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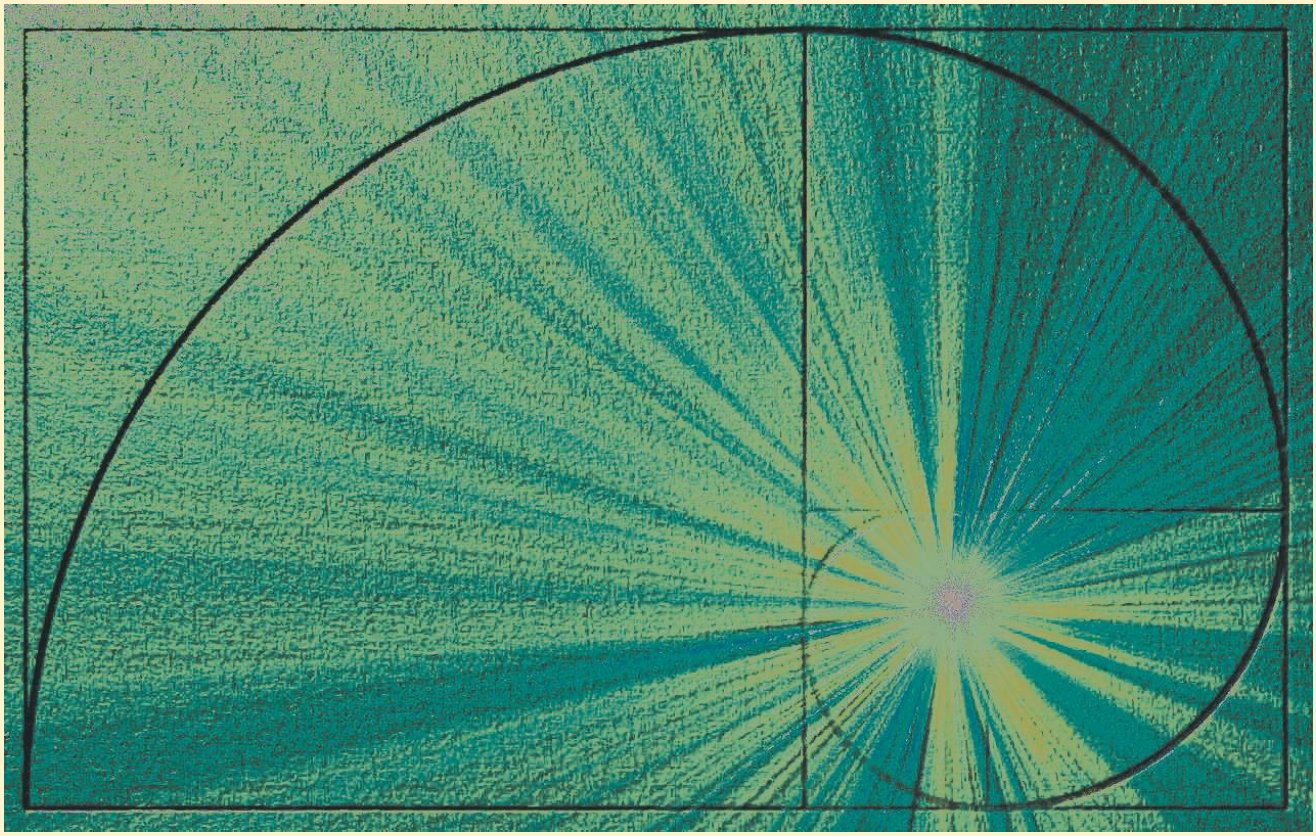

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Purpose – Philosophy - Access

The aim of the INTERNATIONAL JOURNAL OF EDUCATIONAL INNOVATION is to publish research papers that promote any form of educational innovation related to teaching and learning at all levels of education, as well as at any other aspects of the educational process, of school and academic life.

All papers submitted to the journal are subject to blind reviews by the journal scientific committee.

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Contents

EDITORIAL

The third issue of the International Journal of Educational Innovation (I.J.E.I.) of the Scientific Union for the Promotion of Educational Innovation (EEPEK), within 2024 is available, thus, reflecting primarily the great interest in it by the educational community. Particular reference is made to the colleagues-members of the reviewing committee of this journal - for their outstanding work and ongoing effort to establish this journal as a valid means of knowledge contribution to the educational communities of all levels. Colleagues' response to the journal's invitation to participate in the journal processes, as members of the scientific and editorial committee or as authors of research papers, was particularly great and provided the educational community with another form of constructive interaction other than that of conferences, training seminars and other actions implemented. In this way, we come one step closer to our central strategic aim: the creation of a large Learning Community, which will include all teachers, at all levels of education.

Therefore, once more, this issue presents a variety of topics related to education, and educational practices. The aim of every teacher is to find the best way possible to achieve the goals set in any subject taught and/or target group/s addressed. These goals include conveying knowledge, enhancing the cultivation of attitudes and values, such as self-confidence, self-esteem, or empathy, and the cultivation of skills such as interaction, communication or the ability to learn how to learn. However, the main objective of education is to help students meet challenges throughout their lives. Thus, this issue presents innovative suggestions, tools and techniques related to teaching and learning, as well as issues related to education and educational innovation, thereby highlighting both the need for research in education and the need for education to apply research results to practice. In order for teachers to achieve these goals and objectives, the importance of sharing good practices and knowledge are principal. Our goal then is to disseminate teachers' suggestions and ideas as well as their research findings.

