iSafetyApp - "Teaching students to be safe on the Internet using a mobile application based on artificial intelligence"

Link to flipbook version: https://heyzine.com/flip-book/3a9bb3e1f1.html

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iSafetyApp Summary Report

Development of the report

University of Economics and Innovation in Lublin

Partners

IX Liceum Ogólnokształcące im. Kazimierza Jagiellończyka w Toruniu, Poland

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Contents

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Introduction

This transnational report consists of three parts.

The part A of the report shows research on State of the Art on Serious Gaming and Internet Safety Skills. The part A consists out of four separate reports developed by each of the Consortium members. The reports include research on games themselves, serious games, and their application to teaching internet safety. They also include research on curriculum analysis of the national curricula in terms of Internet Safety and research on structural mathematical didactics in Europe – in all three countries of the consortium members.

The part B of the report presents results of empirical study in gaming interests of students in the member countries. The results reveal numerous hints and clues on elements to be taken into consideration during the iSafetyApp development as well as the development of the teachers' materials.

Finally, the part C presents learning concept for iSafetyApp, based both on the results of the part A and part B and study of available literature.

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Summary

Nowadays, the digital and information society of the 21st century largely depend on the Internet. Thus, Internet safety skills is a must. Elementary and high schools' students are not an exception. They highly depend on the Internet. Large portion of their lives goes on the Internet. They are especially vulnerable to dangers that originate in the Internet such as grooming, fake news, cyberbullying or phishing.

Reckless response to those dangers may end up with dire consequences. Dire consequences, young age, and lack of life experience of the victim may end up with a tragedy.

The remedy for lack of knowledge and experience is education.

Mathematics – queen of sciences – come here to the action. By studying mathematics, young people learn strict way thinking and reasoning. The problem is that mathematics is not the most loved topic among young people. Sometimes teachers are not properly trained and overworked. Sometimes students are so focuses on details that they lose ability to notice relations between different topics and even simple facts that something "does not add" – does not make sense.

Internet and Internet Safety topics are part of the IT classes in the studied countries. Students are taught to act in accordance with the principles of netiquette and legal regulations regarding: protection of personal data, protection of information as well as copyright and protection of intellectual property in access to information; is aware of the consequences of breaking these rules. They learn on good practices in the protection of the sensitive information, on authentication techniques, cryptography and protection and access to information. They also learn on importance of encryption and electronic algorithms.

The knowledge young people get is not always sufficient. Proper skills and habit do not always get develop. Sometimes due to insufficient qualifications of the teachers. Sometimes Internet safety topics are considered "difficult" to communicate to the students.

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There are numerous projects and institutions dealing with the Internet safety across Europe. Materials they provide even if comprehensive, get outdated very fast. Their attractiveness varies depending on the project.

There is still a need to develop new and attractive materials on the Internet safety that will be used by the students and their teachers.

People like to play and do not always want to study hard. Serious games is an answer to this dilemma. Serious games are games developed for primary purpose other than pure entertainment. Such games have an additional concept of pedagody through entertainment (making learning fun). They are training and teaching vehicles. Hence, they could provide significant benefit for Internet safety skills education in teenagers.

Since young people spend many hours per week on playing computer games, and they already familiar with the concept of serious games, the report proposes developing a serious game on the Internet safety.

All parts of the report provided valuable input on what gaming interests are, how the game should look like and what elements are necessary to make it attractive.

A game-based tool should:

- focus on an impressive start to capture the learner's attention right from the start
- give the players continuous challenges, each of which leads to another challenge, to keep them "hooked" on playing a game.
- have interesting storyline.
- combine fun and realism.
- have an element of risk.
- ensure that a game is challenging.
- Relate to real life experience.

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- Have clear objectives.
- Consider differences in perception of games between boys and girls

Based on the above and additional research the learning concept has been developed.

A recommendation has been made that the game will focus on: grooming, fake news, cyberbullying and phishing. The platform should be mobile, and the game should function in the multiplayer mode.

Research has been made on inclusion of people with intellectual and motor or sensory disabilities.

Detailed consideration has been made on data collection in serious games.

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State of the Art on Serious Gaming & Internet Safety Skills

Following subchapters show research results on serious gaming and internet safety skills done by T.R.I Technologos Research and Innovation Services ltd from Cypres, IX Liceum Ogólnokształcące im. Kazimierza Jagiellończyka w Toruniu from Poland, University of Economics and Innovation in Lublin from Poland and Innovation Frontiers IKE from Greece.

Results obtained by each of the organizations as well as conclusions and recommendations based on the research we used to develop the learning concept for the iSafetyApp described in the last chapter of this study.

The results will also be an important contribution in the process of development of teachers' materials to be used along with the application.

T.R.I. Technologos Research and Innovation Services ltd, Larnaka, Cyprus

Introduction

The internet has been identified as a (potentially) very valuable avenue for comprehensive, interactive and youth-friendly education (Simon L, 2013), with online sites offering a wide range of innovative, youth-friendly ways to engage young people in education. For example, young people worldwide are using the internet to access information on sexual and reproductive health and rights (Simon L, 2013). New social media platforms have emerged that facilitate online digital interactions with young people, which fill a much-needed gap.

This report performs desk research on all the disciplines related to influencing attitudes to internet safety skills. These disciplines are: Serious Games and Digital solutions for internet safety.

Concerning digital solutions, a brief analysis of serious games is presented, with several examples from the literaturę. The advantages of serious games compared to the traditional school system

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are outlined, as well as studies that argue that the interactivity and confidentiality of video games can prove to be very effective when using them for the purpose of education. In addition, the term “edutainment” and its overarching effects in today’s world of the Internet are investigated, as forums, YouTube channels, and TV shows have become safe havens that offer education information in an inclusive and entertaining manner, especially for adolescents.

Finally, in order to give children the digital skills and tools they need to fully and safely benefit from being online, T.R.I. Technologos Research and Innovation Services, conducted a research on topics in order to gather all the potential dangers that someone, can encounter while browsing for topics of interest.

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Application of serious games to enhance Internet Safety Skills

Nowadays, unlike a few decades ago, games come in many different forms (single-player/multiplayer, story-based/no story, score/no score, short/long/very long, challenging the body/mind/both) and platforms (personal computer, console, tablet, mobile phone) (McGonigal, 2011). And yet, even with all these varieties, when we're playing a game, we just know it's a game. Therefore, what are the defining traits of a game? McGonigal (McGonigal, 2011) suggested four defining features of games; a goal/purpose - the specific outcome that players will work to achieve, rules/limitations and feedback system - how close am I in achieving the goal, and voluntary participation - users of the game knowingly and willingly accept the goal, the rules, and the feedback.

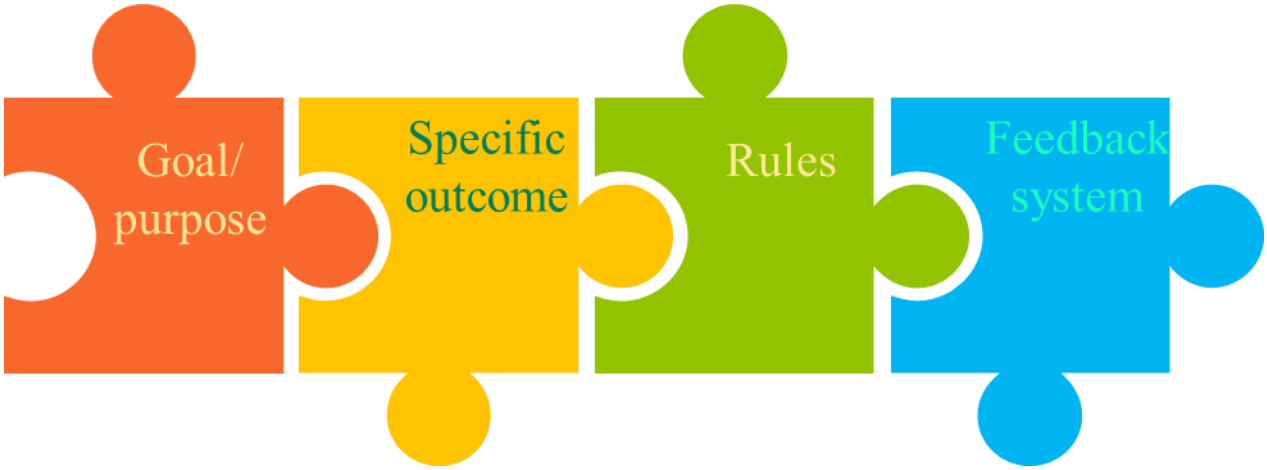

Figure 1 The defining traits of a game

A serious game (sometimes termed e-learning or game-based learning) is a game developed for a primary purpose other than pure entertainment (Djaouti, 2011). Although the words serious and game sound contradictory, the first refers to its educational purpose and not to its content. This kind of game is used by industries like defence, education (Barber N, 2015), scientific exploration (Koepnick B, 2019), engineering, health care (Andrade K, 2014), management, city planning and politics. In contrast with regular computer games, serious games do not only have a story, graphics,

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and clever software; they also introduce the concept of pedagogy through entertainment (making learning fun); they are training and teaching vehicles. Hence, they could provide significant benefit for Internet safety skills education in teenagers.

In particular, Stapleton (Stapleton, 2004) argued that education through games is more efficient and pleasant than classroom teaching for many reasons. Firstly, it is predominantly the player who directs activity in games, while primarily the teacher who leads activity in school. This is why serious games suggest a learner-centred approach to learning, in which learners are involved in the learning process (learning through doing), in contrast with traditional education which suggests a teacher-centred approach where learners are relatively passive. Children and teenagers often find it difficult to properly engage with school exercises (Korteling, 2013) in which the challenge level is not very well adjusted to their skills. In one class there are many students with different skills and it is challenging for the teacher to manage to engage all students in the class equally. On the other hand, video games engage players naturally, by adjusting the difficulty level gradually as the player progresses in the game (Dondlinger, 2007). Game developers know well that players of varying abilities need to feel a sense of reward for a successful game, often enough to retain engagement.

Additionally, students are sometimes discouraged by the school system as they get penalized for their mistakes (i.e. they get bad grades). However, players in games are expected to make some wrong decisions and consequently encouraged to try again. They then modify their strategy to do better, re-evaluate the information they have and act more methodically without being discouraged (ideally - unless the game is poorly designed). Another important characteristic of educational games is the constant real-time feedback to the user. Gamers know almost instantly how well a particular move or strategy worked towards the goal of the game. It can take the form of points, lives, levels, score, rank or progress bar. Real-time feedback ensures that the users are motivated throughout the game by promising that the goal is achievable.

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Another advantage of serious games as a means of learning is that they allow users to train for decision-making situations where the wrong choice may be inherently dangerous or involve some risk, such as in a grooming scenario, that might be life-threating for the victim.

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The educational material for secondary education in Cyprus, includes the following courses

English, Armenian, Ancient Greek, Architecture-Technical plan, Biology, French, German, Geography, Graphic arts, Graphics Applications, Visual arts, Theatrology, Religious, Spanish, History, Italian, Latin, Logic–Philosophy, Mathematics, Music, New Greek, Household economy, Economic Education, Information technology, Russian, Design and Technology, Turkish, Physics, Physical education, Photographic Art, Chemistry.

-Computer Science

The purpose of the Informatics and Computer Science course, is to prepare the students for their inclusion in the Information Society, providing them with satisfactory knowledge and cultivating the necessary abilities, skills and attitudes that will allow them to be responsible, conscious, safe, efficient and creative use of modern IT and Computer Science technologies. At the same time, the course cultivates systematic approaches to solving problems through the development of IT programs and systems on the computer.

The effort to reform the syllabus of the Informatics and Computer Science course began in March 2009, and the priority was to consider the course through the prism of the three pillars of the educational reform, that is, the acquisition of sufficient knowledge by students, the cultivation of values and the manifestation of behaviors that are consistent with the modern concept of democratic citizenship and the cultivation of key abilities and skills, so that they can be ready for 21st century needs.

The learning objectives of the study program have been included in the following seven thematic units which cover the main axes of Informatics and Computer Science:

1. Basic concepts of Information Technology and Computer Science
2. Computer Hardware/Architecture
3. Operating Systems
4. Application Software

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5. Networks and Internet
6. Databases and Development of Information Systems
7. Algorithmic Thinking, Programming and Modern IT Applications

The development of these units is based on the general principle of gradual deepening, which provides additional opportunities for students who could not master the learning objectives in one class, to do so in the next one, alongside the deepening.

Polymorphic and multidimensional teaching methodologies are adopted with the aim of successfully completing the course objectives. This differentiated approach stems from factors such as the triple consideration of the course (theoretical, experimental and technological), the fact that the course has a clear practical and laboratory orientation and the acceptance of the existence of different levels of readiness of the students, taking into account interculturality and gender equality in the context of the Information Society.

The key element of the teaching approach, is the connection of the course with the everyday life and the development of informed decision-making skills in a collaborative work environment with the ultimate goal of developing creative and critical thinking. Within this collaborative environment, students, using computational tools and techniques, experiment, create, build, discover, evaluate, and leverage knowledge so that they are ready to operate in the rapidly changing environment of information technologies and communications.

As mentioned above, Networks and the Internet, is one of the focus areas of Computer Science at schools. Based on the study of Laouris, Y. & Aristodemou[1], parents are not the only adults with a responsibility to mediate children's internet use or safety. To aid comparison, children were asked about the kinds of mediating activities undertaken by their teachers.

[1] Laouris, Y. & Aristodemou, E. (2013).Risks and safety on the internet: the CYreport. CNTI, Nicosia: EU Kids Online.

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One question asked about active mediation in general ('have your teachers ever talked to you about what you do on the internet?'). Another asked about restrictive mediation ('have your teachers ever made rules about what you can do on the internet at school?'). Then it was asked about mediation of internet safety, using items also asked to parents:

- 91% of children say their teachers have done at least one of the forms of active mediation asked about. This is substantially higher than the European average of 73% and is at the top part of the European country ranking for reported teacher mediation.
- More than two thirds of children think that their teachers have engaged with their internet use in terms of suggesting ways to use the internet safely (70%), helping them when something was difficult to find of do (68%) and explaining why some websites are good or bad (68%).
- Six in ten (58%) had talked to children about what to do if something bothered them, and even for the least common form of mediation, a substantial minority (17%) say their teachers have helped when something bothered them on the internet.
- Older children report more mediation by teachers, indicating some further scope for mediation in schools for younger children. Putting this the other way around, one in ten children who use the internet has received no guidance or advice from their teachers.
- There are some gender differences, but this depends on age and the particular form of mediation. Older boys are more likely than older girls to say that teachers explain why some websites are good and bad (72% vs. 69%), to suggest ways to use the internet safely (75% vs. 72%) and show how to behave towards others online (61% vs. 58%)
- seven in ten children (72%) say that teachers have made rules about what they can do on the internet at school, the percentages being higher for older children. By comparison, only 62% of children across Europe said their teachers made such rules.

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- More than two thirds of children (68%) say that their teachers talk to them about what they do on the internet, more for older than younger boys. Again, this compares favourably with the 53% who say this across Europe.
- Figure 30 reveals few differences by gender, age or SES (Socioeconomic status) in children's experience of mediation of the internet by teachers.

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Conclusions and recommendations

It is well known that social media can be a great way to connect with friends. But it also where we reveal lots of information about ourselves to people we might not know, including the companies who own the platforms and the applications, but also to potential cyber stalkers or online predators.

When our team competed the research outlined in this report, we decided to narrow down our material and analyse the topics below, by creating videos and infographics on internet safety topics such as :

- **Grooming:** When an adult approaches an underage online, with the aim to seduce them in real life.
- **Fake news:** Untrue and misleading information online that aim to benefit a company or organisation.
- **Addiction:** Spending long hours on internet activities, making them the only source of joy and satisfaction in life.
- **Cyberbullying:** Making fun online of someone and targeting them for their nationality, background, appearance, religion etc.
- **Phishing:** A type of scam where the scammers disguise as a trustworthy source in attempt to obtain private information such as passwords, and credit card information, etc. through the internet. These fake websites are often designed to look identical to their legitimate counterparts to avoid suspicion from the user.

Hence, for the rest of the time of the project, the team will Focus on the development of the aformentioned training material.

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References

Simon L, D. K. (2013). Adolescents' Use of the Internet for Sex Education: A Thematic and Critical Review of the Literature. *International Journal of Sexual Health*, 305-319.

Andrade K, F. G. (2014). Dynamic Player Modelling in Serious Games Applied to Rehabilitation Robotics. *2014 Joint Conference on Robotics: SBR-LARS Robotics Symposium and Robocontrol* (pp. 211-216). Sao Carlos, Sao Paulo, Brazil: IEEE.

Barber N, S. L. (2015). Online Resources for Understanding Outbreaks and Infectious Diseases. *CBE—Life Sciences Education*.

Djaouti, D. A. (2011). *Origins of serious games. In Serious games and edutainment applications.* London: Springer .

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

Koepnick B, e. a. (2019). De novo protein design by citizen scientists. *Nature*, 390-394.

Korteling, J. E. (2013). *Serious gaming@ work: Learning job-related competencies using serious gaming. .* London: Psychology Press Limited/Taylor & Francis Group.

McGonigal, J. (2011). *Reality is broken: Why games make us better and how they can change the world.* Penguin.

Stapleton, A. J. (2004). Serious games: Serious opportunities. *Australian Game Developers Conference, Academic Summit.* Melbourne.

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Introduction

With the advancement of technology and emergence of Web 2.0, young people spent more time in the online world that in the offline one. Children are introduced by parents to the Internet and mobile devices as early as in early-preschool age and start to develop their digital skills. Although it is believed by many, that digital skills reduce the risk of encountering dangerous situations online, the researches of Livingstone and Helsper from 2010 or Sonck and De Haan from 2012 show that reality is different. The higher the presence of youth online the higher the level of encountering online risks (Sonck Nathalie and de Haan, 2014). Thus, the need for the developing Internet Security Skills was recognized.

E-safety, or Internet Security skills, consist of the so-called C3 – cyberethics (online etiquette, protection of copyright, hacking and online addiction), cybersafety (online predators, unwanted communications, avoiding viruses, spyware and malware) and cybersecurity (firewalls, antivirus software, filters to avoid specific internet content and password protection). Youth online is more exposed to encounter risks regarding personal data, cyberbullying and malware that fall into C3 categories. Lack of awareness of youth regarding the risk and how to prevent encouraging it, is a problem that many academics and policymakers worldwide try to address by, for example, organizing “Safer Internet Day” that aims to “aim to promote the safer and more responsible use of online technologies, especially among children and young people across the world” (Nicolaidou & Venizelou, 2020). Research of Annansingh and Veli (2016) show that many internet safety procedures and policies are not up-to-date with ever-changing online environment. Thus the need to create more resources to teach Internet Security Skills to youth. Many researchers worldwide used gamified activities that focus on different aspects of e-safety, such as the protection from hackers, protection of personal data or protection from cyberbullying to teach abovementioned skills. Examples of such games are “Net-Detectives”, “Cybersmart Detectives” or

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"Auction Hero". Although the results of this researchers and games show that youth self-assess their Internet Security Skills as higher than before playing, the results are not objective and quantified (Nicolaidou & Venizelou, 2020).

The first section of this report consists of the summary of existing resources, project or platforms related to Interned Safety Skills in Poland. The training approaches to teaching Internet Safety Skills in Poland are presented in the second section, while all data are concluded in the last part of the report with some recommendations for the learning design concept of the game.

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Application of serious games to enhance Internet Safety Skills

Many empirical studies have been undertaken in the period of 2000-2019 in Poland regarding the safety of children in the Internet. One of the most recent ones, the report prepared in 2019 by NASK National Research Institute regarding the teenagers in the Internet, indicated that the current curriculum in Polish schools does not prepare student to live in ever-changing technology-based environment. This situation leads to students being ill-informed, for example for many students internet security means cleaning their browser history or blocking access to their devices from their parents or siblings. Taking into account that many respondents that took part in this research indicate to spent more than 4 hours daily online, the possibility of encountering risk online is high for them, and their misinformation about the various risks and how to prevent facing them may lead to dangerous situations online (Bochenek & Lange, 2019).

Over the years, numerous action have been undertaken by the government, foundations or internet providers from Poland to bring the topic of internet security to the forefront and teach the procedures and policies of internet safety. Polish Ministry of Education and Science prepared short online course regarding Internet Safety on their Integrated educational platform (*Bezpieczeństwo w Sieci - Zintegrowana Platforma Edukacyjna*, n.d.). The course consists of videos, texts, exercises and glossary of Internet Safety terms that help to develop Internet Safety Skills. It is not suitable for the young children, but older ones and elderly can find there some useful information. The Centre for Education Development that undertakes to provide self-development services to teachers also has a course about Internet Safety Skills dedicated to teachers. The course is full of informational materials, reports and books for teachers, as well as infographics that can be shared with students and recommendation of other Internet Safety Skills related projects (*Bezpieczeństwo w Sieci – Ośrodek Rozwoju Edukacji*, n.d.). NASK National Research Institute has an webpage about teaching Internet Safety Skills that is full of books, guides and reports prepared by them, providing teachers and parents with useful knowledge on how to teach their children e-safety skills (*Biblioteka - Publikacje i Materiały | Akademia NASK*, n.d.).

