on the development of "Island City" with green energy, involving 17 participants, and in the second session, 22 participants joined.

The thematic days began with collaborative discussions, fostering a connection with the topics among the students. The educational approach included theoretical explanations through presentations, digital educational materials, Minecraft elements, and 3D models. The Moodle framework facilitated knowledge processing during the camp, and the acquired knowledge was evaluated daily. Each day ended with a "mini" theme and a thesis, showcasing the children's capacity to tackle challenges and apply what they had learned effectively. At the end of the camps, participants presented their completed projects, and each camper received an appreciative diploma for their week-long efforts.

The primary goal of the "Developing Smart and Secure Buildings in the World of Minecraft" camp was to familarise participants with building automation, building supervision, industrial control systems, security technology, and information protection. The camp included theoretical classes, modeling and designer occupations, and IT laboratory exercises structured around five thematic days. Through Minecraft, participants explored and deepened their understanding of physical, mathematical, electrical, IT, and security technical curriculum elements in an innovative virtual space. The modified application provided a realistic depiction, offering insights into intelligent technologies, information protection, and security technology equipment. The camp aimed to develop skills such as problem-solving, algorithmic thinking, systems approach, creativity, self-confidence, and concentration. It also offered career guidance, giving participants a real-life glimpse into university life.

The children's camp focused on the built environment and its development within the Minecraft world. Groups engage in daily practical and project activities, promoting cooperation and necessitating the daily planning and implementation of security protection solutions. Documentation and minutes were maintained for each group, and daily presentations showcased the progress and results of each camper's work.

In the world of Minecraft, an industrial park was created on the island to address civil and security protection conditions. The process involved creating automation and security technical plans, modeling objects, and implementing investigations while considering aspects of cyber defense. The camp featured interactive lectures and discussions led by a security technical knowledge instructor, as well as planning tasks facilitated by a game developer instructor within the world of Minecraft (see Figure 1).

Fig. 1. Own design of village dwellings using 2D/3D CAD software

The "Developing Smart and Secure Buildings in the World of Minecraft" camp had the following thematic schedule:

Day 1:

- The text provided a brief discussion and overview of the camp's goals and mission.
- Lecture on the interpretation of security and the dynamics of personal and property protection.

- In-depth exploration of the topic through interactive discussions.
- Design task for students in two groups: designing their own residential buildings using 2D/3D CAD software (see Figure 1).
- Implementation of the designs in the world of Minecraft is divided into two groups.
- Exploration and familiarisation with the installation site of fortress walls.
- Explanation of rules and protocols.

Day 2:

- Lecture on access control systems, iris recognition, RFID technology, and password-based identification.
- Presentation on the history of access control, various identification methods, and their relevance in the Minecraft game.
- Design task for students in two groups: designing and implementing their own access plans for their residences using 2D/3D CAD software in Minecraft. The student, as seen in Figure 1, opted for code-based programming for internal door access, which was accurately explained in a separate text file (due to the absence of pictograms).
- Additionally, the task included implementing a new defense level and equipping fortress walls with access and pass-through points.
- Integration of these theoretical foundations into the Minecraft world through design practice.
- Evaluation task: At the end of the day, the two teams evaluated each other's fortress walls.
- Criteria: Creative design and overall outcome. Formulation of lessons learned from teamwork for upcoming tasks.

Day 3:

- Lecture on the basic concepts of intrusion detection systems will include block diagrams and the elements of a basic 4-zone intrusion detection system. The discussion will cover the role of the central unit, different code types, signalling, remote supervision, operators, alarm devices, defence circles, and outdoor and indoor protection. The place and role of these systems in our daily lives and property protection.
- Design task: Implementation of planned intrusion detection systems in Minecraft by equipping fortress walls with intrusion detection systems.

Day 4:

- Lecture on Internet security and cyber defence: the concept of Internet security, security in email and browsing, the importance of password management, the dangers of social applications (e.g., TikTok), the significance of virus protection, and the importance of offline time.
- Equipping fortress walls with video surveillance systems.