We hope that this issue will help all those, educators and non-educators, who dream of effective education through innovation to provide ideas for a better future for all students. We will keep on with the same passion.

Dr. Charilaos Tsichouridis, Chief Editor, University of Patras
Dr. Dimitrios Kolokotronis, EEPEK President, Publishing Director

Why to regulate AI? The impact of AI on Legality and Regularity:

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Seremeti Lamprini
Phd, Agricultural University of Athens,
lamprini.seremeti@gmail.com

Patropoulos Athanasios
University of Western Macedonia,
apatrop@gmail.com

Karachristos Christoforos
Hellenic Open University,
karachristos.x@gmail.com

Pantermali Maria
ENEEGIL Messologiou,
mpantermali@gmail.com

Papantoni Iliana
M.Sc., M.Ed., 3d Experimental Kindergarten of Thessaloniki (AUTH),
ipapantoni@sch.gr

Dragogiannis Konstantinos
M.Sc., M.Ed., Educational Consultant of Secondary Education West Thessaloniki,
kdragogiannis@sch.gr

Abstract

Unprecedent relationships are emerging in real world mainly due to cutting-edge technologies, like Artificial Intelligence (AI), pervasiveness. People trust the judgement of AI chatbots for their daily choices, businesses decision-making relies on AI tools suggestions, scientists swear to the AI capability to detect new phenomena, etc. What is their common ground? Complexity. This inherent complexity can be controlled only by Law. Besides, the main problem that Law tries to solve is managing the complex reality of societal settings. In that regard, this paper aims to provide insights into the complexities of AI embedding into society through the lenses of legality and regularity, that is, to identify current legal and ethical challenges in order to contribute to the debate on “why to regulate AI?”.

Keywords: Law, Artificial Intelligence, legality, regularity, ethical issues

Introduction

The main problem that Law tries to solve is managing the complex reality of societal nature. Dealing with complexity aims at ensuring the stability and continuity of society cohesion, or alternatively, governing the societal system’s ability to maintain its internal structural and functional balance, legally and regularly. Complexity is not a clear-cut notion and thus its deep understanding involves a set of indicators that are directly correlated to its reproduction. Artificial Intelligence (AI) integration in daily activities is an indicator of paramount importance that implies complexity in real-life settings, since it entails tricky situations that cannot be treated by Law on a cause-and-effect basis, as there is no single cause for an emerging behavior. For example, in the case of an accident caused by a self-driving vehicle, the civil and criminal liability of the manufacturer, the programmer or the user,

encounter difficulties in identifying the causes of the accident, as many factors, such as algorithms, operating models, confused data, etc. have contributed. Any such emerging behavior provokes a set of reactions in the socio-economic system, which seeks the appropriate regulatory framework in order to manage the complex reality. For analytical precision, we adopt the following working definitions: legality denotes full conformity with positive law as enacted by a competent authority, whereas regularity captures the orderly, predictable and consistent application of those rules in practice, including adherence to due-process guarantees and non-arbitrariness (Hildebrand, 2013). This conceptual clarity is essential if legal scholars are to translate philosophical insights into actionable policy.

This regulatory framework should be flexible enough in order to be adaptable to the rapid AI advancements, and in tandem, it should be established in such a way that the nexus between legality and regularity remains stable. The advent of AI has recently complicated the relationship between legality and regularity, which converge to the common ground of managing complexity in societal settings. In this paper, legality is used to refer to the laws and regulations ensuring social order, while regularity is used to denote actions, legal or not, which may not necessary be ethical. Resolving inconsistencies in legal process and adherence to fundamental ethical values are complementary issues for maintaining social order and effectively managing social change during punctual challenges such as the AI full integration in society.

It is generally accepted that societal transformations are triggered by the invasion of AI into daily activities. Indeed, AI has the potential to revolutionize sectors such as healthcare (AI is being used to develop new drugs and treatments, diagnose diseases, create prosthetics, and provide personalized care) (Shalk et al., 2023; Ali et al., 2023), agriculture (AI is being used to develop autonomous crop management, monitor crop and soil, detect leaks or damage to irrigation systems, detect disease and pests, monitor livestock health) (Javaid et al., 2023; Akkem et al., 2023), education (AI is being used to facilitate administrative tasks, create smart content, personalize learning, develop virtual learning environments) (Chen et al., 2020; Alhumaid et al., 2023), finance (AI approaches are being used to detect fraud, manage risk, and provide investment advice) (Giuggioli and Pellegrini, 2022; Pallathadka et al., 2023; Peng et al., 2023), environment (AI is being used to reduce technology industry emissions, measure carbon footprints, collect and analyze real time data, help monitor pollution and wildlife conservation, and improve energy efficiency) (Ye et al., 2020; Isabelle and Westerlund, 2022), transportation (AI is being used to develop self-driving cars, optimize traffic flow, and predict demand) (Biggi and Stilgoe, 2021; Abduljabbar et al., 2019; Bharadiya, 2023), exercise of fundamental rights by individuals, altering the way of thinking and acting. The list of AI applications is not comprehensive. After all, in the period between writing and reading this paper, there will likely be emerged more advancements in the AI field. What is clear is how pervasive AI has become, thus complicating social settings. It is thus apparent that AI has become one of the main driving forces of modern industrial development as well as of the digital economy and now has a profound influence on the degree of complexity of societal formation, human communication, economic transactions, personal development and, thus, of most dimensions of human life (Pannu, 2015; Nayak and Dutta, 2017; Kamble and Shah, 2018; Khyani et al., 2022).