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KURSOR is an educational project implemented by NASK and the Science and Knowledge Foundation since 2012 available online on www.edukator.pl. The target group of the project is the entire school community - students, parents, educators and school principals of primary, secondary and high school education. Its main goal is to support the process of safe and effective use of new technologies at school by increasing the awareness of students, teachers, school principals and parents about online threats, as well as by increasing the knowledge and skills of teachers in the field of using modern technologies, multimedia and edutainment in teaching. Within the project, multimedia materials were developed to support members of the school community in acquiring appropriate knowledge and competences. A total of 9 animated films from the “Dwarfs 2.0” series were produced, 12 training multimedia presentations, 3 feature spots supplementing the content appearing in animated films (plus a spot promoting the project); an interactive decision-based game "Rufus in Danger", and an e-book for teachers, containing proposals for lesson plans and methodological materials in the form of information posters (Rywczyńska A. & Wójcik S., 2018; *Kursor | Akademia NASK*, n.d.).

Saferinternet.pl - a program aimed at increasing public awareness of the threats posed by the latest communication techniques. Among the undertaken activities, the priority is given to the education of both children and parents, as well as raising the competences of professionals in the field of safe use of the Internet. The project is one of the main three project founded by Polish Safer Internet Center (PCPSI) that was established in 2005 as part of the European Commission's Safer Internet program, and currently operates under the Connecting Europe Facility program. The Centre were created by the state-owned research institute NASK (PCPSI coordinator) and the Empowering Children Foundation. The project itself is carried out by FDDS and NASK in cooperation with the Orange Foundation (*Safer Internet w Polsce | SaferInternet*, n.d.).

Sieciaki.pl is an educational project run since February 2005 by the Empowering Children Foundation as part of the "Child on the Web" program. The Sieciaki.pl project is part of the "Safer

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Internet" program. The main partner of the project is the Orange Foundation. The basic element of the Sieciaki.pl project is an educational website for children aged 9-11, devoted to children's safety on the Internet, movies, games, songs and educational materials. The Sieciaki.pl project is primarily aimed at educating children about online safety. Within the project materials for teachers, such as e-learning course, class scenarios, an e-book and podcasts, and for parents, such as pointers on how to talk with children about Internet Safety, e-learning course, e-book and podcasts were prepared (*Sieciaki.Pl - Dla Rodziców i Nauczycieli - O Projekcie*, n.d.).

MegaMisja is a free, nationwide educational program for primary schools founded by Orange Foundation. The results of the project can be used during classes or at the school common room. MegaMisja is addressed to teachers and children aged 6-10. The goal of the project is to increase the knowledge and digital competences of teachers, day care educators and their students. To make sure that the youngest are safe and aware multimedia users, and that teachers have access to proven materials, thanks to which they can conduct modern classes for children. MegaMission provides a solid basis for wise and safe movement in a world in which today we will not do without technology. Teachers taking part in the project are provided with the platform full of class scenarios to be used during their classes and children have an access to the educational game (*MegaMisja – Kompetencje Cyfrowe Dla Dzieci i Nauczycieli w Świetlicach Szkolnych*, n.d.).

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Curriculum analysis of the national curricula in terms of Internet Safety

The Polish core curriculum is a document that outlines the minimum content and standards that must be taught in schools in Poland. It provides a framework for the development of educational programs at the primary and secondary levels and defines the goals and objectives of education in Poland.

The core curriculum covers a wide range of subjects, including language and literature, mathematics, science, social studies, physical education, music, art, and foreign languages. It also specifies the number of hours that should be dedicated to each subject at each grade level and provides guidance on the types of learning activities that should be used to teach these subjects.

The current core curriculum Is based on Regulation of the Minister of National Education of 30 January 2018 on the core curriculum for general education for general upper secondary schools, technical upper secondary schools and second-level vocational schools (Rozporządzenie Ministra Edukacji Narodowej z dnia 30 stycznia 2018 r. w sprawie podstawy programowej kształcenia ogólnego dla liceum ogólnokształcącego, technikum oraz branżowej szkoły II stopnia) (ISAP - Internetowy System Aktów prawnych, 2018)

Computer classes are taught at each level – starting at first year of the elementary school up to the last year of the secondary school.

The most important goal of IT education of students is the development of skills computational thinking focused on creative problem solving from various fields with the conscious and safe use of methods and tools derived from informatics.

Goals of the IT education include:

- Compliance with the law and safety rules.
- Respecting information privacy and data protection,
- intellectual property rights,

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- communication etiquette and standards
- social coexistence,
- assessment of risks associated with technology and their consideration for the safety of yourself and others.

Student is supposed to (basic level):

- act in accordance with the principles of netiquette and legal regulations regarding: personal data protection, information protection and law, copyright and intellectual property protection in access to information and to be aware of the consequences of breaking these rules;
- respect applicable law and ethical standards regarding use and dissemination of computer software, third-party applications and own and electronic documents;
- apply good practices in the protection of sensitive information (e.g. passwords, pin), operating system data and security, explains the role information encryption;
- describe the damage that can be caused by pirate activities on the network, in relation to individuals, selected institutions and the whole society.

Some elements of the Internet Safety may be covered at classes other than the Computer Science. It depends on individual decisions

Grooming, fake news, addiction, cyberbullying or phishing are not specifically listed in the Regulation of the Minister. It is up to teachers to interpret the regulation and to cover necessary topics.

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Training approaches

There were various training approaches used by those project and entities in Poland regarding teaching of Internet Safety Skills. The most prominent one is the awareness rising approach among parents and teachers about risks that children may encounter online. This is achieved by various reports, e-books, infographics and promotional materials that can be distributed in schools. Materials focused on teaching Internet Safety Skills dedicated to children are full of colorful videos, comics, infographics suited to their interests and needs.

Online comics, videos and serious games are used to teach children Internet Safety Skills. Project Sieciaki.pl allows children to play many different games during which they can learn the most important terms and rules regarding Internet Safety. Online courses for teachers and parents are also used to raise awareness between adults and provide them with training and ready-made materials to teach Internet Safety Skills in their classrooms.

Reports suggest that the main difficulty is to stay up-to-date with ever-changing online environment. New risks and threats can be encountered daily (malware or viruses) and out-of-date rules and techniques on how to avoid them may not be enough.

Conclusions and recommendations

Mathematical didactics is traditionally very strong in Poland. Polish students score very high compared to students from other European countries. There are challenges related to the education system. One cannot be sure that mathematics remains strong in Poland forever. It is important to focus on taking advantage of the strong mathematical base and apply it to other domains.

The Internet is a crucial part of young people's lives in Poland. Internet Safety is a very important to every Internet user and it means almost every young man or woman.

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Internet safety is a part of the Computer Science curriculum. It obviously makes sense as the Internet is based on computers and computer science. Internet Safety touches a significant part of social interactions, studying and everyday actions of young people. It is getting more and more important as a part of the national security.

We believe that Internet Safety should be included in the curriculum of other subjects – not just Computer Science. It could be Education for Security (national security), Polish language (everyday communication) or mathematics (calculating probability and cost of the Internet Safety violation).

The results show that Internet Safety Skills are very important in ever-changing digital world. The young members of Internet society have to be equipped with skills that will allow them to surf the net safely and responsibly. Programs and projects available in Poland focus preeminently on rising awareness among parents and teachers, to prepare them to teach the Internet Safety Skills. More and more project that focus on educating young children are being introduced to the public and some of them acknowledge the usefulness of Serious Games.

This study show that the most important thing is while preparing materials for teaching Internet Safety Skills is being up-to-date. The rules and regulations from years ago are not useful in current digital world, that's why it is imperative to prepare materials that not only include universal rules of internet security that will always be relevant, but also up-to-date information's that prepare children how to protect themselves from current threats (malware or cyberbulling).

The second thing resulting from this research is the importance of adequateness of the materials to the target group. It is necessary to have in mind, while preparing the learning and game plan, to fit the need, interests and skills of the target group.

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References

Bezpieczeństwo w sieci – Ośrodek Rozwoju Edukacji. (n.d.). Retrieved October 13, 2021, from https://www.ore.edu.pl/2015/03/bezpieczenstwo-w-sieci/

Bezpieczeństwo w sieci - Zintegrowana Platforma Edukacyjna. (n.d.). Retrieved October 12, 2021, from https://zpe.gov.pl/a/bezpieczenstwo-w-sieci/DLcH59Wno

Biblioteka - Publikacje i materiały | Akademia NASK. (n.d.). Retrieved October 13, 2021, from https://akademia.nask.pl/baza-wiedzy/publikacje.html

Bochenek, M., & Lange, R. (2019). *NASTOLATKI 3.0. Raport z ogólnopolskiego badania uczniów*.

Kursor | Akademia NASK. (n.d.). Retrieved October 13, 2021, from https://akademia.nask.pl/projekt-39/o-nas.html

MegaMisja – kompetencje cyfrowe dla dzieci i nauczycieli w świetlicach szkolnych. (n.d.). Retrieved October 14, 2021, from https://megamisja.pl/

Nicolaidou, I., & Venizelou, A. (2020). Improving Children's E-Safety Skills through an Interactive Learning Environment: A Quasi-Experimental Study. *Multimodal Technologies and Interaction*, *4*(2). https://doi.org/10.3390/mti4020010

O nas - Safer Internet w Polsce | SaferInternet. (n.d.). Retrieved October 13, 2021, from https://www.saferinternet.pl/o-nas/safer-internet-w-polsce.html

Rywczyńska A., & Wójcik S. (2018). Rozwiązania systemowe w profilaktyce i interwencji. In Rywczyńska A. & Wójcik S. (Eds.), *Bezpieczeństwo dzieci i młodzieży online. Kompendium dla rodziców i profesjonalistów* (pp. 101–108). Polskie Centrum Programu Safer Internet. www.saferinternet.pl

Sieciaki.pl - Dla rodziców i nauczycieli - O projekcie. (n.d.). Retrieved October 13, 2021, from https://sieciaki.pl/dla-rodzicow-i-nauczycieli/o-projekcie

Sonck Nathalie and de Haan, J. (2014). Safety by Literacy? Rethinking the Role of Digital Skills in Improving Online Safety. In B. and S. B. van der Hof Simone and van den Berg

This project has been funded with the support from the European Commission (project no: 2020-1-PL01-KA226-SCH-096462).This publication reflects the views only of the author, and the Commission cannot be held responsible for any use which may be made of the information contained therein.

(Ed.), *Minding Minors Wandering the Web: Regulating Online Child Safety* (pp. 89–104). T.M.C. Asser Press. https://doi.org/10.1007/978-94-6265-005-3_5

(2022, 12 18). Pobrano z lokalizacji The Polish School of Mathematics: http://www.psomath.com

Biernacki, M. i Czesak-Woytala, K. (2013). Is education in Poland really effective? *Didactics of Mathematics*, strony 5-18.

ISAP - Internetowy System Aktów prawnych. (2018, 03 02). Pobrano z lokalizacji Dz.U. 2018 poz. 467 Rozporządzenie Ministra Edukacji Narodowej z dnia 30 stycznia 2018 r. w sprawie podstawy programowej kształcenia ogólnego dla liceum ogólnokształcącego, technikum oraz branżowej szkoły II stopnia: https://isap.sejm.gov.pl/isap.nsf/DocDetails.xsp?id=WDU20180000467

Maciuk, A. (2013). SIGNIFICANCE OF THE CONCEPT OF QUALITY OF EDUCATION FOR DIDACTICS OF MATHEMATICS IN UNIVERSITIES IN POLAND. *Didactics of mathermatics*, strony 65-76.

Pardała, A. (2010). The Traditions and Development of Mathematics Education: Case of Poland. W A. Karp, *Russian Mathematics Education History and World Significance* (strony 325-357). World Scientific Publishing Company.

Polish students among the best in the world. Results of the international PISA 2018 survey are out. (2019, 12 6). Pobrano z lokalizacji Instytut Badań Edukacyjnych: https://www.ibe.edu.pl/en/news/1087-polish-students-among-the-best-in-the-world-results-of-the-international-pisa-2018-survey-are-out

Smoczyńska, A. (2014). *The system of education in Poland.* Warszawa: Foundation for the Development of the Education System.

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Introduction

From year to year, access to the Internet and other telecommunications services is becoming more and more common. In 2021, almost 85% of Polish population use the Internet. Over 66% use social media. This is due to many factors - government policy and legal regulations, technological development, competition on the free media market, falling prices, etc. Having access to the network becomes a necessary requirement for good functioning in public life. This applies not only to private individuals, hence owners of computers connected to the Internet, owners of mobile phones, smartphones, etc., but also enterprises and state and social institutions, giving the possibility of using the Internet in the workplace.

Thanks to social networks (the possibility of maintaining contacts and making new, communicating, dealing with everyday matters, etc.) the global network is becoming an important space for social life. However, it is not difficult to notice that the internet also has many negative effects. Researchers emphasize that to the web permeates everything we know from real life, including undesirable phenomena. So you should mention pedophilia, pornography, theft, various types of crime, terrorism etc. Taking into account the ever stronger dependence between the real world and virtual and the fact that the amount of information in the network, including information, is constantly increasing crucial for the safety of each of us, precisely to the issue of security more and more importance must be attached.

Summary

The knowledge of issues related to the security of using the Internet is growing every year, however, as research shows, many Internet users are still victims of various frauds, crimes, and cyberbullying. In Poland, there are organizations, projects are being created, platforms that teach how to use the

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Internet safely. However, it is difficult to say how large a group of recipients uses these resources. It is imperative to develop good and attractive Internet safe teaching strategies.

Application of serious games to enhance Internet Safety Skills

The problem of internet security has been discussed in many Polish publications. Our research allowed us to select more interesting publications.

IAB Polska compiled a report on online privacy in 2017. Here are the most important conclusions:

- The Internet is seen as a public space. In addition to private websites other websites are perceived as public space, or at least partially public.
- There is an increasing level of awareness and knowledge of privacy. Internet users more and more often
- use various types of security (e.g. clear browsing history more often, delete cookies). They also post their photo on the web less frequently.
- Despite the growing public awareness of privacy, some users still believe that
- they are insufficiently informed about it. Further education is required on cyber-security.
- A significant percentage of web users prefer matched content and ads. Determined most are aware of the principles of the digital environment and - although a fact collecting data may be disturbing for some - they see the benefits with content personalization.
- The results of the study indicate that the use of bans, restrictions and limitations in space digital is perceived negatively by Internet users, and even irritates them too much the level of approvals they must give and accept from various settings. It is advisable to go out meet their expectations and minimize the level of irritation and invasiveness, which may result in side effects in the form of discouraging use from digital resources.

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- A sense of security and awareness of privacy issues should be increased through educational activities that should be carried out by all entities shaping the environment digital - both on the side of service providers and regulators.

In 2018, Ipsos presented the results of its research on children's safety on the internet. The study, which involved 1,000 parents of children aged 7-15 and 300 teachers, shows several important conclusions:

- Children spend a lot of time on the Internet. So much so that parents often feel anxious.
- Most parents combine controlling children's activity with setting rules. Control and trust are not mutually exclusive.
- Apart from the parents, the school plays the greatest role in keeping the child safe online. Teachers do not run away from this responsibility.
- It is not always easy to talk to your child about safety. For teachers, the so-called difficult topics. Sometimes they also lack technical knowledge.
- Teachers use a large number of sources of information, many of which are intended to be professional, but still want to deepen their knowledge. This suggests their openness to the new educational program.
- The key to reaching parents may be smart word of mouth marketing and recommendation from other acquaintances, friends, other parents of children from the same class / school and teachers.

Polish projects and institutions dealing with internet security.

1. Polish Safer Internet Center (PSIC) was established in 2005 within the European Commission's Safer Internet Programme and is currently operating within the Connecting Europe Facility Programme. The Center is run by the Empowering Children Foundation (Fundacja Dajemy Dzieciom Siłę – FDDS) and by NASK – National Research Institute – acting in the capacity of the Center's coordinator. The Center undertakes a number of

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comprehensive efforts aimed at improving the safety of children and young people using the internet and new technologies.

2. The campaign against online discrimination The campaign's topic is online discrimination based on sexual orientation. It focuses on the problem of violence against LGBT youth, which was identified by helpline consultants as one of the significant problems affecting young people in Poland.
3. Hotline campaign against sextortion Campaign devoted to the problem of producing and distributing self explicit materials by children and teenagers.

Educational tools /platforms

- "Mr. File and Mr. Folder – on paths of the internet" - performances for children
- Podcasts of the Polish Safer Internet Center „Keeping Children and Young People Safe Online"
- Sieciaki.pl - educational portal and new resources
- Digital Youth project
- SELMA – an European project against hate online
- IMPACT - Cyberbullying Prevention Programme

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Curriculum analysis of the national curricula in terms of Internet Safety

The aim of general education in general upper secondary school and technical upper secondary school is:

1. treating structured, systematic knowledge as the basis for shaping skills;
2. improving mental and linguistic skills, such as: reading comprehension, creative writing, formulating questions and problems, using criteria, justifying, explaining, classifying, inferring, defining, using examples, etc.;
3. developing the student's personal interests and integrating subject knowledge from various disciplines;
4. acquiring the ability to formulate independent and well-thought-out judgments, to justify one's own and other people's judgments in the process of dialogue in the inquiring community;
5. combining critical and logical thinking skills with imaginative and creative skills;
6. developing social, moral and aesthetic sensitivity;
7. developing thinking tools enabling students to experience and understand culture;
8. developing students' respect for knowledge, developing a passion for exploring the world and encouraging them to apply the acquired knowledge in practice.

The most important skills acquired by a student during general education in general upper secondary school and technical upper secondary school include:

1. thinking - understood as a complex mental process consisting in creating new representations by transforming available information, involving the interaction of many mental operations: reasoning, abstracting, reasoning, imagining, judging, solving problems,

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creativity. Due to the fact that secondary school students learn different subjects simultaneously, it is possible to develop the following types of thinking: analytical, synthetic, logical, computational, cause and effect, creative, abstract; maintaining the continuity of general education develops both perceptual and conceptual thinking. The synthesis of both types of thinking is the basis for the comprehensive development of the student;

2. reading - a skill that combines both the understanding of meanings and symbolic meanings of statements; a key linguistic and psychological skill leading to personal development, active participation in the community, transferring experiences between generations;
3. the ability to communicate in the mother tongue and in foreign languages, both orally and in writing, is a basic social skill based on the knowledge of language norms and creating the basis for communication in various communication situations;
4. creative problem solving in various fields with the conscious use of methods and tools derived from computer science, including programming;
5. the ability to efficiently use modern information and communication technologies, including respect for copyright and safe navigation in cyberspace;
6. the ability to independently access information, to select, synthesize and evaluate it, to use sources reliably;
7. acquiring habits of systematic learning, organizing the acquired knowledge and deepening it;
8. ability to cooperate in a group and take individual actions.

One of the most important tasks of a general secondary school and a technical school is to develop language and communication competences, which are a key cognitive tool in all disciplines of knowledge. In this regard, it is important to combine language theory and practice. Enriching vocabulary, including learning the terminology appropriate for each subject, serves the intellectual

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development of the student, and supporting and caring for this development is the responsibility of every teacher.

An important task of the school is to prepare students for life in the information society. Teachers of all subjects should create conditions for students to acquire the ability to search, organize and use information from various sources and to document their work, taking into account the correct composition of the text and the principles of its organization, using information and communication technologies.

The most important goal of IT education for students is the development of computational thinking skills, focused on creative problem solving in various fields with the conscious and safe use of methods and tools derived from computer science. This approach, which started in primary school, is continued in general and technical secondary schools, both in the basic and extended scope. The computer science subject is taken by all students in each grade, starting from the first grade of primary school and continued in general secondary school and technical secondary school.

Most fields use ready-made algorithms and IT solutions, but the essence of computer science is the creative discovery of algorithms, learning methods of solving problems and examining their effectiveness. This approach increases the quality and effectiveness of not only students' IT education, but also brings benefits in teaching other subjects, supports the development of mathematical thinking, teaches a scientific approach to solving problems. The ability to use new technologies in a creative and critical way is now a basic skill useful not only to young people, but also to adults and the elderly. This is a prerequisite for active and full use of e-services, and having this skill is aimed at preventing the risk of exclusion from social life. It also helps to eliminate the generational barrier, improves communication between teachers and students, and consequently in the whole society.

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Basic requirements:

Compliance with the law and safety rules. Student:

1. acts in accordance with the principles of netiquette and legal regulations regarding: protection of personal data, protection of information as well as copyright and protection of intellectual property in access to information; is aware of the consequences of breaking these rules;
2. respects applicable law and ethical standards regarding the use and dissemination of computer software, third-party and own applications and electronic documents;
3. applies good practices in the protection of sensitive information (e.g. passwords, pin), data and operating system security, explains the role of information encryption;
4. describes the damage that can be caused by pirate activities on the web, in relation to individuals, selected institutions and the entire society.

Additional requirements at the advanced level.

Student:

1. explains the role of authentication techniques, cryptography and electronic signature in the protection and access to information;
2. discusses the importance of encryption and electronic signature algorithms.

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Training approaches

The approach to teaching internet safety consists of several principles:

- developing electronic security policies and procedures that will help mitigate risks and respond to concerns
- providing teachers with the knowledge needed to teach students about e-security
- teachers' giving advice on the use of social media and live broadcasting
- supporting and involving parents and guardians, sharing helpful advice and resources
- regular updating of e-security knowledge.