Day 5:

- Closing event: "Battle of Security Protocols" in the world of Minecraft.
- As shown in Figure 2, two teams are constructing fortress walls and outfitting them with various security systems (e.g., intrusion detection, access control and video surveillance systems).
- Virtual battle involves capturing the other team's flag and returning it to their own base.
- Joint assessment of completed tasks, summarising experiences, and closing the camp.

Fig. 2. Designing a village castle using Minecraft

2.2 Summer Minecraft University: Building an Island city powered by green energy

The Children's University summer camp, titled "Developing Island City with Green Energy in the World of Minecraft", aimed to introduce campers to GBL methods, renewable energy sources, green alternatives, systemic operations, and the innovative urban development methodology and tools within the Minecraft virtual space. The camp consisted of five themed days with theoretical classes, hands-on activities for modelers and designers, and IT laboratory exercises. Minecraft provides an innovative and popular virtual environment for enhancing understanding of physical, mathematical, electrical, and energy-related curriculum components. The programmers modified the Minecraft Java Edition to provide campers with a more realistic depiction of technologies and energy-related equipment.

The camp's mission included boosting the island city's economy, harmonising infrastructure and housing, planning and executing a green island city model in virtual space, and considering climate protection aspects. An additional goal was to develop and activate learning skills such as problem-solving, environmental awareness, systems approach, creativity, self-confidence, and concentration, while also providing insight into university life and its real-world applications. The camp focused on raising awareness about environmental issues and promoting self-discovery among participants. Assessing campers' interest areas, providing assistance in career orientation, and inspiring commitment towards a sustainable future were integral aspects of the camp's objectives.

A second camp also focused on the theme of developing island cities with green energy. Each day involved collaborative work where power plants were effectively designed and built. Project characteristics, work documentation, and meeting minutes were maintained. Security technical knowledge instructors conducted interactive lectures and discussions, while game developer instructors helped students with task planning in the Minecraft environment. Design tasks within the project involved children choosing groups and project managers responsible for quality control, procurement, construction, hazardous waste storage, electricity, and security. The goal was to to design living spaces where people could live healthily while minimising negative environmental impacts. The Minecraft game mode, known as "overworld survival" or simply "survival", provides a platform for creative problem-solving.

The second camp featured engaging and innovative afternoon activities that emphasised personal growth and fostering a sense of community through mental training.

Self-awareness tasks are designed to help campers explore and comprehend their inner worlds, fostering stronger connections between their physical and digital lives. The camp aimed to help campers explore their feelings, thoughts, strengths, weaknesses, desires, and goals, which would contribute to shaping their future and career choices.

Self-awareness training focuses on recognising important values in life, enhancing personal and professional aspects, and fostering camp cohesion to improve project efficiency. The self-awareness exercises aimed to help campers envision their own futures, enabling them to establish clearer goals and find motivation for education and personal development.

The theme of the "Developing Island City with Green Energy in the World of Minecraft" camp is as follows:

Day 1:

- Introduction of the camp's educational platform, Moodle, including information on course structure and virtual learning.
- The basics of energy. The concept of energy, different types of energy, and energy transformation.
- Discussion on green awareness and the importance of green living spaces. Designing and modelling an energy-conscious island in the world of Minecraft.
- A discussion about green living spaces, sustainability, and livability.
- Exchange of ideas on energy-efficient buildings and infrastructure.
- Creation of an inspiring, energy-conscious green island.
- Exploration of the issues related to electrical power supply, an overview of the concept of electrical energy, Hungary's electrical energy system, and network elements.

Day 2:

- Interactive discussion on solar energy: advantages and disadvantages of its use.
- Opinions and arguments on why it is worthwhile to invest in solar panels or solar collectors.
- The significance of solar energy in shaping our sustainable future.
- Integration of the discussed topics into the Minecraft world: production, design, and implementation of solar panels.