In this vein, AI affects human life in both positive and negative ways. By analyzing the key hurdles and dilemmas faced by AI legal governing, this paper aims to provide insights into the complexities of AI embedding into society through the lenses of legality and regularity, that is, to identify current legal and ethical challenges that lead to the answer of the critical question "why to regulate AI?" As this is a pressing global concern, the following sections seek to inform policy discussions surrounding the urgency for prompt and thorough response. Recent legislative milestones illustrate that leading jurisdictions are already operationalising this demand for flexible yet rights-preserving regulation. The European Union's Artificial

Intelligence Act adopts a tiered risk-based model that bans certain AI uses (e.g., social scoring) and imposes strict obligations—risk management, transparency, human oversight—on high-risk systems. In parallel, the White House Blueprint for an AI Bill of Rights and the U.S. Executive Order on "Safe, Secure, and Trustworthy AI" articulate enforceable principles on safety, algorithmic discrimination protections, data privacy, and human fallback. These instruments signal a global momentum towards harmonising legality with ethical regularity.

The paper is organized as follows. Section 2 focuses on conceptualizing the nexus between legality and regularity. Next, quality requirements in AI related debates aiming at maximizing the positive impacts of AI innovations on society and minimize potential harms, are discussed in Section 3. In Section 4, an attempt to align legal process and ethical values to legality and regularity, accordingly. Concluding remarks are given the last Section.

The Impact of AI on Legality and Regularity

It is generally accepted that societal transformations are triggered by the invasion of AI into daily activities. AI is a manifold term, whose clear definition does not exist (Wang, 2019). It refers to many technologies, applications and contexts. Broadly speaking, it is a sub-field of computer science which encompasses many techniques, is applied to many contexts, displays specific human-like features (e.g., intelligence, autonomy) in different degrees, and takes tangible or intangible forms (e.g., a robot or a program run on network computers). It is an evolving technology used to simulate human intelligence, and thus, it has the potential to revolutionize all sectors or real-life, affecting humans in both positive and negative ways (Obrenovic et al., 2024; Sonko et al., 2024). For example, the AI-empowered Internet and social media have changed the way groups or individuals exercise their right to freedom of assembly and association, enumerated in Art. 20 of the Universal Declaration of Human Rights. It states that "Everyone has the right to freedom of peaceful assembly and association". However, the digital potentials have posed a challenge to the extent of this right through its online expression. The online exercise of this right is beneficial for some social contexts where assembly and association may endanger lives or be banned and for vulnerable individuals who cannot afford to travel to protests. The alternative online manifestation of this right is compliant with legality, since it can be understood as the individuals' right coming together or forming groups peacefully in a public or private virtual space for some purpose. But it is not in confront with regularity, since this online right may be restricted due to unpredictable content blocking, state-sponsored cyberattacks, internet shutdowns or disruptions and surveillance (Ashraf, 2020).

To the question of how society can ensure that the effects of AI will be beneficial to humans during social transformation, the trendy answer is through developing a flexible regulatory framework involving all stakeholders, from AI experts and industry leaders to social groups and regulatory authorities. But what does flexibility mean in the legal context? Legality and regularity are the defining features of a flexible regulatory framework.

Legality and regularity are interrelated concepts – there is no unanimous understanding of their semantic distinction. In a broad sense, legality refers to the normative nature of law, while regularity to the empirical one (Hildebrand, 2013) – that are frequently invoked and in connection with various disputes regarding the legitimization of specific actions. The purpose of examining the legality of actions taken by a social active entity is to determine whether it has acted lawfully, that is, under the Law, while the purpose of examining the regularity of actions taken is to clarify how the appropriate norms are being societally observed. Although, they are not clear-cut concepts, they have a substantial impact on the functioning of the societal reality, which aims at ensuring the stability and continuity of the legal order. Their in-depth investigation falls outside the scope of this study. Instead, this paper focuses on the debate on the current AI impact on sudden and violent societal transformations.

By analyzing the key hurdles and dilemmas faced by AI research, this paper aims to provide insights into the complexities of AI embedding into society through the lenses of legality and

regularity, that is, to identify current legal and ethical challenges that lead to the answer of the main question "why to regulate AI?" As this is a pressing global concern, the following sections seek to inform policy discussions surrounding the urgency for prompt and thorough response.

Quality requirements of legal and regular AI

Transparency, accountability, fairness, trustworthiness, safety and reliability are frequently used as quality requirements in AI related debates aiming at maximizing the positive impacts of AI innovations on society and minimize potential harms (Balasubramanian et al., 2023). Indeed, transparent, accountable, fair, trustworthy, safe and reliable AI development and deployment is of paramount importance in order to prevent unintended consequences and mitigate potential risks during societal transformations (Thiebes et al., 2021). These quality features of AI depict legal and ethical principles and values (Akinrinola et al., 2024).

Transparency, trustworthiness, accountability, fairness, safety, and reliability are interwined terms that are often defined too imprecisely; their conceptual lines get blurred. This is due to their multifaceted nature, which is context-dependent, and their manifold manifestations. Within the AI field, they have a connotation of societal (understanding how AI affects the individual's life and social reality), legal (ensuring that AI follows the Law), and ethical (making sure that AI behaves fairly and responsibly) implications. Although the number of publications in the field of AI combined with ethics, governance, and society have grown remarkably over the last 4 years, to understand the AI implications for the integrity of the society, it is important to analyze the above-mentioned terms from another perspective, by giving their key requirements, the goals they serve, as well as their interrelations.