Teachers should teach students:

- verifying someone's identity
- verifying link security
- identifying internet fraud
- privacy protection
- creating and using passwords
- identify, not participate and contain cyberbullying.

They should also:

- explain to the students what a digital footprint is
- help the students detect phishing
- encourage positive communication online.

During the trainings, platforms dedicated to network security are used, and ready-made lesson plans prepared by institutions involved in teaching security in the network. Schools also benefit from training courses organized by external institutions.

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When asked about the difficulties related to teaching how to use the Internet safely, teachers report that students declare that they know the issues related to this topic very well and that they often do not want to actively participate in classes. In practice, it turns out that they very often do not know how to avoid threats on the Internet, but they do not want anyone to restrict their freedom of surfing the Internet. They are not always comfortable with the content and methods used by teachers in the classroom. Sometimes they find them unattractive, boring, schematic.

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Conclusions and recommendations

Polish resources on teaching Internet safety are quite rich, but teaching how to use the Internet safely is often limited to conducting a few lessons. It is difficult to say to what extent the available materials are used in schools.

Based on the analyzed research, it can be concluded that the declared knowledge of Internet safety rules does not always coincide with the actual state of affairs. It is necessary to constantly update knowledge about the risks associated with using the Internet. It is worth creating new resources, platforms, materials and applications that would support the process of teaching the principles of safe use of the Internet in schools.

On the basis of conversations with students about computer games, it can be concluded that effective game-based teaching tools should:

- focus on an Impressive start to capture the learner's attention right from the start
- give the players continuous challenges, each of which leads to another challenge, to keep them "hooked" on playing a game
- have interesting storyline
- combine fun and realism
- have an element of risk
- ensure that a gam eis challenging

We need to make sure that the game is as intrinsically motivating as possible. The actual key activity in the game must be interesting and engaging. Motivation should be in tune with the requirements of good gameplay like good balancing, a well tuned rewards system, varied consequences, and quick user feedback

References

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1. Akademia Leona Koźmińskiego, CBOS. 07.2013. Internet safety reviews. Warsaw. Microsoft Word - kom099_13.doc (cbos.pl)
2. Sylwia Czubkowska. 17.08.2021. 30 years of the Polish Internet. We have grown into a power that governs people and the economy. 30 lat polskiego internetu. Wyrosła nam potęga rządząca ludźmi i gospodarką (spidersweb.pl)
3. PSIC. POLISH SAFER INTERNET CENTER PUBLIC REPORT. Raport Saferinternet_final.pdf
4. IAB Polska. Online Privacy. 2017. IAB_Polska_Prywatnosc_w_sieci_2016_2017_raport.pdf
5. IPSOS. 2018. Children's safety on the Internet. Ipsos | Global Market Research and Public Opinion Specialist
6. Informacja o wynikach kontroli. Nauczanie matematyki w szkołach, Najwyższa Izba Kontroli, Warszawa 2019 r., https://www.nik.gov.pl/plik/id,19331,vp,21939.pdf, DOA: 16.12.2022.
7. Osiecka-Chojnacka Justyna, Doskonalenie kształcenia matematycznego, https://orka.sejm.gov.pl/WydBAS.nsf/0/5EB348B848753F72C12585E4003FD0B3/$file/Infos_277.pdf, DOA: 16.12.2022.
8. Sysło Maciej, Na ratunek uczącym się matematyki w szkołach, https://www.edunews.pl/badania-i-debaty/opinie/4654-na-ratunek-uczacym-sie-matematyki-w-szkolach, DOA: 16.12.2022.

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Innovation Frontiers IKE, Athens, Greece

Introduction

The Internet can be a wonderful place to learn, shop, play games, and talk to your friends. Unfortunately, there are also predators, identity thieves, and others online who may try to harm you. In order to be safe online, it's important to be aware of the dangers. Many kids are confident that they know how to be safe online. However, there are a few reasons kids are often more at risk. They may not always think about the consequences of their actions, which can cause them to share too much information about themselves. Kids also are sometimes specifically targeted by cyberbullies or predators.

Children need to be made aware of these dangers by so they can use the valuable resource for their educational needs without falling prey to any kind of cybercrime. More and more schools are coming up with special campaigns to teach the importance of Internet safety for students, resources that can shared by teachers, students and parents alike so that there is a comprehensive protection formed for all users.

The first section of this report consists of applications of serious games to enhance Interned Safety. The training approaches to teaching Internet Safety Skills are presented in the second section. Finally some recommendations are presented in the third section.

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Application of serious games to enhance Internet Safety Skills

The concept of serious games for cybersecurity awareness initially was one part of a broader awareness campaign led by governments, corporations, cyber education organizations to teach basic information assurance concepts such as: confidentiality, authentication, integrity, and availability to informal learners (people with no prior knowledge or limited knowledge). When it comes to formal learners or Computer Science students in a higher education setting, the use of games as a supplemental educational material has been investigated and utilized 4 . Nevertheless, the mass adoption of serious games to teach cyber security in general, has not yet materialized. Studies have shown that today's schools face major problems when it comes to holding student motivation, engagement and focus for an extended period of time . Because learners of this generation are "digital natives", it has also been argued that using games is more in tune with their general habits6 . In comparison to traditional teaching methods, game-based learning allows students to make mistakes and learn from them in a risk-free environment 7 , 8 . Students are free to re-enact a precise set of circumstances multiple times. Thus, they can explore the consequences of different in-game actions which are not repeatable in most school settings.

Gamification has been explored to various extents in prior work. Serious games for general security awareness are arguably the most popular. Anti-phishing Phil for instance is one of the most well-known games that has sought to educate people about detecting phishing attacks. The domain of phishing attracts a large amount of gamification research, likely due to the prominence of phishing and its perception as a user-oriented threat. Beyond phishing, topics such as password security and cryptography also feature. Sholefield and Shepherd design a role-playing quiz application (RPG) to educate the general population about good password practices. Their evaluation highlights the im portance of games as an enjoyable way to learn, but also the difficulties in such pursuits (e.g. challenges in implementing effective leader boards). Similar positive findings are found by Deeb and Hickey as they explore the use of a 3D escape room game to teach students about cryptography. Offline serious games present another way to engage individuals. Riskio is a tabletop game to raise

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awareness of cyber security concepts for those in business and for those studying security at university. It is oriented around playing the roles of attackers and defenders within an organisational security context. Crypto Go is another physical card game proposed which can be used for educating about security, particularly cryptography. Through user workshops, researchers found that the game improved motivation to study the topic and the understanding of the field. Focusing specifically on formal teaching contexts, Jin et al. situate their research on the growing need for a security workforce and use games to educate high school students. They propose and evaluate four cyber security education games (e.g. using virtual reality and tower defence) to teach topics such as security foundations, secure online behaviour, cyber-attack and defense methods and social engineering. Results were highly positive, and games were favoured by students and staff. Mostafa et al. also explore multiple games for teaching security through their testing of six games and how well they were received by university students. The games spanned topics such as network attacks, key management and web security, were implemented as image puzzles, simulations, role playing and action/adventure genres. Based on a user study, they conclude that the games could contribute greatly to the educational process. Lastly, capture the flag (CTF) games and exercises are extremely popular in cyber security. They allow participants (many of which may be students new to the field) to learn about the technical aspects of security, including finding and exploiting vulnerabilities (thus capturing 'flags'). Sv´abensk`y et al. provide a ˇ recent overview of the field and highlight the various types of challenges implemented to teach security. A key finding of their work is that while CTFs clearly are an attractive proposition alongside traditional lectures, they currently predominately focus on technical knowledge but often neglect the human aspects of security; this is clearly a shortcoming given how much cybercriminals use these factors. More specifically, we have seen CTFs applied for introducing new students to security, formative assessment, and as part of teaching in online universities. This spread of application areas demonstrate the use of these exercises within education.

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Curriculum analysis of the national curricula in terms of Internet Safety

In Greek schools there are no curricula in the strict sense of the term. However, most Greek schools cooperate with several institutions that can provide appropriate training for students and teachers, under the auspices of the Ministry of Education. For example, the Greek Safer Internet Centre (saferInternet4kkids.gr), in cooperation with the Ministry of Education, provides information, assistance and support to Greek schools, students and teachers on the safe use of the Internet. Initially, it provides courses for 8-11 year olds and 11-14 year olds. These courses are designed to cover a wide range of internet risks, such as phishing, cyberbulling, etc. The lessons provide detailed instructions and timelines for teachers to provide comprehensive information to enable them to educate pupils to be able to distinguish and protect themselves from the risks of the internet.

It is worth noting that a proposal has been made by individual computer science teachers to teach internet safety in Greek schools as a stand-alone subject. In detail, this course will include the following modules: Safe navigation (4 hours of teaching), privacy and security (4 hours of teaching), communication and contacts (4 hours of teaching), cyber bullying (4 hours of teaching), digital footprint and publication of personal data (4 hours of teaching), personal image and identity (4 hours of instruction), evaluation of information sources (4 hours of instruction), copying and copyright (4 hours of instruction), creation of material for the Internet (4 hours of instruction). Of course, these modules can be modified according to the needs and requirements of the students.

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Training approaches

Here are some training approaches for Internet Safety on Students:

CREATE A SCHOOL POLICY, AND HAVE STUDENTS SIGN IT

The first thing you'll need to do is create a school policy about internet usage. Lay everything out in clear, easy-to-understand terms. Describe how you expect the students to use the internet, what they should avoid and how they should communicate with others online. Then, share this policy with students and require them to sign in before using IT facilities at school. Having a policy will help pupils understand how seriously they should be taking their online safety.

TEACH STUDENTS ABOUT ONLINE PRIVACY

Kids these days often know better than to share passwords or their addresses online; however, there are new threats that they may not understand. Take the time to have a conversation with your students about how their favorite sites and apps store their information. Do they know that Snapchat, for example, keeps messages on a server for 30 days?

CREATE AN EFFECTIVE CYBERBULLYING REPORTING SYSTEM

"Cyberbullying is a common problem that nearly every school is dealing with," says educational expert Janet Moran from Elite Assignment Help. "You need to be able to support your students when it happens and educate them on the correct way to use the internet. Create a good reporting system that both students and parents can use to report cyberbullying, and follow through on any reports that you get."

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GET STUDENTS INVOLVED

When you're creating new technology usage guidelines or introducing new hardware or software, ask students for their input. They're much more likely to work with you if they feel as though have some ownership of the process. They can also inform you of devices, apps and programs that you may not have known about.

KEEP UP WITH TECHNOLOGY

Teens often turn to their friends for advice online because they may feel more comfortable talking to peers or think their parents and other adults are unaware of the current technology landscape. Keep yourself up to date about online developments, and make sure that students can come to you about any concerns they have. The more you know, the more you can help.

PROVIDE RESOURCES TO STUDENTS

There's lots of educational services out there, but not all of them are trustworthy. Research educational resources before recommending or using them to make sure others have had a positive experience from a security, online safety and privacy perspective.

KNOW THE LAWS ON SEXTING

Sexting has become a real problem, and there have been many instances in which private photos and messages have been shared more publicly than the senders had originally intended. Look into the laws on sexting, and ensure the whole school staff know what to do if they discover evidence of it in your school. Then, talk openly and honestly with students and parents about it. Give the

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students the information on the law, and ask their parents to discuss with them. Teens are much less likely to engage in risky behavior if their parents are open with them.

Conclusions and recommendations

As a general conclusion we could say that in recent years the issue of internet safety has been at the forefront of the minds of the state, citizens and students. Everyone recognises the importance of safe navigation on the Internet, as it is a vast space with many dangers lurking behind a screen. For this reason, actions, workshops and curricula are being rapidly developed to equip students with the right tools. All one can say with certainty is that technology has entered our lives for good, and even more so in the lives of students, if we consider the two years of pandemic during which the daily use of the Internet was and is the new reality. However, in Greece, several steps still need to be taken to introduce independent lessons on safe surfing on the internet into the daily school timetable, which is not the case so far.

Continuing, the Greek educational system places particular emphasis on the teaching of mathematics, as it is considered one of the most basic subjects at all levels of education. Most of the information used for this research shows that Greek students and teachers attach great importance to the teaching of mathematics and thus teachers try to update and develop their curricula. Also, it should be mentioned that there is not much information available on the teaching of mathematics in technical schools, as the logic is the same, i.e. that no matter what grade or type of school the student is in, the way of teaching mathematics is the same. The goal of the teachers and the system in general is the same, that is, through mathematics students learn to be critical thinkers and to solve their problems using mathematics.

We propose the creation of a serious game to teach students Internet Safety Skills. Specifically we propose the development of a serious game in the form of an escape room game in which students will need to solve quizzes so as to escape from each rooms. The rooms will be have quizzes based at least on the following topics.

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- Grooming
- Fake news
- Cyberbullying
- Phishing

Through playing that game students will learn about Internet Safety through a playful way that will be a stealth environmnent that will hide knowledge in the game.

References

Aguilera-Hermida, A.P.: College students' use and acceptance of emergency online learning due to covid-19. International Journal of Educational Research Open 1, 100011 (2020) Barata, G., Gama, S., Jorge, J., Gon¸calves, D.: Engaging engineering students with gamification. In: 2013 5th International Conference on Games and Virtual Worldsfor Serious Applications (VS-GAMES). pp. 1–8. IEEE (2013)

Chicone, R., Burton, T.M., Huston, J.A.: Using facebook's open source capture the flag platform as a hands-on learning and assessment tool for cybersecurity education. International Journal of Conceptual Structures and Smart Applications (IJCSSA) 6(1), 18–32 (2018)

Chothia, T., Novakovic, C.: An offline capture the flag-style virtual machine and an assessment of its value for cybersecurity education. In: 2015 USENIX Summit on Gaming, Games, and Gamification in Security Education (3GSE

15). USENIX Association (2015), https://www.usenix.org/conference/3gse15/ summit-program/presentation/chothia

Deeb, F.A., Hickey, T.J.: Teaching introductory cryptography using a 3d escapethe-room game. In: 2019 IEEE Frontiers in Education Conference (FIE). pp. 1–6. IEEE (2019)

This project has been funded with the support from the European Commission (project no: 2020-1-PL01-KA226-SCH-096462).This publication reflects the views only of the author, and the Commission cannot be held responsible for any use which may be made of the information contained therein.

Ford, V., Siraj, A., Haynes, A., Brown, E.: Capture the flag unplugged: an offline cyber competition. In: Proceedings of the 2017 ACM SIGCSE Technical Symposium on Computer Science Education. pp. 225–230 (2017) SherLOCKED: A Serious Game for Security Education

Fortes Tondello, G., Premsukh, H., Nacke, L.: A theory of gamification principles through goal-setting theory. In: 51st Hawaii International Conference on System Sciences (2018)

Gonz´alez-Tablas, A.I., Gonz´alez Vasco, M.I., Cascos, I., Planet Palomino, A.: Shuf fle, cut, and learn: Crypto go, a card game for teaching cryptography. Mathematics 8(11), 1993 (2020)

Hart, S., Margheri, A., Paci, F., Sassone, V.: Riskio: A serious game for cyber security awareness and education. Computers & Security 95, 101827 (2020)

Ελληνικό Κέντρο Ασφαλούς Διαδικτύου ITE, retrieved from https://saferinternet4kids.gr/yliko-gymnasiou/?age[]=for-elder children&submit=%CE%91%CE%BD%CE%B1%CE%B6%CE%AE%CF%84%CE%B7%CF%83%CE%B7

Μπαλής, Χ, Ταγκόπουλος, Η, Σταμούλη, Μ, (2019) "Ασφάλεια στο Διαδίκτυο": Μια πρόταση για αυτόνομο μάθημα, retrieved from, http://synedrio.pekap.gr/praktika/7o/ergasies/3balis3.pdf

"Σκοποί και στόχοι της διδασκαλίας των μαθηματικών" retrieved from https://eclass.uoa.gr/modules/document/file.php/MATH115/%CE%A3%CE%B7%CE%BC%CE%B5%CE%B9%CF%8E%CF%83%CE%B5%CE%B9%CF%82.pdf

"Εκπόνηση Προγραμμάτων Σπουδών Πρωτοβάθμιας και Δευτεροβάθμιας Εκπαίδευσης και οδηγών για τον εκπαιδευτικό, Εργαλεία Διδακτικών Προσεγγίσεων", (2007), retrieved from http://ebooks.edu.gr/info/newps/%CE%9C%CE%B1%CE%B8%CE%B7%CE%BC%CE%B1%CF%84%CE%B9%CE%BA%CE%AC/%CE%9C%CE%B1%CE%B8%CE%B7%CE%BC%CE%B1%CF%84%CE%B9%CE%BA%CE%AC%20%E2%80%94%20%CE%93%CF%85%CE%BC%CE%BD%CE%AC%CF%83%CE%B9%CE%BF.pdf

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“Οδηγίες διδασκαλίας μαθηματικών γενικής παιδείας Γ’ τάξη Γενικού Λυκείου” retrieved from https://docs.google.com/document/d/1O3rZLTVwKFfySfWE18LP1wrQ6X-1YLPJ/edit

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Research on gaming interests of students

Introduction

The history of computer games is closely linked to the history of modern computers. Tennis for Two, appearing in 1958, was the first video game programmed purely for entertainment. A group of MIT students created a dueling game of two spaceships called "Spacewar" in 1962. (Spacewar!, the First Video Game, 2022) *1970s starts the era of video game machines. 1980s and 1990s was the time of fast development of the video games' industry with many classic games. 2000s starts the time of online games. 2010s is the time of playing games on any platform and at any age.* (Rechsteiner, 2022)

Currently computer or more precisely video games are played by most of young people. Survey shows more than 90% of the Internet users aged 16-24 play video games in 9 countries (Philippines, Indonesia, Vietnam, Thailand, Turkey, Saudi Arabia, Mexico, Taiwan, and India). 78.9% of Polish Internet users play video games.

The concept of "serious games" was first introduced by researcher Clark C. Abt (1970) in his book Serious Games. Abt suggested that simulations and games can improve education in the classroom as well as in informal environments. In addition, serious games have a positive effect on students as well as on academic performance. According to Djaouti Damien (Djaouti), the use of serious games is believed to influence student motivation, learning through trial and error, considering differences in learning rhythms, stimulating pedagogical interactions between learners".

Objectives of the "iSafety App Teaching Students Internet Safety Through an Artificial Intelligence Mobile Application" project include design of a mobile serious game on computer safety as well as development of teachers training courses and materials on using the game.

That would not be possible without learning on the gaming interest of students – the target of the application.

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To learn more about the students' interests on gaming a questionnaire has been developed. Almost 600 students from Poland, Greece and Cypress have filled the questionnaire. Most of them were at age between 10 and 18 years old and that is the group whose interests needed to be examined.

The results of the study confirm that both high school boys and girls play video games very often. The study also shows multiple clues on how to make a game interesting and engaging to its young users. The results provide clues on how to make the teaching process more effective.

High interest in mobile games combined among the students, a trend of growing share of the mobile phone gaming (Knezovic, 2023)and the clues obtained during the research make a solid basis for the development of very successful educational game on the Internet safety.

Research results

Research on gaming interests of high school students was carried out in 2022. 598 students from Poland, Greece and Cypress were examined to learn on their gaming interests.

Data was processed using SPSS statistical package. Ch-Square and Mann-Whitney U statistic were used to evaluate differences of distribution of answers between girls and boys – see (IBM SPSS Statistics 28 Documentation, 2022).

Demographics

Total number of 598 students were examined.

Most of them (90.5%) came from Poland, 5% from Cypress and 4.4% from Greece. The disproportion of number of students from different countries was caused by the amount of available data. We believe that use of such data is acceptable based among others on the disproportion of the sizes of each country population.

Country

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		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Greece	26	4.4	4.4	4.4
	Cypress	30	5.0	5.0	9.4
	Poland	541	90.6	90.6	100.0
	Total	597	100.0	100.0	

Table 1 Origin of the students

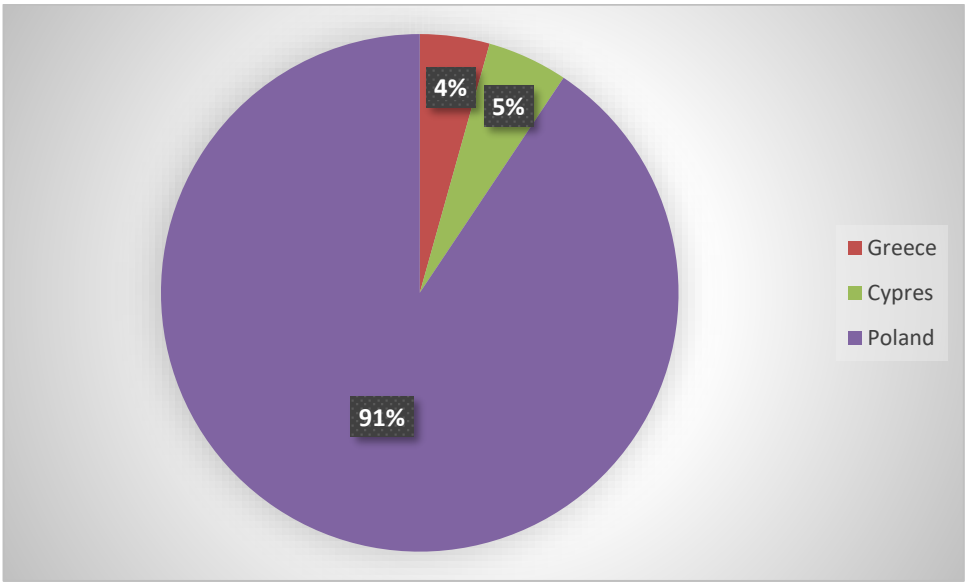

Chart 1 Origin of the students

The number of boys and girls was almost equal – 297 and 299 respectively. The number of boys and girls in is almost equal in the general population as well as in the surveyed schools. The questionnaires have been handed to all students in each of the class so the number of girls and boys who returned the questionnaires corresponds to the proportions of the general population.