Day 3:

- Exploring the topic of wind energy through an interactive game.
- History and development of wind energy, its significance, and application in everyday life.
- Brainstorming on how much more efficient wind energy is compared to solar energy.
- The role of wind energy in producing larger quantities of electrical energy and its importance for sustainability.
- Arguments for the benefits of utilising wind energy.
- Benefits of wind energy and other green energies include environmental friendliness, energy efficiency, and long-term cost savings.
- Discussion on how all of this contributes to a sustainable future and how to be active participants in this process within the world of Minecraft.
- Exchange of ideas on how to incorporate wind energy into Island City, such as utilising windmills and wind turbines.
- As shown in Figure 3, a group building activity aims to revitalise Island City and create an eco-friendly, livable city.
- As shown in Figure 4, the creation of a Minecraft world includes its own subway, vast forest, flourishing farm, and rich wildlife.

Fig. 3. Planning and implementing a wind turbine in the Minecraft world

Fig. 4. Creating a Minecraft world

Day 4:

- Discussion on the operation, structure, use, advantages, and disadvantages of hydropower.
- Comparison of the operation of water turbines with wind turbines.
- Debate on sustainable energy and its possibilities in Hungary.
- In Minecraft, the construction of hydropower plants involves various elements, including the utilisation of water energy, the operation of the plants, and building essential elements such as structures and tools required for water wheels.

Day 5:

- Discussion on nuclear energy: pros and cons of nuclear energy based on security, environmental, and energy perspectives.

- Operation and effects of fission nuclear reactors.
- Exchange of ideas on how all of this contributes to a sustainable future and how to incorporate nuclear energy into the world of Minecraft.
- Implementation of a nuclear power plant in Island City for sustainable handling of hazardous waste.
- Joint assessment of completed tasks, summarization of experiences, and closure of the camp.

The camp experiences provided valuable insights into the personal growth and dedication to projects among the campers during all three sessions. The children demonstrated high levels of activity and enthusiasm, effectively completing assigned tasks with great satisfaction. The campers' engagement in interactive tasks was remarkable, and they demonstrated discipline while actively assisting and cooperating with each other. Together, they collaboratively crafted a distinctive Minecraft world that reflected their creativity and shared efforts.

3 QUESTIONNAIRE SURVEY ON THE EFFICIENCY OF MINECRAFT CAMPS

3.1 Research objective and hypothesis

On the first and last days of the camps, we conducted questionnaire surveys. The purpose of this study was fourfold: (1) to examine the effectiveness of the methods used in the camp; (2) to assess the students' knowledge of renewable energy sources and security technology; (3) to measure collaboration in the camp; and (4) to examine the "creative climate" of the camp. The research plays a role in filling a gap, as, to the best of our knowledge, no such initiative has been undertaken yet. We are not aware of a similar Minecraft camp that focuses on renewable energy sources and security technology. Additionally, we have not come across any camp developers who have modified the Minecraft Java Edition software for educational purposes. Furthermore, we did not find any studies that investigated the effectiveness of a Minecraft camp in terms acquiring of scientific knowledge and developing skills.

Since many literature sources [5–10] emphasise that GBL increases students' motivation and interest and also improves students' cognitive and social skills, we believed that we could successfully apply this innovative method in the Minecraft camp. The research formulated a hypothesis suggesting that the camp's effectiveness extended beyond knowledge acquisition to include collaboration and the development of creative work.

3.2 Materials and methods

Each camp involved participants filling out an eight-question stationary survey measuring their proficiency in Minecraft. Furthermore, a professional questionnaire was administered to assess participants' current knowledge levels in security technology and renewable energy sources.

In the "Developing Smart and Secure Buildings in the World of Minecraft" camp, a professional questionnaire with five multiple-choice questions on security technology was administered on the first day. Similarly, the "Island City" development camp, which focused on green energy in the Minecraft world, utilised a

questionnaire about renewable energy sources. The questionnaire consisted of five multiple-choice questions and was administered on the first day.

On the final day of each camp, participants were asked to complete a questionnaire designed by the researchers to assess their mastery of professional knowledge. The assessment included background variables, expectations, experiences related to the camp, and opinions regarding the application of Minecraft.