When focusing on AI transparency, the literature often refers to explainability (the ability of an AI entity to provide understandable explanations for its decisions and actions), interpretability (human understanding about an AI entity's operation and behavior), and accountability (ensuring AI entities are held for their actions or decisions) (Larsson and Heintz, 2020). Regarding AI accountability, it denotes the expectation that AI stakeholders comply with ethical and legal standards to ensure the proper functioning of AI entities. Accountability is narrowly defined in terms of answerability and through its goals of compliance with Law. It is conceived as the AI entities' quality linked to liability and regulation consequences (Novelli et al., 2023). With regard to AI fairness, many publications refer to statistical/probabilistic measures ensuring that decision support systems prevent disparate harm or benefit to different groups. It includes a quantification of unwanted bias especially in training data that leads to discrimination according to sensitive attributes such as gender, race, religion, as well as other ostensibly non-sensitive attributes such as salary, family structure, ZIP code (Feuerriegel et al., 2020).

When focusing on AI reliability, it refers to an AI system performance without failure under given conditions. This quality requirement is an objective for the overall correctness of AI systems operation under the conditions of their expected use and over a given period of time (Silva et al., 2022). Regarding AI safety, it refers to the severity of potential risks caused by AI systems related with harms in human life, health, property, or environment. Employing safety consideration in the AI development and deployment can prevent failures or conditions that can render AI systems dangerous (Schneider et al. 2022).

Focusing on AI trustworthiness, the literature refers to an umbrella term that is synthesized by the special characteristics of fairness, accountability, reliability, safety, and transparency aiming at reducing the negative socio-economic consequences of AI use. Addressing AI trustworthiness does not mean considering every characteristic on its own. Simultaneously, rarely do all characteristics apply in every setting, since some of the characteristics may be

more or less important in any given situation. Thus, trustworthiness characteristics influence each other (Kaur et al., 2022).

All these terms play a very important role in the overall strive to societal transition, and they include addressing technical challenges in AI development, such as algorithmic bias, data privacy breaches and security vulnerabilities. Algorithmic bias refers to the inherent tendency of AI systems to reproduce existing biases in the training data or underlying assumptions made during algorithms development. This can lead to unfair or discriminatory outcomes, particularly in crucial domains like healthcare, hiring, and criminal justice (Islam, 2024; Kumar et al., 2024). Data privacy breaches refer to failure to adequately protect sensitive information stored and transmitted across various digital platforms, which may result in financial losses, reputation damage, and legal consequences for organizations, individuals, and governments alike (Farayola et al., 2024). Regarding security, due to their pervasive nature, AI-based systems like robots are prone to diverse attacks by actors that aim to exploit vulnerabilities in the underlying technologies to threat the functionality, safety and reliability of systems. Security breaches can lead to accidents and property damage (Neupane et al., 2024).

The above-mentioned quality requirements and technical characteristics of AI systems represent the consensus views of academia, industry and governments about the AI challenges. Several studies have been published that discuss these challenges, by focusing either on more technical details or on specific sector (Sonko et al., 2024; Jan et al., 2023). However, a distinguishing aspect of this Section is that it has been written for an audience who may not possess expert knowledge in AI technologies.

AI affects legal processes and ethical values

The advent of AI has recently complicated the relationship between legality and regularity. In this paper, legality is used to refer to the laws and regulations ensuring social order, while regularity is used to denote actions, legal or not, which may not necessary be ethical. Resolving inconsistencies in legal process and adherence to fundamental ethical values are complementary issues for maintaining social order and effectively managing social change during punctual challenges such as the AI integration in society. Uncertainties in development of AI, unpredictability and unforeseen uses of AI systems can make it difficult to identify the AI impact in both the short – and long – term. There are a number of challenges related to AI that are discussed on a philosophical, technical, societal, and regulatory level. Ensuring transparency, fairness, safety, reliability, and accountability, protecting privacy, preventing bias and discrimination, mitigating the risks of AI systems, preventing violations of fundamental human rights, and promoting innovation, are some of these challenges that also reflect the reasons to urgently regulate the AI development and deployment. This Section presents a panoramic, non-exhaustive overview of these challenges by using the notions of legal processes and ethical values in order to emphasize to the dual nature of the same issue. In the AI field, legal processes and ethical values are occasionally used as they are interchangeable notions but a deeper insight may perceive they are indeed different (Nweke and Nweke, 2024).

Accepting that legal processes and ethical values exert rather different impulses on societal reality, their fundamental distinctions, from a philosophical aspect, may limited to the following: (a) Legal processes refer to the guidelines for conduct dictated by the current laws. Ethical values provide the principles and ideals upon which judgement is made of what is spatiotemporally more important. (b) Legal processes are based on a system of fundamental principles. Ethical values stimulate thinking. (c) Legal processes compel an entity to act in a predefined manner. Ethical values affect an entity's motivation. (d) Legal processes are consistent, affecting all equally. Ethical values may differ between human entities.