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Female	299	50.1	50.2	50.2

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	Male	297	49.7	49.8	100.0
	Total	596	99.8	100.0	
Missing	9	1	.2		
Total		597	100.0		

Table 2 Gender

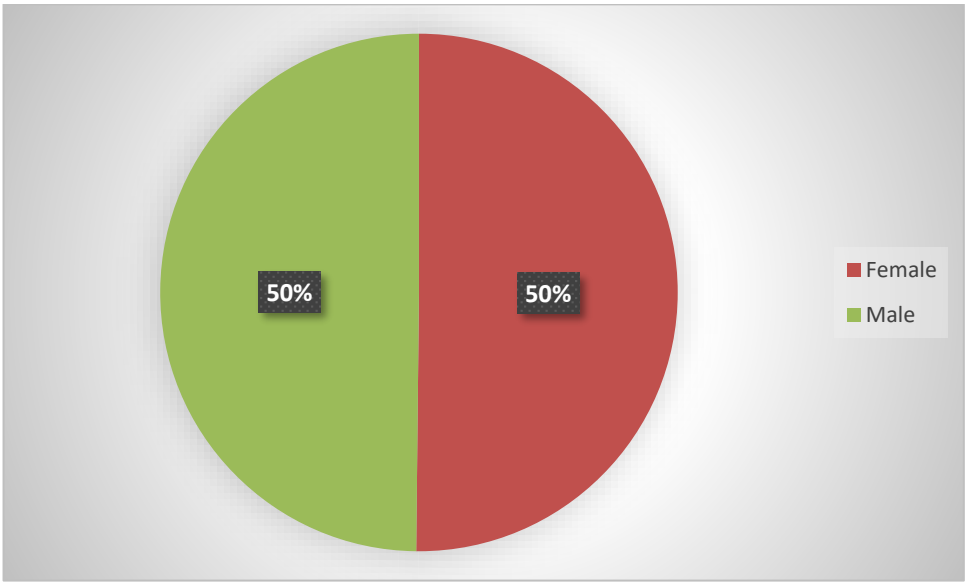

Chart 2 Gender

The age of students (with very few exceptions) was between 10 and 18 years old. The group split into roughly equal subgroups – 10 -13 years old and 14-18 counting 294 and 296 students respectively.

10-13 years old is a roughly a group of younger teenagers. 14-18 is a group of older teenagers. We decided to choose such groups as they are our target group of the internet safety game.

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	9 or under	1	.2	.2	.2

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	10-13	294	49.2	49.3	49.5
	14-18	296	49.6	49.7	99.2
	19-20	5	.8	.8	100.0
	Total	596	99.8	100.0	
Missing	99	1	.2		
Total		597	100.0		

Table 3 Age

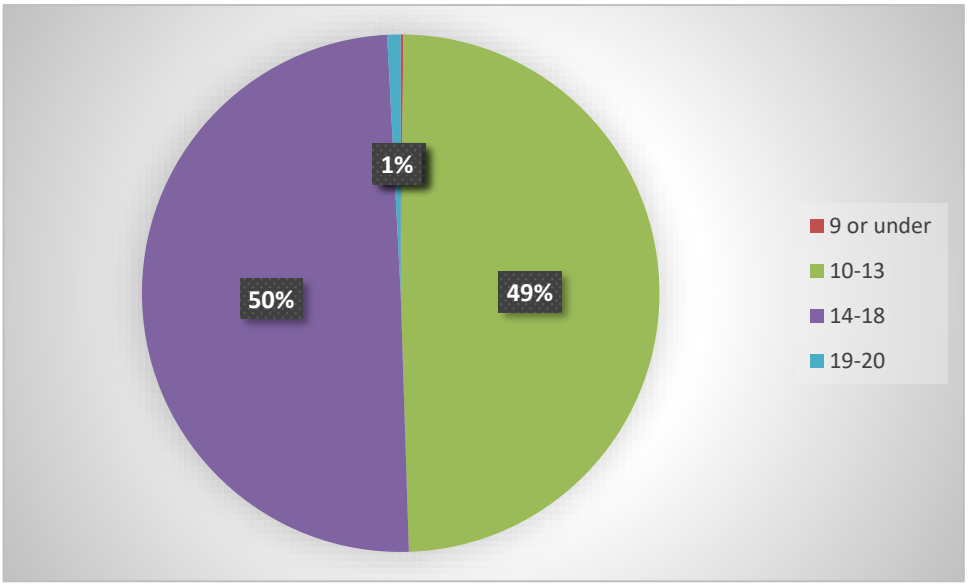

Chart 3 Age

Gaming interests

Several questions have been asked to the students. The questions, answers and the analysis are stated below.

Have you ever played a serious game?

Firstly, they were asked if they even played serious games. 79.2% of the students declared that they had played in a serious game. 14.4% say they had not. 14.4% were not sure.

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That clearly shows that serious games are widely knows amongst young people. That means that that by creating a new game – in our case related to the internet safety, will not lead us to an unknown land. As most of students has already played serious games, they will play a computer safety game as well and based on a right learning concept learn necessary skills.

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Not sure	86	14.4	14.4	14.4
	No	38	6.4	6.4	20.8
	Yes	473	79.2	79.2	100.0
	Total	597	100.0	100.0	

Table 4 Frequency of playing serious games

Do you think that solving mathematical problems is important in games?

When asked if solving mathematical problems is important in games, 44.7% of the students believed that solving mathematical problems was important in games. 21.9% had an opposite opinion. 33.3% did not know.
While 44.7% of the surveyed group who believes that solving mathematical problems is important in games, is not really a large number, we believe that it is caused by fact that children usually do not like mathematics and are sometimes 'allergic' to mathematic. (Manthey, 2022). However strict logic of games may and usually does closely resembles strict rules of mathematics. Thus, solving problems in games resembles solving mathematical problems.

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	I don't know	199	33.3	33.3	33.3
	No	131	21.9	21.9	55.3
	Yes	267	44.7	44.7	100.0
	Total	597	100.0	100.0	

Table 5 Mathematics important in games

Time spent on playing games per week.

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When asked about time spend on playing games per day, almost 80% of students said that they play 1 to 8 hours per week. Over 20% of them declared playing up to 1 hour per week. Same number of students said that they played more than 8 hours per week.
When we look at the detailed results – see the table below, we see the full picture of the potential for using games for educational purposes. Young people play a lot. If we can offer them a serious game that will only take a small fraction from their play time, we will be able to teach young people a lot.

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	0-1 hours	107	17.9	20.7	20.7
	1-2 hours	84	14.1	16.3	37.0
	2-4 hours	79	13.2	15.3	52.3
	4-6 hours	75	12.6	14.5	66.9
	6-8 hours	64	10.7	12.4	79.3
	more than 8 hours	107	17.9	20.7	100.0
	Total	516	86.4	100.0	
Missing		81	13.6		
Total		597	100.0		

Table 6 Time spent on playing games

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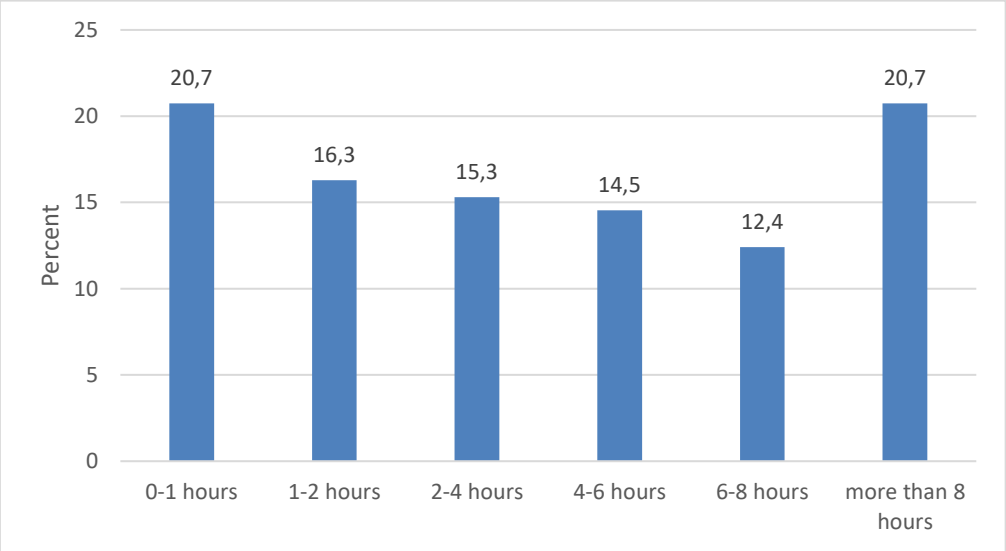

Chart 4 Time spent on playing games

When you compare time spend on playing games by boys and girls, you see that boys are more likely to play longer hours than the girls. The difference is statistically significant. The value of the Pearson's Chi-Square statistics equals to 92.095 which gives asymptotic significance lesser than 0.01.

There is more time of playing games we can 'still' from boys to be spent on educational games. Does it mean that the potential of serious games is lower for girls? We do not know it yet and more research can be done in the future.

			gender		
			Female	Male	Total
Time spent	0-1 hours	Count	90	17	107
		% within gender	34.7%	6.6%	20.7%
	1-2 hours	Count	51	33	84
		% within gender	19.7%	12.8%	16.3%
	2-4 hours	Count	40	39	79
		% within gender	15.4%	15.2%	15.3%
	4-6 hours	Count	32	43	75

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		% within gender	12.4%	16.7%	14.5%
	6-8 hours	Count	19	45	64
		% within gender	7.3%	17.5%	12.4%
	more than 8 hours	Count	27	80	107
		% within gender	10.4%	31.1%	20.7%
Total		Count	259	257	516
		% within gender	100.0%	100.0%	100.0%

Table 7 Time spent on playing games - boys vs girls

Devices used for playing games.

55.6% of the students declared they used desktop and laptop PCs to play games. Mobile phones were used by 27.3% and consoles by 15.1%. It is no surprise and corresponds to the global trends (Hruska, 2020). The quoted research shows that 17% of users in Europe uses a mobile phone as their primary gaming device. Notably more than 50% of gamers in Asia uses a phone to play games most often.

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Desktop PC	296	49.6	53.2	53.2
	Laptop	13	2.2	2.3	55.6
	Console	84	14.1	15.1	70.7
	Tablet	11	1.8	2.0	72.7
	Phone	152	25.5	27.3	100.0
	Total	556	93.1	100.0	

Table 8 Devices

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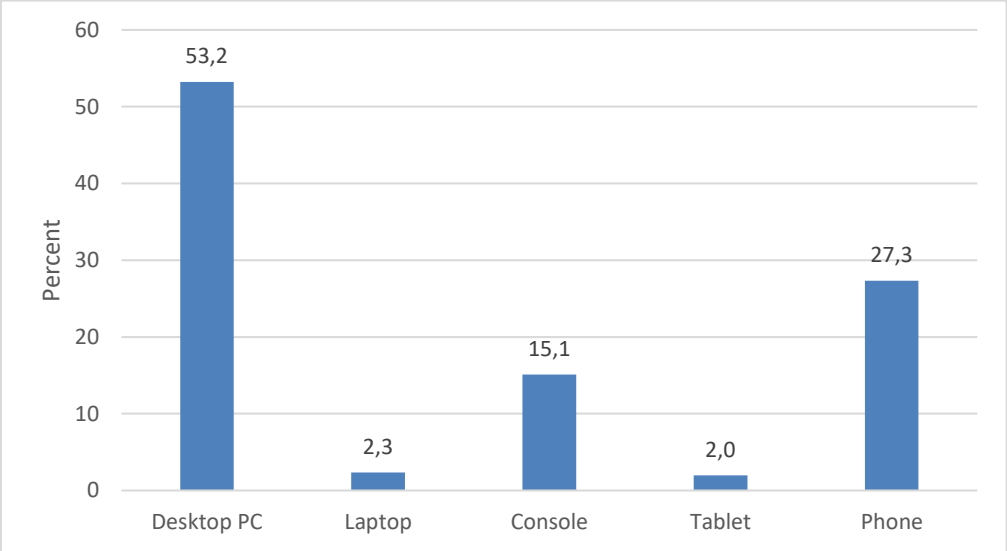

Chart 5 Devices

It is interesting to notice that there is a statistically significant difference between the distribution of the devices used by the girls and the boys. The boys are more likely to use desktop pcs and consoles. The girls are more likely to use mobile phones. The value of the Pearson's Chi-Square statistics is 79.94 with the asymptotic significance lesser than 0.01.

Note, that developing a game for mobile phones give more equal impact on both girls and boys.

			gender		
			Female	Male	Total
Which of the following devices do you use?	Desktop PC	Count	118	178	296
		% within gender	42.8%	63.6%	53.2%
	Laptop	Count	9	4	13
		% within gender	3.3%	1.4%	2.3%
	Console	Count	23	61	84
		% within gender	8.3%	21.8%	15.1%
	Tablet	Count	8	3	11
		% within gender	2.9%	1.1%	2.0%
	Phone	Count	118	34	152

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	% within gender	42.8%	12.1%	27.3%
Total	Count	276	280	556
	% within gender	100.0%	100.0%	100.0%

Chart 6 Devices by gender

Reasons for playing games

When asked about the reasons of playing games, the answers are as follows:

- To have fun – 71.4%
- To kill time – 63,8%
- To relief stress – 11.6%
- To teamwork – 9.7%

There is a statistically significant difference between frequency of answers between boys and girls in the following cases:

- Boys play to have fun more often than girls – 78.8% vs 63.9%
- Boys play to teamwork more often than girls do – 13.1% vs 6.4%
- Girls play to relief stress more often than boys do – 13.7% vs 9.4

Favorite games' genres

Top favorite video games' genres are

- First person shooter (FPS) – 26.5%
- Adventure 21.9%
- Action – 11.5%
- Simulator – 9.4%

There is a statistically significant difference in games' genres preferences between boys and girls.
Top genres for boys are:

- FPS – 43.9%
- Adventure – 11.2%
- Action 10.7%

Top genres for girls are:

- Adventure – 32.7%
- Simulator – 13.8%
- Action – 12.2%

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			gender		
			Female	Male	Total
What are your favorite video game genres?	Action	Count	24	21	45
		% within gender	12.2%	10.7%	11.5%
	Adventure	Count	64	22	86
		% within gender	32.7%	11.2%	21.9%
	Casual	Count	18	0	18
		% within gender	9.2%	0.0%	4.6%
	Strategy	Count	16	13	29
		% within gender	8.2%	6.6%	7.4%
	Simulator	Count	27	10	37
		% within gender	13.8%	5.1%	9.4%
	FPS	Count	18	86	104
		% within gender	9.2%	43.9%	26.5%
	Sports	Count	7	16	23
		% within gender	3.6%	8.2%	5.9%
	Racing	Count	10	8	18
		% within gender	5.1%	4.1%	4.6%
	RPG	Count	12	20	32
		% within gender	6.1%	10.2%	8.2%
Total		Count	196	196	392
		% within gender	100.0%	100.0%	100.0%

Table 9 What are your favourite video game genres (by gender)?

Preferred way of interaction in games

Students like multiplayer games most (47%) followed by single player (22.8%) and two player (21.1%).

There is a statistically significant difference in preferences between boys and girls. Multiplayer games are preferred by 57.2% boys and only by 36.8% girls. At the same time, girls are more likely than boys to play Single and Two player games.

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			gender		
			Female	Male	Total
Which way of interaction in the game do you prefer?	Single Player	Count	90	46	136
		% within gender	30.1%	15.5%	22.8%
	Two Player	Count	75	51	126
		% within gender	25.1%	17.2%	21.1%
	Multiplayer	Count	110	170	280
		% within gender	36.8%	57.2%	47.0%
	No answer	Count	24	30	54
		% within gender	8.0%	10.1%	9.1%
Total		Count	299	297	596
		% within gender	100.0%	100.0%	100.0%

Table 10 Preferred ways of interaction in a game

Students were asked more questions – all with available answers:

- Strongly disagree
- Disagree
- I do not know
- Agree
- Strongly agree

I learn better when I can relate experiences from an educational game to real-life

The mode of the answers was “Agree”.

Based on the Man-Whitney U test, there was no statistically significant difference between the distribution of answers from boys and girls.

That shows that students expect a link between real life and educational games. It indicates that educational games should be good for teaching practical skills rather than just theory.

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		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Strongly disagree	27	4.5	4.5	4.5
	Disagree	100	16.8	16.8	21.3
	I do not know	114	19.1	19.1	40.4
	Agree	223	37.4	37.4	77.7
	Strongly agree	121	20.3	20.3	98.0
	No data	12	2.0	2.0	100.0
	Total	597	100.0	100.0	

Table 11 I like games that seem too difficult

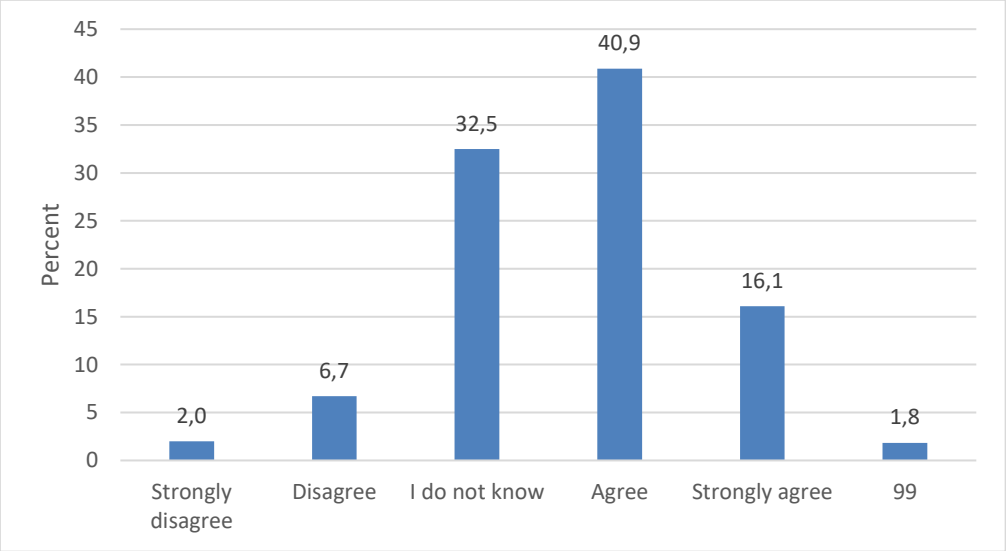

Chart 7 I learn better when I can relate experiences from an educational game to real-life

I learn better when new knowledge builds on knowledge I already have

The mode of the answers was “Agree”.

Based on the Man-Whitney U test, there was no statistically significant difference between the distribution of answers from boys and girls.

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The results give a clue on how to use a game in classes. Students should be provided with some initial knowledge so they can relate to while acquiring new skills by playing a game.

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		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Strongly disagree	4	.7	.7	.7
	Disagree	13	2.2	2.2	2.8
	I do not know	110	18.4	18.4	21.3
	Agree	276	46.2	46.2	67.5
	Strongly agree	182	30.5	30.5	98.0
	No data	12	2.0	2.0	100.0
	Total	597	100.0	100.0	

Table 12 I learn better when new knowledge builds on knowledge I already have

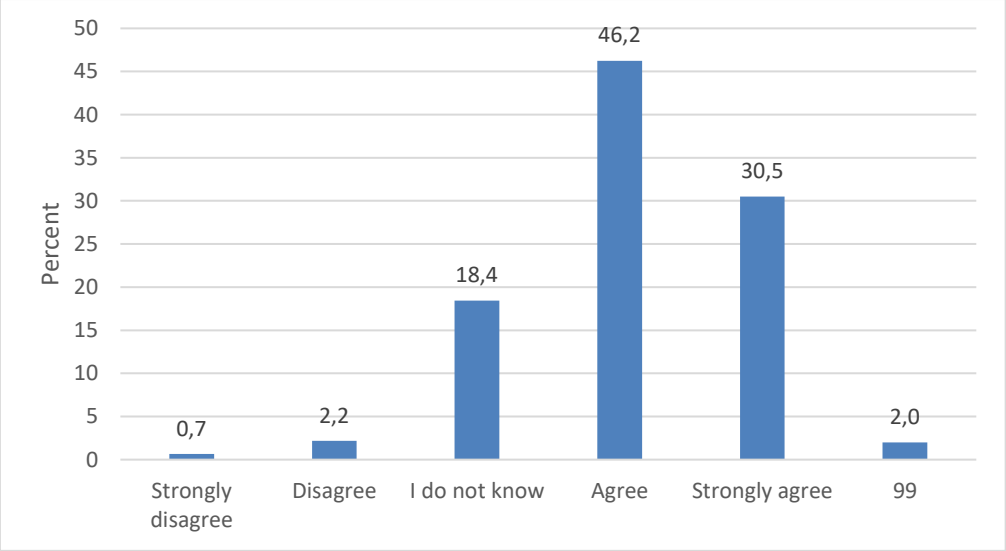

Chart 8 I learn better when new knowledge builds on knowledge I already have

I like games that seem too difficult

The mode of the answers was “Agree”.