To measure collaborative abilities, the researchers used a questionnaire [25] that assessed respondents' skills in group problem-solving situations and their ability to cooperate. The 18 self-evaluative items required respondents to rate statements on a scale from 1 to 7, reflecting the extent to which the statements described their collaborative abilities. Additionally, a questionnaire [26] was used to explore the creative climate within the camp's internal world. This questionnaire focused on environmental factors influencing creativity. It comprised 47 statements across five dimensions: group atmosphere, openness, diversity, autonomy, encouragement, challenge, interest, limits, and pressure. Respondents rated each statement on a scale from 1 to 7 based on the degree of characteristicness.

We utilised the aforementioned measuring tools because they are appropriate for assessing students' knowledge and social skills, as well as for evaluating the creative atmosphere of the camp. Surveys conducted on the first and last days of the camp offer an opportunity to assess the effectiveness of the activities implemented during the camp.

3.3 Research sample

The "Developing Smart and Secure Buildings in the World of Minecraft" camp had 12 students participating, while the "Developing Island City with Green Energy in the World of Minecraft" camp had 17 participants in the first session and 22 in the second session, totaling 51 participants across both camps. However, the number of completed questionnaires varied because some students attended the camp multiple times or missed a day, resulting in a total of 45 questionnaires being filled out on the first and last days. Among the participants, 31.1% were female and 68.9% were male, with an average age of 12.36 years.

Participants spent a significant amount of time on computerised activities in terms of screen time. Specifically, 32% played for 1–2 hours, 25% for 2–3 hours, 11% for 3–4 hours, and 25% for more than 4 hours daily, engaging in computer use, video games, and online games.

Upon arriving at the camp, participants had various expectations. The predominant expectations were centered on having fun, with a mean rating of 3.75 (standard deviation (SD): 0.44) on a four-point scale, and efficiently utilizing their time, with a mean rating of 3.61 (SD: 0.58).

3.4 Main results

On the first day of each of the three camps, we assessed the participants' initial proficiency in Minecraft and their expertise in the subject areas relevant to the camp. The answers to the questionnaire we had developed revealed that the participants in the camp already possessed a significant amount of knowledge about the world of Minecraft (see Figure 5).

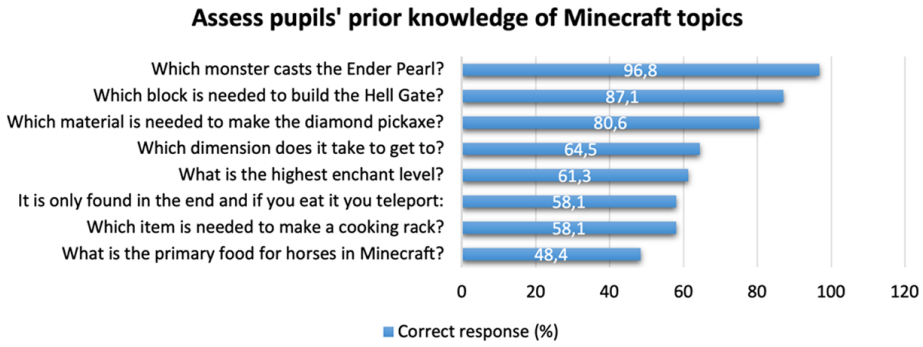

Fig. 5. Students' prior knowledge of Minecraft (N = 31)

Upon analysing the motivation for using the video game, we concluded that participants mainly favored Minecraft. They highlighted the opportunity to bring their ideas to life, build new worlds, and unwind. At the end of the camp, participants were surveyed about their preferences for the activities in Minecraft during the camp. The prominent responses highlighted the students' enjoyment in solving tasks with Minecraft, finding it to be a source of relaxation, and appreciating the collaborative aspects of working with others (refer to Table 1).

Upon examining the differences in answers provided on the first and last days of the camp, it becomes evident that the participants acknowledged the potential of Minecraft as a platform for engaging in interesting and beneficial activities. Moreover, they acknowledged the excellent opportunities provided by the game for collaborative efforts with their peers.