In summary, legal processes refer to constraints dictated by the laws, while ethical values motivate actors to define priorities in life. Both notions reflect the concern of the AI integration into social cohesion. Legal processes are concerned with the extrospective

judgement of decisions (Is the decision in alignment with the practice policies, procedures and guidelines? Is the decision acceptable under the applicable laws and regulations?), while ethical values are concerned with the introspective judgement of decisions (Does the decision conform to universal principles? Does the decision satisfy fairness?)

Extensive literature focuses on legal issues of AI, potential solutions, gaps and challenges, as well as affected human rights principles (Rodriguez, 2020). Indeed, legal issues related to AI risks and challenges has been discussed, from a legal perspective, in policy documents, academic literature, and media. Policy documents analyze how AI affects human rights (van Dijk et al., 2021; Khan and Mer, 2023; Yilma, 2023; Breczko et al., 2021; Huang et al., 2024). Academic literature mainly analyzes AI risks and challenges focusing on contexts with a high impact on social dynamics such as healthcare (Chikhaoui et al., 2022), defense (Molloy, 2021), transport (Taeihagh and Lim, 2021). Apart from the AI risks and challenges on specific domains, studies include issues related to intellectual property (Zakir et al., 2023), labor protection (De Stefano, 2020), algorithmic bias (Kordzadeh and Ghasemaghaei, 2021), discrimination (Heinrichs, 2022), unfairness (Pfeiffer et al., 2023), legal personality (Ziemianin, 2021), cybersecurity (Watney, 2020), accountability (Novelli et al., 2023), trustworthiness (Salloum, 2024), liability for harms (Yas et al., 2023), access to justice (Nowotko, 2021), transparency (Wulf and Seizov, 2020), surveillance (Saheb, 2023), democracy (Kan, 2024). The media coverage of AI legal issues investigates everyday incidents which reveal the urgent need of AI regulation in areas such as self-driving cars (Jelinski et al., 2021), autonomous weapon systems (Solovyeva and Hynek, 2018), algorithms creating art (Rani et al., 2023), etc.

According to the international literature, the issue of adherence to ethical values in ambient intelligence environments is examined in the light of three interrelated levels; institutional, social and individual (Khan et al., 2022; Ayinla et al., 2024). At the institutional level, the dominant issue is whether AI entities should be given legal personality. At the societal level, issues of safeguarding individual rights and security are addressed, given their essential characteristic of autonomy. At the individual level, issues of responsibility, accountability and trust in AI systems are analyzed. Given that ethical values are culture-specific, various conceptual considerations have been developed for the impact of AI on social transformation. Indeed, the European Union (EU), the United States (US), and China, recognizing the ethical challenges posed by the integration of AI applications in all areas of human activity, have begun to take steps to address them (Hine and Floridi, 2022; Dixon, 2022; Saheb, 2024). The difference among the approaches is that they focus on the same ethical challenges, but from a different aspect, due to their different socio-cultures. The Western world places greater emphasis on the protection of individual integrity, privacy and the responsible use of AI over the rule of law and respect for fundamental rights. In the East, the use of AI is more oriented towards the benefit to the state and the country as a whole, even if this implies sacrifices from the perspective of individuals. Of course, this difference lies in the fact that in the West there is a tradition of individualism and humanism that places greater value on personal autonomy and dignity, whereas in the East the priority is social harmony and collective responsibility. A further difference lies in the extent and depth of the government's role. In the West it is limited to supervision and control, whereas in the East the authorities play a more direct and active interventionist role with regard to AI. These variations in approaches to aligning the use of AI with ethical values are mainly due to the fact that there is no commonly accepted understanding of what the core ethical values are (What is ethical or not is always the result of a function of many individualized ideas about the value or worthlessness of a given instance).

In conclusion, the legal and ethical dilemmas regarding AI which are extensively studied in the literature demonstrate that what remains constant is the anthropocentric approach based on the need to preserve the universal principles that should govern any societal transition. The primary objectives are to improve human life, to ensure that AI does not lead to humans'

harm, to preserve human choices' autonomy, to safeguard that the development, use, and regulation of AI is based on the principles of Law.

Conclusions and Future Work

In this paper, the urgent and prompt need to answer the question "why to regulate AI", is discussed, through the interplay between legality (legal norms) and regularity (ethical norms) that are the building Law-factors to prevent increasing divergences in societies from undermining their long-term stability.

Theoretically, this paper contributes to an enriched understanding of the pressing need for a flexible legal framework that can keep pace with AI transformative impact. Practically, it offers insights for all stakeholders to identify the quality requirements of legal and regular AI. Building on these recent regulatory experiments and documented AI failures, future work should prioritise the development of urisdiction-agnostic compliance toolkits—shared methodologies for risk classification, bias auditing, and post-deployment monitoring—capable of adaptation to diverse legal cultures while preserving functional equivalence in safeguarding human rights and societal regularity. The fulfilment of these requirements is essential for safeguarding ethical values while embracing AI progress, and ensuring AI development and deployment is both legally sound and ethically responsible.

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Enhancing self-confidence through creative reading and writing activities in primary school

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Tsatsou-Nikolouli Sofia
Postdoc Researcher, University of Thessaly
sofitsatsou@gmail.com

Abstract

This paper aims to highlight the effectiveness of creative reading and writing in enhancing students' self-confidence in primary school. It includes a survey, which was conducted during the academic year 2023-2024 in primary schools in Greece and in which 1020 students and 71 teachers participated. The students were divided into two groups: Intervention group, which included students who applied creative reading and writing activities, having as a stimulus a variety of textual genres and textual types, and Control group, which included students who did not participate in the aforementioned activities and followed the school curriculum. This research/intervention project was approximately four months long and the evaluation was achieved through an impromptu weighted questionnaire. The results, which showed a positive correlation between creative reading/writing and students' self-esteem in primary school, are presented and analysed in the paper.