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Based on the Man-Whitney U test, there was statistically significant difference between the distribution of answers from boys and girls.

While in general 'too difficult' is not a problem, some 50% of girls did not indicate agreement with the statement. The games should not seem too difficult as it may scare a large portion of potential users, especially girls.

gender			Frequency	Percent	Valid Percent	Cumulative Percent
Female	Valid	Strongly disagree	21	7.0	7.0	7.0
		Disagree	63	21.1	21.1	28.1
		I do not know	67	22.4	22.4	50.5
		Agree	105	35.1	35.1	85.6
		Strongly agree	37	12.4	12.4	98.0
		No data	6	2.0	2.0	100.0
		Total	299	100.0	100.0	
Male	Valid	Strongly disagree	6	2.0	2.0	2.0
		Disagree	37	12.5	12.5	14.5
		I do not know	47	15.8	15.8	30.3
		Agree	117	39.4	39.4	69.7
		Strongly agree	84	28.3	28.3	98.0
		No data	6	2.0	2.0	100.0
		Total	297	100.0	100.0	
9	Valid	Agree	1	100.0	100.0	100.0

Table 13 I like games that seem too difficult

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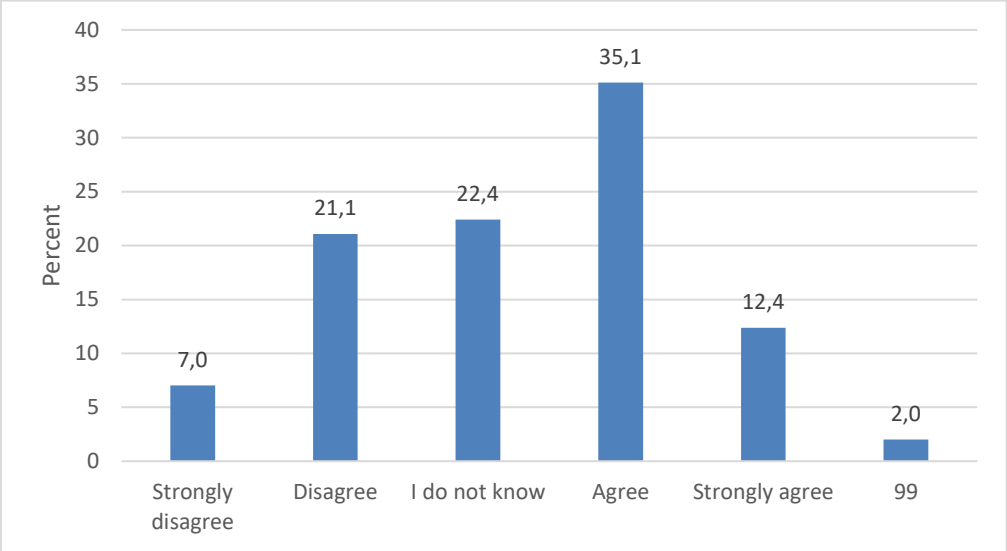

Chart 9 I like games that seem too difficult – girls

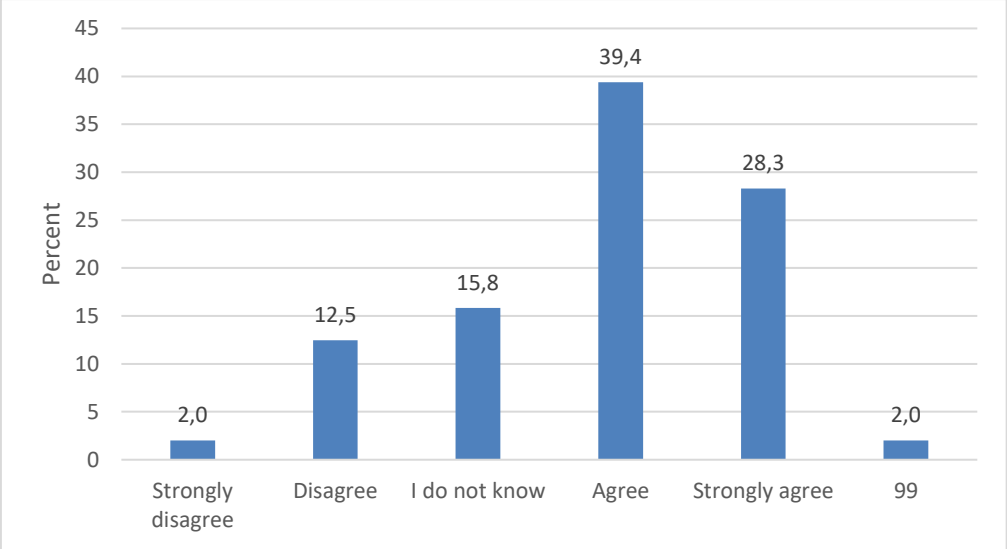

Chart 10 I like games that seem too difficult - boys

I find that feedback on my actions in the game helps me grow

The mode of the answers was “Agree”.

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Based on the Man-Whitney U test, there was statistically significant difference between the distribution of answers from boys and girls.

The feedback is important to both genders, especially to boys. This is a significant clue to developing a serious game for young people.

gender			Frequency	Percent	Valid Percent	Cumulative Percent
Female	Valid	Strongly disagree	7	2.3	2.3	2.3
		Disagree	31	10.4	10.4	12.7
		I do not know	97	32.4	32.4	45.2
		Agree	117	39.1	39.1	84.3
		Strongly agree	44	14.7	14.7	99.0
		No data	3	1.0	1.0	100.0
		Total	299	100.0	100.0	
Male	Valid	Strongly disagree	4	1.3	1.3	1.3
		Disagree	21	7.1	7.1	8.4
		I do not know	79	26.6	26.6	35.0
		Agree	123	41.4	41.4	76.4
		Strongly agree	64	21.5	21.5	98.0
		99	6	2.0	2.0	100.0
		Total	297	100.0	100.0	
9	Valid	Agree	1	100.0	100.0	100.0

Table 14 I find that feedback on my actions in the game helps me grow

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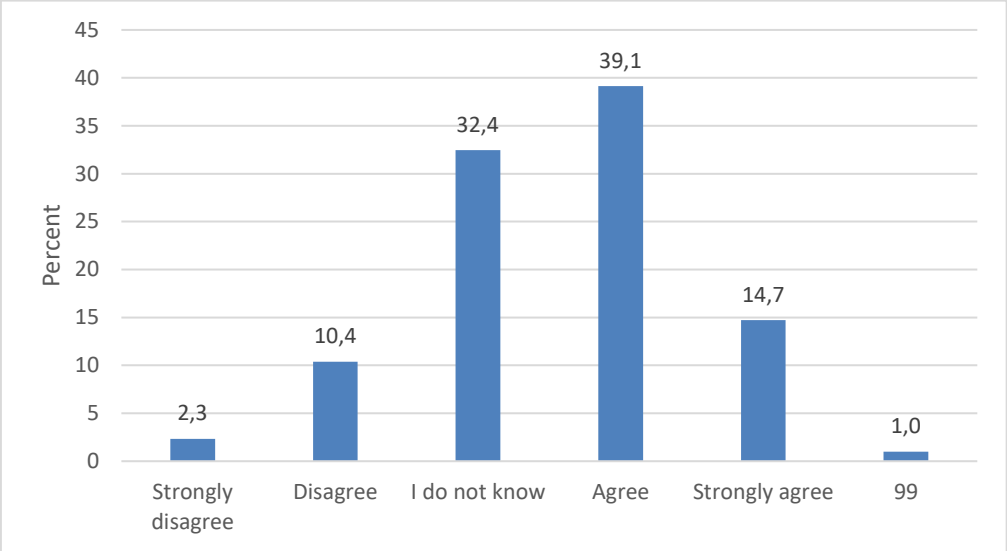

Chart 11 I find that feedback on my actions in the game helps me grow - girls

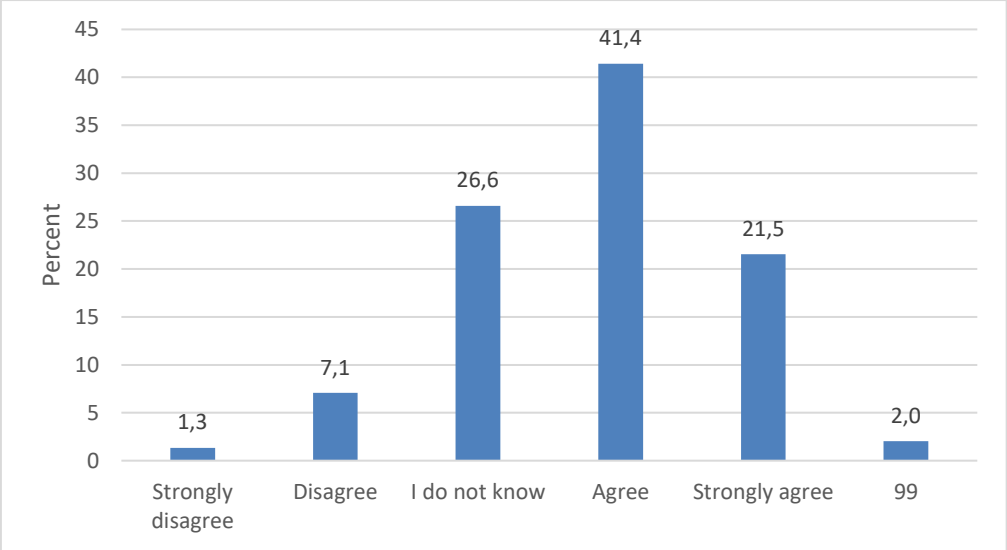

Chart 12 I find that feedback on my actions in the game helps me grow - boys

I prefer to play games that have clear objectives

The mode of the answers was “Agree”.

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Based on the Man-Whitney U test, there was no statistically significant difference between the distribution of answers from boys and girls.

Clear objectives are a clear clue for games for young people i.e. our target.

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Strongly disagree	24	4.0	4.0	4.0
	Disagree	56	9.4	9.4	13.4
	I do not know	124	20.8	20.8	34.2
	Agree	241	40.4	40.4	74.5
	Strongly agree	141	23.6	23.6	98.2
	No data	11	1.8	1.8	100.0
	Total	597	100.0	100.0	

Table 15 I prefer to play games that have clear objectives

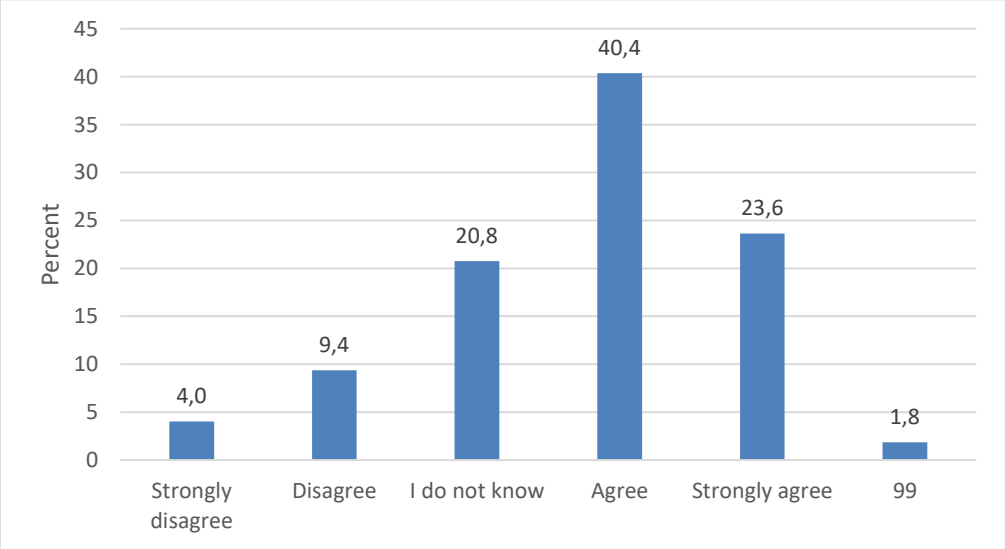

Chart 13 I prefer to play games that have clear objectives

I find that I learn better when I am involved in the role I play in the game

The mode of the answers was “Agree”.

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Based on the Man-Whitney U test, there was no statistically significant difference between the distribution of answers from boys and girls.

The answers show that being involved in the role one plays is important. That should be kept in mind while designing a game for young people.

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Strongly disagree	24	4.0	4.0	4.0
	Disagree	81	13.6	13.6	17.6
	I do not know	160	26.8	26.8	44.4
	Agree	199	33.3	33.3	77.7
	Strongly agree	121	20.3	20.3	98.0
	No data	12	2.0	2.0	100.0
	Total	597	100.0	100.0	

Table 16I find that I learn better when I am involved in the role I play in the game

Chart 14 I find that I learn better when I am involved in the role I play in the game

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I think I understand the topics taught better if I can experiment with them

The mode of the answers was “Agree”.

Based on the Man-Whitney U test, there was no statistically significant difference between the distribution of answers from boys and girls.

Games are perfect for experimenting. You can experiment with different options and there is feedback available. And this is what young people like.

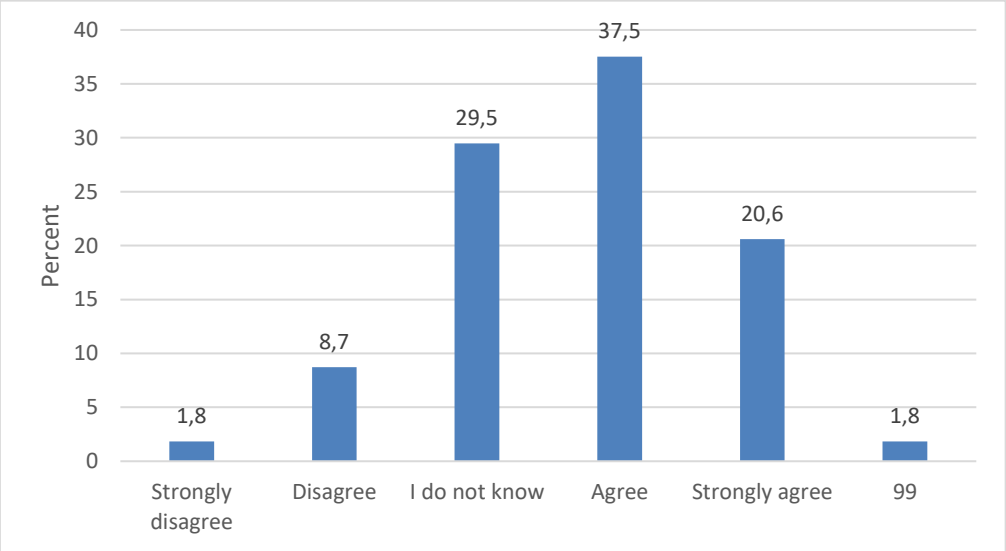

Chart 15I think I understand the topics taught better if I can experiment with them

I feel more involved in the game if I can use my knowledge of the plot and the game world

The mode of the answers was “Agree”.

Based on the Man-Whitney U test, there was statistically significant difference between the distribution of answers from boys and girls.

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Both genders and especially boys agree with the statement. This is a clue to both how to use the game in classes and how develop the game itself. The plot and the game world should be explained in a class or within the game itself.

gender			Frequency	Percent	Valid Percent	Cumulative Percent
Female	Valid	Strongly disagree	9	3.0	3.0	3.0
		Disagree	17	5.7	5.7	8.7
		I do not know	71	23.7	23.7	32.4
		Agree	127	42.5	42.5	74.9
		Strongly agree	67	22.4	22.4	97.3
		No data	8	2.7	2.7	100.0
		Total	299	100.0	100.0	
Male	Valid	Strongly disagree	5	1.7	1.7	1.7
		Disagree	16	5.4	5.4	7.1
		I do not know	50	16.8	16.8	23.9
		Agree	122	41.1	41.1	65.0
		Strongly agree	96	32.3	32.3	97.3
		99	8	2.7	2.7	100.0
		Total	297	100.0	100.0	
9	Valid	Agree	1	100.0	100.0	100.0

Table 17 I feel more involved in the game if I can use my knowledge of the plot and the game world

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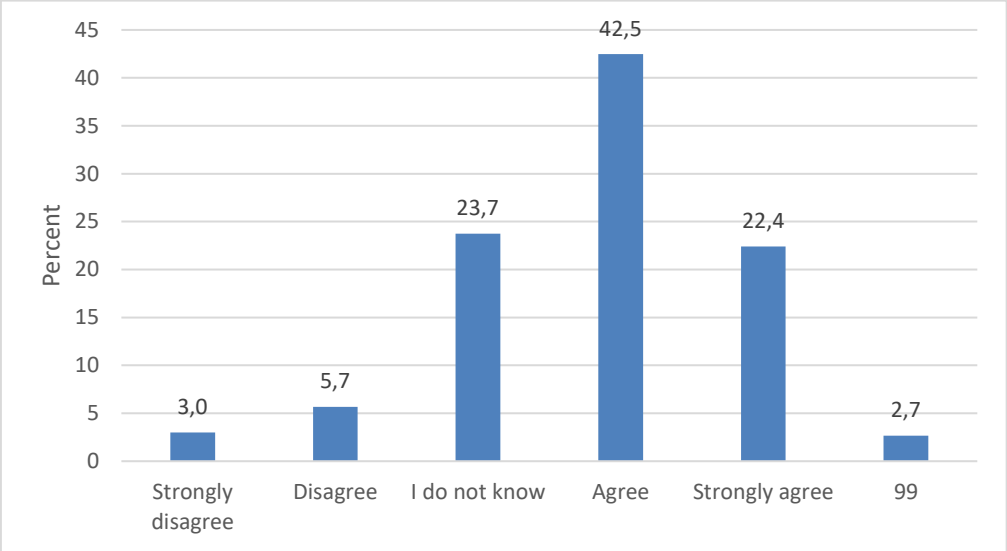

Chart 16 I feel more involved in the game if I can use my knowledge of the plot and the game world – girls

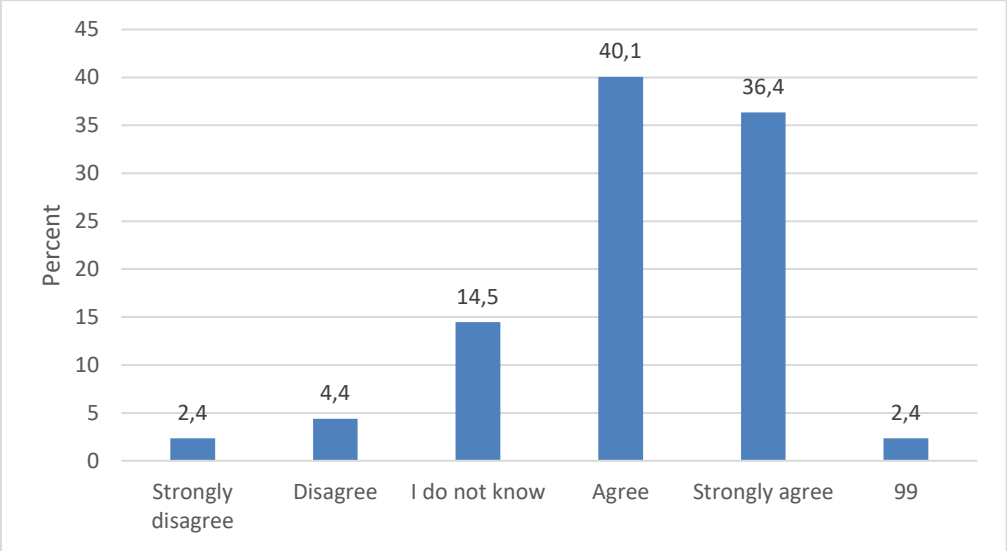

Table 18I feel more involved in the game if I can use my knowledge of the plot and the game world - boys

I feel more engaged in the game if the rewards/bonuses are matched to the difficulty level

The mode of the answers was “Agree”.

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Both mode and mean of the answers were “Agree”.

Based on the Man-Whitney U test, there was statistically significant difference between the distribution of answers from boys and girls. Boys tend to agree more with the statement.