The correlations between motivational factors were revealed through spearman correlation analysis conducted on the data. In the questionnaire administered at the start of the camp, the most notable correlation was found between the execution of ideas and the creation of a new world ($r = 0.587$, $p = 0.000$). Thus, the ability of students to create something new with the support of their imagination and creativity serves as a significant motivating factor. According to the questionnaire completed on the last day of the camp, the closest significant correlation was observed between the implementation of ideas and playing together with others ($r = 0.561$, $p = 0.000$). We assume that the creative work conducted at in the Minecraft camp and playing together with other children improved the social relationships of the campers.

Table 1. Evaluation of the Minecraft game on the first (N = 44) and last (N = 41) day of the camp

	What I Love about Minecraft is that ...		What I Liked about Minecraft During the Camp was that		The Difference between the Age
	Age	SD	Age	SD	
I can play together with others	3.34	0.834	3.41	0.805	0.07
I can build a new world of my own	3.55	0.730	3.37	0.968	–0.18
I can implement my own ideas	3.59	0.844	3.27	0.949	–0.32
the graphics are good	2.77	0.937	2.93	1.034	0.16
I can learn a lot from it	2.80	1.025	3.27	0.742	0.47
I can complete tasks	2.77	0.961	3.49	0.597	0.72
It provides good relaxation	3.52	0.628	3.39	0.586	–0.13
It models the real world	2.41	1.019	2.78	1.061	0.37

In order to uncover additional correlations, we conducted a cross-tabulation analysis using the chi-square test. No significant correlation was found between the motivational factors of the Minecraft game and the amount of time spent playing video games per day. In comparing background variables, we found that the importance of Minecraft having good graphics was significantly higher for girls ($p = 0.029$) than for boys. Boys, on the other hand, preferred Minecraft because it provided good relaxation ($p = 0.90$) and because it models the real world ($p = 0.025$).

During the camp, participants were assessed on their initial professional knowledge through a series of five questions.

The findings revealed that a majority of the campers had a basic understanding of concepts closely related to the camps' thematic focus (see Figures 6 and 7).

The rate of correct answers regarding renewable energy sources, especially high (see Figure 7), indicates that students are well-informed in this area.

At the conclusion of the "Island City Development with Green Energy in the World of Minecraft" camp, feedback was solicited from participating students (N = 21) regarding their experiences. The responses indicated that 38.9% of the participants felt they had a thorough understanding of the systematic operation of renewable resources and green alternatives presented during the camp, while 55.6% felt well-acquainted but still somewhat uncertain about certain details. Additionally, 5.6% had only grasped some basic concepts.

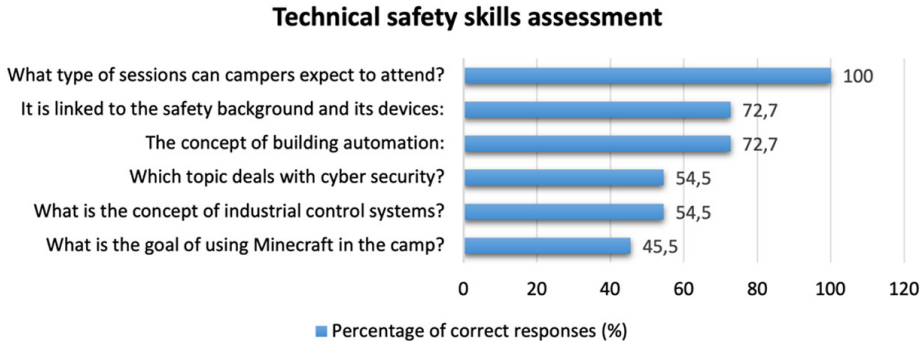

Fig. 6. "Developing smart and secure buildings in the World of Minecraft" camp professional knowledge survey (N = 11)