Keywords: creative reading/writing, self-confidence

Introduction

The term self-confidence relates to the everyday life of a person and can take various forms in many situations. We could even say that it is the most important aspect of human nature, as it is a prerequisite for a person to be able to cope with any condition. It is based on self-acceptance and enables a person to have a sense of control over his or her life. As far as school is concerned, it is closely intertwined with the formation of students' critical thinking (Laird, 2005), their ability to solve problems (Otacıoğlu, 2008), as well as the development of their communication skills (Park & Lee, 2005). Besides, children who display high levels of self-confidence are very likely to display correspondingly high levels in their later adult life.

On the other hand, creative reading, in which the reader goes beyond the mere comprehension of a text, creating personal meanings (Adams, 1968), and creative writing, which is a powerful stimulus for self-expression and self-understanding, can help to enhance it. Besides, creativity, a characteristic of creative reading and writing activities, contributes to the creation of a safe and supportive learning environment for children, which enhances their self-confidence through the adoption of diverse forms of expression in the educational process (Lozančić & Tot, 2020).

In this article, in the theoretical part, the concepts of creative reading and writing, self-confidence, and the related activities are briefly described, while in the research part, the results of a survey conducted during the academic year 2023-2024 in primary schools in Greece on a sample of 1020 students of the last two grades of primary school are presented, aiming to assess the enhancement of their self-confidence through creative reading and writing activities.

Theoretical part

Creative reading

Creative reading enables the reader to create their own meanings and make their own additions to what the author expresses, always, however, in the light of their own experiences and feelings (Adams, 1968). For Emerson (1837), essayist, poet and philosopher, it is an active

reading, productive and original, and it is not a mere quotation of what each reader reads. Indeed, for him (Emerson, 1844), it gives the opportunity to learn more about ourselves and others, as it is not a passive consumption of the words on a page.

To this we should add that for Ada (1988), a children's book author and professor at the University of San Francisco, creative reading includes the following four phases: a) descriptive phase, b) personal interpretation phase, c) critical analysis phase and d) creative action phase. Any text can be used as a stimulus for creative reading and the methodology is applicable to any age group. Note that the phases seem to be distinct from each other, however, they are often interrelated and implemented simultaneously. More specifically, the phases are as follows:

Descriptive phase: the content of the reading is shared with the students by the teacher. This phase works as a stepping stone for students' interaction with the new knowledge.

Personal interpretation phase: Students approach the new information based on their experiences. The teacher's questions are not only aimed at what, who, where, when and how, but also at the children's general reflection.

Critical analysis phase: after understanding the new knowledge and making connections with the pupils' lives, children are encouraged to reflect critically, draw conclusions, seek consequences and analyze.

Creative action phase: this is the phase of learning that relates to how children can use the new knowledge to improve their own lives and the lives of others. In other words, how learning can be moved from the classroom to the real world of students.

Creative writing

Creative writing is a stimulus for self-expression, but also for self-understanding (Anae, 2014), as it is not only an educational tool in the teaching of literature (Ramey, 2007) and language (Ghani & Din, 2017), but also a form of treatment for various psycho-emotional problems (Smyth, 1998). Complementarily, Oral (2008) emphasizes that creative writing develops the personality of each person involved, providing them with the opportunity to capture thoughts and feelings on paper, but also to use them to understand the world around them. Besides, the experiential and playful nature of the exercises (Simeonaki, 2013), the discussion and interaction between children in the context of group creative writing activities (Guillen & Bermejo, 2011), and the students' own contact with art, the art of words (Tulgan, 2015), transform their experiences into skills, attitudes, values, emotions and beliefs (Ling, 2016).

As a continuation of the above, it is important to emphasize that the process of implementing creative writing activities includes the following stages: a) Students discover knowledge and techniques through the reading of any form of text, b) They apply the above knowledge to a written text, transforming it into new knowledge under the influence of a stimulus and based mainly on their own experiences, c) They receive feedback by communicating their texts to the public, even giving their opinions, announcing the processes of writing, and finally d) they receive feedback on their texts. To conclude, another evidence about the effectiveness of creative writing is that it enhances the skills of self-awareness, emotional self-regulation, decision-making and planning (Gündüz & Şimşek, 2016).

Self-confidence

Self-confidence is the confidence people have about their abilities and is 'built' through significant experiences during childhood or through messages received by the individuals themselves about who they are (Efstathiou & Lekka, 2020). For Dubrin (2017), self-confidence is influenced by an individuals' experiences and achievements, but also by the comparisons they make in relation to other people in their environment and in relation to themselves. Indeed, since comparison is involved in the formation of self-confidence and given that this

comparison involves value judgments, we could classify it in the conceptual field of self-esteem, without, however, implying that these are identical concepts (Varfi, 2005).

Following on from the above, for Shrauger and Schohn (1995), the factors that can influence an individual's perception of their abilities are: (a) objective abilities in one or more areas for which the individual receives often feedback; (b) selective praise associated with a distorted image of one's self-esteem that may lead to over or underestimation of the self; (c) self-presentation, the way in which people try to present themselves, while disregarding their feelings and abilities and finally d) time, since very often people tend to ignore the changes in time and persist in judgements about themselves that are in line with their general image of themselves.