What is means is that the game’s rewards must be matched with the level of difficulty.

gender			Frequency	Percent	Valid Percent	Cumulative Percent
Female	Valid	Strongly disagree	8	2.7	2.7	2.7
		Disagree	18	6.0	6.0	8.7
		I do not know	56	18.7	18.7	27.4
		Agree	124	41.5	41.5	68.9
		Strongly agree	88	29.4	29.4	98.3
		No data	5	1.7	1.7	100.0
		Total	299	100.0	100.0	
Male	Valid	Strongly disagree	7	2.4	2.4	2.4
		Disagree	13	4.4	4.4	6.7
		I do not know	43	14.5	14.5	21.2
		Agree	119	40.1	40.1	61.3
		Strongly agree	108	36.4	36.4	97.6
		No data	7	2.4	2.4	100.0
		Total	297	100.0	100.0	
9	Valid	Agree	1	100.0	100.0	100.0

Table 19 I feel more engaged in the game if the rewards/bonuses are matched to the difficulty level

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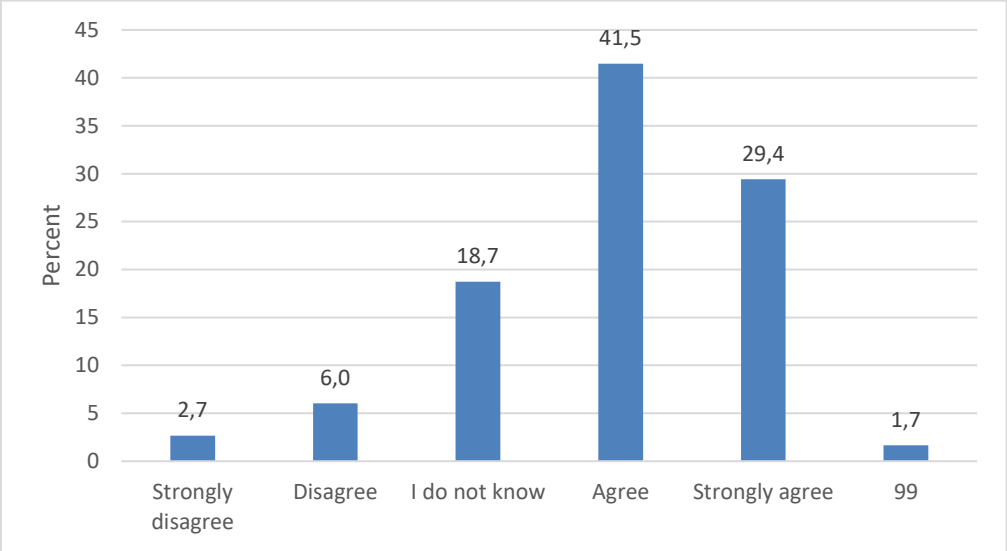

Chart 17 I feel more engaged in the game if the rewards/bonuses are matched to the difficulty level – girls

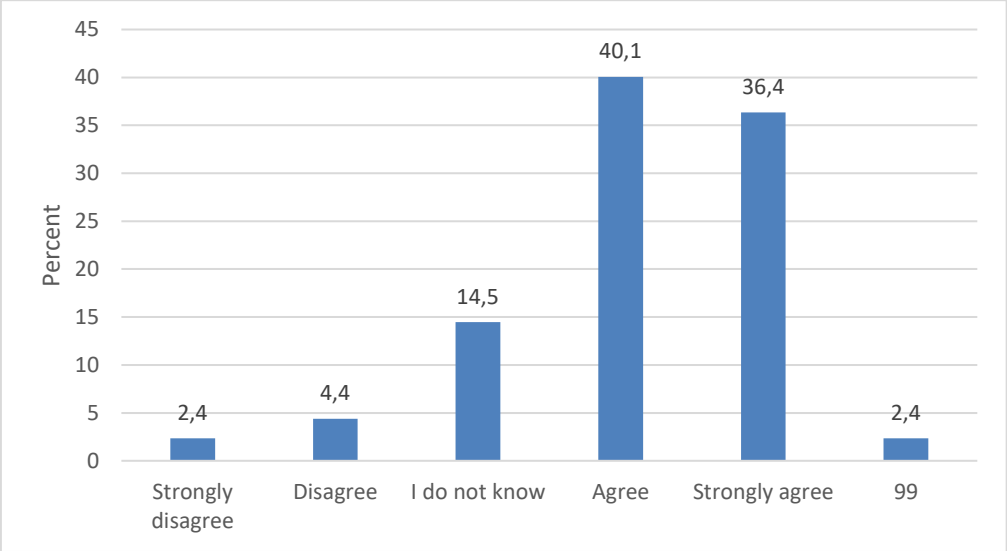

Chart 18 I feel more engaged in the game if the rewards/bonuses are matched to the difficulty level –boys

Do you want to be notified about the progress of the game development?

76.1% of boys and 62.2% of girls answered “Yes”.

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It means that young people are interested in new games and want to see the development of games that concern them.

Conclusions and recommendations

Student of our target demographics play a lot. Some 80% of them play between 1 and 8 hours per week. It is a lot of time that can potentially be used for studying. An educational game is a game, but it teaches something. And it our goal to teach young people.

It is important to notice that girls, in general, play less than boys do. We cannot expect girls to be as engaged in playing as boys. A video game cannot be the only source of knowledge and it should be accompanied with other tools and activities.

Almost 80% of the examined group declared they had played a serious game. It shows that the concept of serious games is not unknown to the majority of the high school students. That means that offering a serious game will not cause an immediate confusion.

More than a quarter of the studied group play on mobile phones. As we know this figure is likely to grow within next years. The finding combined with a great versatility of mobile phones makes a mobile phone a perfect platform for a future serious game. Practically everybody owns a mobile phone. Mobile phones can be used in any classroom. You do not need any special classroom equipped with PCs. You can play at school, at home and anywhere.

Students play to have fun and kill time primarily. The game needs to be fun – that is obvious. The game needs to be properly 'marketed' so the students can kill time and study at the same time.

Preferences of games' genres depend on the gender. Boys' favorite game genre is FPS. Girls like Adventure most. As Adventure is number 2 on the boys' list, we believe that it makes the perfect genre for the game that will fit both boys and girls.

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Multiplayer is the preferred way of interaction for both boys and girls. That means that the game should either be designed as multiplayer or at least multiplayer feature should be included in the product's roadmap.

Students expect to relate to real life experience in games. That means that computer games may teach real life topics and internet safety is one.

New knowledge needs to build on knowledge students already have. That indicate need for some introduction to the topic before students start playing. That may be the role of teachers.

Students want to the game to have clear objectives and have knowledge of the plot and the game world. That is another point to an introduction to the game – either as a part of a class or within the game itself.

Students want to be involved in the role they play and experiment with the topics. They want to receive clear feedback. All of those are clear tip to the game designers.

Both genders, in general, like to play games perceived too difficult and receive bonuses that match the difficulty level. There is some difference in the perception of those topics between girls and boys. Girls are less like to accept games that seem to be too difficult and receive bonuses matched to the difficulty level. Those differences should be taken into the consideration.

Majority of the students want to follow the development of the game. It is a clue to the dissemination routes. Students should be informed about the game before it is ready.

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References

Djaouti, D. (n.d.). Serious Games pour l'éducation: utiliser, créer, faire créer?. *Trema*, 51-64.

Hruska, J. (2020, 8 19). *3 Billion People Worldwide Are Gamers, and Nearly Half Play on PCs.* Retrieved from Extremetech: https://www.extremetech.com/gaming/314009-3-billion-people-worldwide-are-gamers-and-nearly-half-play-on-pcs

IBM SPSS Statistics 28 Documentation. (2022, 12 15). Retrieved from IBM: https://www.ibm.com/support/pages/ibm-spss-statistics-28-documentation#en

Knezovic, A. (2023, 2 17). *Mobile Game Market Trends in 2023 You Need to Watch Out For.* Retrieved from Udonis: https://www.blog.udonis.co/mobile-marketing/mobile-games/mobile-game-market-trends

Manthey, E. (2022, 06 27). *Dlaczego dzieci nie lubią matematyki?* Retrieved from Juniorowo: https://www.juniorowo.pl/dlaczego-dzieci-nie-lubia-matematyki/

Rechsteiner, A. (2022, 12 15). *The history of video games.* Retrieved from Swiss National Museum: https://blog.nationalmuseum.ch/en/2020/01/the-history-of-video-games/

Spacewar!, the First Video Game. (2022, 12 14). Retrieved from Analogue: https://www.analogue.co/developer/spacewar

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IsafetyApp game concept

Description of the initial concept:

IsafetyApp is an innovative mobile game that combines elements of safe Internet use with learning mathematics. The game takes players to a fantasy world called Phantom, where they have to solve mathematical puzzles while gaining

knowledge about safe use of the Internet.

Plot:

The player assumes the role of a young hero who is transported to Fantazjomat, a magical world full of mysteries and challenges. The hero learns that the Phantomat is threatened by the Dark Forces of the Internet, who want to use its power for evil purposes. In order to save the Phantomat, the hero must overcome various levels and challenges, gaining mathematical knowledge and learning the rules of safe use of the Internet.

Game:

IsafetyApp offers a variety of levels that consist of interactive math puzzles and tasks related to the safe use of the Internet. The player will have to solve equations, calculate sums, multiply numbers and perform other mathematical operations to progress to the next levels of the game.

In addition, during the game, the hero will have to make decisions regarding the safe use of the Internet, such as recognizing fake websites, avoiding dangerous links and protecting his online privacy. Correct answers to math tasks and appropriate safety decisions will be rewarded with points and will allow the player to gain new skills and advance to the next levels.

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Characters and environments:

During the journey through the Phantasyomat, the hero will meet various characters, such as the Wise Owl Mathematician, who will give him valuable mathematical tips, and the Digital Knight, who will help him in the fight against the Dark Forces of the Internet. The player will explore the picturesque locations of the Phantasyomat, such as Magic Lasers, Digital Labyrinths and Mathematical Cities.

Educational goals:

Isafetyapp aims to combine learning math with education about safe use of the Internet. The game aims to teach players basic math skills such as addition, subtraction, multiplication and division, while teaching them to protect their online privacy, recognize threats and make the right decisions.

Summary:

Safe Journey Through the Phantom Internet is an exciting mobile game that combines educational elements with entertainment. By solving mathematical puzzles and making decisions regarding online safety, players will be able to develop their mathematical skills and gain knowledge about safe use of the Internet. An adventure in the fantastic world of Fantazjomat will not only provide entertainment, but also encourage you to explore mathematics and take care of security in the digital world.

List of disadvantages of the previously developed game concept:

1. Possibility of Losing Engagement: Playing in a fantasy world may not interest some players or provide enough motivation to continue. Not all players may be interested in fantasy, which may affect their commitment and willingness to learn.

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2. Difficulties transferring knowledge to real situations: While the game teaches both mathematics and safe use of the Internet, it is not always clear how the acquired knowledge can be practically applied in everyday life outside the context of the game. The lack of specific examples or real-world applications may limit the educational value of the game.

3. No interaction with the real world: In a fantasy world, player interactions are mostly virtual. The lack of physical interaction with the real world and objects can affect the level of engagement and impact of the game on the player.

Changing the concept of the game

In the course of the discussion and based on the results of the evaluation, we decided that transforming the concept of the game into a model based on the escape room principle, where the rooms of a teenager's house are game rooms, can bring many educational benefits. Here are a few reasons why such a concept might be more educational than a game set in a fantasy world:

1. Realistic scenarios: Using the model of an escape room and a teenager's home room, the game can depict realistic situations that young people encounter on a daily basis. The player can find himself in the bedroom, living room or office, where topics related to online safety and mathematics that have direct application in everyday life will be discussed.

2. Specific and practical knowledge: An escape room based game can focus on specific online safety and math topics that are relevant to young people. The player will have to solve tasks and answer questions about Internet threats, privacy protection, online fraud recognition, Internet addiction, online grooming. Such concrete and practical challenges will help players understand the relevance of these topics in the context of their daily lives.

3. Closeness to the player's reality: Placing the player in the room of the teenager's house means that they will be able to more easily identify with the game's protagonist. Scenarios based on

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everyday online safety and math situations will help players see how these issues have a direct impact on their lives. This can stimulate them to learn more and apply these skills in practice.

4. Interaction with real objects: Escape rooms often use physical objects and puzzles to solve. In this game, the player can manipulate objects in the room such as books, computers, televisions to discover clues, solve math puzzles, and answer online safety questions. This interaction with real objects can enhance understanding and memory among players.

5. Educational context: The escape room game allows you to introduce didactic elements, such as short lessons, hints and explanations that can accompany solving puzzles. For example, after answering a question about using the Internet safely, the game may provide a short lesson on the topic, with specific rules and practical tips. This enables players to gain knowledge while playing and put it into practice.

Transforming the game concept into a model of an escape room in a teenager's home, where players answer questions related to online safety and math, can increase the educational value of the game, providing realistic scenarios, practical knowledge, proximity to the player's reality, interaction with real objects and educational context. This concept allows you to engage and learn in a more authentic and practical way.

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Learning concept for iSafetyApp

Choice of platform

Introduction

Gadgets are an integral part of our daily lives. It is difficult to even imagine what a day would be like without having our smartphone, since we communicate with it, we use its applications, find information and much more. Especially nowadays, in the age of pandemics, the demand for technological means has skyrocketed.

Specifically, in gaming, the number of available platforms is growing at a steady pace, varying from handheld devices to home consoles and hybrid consoles, but with a visible focus on handheld devices. Even though it may seem that traditional gaming consoles (such as Nintendo, Sony PlayStation, Xbox etc.) are more popular for the purpose of playing video games, game development companies and smartphone companies are attempting to draw more players to smartphones. Considering the rapid advancement of smartphone technical features and the increasing development of high-end games for mobile platforms, it is likely that at some point in the future, mobiles will be the dominant source for gaming. A gamer can easily even connect a gaming controller to their smartphone, getting a similar control-wise experience as on a console.

Even though most young people have some kind of gaming console, almost everyone has a smartphone, meaning that a household can have multiple smartphone gamers. On the one hand, console gamers are adding the smartphone to their game platforms of choice for the new high-end games that are coming out, while non-gamers are getting into gaming through the smartphone itself. In 2016, over 37% of total video game revenue was generated by mobile games.

The Isafetyapp game will be a serious game with educational content about internet safety. Therefore, the consortium wants the game to be as accessible as possible, making the platform decision crucial. Even though the Isafetyapp game could have been developed for gaming consoles

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or personal computers (PC), by developing it for mobile (smartphone) platforms, we can reach a wider audience, as individuals won't be required to purchase an additional device.

When it comes to mobile apps versus mobile websites, the time users spend on mobile apps is growing, as opposed to using a browser, as users prefer mobile apps for better user experience and speed. Out of the time users spend on their smartphone, the time spent on apps has grown to 86%, while just 14% is spent on browsers. Young people tend to access the web using their mobile device rather than a desktop or laptop computer. In addition, studies also show that young people in lower socioeconomic groups are just as likely, and in some cases more likely, than those living in higher income households to use their smartphone as a primary point of access (Vogels, 2021).

For many companies, then, the following dilemma arises: to develop iOS or Android applications. To ensure that our choice is correct and profitable, we must consider the advantages and disadvantages of each operating system.

Inclusion of multiplayer components

Objectives

The following report aims at providing technical information regarding the inclusion of multiplayer components into the Isafetyapp serious game.

Background

Games

There are multiple theoretical frameworks that could be used to describe the design and operation of games. We have chosen to make use of the four domain classification created by Schell (2008). He classified all game elements into four domains: Aesthetics, Stories, Mechanics and Technology. We will focus our analysis on the Mechanics domain, the domain which is most heavily influenced by the inclusion (or not) of a multiplayer component. Mechanics are defined as the core of the game,

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what is left if all "superficial" elements (Aesthetics, Stories and Technology) are stripped down. These comprise the rules and procedures in play during the game.

To understand how the mechanics of a game involving several players work, we should also consider some basic terminology regarding game design. We will focus our analysis on three core concepts. However, we should be mindful that these definitions are not clear-cut, neither in their classification nor the name they are given by different authors.

Competition

Competition is also one of the core elements of a game. The will to play a game can originate from the joy of play itself, but it can also derive from its competitiveness (Salen & Zimmerman, 2004). As we have described before, a game implies a quantifiable outcome; since that result is objective, it lends itself to be a source of competition.

Competition can be seen in all sorts of games. Although it is more evident in games in which players play against other players, it is also present in games where a player plays against the environment. The competition in the latter type of games stems from the comparison with users' previous personal outcomes, desired outcomes, or those achieved by other players.

Collaboration

Dillenbourg (1999) defined collaboration in learning as a situation in which two or more people learn (or attempt to learn) something together. He contrasted this against the similar concept of cooperation, in which two or more people split the work and resolve smaller tasks on their own and then assemble it in a final product. For collaborative learning, participants need to complete the tasks together.

Multiplayer game mechanics

We will consider then two types of multiplayer game mechanics. One promotes the resolution of an in-game conflict through collaboration and another uses competition to spur a better resolution of

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the conflict by the player. Both can operate in individual players or teams. Schell (2008) made a further subdivision of the component into six general types of mechanics.

Requires a communication mechanism

One of the most critical elements in a multiplayer experience is the need for communication among players (Dudzinski et al., 2013). Wang and Huang (2021) identified two game mechanics related to communication among players:

1. Chatting channel (Free communication): Its main goal is to enable communication to assess and make decisions regarding the game. Although Wang and Huang only mentioned a written text style of chat, nothing prevents using an audio-based form of communication. The authors have identified the use of both synchronous and asynchronous chatting channels. The first operate as instant messaging platforms, while the others are more like internet forums.
2. Nonverbal communication (Pre-defined communication). This is a less specific, more emotional sort of communication system. Its goal is to encourage and show support towards other players. This system makes use of standardised avatar gestures, emojis, emoticons to facilitate the interaction between players.

The existence of a communication mechanism is a heavy task to consider, mainly because it implies costs of upkeep and, depending on the type of communication, the responsibility for monitoring the quality of the share content and mediating for learning.

Options for inclusion

The following section aims to provide guidance regarding inclusion strategies for participants of the Isafetyapp serious game.

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Background

There is increasing recognition of need to consider how best to develop/adapt serious games for people with disabilities, although game development has mainly focused on the non-disabled population rather than adopting a "design for all" approach (Hersh & Leporini, 2018). Below we briefly review the relevant literature that has focused on how video games can be made more inclusive for young people with specific disabilities/needs.

Intellectual disabilities

An Intellectual Disability (ID) is a condition where a person has significant limitations in their cognitive and intellectual functioning; poor socially adaptive skills might also be apparent (Schalock, 2014). Intellectual disabilities are usually diagnosed by the time a child turns 18 but stay with someone for life. Intellectual disabilities affect roughly 1% of the population (Maulik et al., 2011).

Dyslexia is a common specific learning disability where individuals experience difficulty reading, writing, and spelling. Shabbir et al. (2019) discussed how serious games can be developed to appeal to and enhance the cognitive learning, of children with dyslexia. They suggested all of the following design components be considered in order to make serious games more inclusive of children with this learning disability: reduce cognitive fatigue; avoid 'cluttering' (an overloaded user interface); offload tasks (e.g., avoid finding hidden menus, navigations, etc.); avoid use of jargon in layout design; ensure text is legible and distinct; use visually and functionally consistent layout and interface design; avoid instant alert messages; and remove background stimuli (i.e., use plain or visually simple backgrounds).

Autistic spectrum disorder (ASD) is a developmental disorder that can cause significant communication, social, and behavioural challenges. Many individuals with ASD also have ID and/or language impairment (American Psychiatric Association, 2013). Bossavit and Parsons (2018) carried out a pilot study that explored an educational game that was co-designed with and for young people

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with ASD. They concluded that there were significant benefits to including young people with specific disabilities in the design process of a serious game, but that most digital games research to date has lacked ecological validity by not adequately considering the views and perspectives of young people with disabilities.

Durkin et al. (2013), after reviewing the literature on the challenges and attractions of video games for adolescents with special educational needs, suggested that young people with high functioning ASD would do better in video games based on logic, involving cause-and-effect relationships, and other careful attention to detail elements.

In an exploratory study involving 10 children with ASD, Malinverni et al. (2017) designed and developed a Kinect-based game for high-functioning children with ASD called “Pico's Adventures,” aimed at promoting social initiation in young children with ASD. Findings indicated that the game was effective in eliciting social initiation behaviours. A key aspect of the design was the use of elements and mechanics that were appealing for the children and testing out the suitability of the game with children with ASD.

Motor or sensory disabilities

Few studies have addressed the challenges and special needs of children with motor or visual impairments. Some children with cognitive impairments such as Attention Deficit Hyperactivity Disorder also have problems with motor coordination, and executive function as well as possible low tolerance of frustration (Durkin et al., 2013).

Hersh and Leporini (2018) reviewed the literature on games that have been developed for children and adults with visual impairments and noted that some games incorporated special features such as musical sequences and movement.

To date there has been relatively little research carried out on inclusion for young people with disabilities in serious games. Most of the studies we identified were carried out in the last five years.

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It is difficult to make recommendations that are applicable across the range of disabilities that individual might experience, but authors in this area have advocated the involvement of people with disabilities in the design and evaluation of new games (Bossavit & Parsons, 2018; Hemingway et al., 2019). This is something that therefore should be considered in the development process of the Isafetyapp game.

Personal data requirement

Data Collection in Serious Games

The main paper we considered is a meta-analysis by Smith et al. (2015) which analysed 8 different review papers.

This paper raises 2 challenges:

- How to collect data without influencing its generation
- How to collect and validate data where an emphasis is on what people are thinking and doing.

Interventional techniques such as interviews and focus groups can bias feedback due to issues such as interviewees answering to please the interviewer. Observational techniques are limited in what they can measure and one can miss information on more subjective/qualitative responses.

Focusing on the temporal aspect of data collection there are 3 distinct periods when data can be collected: Before, During, and After gameplay. All three periods are important but require different approaches and the relevant data available differs.