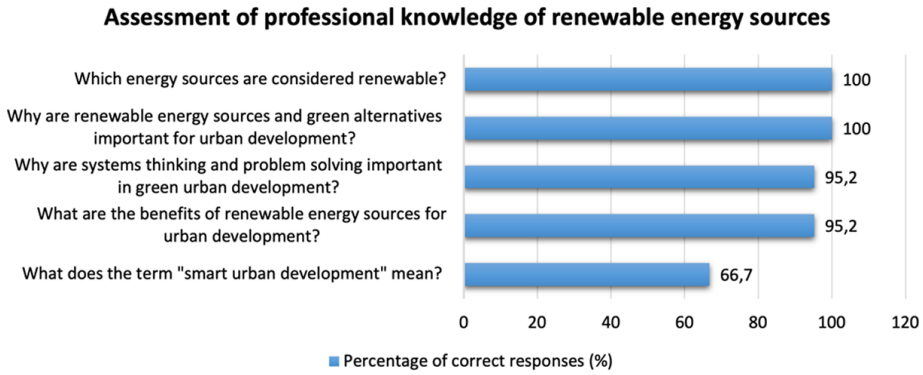

Fig. 7. "Developing smart and secure buildings in the World of Minecraft" camp professional knowledge survey (N = 21)

Of those surveyed, 50% of them have actively participated in the design and construction of a green island city in Minecraft; 38.9% have created various models and plans related to renewable energies; and 11.2% have acquired basic knowledge

in Minecraft but have not used it for urban development. Regarding skill development, 55.6% of the participants believed they had acquired numerous skills during the camp, foreseeing their usefulness in the future. Among the participants, 38.9% acknowledged acquiring new skills but recognised the need for further practice, while only 5.6% felt they had gained basic skills. Concerning the perceived usefulness of the camp's knowledge for future studies and careers, 33.3% found it very useful, 38.9% considered it useful but acknowledged the need for additional learning and practice, and 27.8% were uncertain about the relevance of these topics to their future goals. Participants also experienced improvements in problem-solving and creativity skills. Specifically, 55.6% felt a significant improvement, 27.8% perceived a lesser but still noticeable improvement, and 16.7% reported no change in their problem-solving and creativity skills.

Collaborative abilities were assessed using a reliable questionnaire [25], with a Cronbach's alpha value of 0.88 (first day) and 0.91 (last day). Participants reported active involvement and effectiveness in group work throughout the camp. The "School Creative Climate" questionnaire [26], with a Cronbach's alpha value of 0.887, assessed the camp's influence on creativity. Respondents highlighted the encouragement of new solutions by teachers (mean: 6.27, SD: 0.895), openness to new ideas (mean: 6.05, SD: 0.921), and tasks that could be approached in multiple ways (mean: 5.98, SD: 0.935). Five dimensions, each with distinct subscales, were evaluated (refer to Table 2).

Table 2. Dimensions of creative climate in Minecraft camps (N = 41)

Dimensions	Mean	SD
Group	5.29	1.094
Openness	5.80	0.786
Encouraging Diversity and Autonomy	4.99	0.940
Challenge and Interest	5.595	0.741
Limitations	4.900	1.051

The "group trust and support" subscale assesses the degree of acceptance and mutual assistance among group members, reflecting the cooperative nature of the group. The "openness" subscale explores the extent to which students are encouraged to adopt new perspectives, seek alternative solutions, and formulate new ideas. The "Encouraging Diversity and Autonomy" subscale assesses how teachers foster acceptance of diverse viewpoints and opinions among students. The "Challenge and Interest" subscale explores how teachers and students establish meaningful challenges to engage students towards specific goals. The "Limitations" subscale reveals the extent to which students have the opportunity to make decisions during the learning process, encompassing both autonomy and temporal constraints. In our research, the dimension of "Openness" emerged as the strongest, indicating that campers supported an environment where students are open to new approaches, explore emerging questions, and try new things. The "Challenge and Interest" dimension indicated a moderate level of challenges presented to students with limited constraints on their autonomy. "Encouragement" is most closely related to the "Openness" dimension (Spearman correlation $r = 0.695$; $p = 0.000$).