Self-confidence is also linked to the development and cultivation of a variety of skills. Otacıoğlu (2008), for example, points out its close relationship with the ability to solve problems, while Laird's (2005) research highlighted its connection with enhancing students' critical thinking and thus improving their academic performance. Complementarily, Park and Lee's (2005) study focuses on the contribution of self-confidence in enhancing students' communication skills.

It would be remiss not to emphasize that the foundations of self-confidence are built from infancy, as it is very difficult to change one's beliefs once an individual reaches adulthood. Children with low self-confidence do not try new things, cannot handle disappointment, give up easily and have a negative self-image. In contrast, confident children enjoy interacting with others, are adaptable to different environments and do well in both individual and group activities. In fact, they try to face any difficulties with optimism without underestimating themselves or others and are well aware of their strengths and weaknesses (Araujo, 2023).

Brief literature review

It is particularly important to enhance students' self-confidence in school as it will enable them to believe in their abilities, not to give up easily, try to solve a variety of problems and perform the tasks assigned to them to the best of their capacity (Goel & Aggarwal, 2012). In fact, Norman and Hyland (2003) state that self-confidence is an important learning factor that influences students' participation in school and their own progress. According to Akbari and Sahibzada (2020), a large part of the crisis that education is going through is the low self-confidence in many students which leads them to not participating adequately in school and also not making progress despite spending a lot of time in the classroom.

As a continuation of the above, it is worth highlighting that various studies have shown the low self-confidence of students at school (Ballane, 2019; Diniyah et al., 2018), but also of students at university (Laird, 2005). For Eccles (2004), in middle and high school, students' achievement is closely related to their grades, which plays an important role in their opinion of themselves. In fact, students perceive their performance in school as an indicator of their abilities, which has a strong impact on their self-confidence (McMahan & Thompson, 2015). Moreover, other studies (Fatma, 2015. Verma & Kumari, 2016.) have shown the important role of self-confidence in students' learning, emphasizing the importance of enhancing it.

Creative reading and writing activities

In the context of creative reading and even during the descriptive phase, the students of the Intervention Group watched from YouTube the short film "Pip" related to self-confidence and then they were divided into groups of two, so that in each pair, one student would present to the other what the film mentions and what are the interesting points in his/her opinion. The students then returned to their seats and through a short plenary discussion they all summarised the main points of the film together.

In the personal interpretation phase, they used Rosenberg's "Rosenberg Self-Esteem Scale" (1965), which is a tool for assessing self-image, in order to explore what the hero, Pip, might have of himself. In a playful and, most importantly, fun way, the students had a first contact

with the concepts of "low self-esteem" and "high self-esteem", commenting on the results of the questionnaire and reporting their own possible similar incidents. In the next phase, they played experiential group games through which they recognized that each of them not only has flaws, but also many assets, which in most cases are easily identified by the others.

In the context of creative writing and even at the stage of invention they were encouraged to write poems. During the organisation stage, the children were given the poem "When I loved myself enough" by Kim and Alison McMillen, after some of the lines were removed from the beginning in order to be completed by the pupils themselves. It should be noted that this poem is dedicated to self-love, i.e. loving oneself. In the last phase they read their poems in plenary, receiving feedback from their classmates, while several students went on to rewrite their poems a second time according to the comments they received.

Research part

Purpose of the research

This research attempts to investigate whether and to what extent creative reading and writing activities can contribute to boosting the self-confidence of pupils in the last two years of primary school.

The research methodology

The research which was designed and implemented is:

- Applied, as it aims to solve a problem of the modern world.
- Interventionist, since its scientific purpose is to develop techniques for a modifying intervention and for evaluating the results.
- Quantitative, as its data are sought through questionnaires and its findings are subject to statistical analysis.

The research sample

A total of 1020 students and 71 teachers participated in the study, who completed a structured, self-administered, closed-ended questionnaire called the "Soft Skills Assessment Questionnaire for the Evaluation of Soft/ Horizontal Skills in Grades 5 and 6 of Primary School". Of the 1020 students, 679 participated in the implementation of creative reading and writing activities (Intervention Group), while 341 followed only their school's curriculum (Control Group).

Evaluation tool

The "Soft Skills Assessment Questionnaire for 5th and 6th grade elementary school" includes 26 questions to assess soft/horizontal skills as they appear in the students' immediate and wider environment. The following soft/horizontal skills assessment questionnaires were studied to create the questions: a) "Soft Skills Assessment for Secondary Students" by Schochler (2014) and b) "Soft Skills Self-Assessment" by Junior Achievement (2013).

The questionnaire includes 26 statements divided into 13 subscales which are:

A. Communication (2 statements)
B. Communication (2 statements) A. Communication (2 statements)
Γ. Conflict resolution (2 statements)
D. Flexibility (2 statements)
E. Problem solving (2 statements)
Z. Creativity (2 statements)
H. Motivation (2 statements)
Θ. Personal development (2 statements)
I. Time management (2 statements)
K. Self-confidence (2 statements)

L. Leadership (2 statements)
M. Encouragement (2 statements)
N. Interpersonal relations (2 statements)

Students are assessed on the frequency with which they display each skill using a five-point Likert-type scale (a=never, b=rarely, c=sometimes, d=often, e=always).
In particular, the two statements concerning self-confidence are:
Students

1. Do they express their opinion comfortably?
2. Do they accept the comments of others without getting angry or upset?

As part of the evaluation, an additional questionnaire was used which was entitled: "Teacher Satisfaction Form". It consists of 13 closed-ended questions and the answers are given using a four-point Likert-type scale (not at all, a little, quite a bit, a lot). The self-esteem related question that the teachers who implemented the creative reading and writing program were asked to answer was: "Have students improved in working comfortably and freely without fear of making mistakes or the stress of criticism?". The questionnaire was completed by the 44 teachers of the Intervention Group, thus giving them the opportunity to evaluate themselves the effectiveness of the creative reading and writing activities in terms of strengthening soft skills and, indeed, in terms of enhancing the self-esteem of their students.