Reviewing the meta-analysis revealed that the following data is being collected:

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- Before game: Mostly demographic information (gender, age, nationality, culture) and some experience (previous exposure to computer games, VR etc.).
- During game: Game metrics, time to complete, number of errors, progress.
- After game: Subjective feedback on enjoyment.

There was a tendency to collect certain types of data during the different phases. During the pre-game, it is less common to collect data on a participant's attitudes, their intrinsic and extrinsic motivation, learning and personality styles, etc. In many cases, both pre- and post-tests were used to generate skill or knowledge performance metrics directly related to intended serious outcomes of the game. If measuring effectiveness of the game as an intervention, then a minimum expectation could be for a pre-test and post-test, and it would also be desirable to obtain some in-game data, e.g., score or duration metric.

During the gameplay, measures tend to focus on issues of performance. Less common were measures that examined player approaches to completing the game and measures of experience such as "flow", immersion, presence, and the general affective state of the participant.

Despite some good work in the area of relating game design features to serious outcomes (Smith et al., 2015), most studies focus on collecting data to support the message of efficacy rather than data that helps explain why and how they are effective or indeed how to apply design rules that lead to the required efficacy. Causality may allow us to draw conclusions on this efficacy, answering "why" questions as opposed to just measures of effect.

Different data collection techniques have inherent biases; thus, it is important to consider multiple data collection methods. Common data collection methods in this field are:

- Interviews
- Focus groups
- Questionnaires

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- Direct observation
- Indirect observation -> Highlighted as particularly attractive for serious games

Indirect observation involves gathering data where users are not distracted by the data collection mechanism. This could include collecting qualitative data, for example, from a user diary, or quantitative data from automated event logging. Much data during the game can be collected in logs without distracting users.

Another feature highlighted in the data collection review that occurred during gameplay was the lack of direct observation in the field (10%) compared to observations that were made in a controlled environment such as a computer laboratory (54%). Research by nature tends to occur in university environments, and controlled environments allow contextual variations associated with data collection to be controlled in traditional experimental designs. This does, however, influence the data generation and is perhaps not reflective of more organic use.

An example of a serious game comprising data collection is provided by Arnab et al. (2013). In this study, however, it seems that the only demographic information collected is age. The authors stated there was a diversity in terms of ethnicity but do not say that this was necessarily recorded.

The following are some key considerations when collecting data from human subjects:

Will participants be uncomfortable or feel unsafe with other individuals knowing that they are participating? Have the local community, relevant individuals and organizations been consulted, and a situational analysis been undertaken to determine the likely local perceptions of the evidence generation process?

Consider the cultural context in which you are collecting data – is this a collective or individualistic culture? If it is the former, what are likely attitudes towards privacy? Are family or community members going to insist or presume attendance when survey/interview/focus group/tests are undertaken?

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Consider if explicit questions are required. For the safety and privacy of the individual it may be worthwhile reframing questions so that they are generalised rather than personal (e.g., “Have you experienced violence in the home” versus “Do you think violence in the home is common in your community?”

Anonymising Data

- Remove or do not collect direct identifiers (e.g., personal information such as names and addresses).
- Aggregate or reduce the precision of variables that might be identifiable (such as postcodes).
- Generalise text variables to reduce identifiability (in reports).
- Restrict continuous variables (examples of continuous variables include height and age (i.e. anything that is measurable and therefore identifiable), to reduce outliers (those variables that are outside the norm and therefore easily identifiable).
- Pay particular attention to anonymising relational data – some anonymised variables may become identifiable when considered in combination.
- In the instance of geo-referenced data, use encryption coding to transmit information and consider de-identifying, de-locating data or, if not feasible, the assignment of data to broader geographical areas.

Preliminary conclusions for iSafetyApp

Methods: Interviews and focus groups are resource intensive and can introduce several biases that less direct methods can avoid. Direct observation is similarly costly. Depending on resources it may be worthwhile using some of these methods as additional data points, but we would describe them as lower priority. For this reason, we would suggest relying on questionnaires and indirect observations.

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Data to Collect:

- Pre-game
  - Demographic information (gender, age, nationality, culture) and some experience variables (previous exposure to mobile games, VR etc.).
  - A short test to assess some measure for the effectiveness of the game, in the form of a short questionnaire. Questions would be aligned with intended learning outcomes.
  - May be interesting to assess some attitudinal questions in this initial data collection to allow for a more nuanced understanding.
- During game
  - Game metrics, time to complete, number of errors, progress
  - Player approaches to completing the game and measures of experience such as flow, immersion, presence.
  - This information would all be intended to be logged as indirect observation.
- Post-game
  - Short test to assess some measure for the effectiveness of the game, in the form of a short questionnaire. Questions would be aligned with intended learning outcomes. This allows for an estimation of the effect of the game on knowledge of the topics gained through the game. Attitudes to measure attitudinal changes could also be assessed. This type of questionnaire would be carried out shortly after completion and a later follow up assessment could be conducted to see how lasting the game's impact is.
  - Questionnaire assessing enjoyment and pain points of the game. These subjective measures would allow more insight into players mindsets during the game, and we could relate these to in-game information to inform improvements to the game and also to identify how these impact the effectiveness of the learning outcomes.

Benefits of Using Escape Rooms in Education

The benefits of using escape rooms in education outlined below are based on previous literature (Alsham, 2020; Ioannis, 2013; Κυπριωτάκη, 2020).

Initially, it was reported that, regardless of the teaching content and age, escape rooms in education were an auxiliary tool for understanding concepts difficult to understand in the traditional way,

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while enabling users to have improved attitudes, mood, and activity. Through the educational escape rooms, the students developed communication and cooperation skills, as well as practiced problem-solving strategies. At the same time, with the use of this educational tool students are transformed from passive receivers into active participants in learning, as they are asked to explore data, accept challenges. and solve problems.

In the context of education, the adoption of escape rooms as problem-solving games could provide a simulation of the world in which students practice and develop skills and perceptions. According to previous literature, most escape training rooms were based on Collaborative Learning Theory, Active Learning Theory, Game-Based Learning Theory, Problem Solving Learning, and Collaborative Problem Solving:

Active Learning

Active learning techniques cultivate superior skills and show better learning outcomes compared to traditional teaching methods. Students have a deep understanding of new knowledge, cultivate skills, acquire a sense of responsibility as well as perseverance, to actively solve a problem situation.

Game Based Learning

This focuses on the learning object and the mobilization of the students through a playful process, such as rewarding and ranking the students according to their learning performance. In addition, it has been argued that a play and problem-solving environment provides students with immediate learning outcomes within a pedagogical context. It has been shown that this kind of process facilitates the acquisition of motivation, skills, and knowledge. This results in students getting involved and experimenting without being overwhelmed by the feeling of failure.

Collaborative learning

Collaborative learning as an educational methodology provides opportunities for students to develop communication and collaborative skills. A prerequisite for collaborative learning is the

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existence of communication (i.e., the development of dialogues for the exchange of messages and information between collaborators). To facilitate communication without spatial and time restrictions during the cooperation of the students, various internet tools of modern and asynchronous communication can be used.

Learning through Problem Solving

Constructivism is a theory of learning that advocates that knowledge is constructed through the interpretation of the learner's experiences, which originate from the real world. At the same time, this learning theory focuses on knowledge building, critical thinking, and problem-solving strategy. A constructivist framework that has been successfully applied to the learning process is the Problem-Solving Learning model.

Benefits of digital mobile games

Mobile learning games are considered to encourage both cognitive and social-emotional learning in young people and adults. Most of the research that has been done on mobile games in education focuses on improving students' knowledge through the application of digital mobile games. Several studies have shown that students understood and interpreted difficult concepts, terms and situations more easily through games. In addition, an increase in knowledge was identified. In most of the research that has been done, the emphasis is on developing skills using the game. Games stand out as promoting communication skills and the ability to collaborate between students. In addition, some research demonstrates the cultivation of problem-solving ability. Finally, in research in special education, digital games have been shown to contribute to the development of cognitive skills such as memory and observation. Most of the research on the use of portable digital game in education reports positive attitudes of the participants, showing an increase in students' interest in the learning process, gaining a positive experience through the game and minimizing the feeling of failure. At the same time, the mobilization of the participants and the feeling of involvement in relation to the learning object is maximized.

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Strengths and Weaknesses of using the escape room concept in the Isafetyapp game

There are both strengths and weaknesses of applying the escape room concept to the Isafetyapp game.

Strengths

This game concept exploits various gamification elements that increase engagement and offer extrinsic motivation for learning. This concept also offers the flexibility of incorporating all the required key messages in the stand-alone lessons that will pop up after the player clicks on an object. In this way it also allows having mini lessons and activities within the main game. The game could also be used as an opportunity to instigate follow-up group discussions and learning.

By setting the game in a house environment, with a limited number of objects, even if the player finds some of the lessons challenging, they will be able to move forward in the game by simply exploring the house and different objects.

Weaknesses

The complication that arises with this escape room concept is a common one in the design of serious games, and one which would be evident in most concept selections. A serious game must ensure that the key messages of the lessons are embedded and delivered in an engaging way, where the player learns through play, in an active way.

With the escape room concept, the pop-up lessons that are related to internet safety are partly disjointed from the “playing” part of the game, which includes solving the quizzes and finding the objects in the house. One could say that the player won’t be able to learn about internet safety through performing the “play” actions but will simply be offered disjointed learning material to consume as they would on a website or blog.

This may seem the case at first glance, but there is a thin line between making the game relevant to the material or not relevant.

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Learning and Personalisation Elements

Serious games follow a typical game structure, while including elements of learning or training, adding an educational value to the game.

The Pop-up Lessons

In Isafetyapp, the key messages of the intervention are hidden in those objects, and they are revealed when the player clicks on the objects.

The pop-up lessons will come in different forms, such as text, infographics, videos, simulations and quizzes, or a combination of these. Text, infographics and videos are considered “passive” methods of delivery, where the user consumes material, while videos, simulations and quizzes are interactive and engaging activities.

By including engaging delivery methods in the pop-up lessons, and not simply consumable material, a continuity of the gaming experience will be achieved, where the player is learning while still having fun and interacting with the material. However, the “passive” methods are also necessary in this case, as they will provide the context and information that will guide the player in the ensuing activities. The material that will be presented in this way will be structured in short but comprehensive portions that will achieve to transfer the key messages efficiently.

References

Ak, O., & Kutlu, B. (2017). Comparing 2D and 3D game-based learning environments in terms of learning gains and student perceptions. *British Journal of Educational Technology*, *48*(1), 129–144. https://doi.org/10.1111/bjet.12346

Alemi, F., Cherry, F., & Meffert, G. (1989). Rehearsing decisions may help teenagers: An evaluation of a simulation game. *Computers in Biology and Medicine*, *19*(4), 283–290. https://doi.org/10.1016/0010-4825(89)90015-2

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Alexiou, A., Schippers, M. C., Oshri, I., & Angelopoulos, S. (2020). Narrative and aesthetics as antecedents of perceived learning in serious games. *Information Technology and People*, *35*(8), 142–161. https://doi.org/10.1108/ITP-08-2019-0435

Cowley, B., Moutinho, J. L., Bateman, C., & Oliveira, A. (2011). Learning principles and interaction design for "Green My Place": A massively multiplayer serious game. *Entertainment Computing*, *2*(2), 103–113. https://doi.org/10.1016/j.entcom.2011.01.001

Cunningham, A. (2021, January 27). *iPhone vs. Android: Which Is Better for You? | Reviews by Wirecutter*. https://www.nytimes.com/wirecutter/reviews/ios-vs-android/

DDI Development. (2021, April). *The Good and the Bad of Android App Development in 2021 | DDI Development*. https://ddi-dev.com/blog/programming/pros-and-cons-of-android-app-development/

Deulgaonkar, P. (2017, March 15). *Dubai opens its first escape-reality game - Arabian Business*. https://www.arabianbusiness.com/industries/technology/dubai-opens-its-first-escape-reality-game-666993

Digital Aptech. (n.d.). *Advantages and Disadvantages of iOS | IOS App Development Service*. Retrieved October 23, 2022, from https://www.digitalaptech.com/advantages-and-disadvantages-of-ios

Dillenbourg, P. (1999). What do you mean by collaborative learning? In P. Dillenbourg (Ed.), *Collaborative-learning : cognitive and computational approaches* (Vol. 1, pp. 1–19). Elsevier. http://tecfa.unige.ch/tecfa/publicat/dil-papers-2/Dil.7.1.14.pdf

Dudzinski, M., Greenhill, D., Reem, K., Nabhani-Gebara, Shereen Philip, N., Caton, H., Ishtiaq, S., & Gatsinzi, F. (2013). *The Design and Evaluation of a Multiplayer Serious Game for Pharmacy Students* (pp. 140–148).

Durkin, K., Boyle, J., Hunter, S., & Conti-Ramsden, G. (2013). Video games for children and adolescents with special educational needs. In *Zeitschrift fur Psychologie / Journal of Psychology* (Vol. 221, Issue 2, pp. 79–89). https://doi.org/10.1027/2151-2604/a000138

Emmanuel, F., Kaimara, P., Fokides, E., & Oikonomou, A. (2019). Evaluating 2D and 3D serious games : The significance of student-player characteristics. *Διάλογοι! Θεωρία Και Πράξη Στις Επιστήμες Αγωγής Και Εκπαίδευσης*, *5*, 36–56.

Escape Rooms. (n.d.). *Top 25 Countries with the Best Escape Rooms – March 2019 « Escape The Roomz*. Retrieved October 23, 2022, from https://escapetheroomz.com/top-25-countries-with-the-best-escape-rooms-march-2019/

Funzi. (n.d.). *Funzi*. Retrieved October 23, 2022, from https://www.funzi.fi/

This project has been funded with the support from the European Commission (project no: 2020-1-PL01-KA226-SCH-096462).This publication reflects the views only of the author, and the Commission cannot be held responsible for any use which may be made of the information contained therein.

Gamage, V., & Ennis, C. (2018). Examining the effects of a virtual character on learning and engagement in serious games. In *Proceedings - MIG 2018: ACM SIGGRAPH Conference on Motion, Interaction, and Games*. https://doi.org/10.1145/3274247.3274499

Garneli, V., Patiniotis, K., & Chorianopoulos, K. (2021). Designing multiplayer serious games with science content. *Multimodal Technologies and Interaction*, *5*(3). https://doi.org/10.3390/mti5030008

Gerling, K. M., Birk, M., Mandryk, R. L., & Doucette, A. (2013). The effects of graphical fidelity on player experience. In *Proceedings of the 17th International Academic MindTrek Conference: "Making Sense of Converging Media", MindTrek 2013* (pp. 229–236). https://doi.org/10.1145/2523429.2523473

Gomes, S., Dias, J., & Martinho, C. (2019). GIMME: Group interactions manager for multiplayer sErious games. *IEEE Conference on Computatonal Intelligence and Games, CIG*, *2019-Augus*. https://doi.org/10.1109/CIG.2019.8847962

Hall, C. (2015, March 5). *The games industry is wrong about kids, gaming and gender (update) - Polygon*. https://www.polygon.com/2015/3/5/8153213/the-games-industry-is-wrong-about-kids-gaming-and-gender

Hemingway, C., Baja, E. S., Dalmacion, G. V, Medina, P. M. B., Guevara, E. G., Sy, T. R., Dacombe, R., Dormann, C., & Taegtmeyer, M. (2019). Development of a Mobile Game to Influence Behavior Determinants of HIV Service Uptake Among Key Populations in the Philippines: User-Centered Design Process. *JMIR Serious Games*, *7*(4), e13695. https://doi.org/10.2196/13695

Hersh, M., & Leporini, B. (2018). Editorial: Serious games, education and inclusion for disabled people. *British Journal of Educational Technology*, *49*(4), 587–595. https://doi.org/10.1111/bjet.12650

Hohl, W., Kharvari, F., & Klinker, G. (2020). Wayfinding in Museums: A Cross-sectional Comparison between 3D Serious Games and 2D Drawings as Tools for Participatory Design. *IEEE Conference on Computatonal Intelligence and Games, CIG*, *2020-Augus*, 592–595. https://doi.org/10.1109/CoG47356.2020.9231921

Ioannis, P. (2013). *Serious Games in education and adoption in Medical Applications*.

Juego Studio. (2020, July 23). *Should I Develop My Game in 2D or 3D? | by Juego Studio | Medium*. https://juegostudio.medium.com/should-i-develop-my-game-in-2d-or-3d-d759dd19974

Kampa, A., Haake, S., & Burelli, P. (2016). Storytelling in serious games. *Lecture Notes in Computer Science (Including Subseries Lecture Notes in Artificial Intelligence and Lecture Notes in Bioinformatics)*, *9970 LNCS*, 521–539. https://doi.org/10.1007/978-3-319-46152-6_19

This project has been funded with the support from the European Commission (project no: 2020-1-PL01-KA226-SCH-096462).This publication reflects the views only of the author, and the Commission cannot be held responsible for any use which may be made of the information contained therein.

Knight, S. (2021, June 30). *What Are 2.5D Games? How They Differ From 2D and 3D Games*. https://www.makeuseof.com/what-are-2-5d-games-2d-3d/

Koops, M. C., Verheul, I., Tiesma, R., de Boer, C. W., & Koeweiden, R. T. (2016). Learning Differences Between 3D vs. 2D Entertainment and Educational Games. *Simulation and Gaming*, *47*(2), 159–178. https://doi.org/10.1177/1046878116632871

Lee, S. (2019, December 12). *Top Ten Advantages Of Android | Glance*. https://thisisglance.com/top-ten-advantages-of-android/

Lin, B. (2022, May 14). *Diversity in Gaming: An Analysis of Video Game Characters*. Diamond Obby. https://diamondlobby.com/geeky-stuff/diversity-in-gaming/

Logan, S. (2015). *Cultural Competence and Ethnic Sensitive Practice*.

Malinverni, L., Mora-Guiard, J., Padillo, V., Valero, L., Hervás, A., & Pares, N. (2017). An inclusive design approach for developing video games for children with Autism Spectrum Disorder. *Computers in Human Behavior*, *71*, 535–549. https://doi.org/10.1016/j.chb.2016.01.018

Maulik, P. K., Mascarenhas, M. N., Mathers, C. D., Dua, T., & Saxena, S. (2011). Prevalence of intellectual disability: A meta-analysis of population-based studies. In *Research in Developmental Disabilities* (Vol. 32, Issue 2, pp. 419–436). https://doi.org/10.1016/j.ridd.2010.12.018

Mortara, M., Catalano, C. E., Bellotti, F., Fiucci, G., Houry-Panchetti, M., & Petridis, P. (2014). Learning cultural heritage by serious games. In *Journal of Cultural Heritage* (Vol. 15, Issue 3, pp. 318–325). https://doi.org/10.1016/j.culher.2013.04.004

Moukhallati, D. (2014, October 31). *Escape from daily stresses in UAE-devised game*. https://www.thenationalnews.com/business/travel-and-tourism/escape-from-daily-stresses-in-uae-devised-game-1.566115

Need Tricks. (22 C.E., May 12). *Disadvantages Of Android Devices -*. https://www.needtricks.com/disadvantages-android-devices/

Oksanen, K., Van Looy, J., & De Grove, F. (2013). Avatar identification in serious games - The role of avatar identification in the learning experience of a serious game. *Proceeding of: The Power of Play : Motivational Uses and Applications. Pre-Conference to the 63rd International Communication Association (ICA) Annual Conference, Abstracts*, *January*, 0–3.

Ravyse, W. S., Seugnet Blignaut, A., Leendertz, V., & Woolner, A. (2017). Success factors for serious games to enhance learning: a systematic review. *Virtual Reality*, *21*(1), 31–58. https://doi.org/10.1007/s10055-016-0298-4

This project has been funded with the support from the European Commission (project no: 2020-1-PL01-KA226-SCH-096462).This publication reflects the views only of the author, and the Commission cannot be held responsible for any use which may be made of the information contained therein.

Salen, K., & Zimmerman, E. (2004). *Rules of Play : Game Design Fundamentals*. The MIT Press. https://www.researchgate.net/publication/31760116_Rules_of_Play_Game_Design_Fundamentals_K_Salen_E_Zimmerman_prol_de_Frank_Lantz

Sanchez, E. (2017). Competition and Collaboration for Game-Based Learning: A Case Study. In *Instructional Techniques to Facilitate Learning and Motivation of Serious Games* (pp. 161–184). https://doi.org/10.1007/978-3-319-39298-1_9

SCAND. (2020, May 29). *Pros and Cons of Android and iOS Development*. https://scand.com/company/blog/android-vs-ios-development/

Schalock, R. (2014). Intellectual disability. In *The Encyclopedia of Clinical Psychology*.

Schell, J. (2008). The art of game design: A book of lenses. In *The Art of Game Design: A Book of Lenses*. Morgan Kaufman. https://doi.org/10.1201/9780080919171

Smith, S., Blackmore, K., & Nesbit, K. (2015). A Meta-Analysis of Data Collection in Serious Games Research. In *Advances in Game-Based Learning*. Springer.