Comparing these results with data from our Minecraft camp in 2022 [27], [28], where the dimensions of "Openness" and "Challenge" also exhibited the highest average values, followed by "Group Trust and Support", "Encouraging Diversity and

Autonomy", and "Limitations" subscales, suggests a consistent pattern in the creative climate of the two years of Minecraft camps. Additionally, feedback was collected from parents at the end of the camp. Out of the 13 parents surveyed, all reported high satisfaction with the camp, finding the topics and lectures useful and interesting. Responses to an open-ended question further indicated positive experiences. Overall, both children and parents provided overwhelmingly positive feedback regarding the camp.

Our findings confirmed our hypothesis that the camp would be effective not only in acquiring knowledge but also in improving cooperation and fostering creative work. This result is consistent with the findings of other studies on the effectiveness of incorporating Minecraft into STEM education [29–31].

4 DISCUSSION

Game-based learning is becoming increasingly popular in the sciences because games enhance the acquisition of subject matter and promote the development of students' cognitive and social skills. Games make learning interactive and provide an engaging experience for students. The Minecraft Java Edition main game offers an excellent opportunity for playful learning, encouraging students to discover and creatively learn about new concepts and connections in a virtual world. It provides an attractive learning environment that engages and motivates students while developing skills that are essential in today's everyday life, learning, and future work environments (e.g., communication, cooperation, logical thinking, creativity, problem-solving, and spatial orientation).

In the summer of 2023, we implemented the potential of Minecraft in three children's camps to assess its effectiveness in fostering safety and environmental awareness. The three Children's University summer camps focused on the crucial area of sustainable development, utilizing the innovative programming of the game Minecraft to create an engaging and creative virtual world. The primary goal of these camps was to introduce young participants to safety solutions and green energies, both in the physical and virtual realms. Through challenges and projects, the camps brought to life the principles of words and sustainability awareness within the Minecraft platform. This initiative can be considered unique and innovative, both in terms of content and methodology.

The participants were actively engaged in solving exciting tasks and planning assignments, such as developing solar panels, wind turbines, and improving a town's energy efficiency, as part of the "Island City Development Green with Energy in the World of Minecraft" camp. The programme and camp themes helped bring students closer to a sustainable future, which is particularly important in the aftermath of the COVID-19 pandemic [32]. Surveys and tests were conducted to collect children's feedback on the camp experience and to assess the results and progress made. The results of our questionnaire survey confirmed our hypothesis that the camp would be effective not only for acquiring knowledge but also for improving cooperation and creative work.

Overall, the participants gave positive evaluations of the camp, indicating a measurable increase in their knowledge within the thematic area. The camp provided a noticeable opportunity for children to explore and master potential career paths, fostering self-awareness about their preferred occupations. Through these activities, 10–14-year-olds were able to establish clearer goals and motivations for their education and personal development.

Throughout the camp, the participants remained highly motivated. They created unique solutions and projects that reflected the importance of the camp themes and the immediate applicability of the knowledge acquired. The camp utilised a GBL methodology, which facilitated intensive knowledge transfer and skill development within the community.

Based on our experiences in the camps and the results of our questionnaire survey, we have concluded that the Minecraft version of the video game we have developed can be effectively integrated into educational processes.

5 CONCLUSIONS

This paper presents the GBL method, the theme of the camps, possible applications of the Minecraft video game, as well as the methodology and results of questionnaire surveys. The surveys aimed to assess campers' existing knowledge and study the climate of collaboration and creativity in the camp. All these elements can provide valuable information for creative and adventurous education interested in utilizing the Minecraft game for teaching, learning, and motivational purposes. They also present new ideas for those who are still in training. In addition, they may represent a unique and unusual opportunity for higher education institutions involved in training engineers as part of their career guidance programs.

The limitations of the study are as follows: 51 students participated in the three camps, and 45 of them completed our questionnaires. Consequently, the small size of this research sample did not allow for more in-depth statistical analysis. However, we plan to expand our camps in the future by covering new scientific fields and targeting students, trainee teachers, and educators in higher education. This will enable us not only to broaden the range of camps on offer but also to carry out a more extensive and meaningful analysis.

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