Srivastava, S. (2022, March 11). *Advantages of iPhone Application Development for Your Business*. https://appinventiv.com/blog/advantages-iphone-application-development-business/

Starloop Studios. (n.d.). *3D Vs. 2D: The Eternal Battle to Develop Video Games | Starloop Studios*. Retrieved October 23, 2022, from https://starloopstudios.com/3d-vs-2d-the-eternal-battle-to-develop-video-games/

Startseite. (n.d.). *Ankommen*. Retrieved October 23, 2022, from https://ankommenapp.de/APP/DE/Startseite/startseite-node.html

Statista Research Department. (2022, June 27). *Asylum seekers origin countries in Germany 2022 | Statista*. https://www.statista.com/statistics/911586/country-origin-asylum-applicants-germany/

Stegner, B. (2020, October 7). *2D Games vs. 3D Games: What Are the Differences?* https://www.makeuseof.com/2d-games-vs-3d-games-differences/

Tantine. (n.d.). *Tantine – Amakuru na Service ku buzima bw'imyororokere*. Retrieved October 23, 2022, from https://www.tantine.rw/

Ter Vrugte, J., De Jong, T., Vandercruysse, S., Wouters, P., Van Oostendorp, H., & Elen, J. (2015). How competition and heterogeneous collaboration interact in prevocational game-based mathematics education. *Computers and Education*, *89*, 42–52. https://doi.org/10.1016/j.compedu.2015.08.010

Terras, M. M., Boyle, E. A., Ramsay, J., & Jarrett, D. (2018). The opportunities and challenges of

This project has been funded with the support from the European Commission (project no: 2020-1-PL01-KA226-SCH-096462).This publication reflects the views only of the author, and the Commission cannot be held responsible for any use which may be made of the information contained therein.

serious games for people with an intellectual disability. *British Journal of Educational Technology*, *49*(4), 690–700. https://doi.org/10.1111/bjet.12638

Translators without borders. (n.d.). *The importance of language data in humanitarian communication*. Retrieved October 23, 2022, from https://translatorswithoutborders.org/language-data

Turkay, S., & Kinzer, C. K. (2015). The effects of avatar-based customization on player identification. In *Gamification: Concepts, Methodologies, Tools, and Applications* (Vols. 1–4, pp. 247–272). https://doi.org/10.4018/978-1-4666-8200-9.ch012

UNESCO. (n.d.). *Pashto | Silk Roads Programme*. Retrieved October 23, 2022, from https://en.unesco.org/silkroad/silk-road-themes/languages-and-endanger-languages/pashto

UNICEF. (2015). *UNICEF Procedure for Ethical Standards in Research, Evaluation, Data Collection and Analysis* (Issue April, pp. 1–23).

Van Laer, T., De Ruyter, K., Visconti, L. M., & Wetzels, M. (2014). The extended transportation-imagery model: A meta-analysis of the antecedents and consequences of consumers' narrative transportation. *Journal of Consumer Research*, *40*(5), 797–817. https://doi.org/10.1086/673383

Vogels, E. (2021, June 22). *Digital divide persists even as Americans with lower incomes make gains in tech adoption*. Pew Research Center. https://www.pewresearch.org/fact-tank/2021/06/22/digital-divide-persists-even-as-americans-with-lower-incomes-make-gains-in-tech-adoption/

Wang, C., & Huang, L. (2021). A Systematic Review of Serious Games for Collaborative Learning: Theoretical Framework, Game Mechanic and Efficiency Assessment. *International Journal of Emerging Technologies in Learning*, *16*(6), 88–105. https://doi.org/10.3991/ijet.v16i06.18495

Wendel, V., Gutjahr, M., Göbel, S., & Steinmetz, R. (2013). Designing collaborative multiplayer serious games. *Education and Information Technologies*, *18*(2), 287–308. https://doi.org/10.1007/s10639-012-9244-6

WhatPhonePlans. (n.d.). *Which Phone is Best? Android vs iOS vs Windows 8*. Retrieved October 23, 2022, from https://whatphone.com.au/compare/android-vs-ios/

Whiteley, L., Craker, L., Haubrick, K. K., Arnold, T., Mena, L., Olsen, E., & Brown, L. K. (2021). The Impact of a Mobile Gaming Intervention to Increase Adherence to Pre-exposure Prophylaxis. *AIDS and Behavior*, *25*(6), 1884–1889. https://doi.org/10.1007/s10461-020-03118-3

Zagal, J. P., Rick, J., & Hsi, I. (2006). Collaborative games: Lessons learned from board games. *Simulation and Gaming*, *37*(1), 24–40. https://doi.org/10.1177/1046878105282279

This project has been funded with the support from the European Commission (project no: 2020-1-PL01-KA226-SCH-096462).This publication reflects the views only of the author, and the Commission cannot be held responsible for any use which may be made of the information contained therein.

Κυπριωτάκη, Ά.-Μ. (2020). *Σχεδιασμός, ανάπτυξη και διαμορφωτική αξιολόγηση ενός διαδραστικού mobile game με επαύξηση του πραγματικού περιβάλλοντος της τάξης: Σώσε την Ιστορία*.

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Conclusions

Taking all into a consideration, it is evident that most of the students have played an 'educational game' before. The majority of students, spend playing games on average 0-2 hours per week but there is a significant percentage of students that play more than 8 hours. The majority of the students used a smartphone to play a game and they prefer games in a real world setting. In terms of interaction, they prefer to play a game with 2 or more players and they would like to compare their performance with that of other players. Most of them they would like to create their own character. The students, also, mentioned that, the most appealing features of the games are challenges, graphics, storyline and clear goal. The majority of them play for pleasure, excitement, competition, challenge relaxation and leisure. Additionally, students supported that they learn better if they can relate the experiences of an educational game to experiences in real life and when each new piece of knowledge builds on pre-existing knowledge. Furthermore, they enjoy games that seem too hard and they find feedback on their actions in-game helps them to progress. They prefer playing games which have clear goals to achieve. They feel that they learn more when they are engaged in a role they play in a game and they can understand a subject being taught to them if they can experiment with the ideas that are taught. Finally, they are more engaged in games when using knowledge about the game's story and world to solve problems and if the rewards/bonuses are adjusted to the difficulty of the performance.

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Research on structural mathematics didactics in Europe

It is widely accepted that mathematics is one of the most important areas of human life and therefore it is important to pay special attention to its teaching from primary school to university.

According to mathematicians, the understanding of mathematics can be ensured through 4 processes: mathematical reasoning and argumentation, making connections/connections, communication using tools, the main of which is natural language, but also symbols, various forms of representation and tools of technology. According to some mathematicians, the main goal of learning mathematics is to combine theoretical thinking with practice.

Mathematics has many dimensions - domains, in addition to the purely numerical dimension. More specifically, the domains that mathematics touches are: the cognitive, psychomotor, affective and social domains. Moreover, naturally, mathematics taught in Greek secondary schools is of a fairly high standard and the way it is taught requires the active participation of students, solving more complex mathematical problems in the classroom individually or in groups. The typical high school curriculum includes courses in statistics, probability, and graph analysis.

1. Mathematics is a compulsory subject taught at every level of education. Its elements are already implemented in pre-school education. It has been functioning as a separate subject since the fourth grade of primary school.

2. The education system in Poland distinguishes between compulsory education and compulsory education. The first applies to children from the age of 7 and lasts until the end of the 8th grade of primary school. Compulsory education requires continuing education until the age of 18. It can be pursued by attending one of several types of post-primary schools (e.g. general high school, vocational school or technical school). Technical and commercial schools include general and vocational education and will not be discussed here.

3. In the Polish education system, each student takes the eighth grade exam, which is necessary to complete school, but there is no minimum pass rate. This means that even with a low score, the student will receive a basic education. In the years 2019-2023 subjects Polish and a foreign language as well as mathematics are compulsory. The result of the eighth-grader exam is taken into account when recruiting to upper secondary schools.

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4. A general secondary school lasts 4 years and is intended to prepare young people for the final exam, and then for further education at universities. Among the compulsory subjects, i.e. Polish and a foreign language, there is also mathematics.

5. In our experience, mathematics, although it is the "queen of the sciences", is not the favorite subject of students. This is also confirmed by the 2019 Report of the Supreme Audit Office on teaching mathematics in schools. This indicates many problems affecting the correctness of the tasks in the field of teaching this subject. In the survey, teachers admitted that when implementing mathematics curricula, they put emphasis primarily on the content and skills necessary for students to take the exam.

6. The problem in teaching mathematics was e.g. shaping imitative attitudes in students. Math teachers put too little emphasis on teaching reasoning - instead they focus on teaching basic skills. High school graduates have difficulty with tasks that require them to combine information and knowledge from different units or use different mathematical techniques. However, they were good at tasks where simple procedures had to be recreated. Mathematics exam results indicated major failures in the final exams. In 2019, 16% of high school graduates failed it, and in 2020 - 21%. The average percentage score obtained on the exam in 2019 was 55%, and in 2020 - 52%. In 2019 and 2020, 26.6% and 27.6% of the candidates took the exam at the advanced level, respectively. Their average score was 39% and 34%, respectively. It is worth noting that from 2025 the pass threshold will also apply to the extended matura exam.

7. The teaching of mathematics in schools is not conducive to the full development of students' mathematical competences. The main causes of problems in teaching and learning mathematics are:

• no division of classes into groups according to students' abilities,

• lack of own curricula or modifications of existing curricula,

• failure to adjust the tasks and pace of work in the lesson to the students' abilities,

• limited access to classes at various levels, i.e. to compensatory classes in mathematics or classes for mathematically gifted students,

• unequal support of teachers by methodological advisors,

• timetables unevenly load students with activities or subjects such as mathematics taking place in the last hours of school,

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• too short breaks between lessons, which did not allow students to rest.

The results collected by NIK regarding the effects of teaching mathematics in Polish schools were summarized in the General Report with the statement that "teaching mathematics in Polish schools is not the best". The following negative phenomena were indicated:

• poor grades in mathematics on school reports,

• high tutoring costs,

• difficulties in teaching other subjects,

• lower graduation rate,

• mental disorders,

• unsatisfactory level of mathematical skills among science students.

However, the NIK's thesis about the decline of mathematical education in Poland has not been fully documented and, to some extent, it is contradicted by the results of international research. Despite the problems, it turns out that subsequent core curricula and examination requirements standards in Poland were consistent with the assumptions of the Program for International Student Assessment - PISA for students. The results of the PISA study show that students educated in very different education systems, using different methods, are successful in them.

Although learning math is difficult for many students, it is clear that math education has a huge impact on students' personal development. In addition to meeting the detailed requirements contained in the core curriculum for general education in the field of Mathematics, it is important to make students aware of the importance of learning mathematics for their personal development and the benefits it brings. The student must therefore be prepared to make decisions about his own education, presenting him with various possibilities and skillfully helping him in making choices. An important attitude is the personalization or individualization of education.

According to many teachers, the most important thing is to focus on development - both students and teachers. Positive and development-oriented thinking of young people is the reason for their good attitude and is the basis for overcoming learning difficulties. Students should feel that the system allows them to work on understanding their mistakes as this can bring real reflection through which they can learn and grow. On the other hand, the task of a mathematics teacher is to create conditions for learning, create a friendly atmosphere, accompany students in learning and approach

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individual students' problems, because each student is different and each brain is different. The school should provide each student with the conditions necessary for his/her development. The uniform core curriculum in mathematics hinders the implementation of this educational mission. Routine dominates the teaching of mathematics at school, which results in the failure to use both the full development potential of children and youth, as well as the possibilities of the education system. Therefore, no corrective actions will significantly change the math performance of our students if every student has to study according to the same core curriculum, i.e. study the same, and - especially - pass the same exam.

NIK proposes to consider the possibility of suspending the matriculation exam in mathematics as compulsory for all students until the effectiveness of teaching this subject in schools is improved. Not everyone supports this solution. The Polish Ministry of National Education is concerned that the abolition of the uniform and compulsory Matura exam in mathematics, recommended in the Report, would "destroy an objective and nationally comparable recruitment tool for Polish universities."

According to prof. Maciej M. Sysło, mathematics, computer science and lecturers of the Nicolaus Copernicus University in Toruń, an opportunity for mathematics at school is to create conditions for the development of students' individual interests, not only in mathematics. We learn more willingly when something interests us, because it is impossible to pour in any knowledge under duress. There is a certain canon of mathematical knowledge that is necessary for the development of students' own interests, but defining its scope and the method of transfer and education is the role of the teacher who should take into account the development of individual abilities and interests of his students. In addition, it is also necessary to work on mitigating the negative effects of teaching mathematics, as mentioned in the NIK report.

Mathematics in Polish schools is too theoretical, especially in high schools. There are few practical applications of certain issues, although this is changing for the better.

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When it comes to the curriculum, its content goes far beyond what students in Western Europe learn - our students who emigrated to the West do well in mathematics there, while those who studied from the beginning in the UK, the Netherlands and other countries, and then returned to Poland, have serious problems with learning this subject.

Requirements in Poland are often higher than in other countries. This is confirmed by students and parents who emigrated from Poland. Interviews with them show that in many European countries Polish students do not have major problems with learning mathematics, on the contrary, they achieve better results than their peers from these countries. Conversely, if foreigners or Poles return to Poland, there are problems with learning because the level of education in other countries was much lower. As mentioned earlier, the math exam requirements standards meet PISA requirements. The problem is passability. Unfortunately, a certain percentage of high school graduates fail this exam and have to repeat it. The second problem is the way of teaching. Due to large groups of students - an average of 34 per class - and a small number of hours (3 or 4 lessons per week at the basic level), as well as an overloaded curriculum in which some content seems redundant, it is not possible to approach the student individually and work on specific areas of mathematics that are difficult for individual students.

The mathematics education system in Greece has its own unique characteristics, which can be described as follows:

1. Basic Curriculum: In the Greek education system, mathematics is one of the core subjects. It is compulsory for all pupils at different levels of education, from primary school to secondary school.

2. Curriculum structure: The mathematics curriculum in Greece includes many topics and skills that are gradually introduced over the course of the different years of study. Mathematics education covers areas such as arithmetic, geometry, algebra, statistics and analysis.

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3. Examinations: In Greece, there is an examination system that assesses students' knowledge and skills in mathematics. Repeatedly, there are final examinations at the end of each school year and state examinations at the end of primary and secondary education.

4. Use of textbooks: The Greek mathematics education system uses textbooks that are approved by the Ministry of Education. Teachers use these textbooks as their primary source of information and teaching material.

5. Importance of Geometry: In Greece, geometry is very important because of its historical roots in ancient Greece. Geometry is an important part of teaching mathematics and is taught from an early age in education.

6. Use of technology: Nowadays, the Greek system of mathematics education is increasingly involving technology. Students use computers, graphing calculators, and other technological tools to support the learning process and help them understand more advanced mathematical concepts.

7. Extra lessons and exam preparation: Many students in Greece choose to take extra lessons and preparation courses to increase their chances of getting better results in exams. There are many private learning centers that offer these services.

8. Participation in mathematical competitions: Greece actively participates in various international mathematical competitions, such as the International Mathematical Olympiad. Students with high achievements in mathematics have a chance to represent Greece in such competitions.

Students in Greece face some difficulties in learning mathematics, as do students in other countries. Some common difficulties they may encounter include:

Abstractness: Mathematics can be difficult for some students due to the abstract nature of some mathematical concepts and operations. Algebraic concepts, symbolic equations, and manipulation of abstract numbers may require some abstract thought that may be challenging for some students.

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Lack of understanding of the basics: Sometimes students have difficulty in math because they have not solidly grasped the basic mathematical concepts and operations that are necessary to understand more advanced concepts. The lack of strong mathematical foundations can lead to difficulties in the next stages of learning.

Teaching speed: Some students may find it difficult to learn maths at a fast pace in school. If material is introduced too quickly or is not properly absorbed and repeated, students may have difficulty keeping up with the rest of the class.

Fear of mistakes: Mathematics is a subject that requires precision and logical thinking. Some students are afraid of making mistakes and may stop or be afraid to experiment and solve math problems. Fear of making mistakes can limit their progress in learning math.

Lack of motivation: Some students see math as a difficult, incomprehensible and useless subject. Lack of motivation and interest can affect their commitment to learning maths and the effectiveness of learning.

The philosophy of mathematics teaching is based on the basic principles of inquiry-based learning (Artigue and Blomhoj, 2013). In addition, widely accepted theories of learning are adopted, according to which students learn through continuous creation, creating links between pre-existing knowledge and new learning experiences, in a dynamic and changing socio-cultural context (Vygotsky, 1978).

Based on the above theoretical principles, Cyprus has the following teaching model, which consists of 3 phases.

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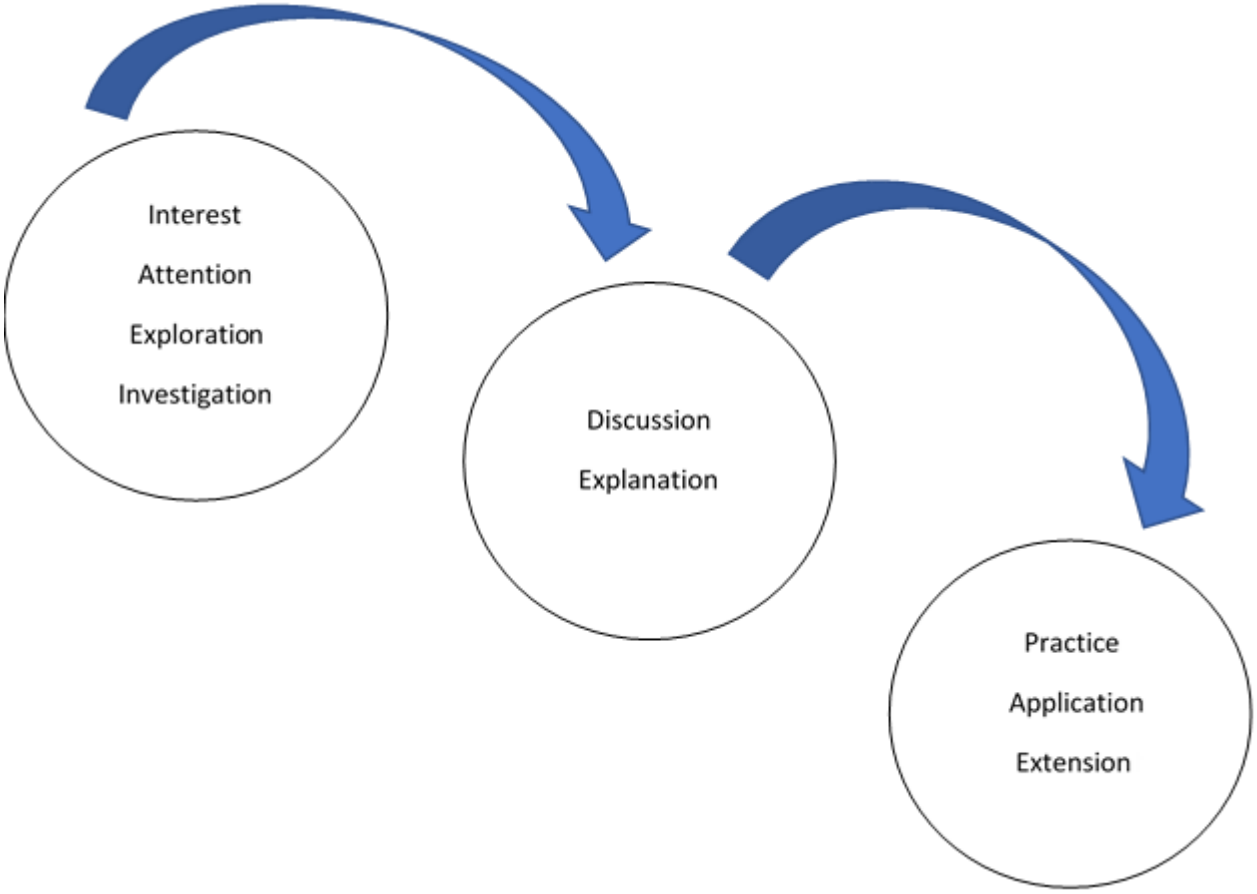

In the first phase, students are involved in situations that arouse their interest and attract attention. These situations are effective if they highlight questions that are relevant to the students themselves and that can be answered based on their observations and interpretations. In the process of learning new things and concepts, some students may misunderstand them. Interesting states are most often Searches or Investigations, which are present in the didactic material (textbooks, applications).

Explorations are activities in which students freely explore mathematical concepts and contribute to their differentiation and personalization, teaching, motivating, conceptually combining concepts, developing mathematical reasoning, creativity and imagination in mathematics. To this end, exploration provides students of all levels with the opportunity to ask questions relevant to their

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needs, develop divergent thinking and creativity, and problem-solving skills through appropriate apps, and emphasize the "how" and "why" questions. In addition, explorations provide a tool to explore the historical elements of mathematics in order to highlight the dynamic dimension of mathematics.

Investigations are activities where students explore mathematical ideas in a specific context and are able to make assumptions, validate their assumptions, substantiate their answers, with the ultimate goal of drawing conclusions. These procedures can be carried out by example, using supervisory measures or digital means of supervision, or with appropriate problems. In studies, students are given enough time to work, and teachers facilitate the work through appropriate questions and student interventions.

The study is followed by an explanation and discussion phase, during which the teacher introduces the terminology of the course through appropriate interventions, and the students interpret, analyse, present and document their findings.

In the Practice/Apply/Extend phase, students have the opportunity to engage in activities designed to practice, apply and expand their mathematical knowledge. Through extension activities, students are asked to expand, transfer or transform their knowledge to meet the needs of new problems.

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iSafetyApp - "Teaching students to be safe on the Internet using a mobile application based on artificial intelligence"

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