In addition to the above, the "Creative Reading and Writing Workshop Implementation and Evaluation Form" was used as an additional evaluation tool, which was completed by the teachers of the Intervention Group, who answered four closed-ended questions for each workshop out of the thirteen of the research/intervention project. Specifically, the questions were as follows. 2. Did students understand the main objective of the workshop? 3. How effective was the workshop as a whole? 4. Would you as a teacher use the techniques of the workshop again? In the next chapter of the paper, the results of the questionnaire will be presented in detail regarding the workshop on self-confidence.

Reliability

The " test-retest" procedure was carried out to assess the reliability of the questionnaire in terms of the consistency of responses over time. The questionnaire was administered to 30 students, 30 parents and 30 teachers. This procedure was carried out twice. The reliability of each item was measured by calculating Gwet's (2008) AC2 Agreement Coefficient (AC2), which is used in cases where there is a layout scale. According to Gwet (2014), the value of the coefficient is interpreted according to the following categorization: 0-20: little to no agreement; 20-40: agreement; 40-60: moderate agreement; 60-80: significant agreement; 80-100: almost perfect agreement. For the two statements concerning self-confidence, reliability is considered perfect (agreement rate = 0.90 for the first statement and agreement rate = 0.96 for the second).

Permission

A request was submitted to the Regional Department of Primary and Secondary Education of Central Macedonia to conduct the research. The relevant documents were submitted to the Department in September 2023 for the school year 2023-2024 in order to receive the approval. The documents included: (a) the Application for Permission to Conduct Research in Schools of Primary Education of Central Macedonia, (b) Form with the basic descriptive data of the project, (c) Form with the necessary educational criteria (target group, time of implementation, potential costs, evaluation), (d) Form with the necessary pedagogical and scientific criteria (achievement of goal/actions, knowledge, connection with the Curricula for Primary School, school support, compatibility with the principles of modern pedagogy, promotion of principles of respect, democratic coexistence, non-violent conflict resolution and solidarity, security rules for confidentiality and anonymity), e) Certificate from the Internal

Ethics Committee of the Department of Pre-school Education of the University of Thessaly, g) CV of the researcher, h) Declaration of Participation of the teachers, i) Parental Consent Form, j) Letter/Invitation to participate in the project to the teachers, k) Questionnaire for the evaluation of soft skills in grades 5 and 6 of primary school (for teacher, student, parent).

Results

Teachers' assessments of students in relation to the skill of self-confidence are presented in Table 1 in the form of averages and standard deviations for each assessment (pre- and post-intervention) and for each group of students (Control and Intervention).

Table 1. Descriptive statistics for teachers' ratings of students before and after the intervention by student group

		Group			
Skill	**Assessment**	**Control**		**Intervention**	
		Average	Standard deviation	Average	Standard deviation
Self-confidence	Initial	3.61	0.85	3.54	0.81
	Final	3.66	0.81	3.77	0.77

It is observed that teachers have assessed students' self-confidence after the intervention with a higher degree, on average, compared to the degree before the intervention for both groups of students.

In terms of pre-intervention assessment, teachers' marks, on average, were higher for students in the Control Group compared to students in the Intervention Group, while in terms of post-intervention assessment, teachers' marks, on average, were higher for students in the Intervention Group compared to students in the Control Group.

It should be clarified that teachers' assessments for the post-intervention students were compared between the two groups of students (Control and Intervention) for each of the thirteen skills using ANCOVA (Analysis of Covariance). These comparisons are made after controlling ("removing") for the effect of the pre-intervention assessment on the post-intervention assessment (as would be the case if all students had the same pre-intervention assessment).

Table 2 presents the results of the ANCOVA and adjusted averages for the post-intervention assessment scores obtained after controlling for (removing) the effect of the pre-intervention assessment on the post-intervention assessment. It should be clarified that the average is the adjusted average obtained after controlling ('removing') the effect of the pre-intervention evaluation on the post-intervention evaluation.

Table 2. Results of the comparisons between the two groups of students (Control and Intervention) in relation to teachers' post-intervention assessment scores for each of the thirteen skills, with the corresponding pre-intervention assessments as covariates (ANCOVA)

	Group					
	Control		**Intervention**			
Skill	Average	Standard error	Average	Standard error	F(1. 1017)	p
Self-confidence	3.63	0.03	3.79	0.02	16.18	< 0.001

Regarding the "Teacher Satisfaction Form", Table 3 presents the teachers' level of satisfaction regarding the improvement of students' self-esteem skills. The majority of teachers (93.2%) stated that students' self-confidence improved to a quite or very high degree.

Table 3. Teachers' level of satisfaction with the improvement of self-confidence skills

Question/Skill	At all	A Little	Enough	Very
Self-confidence	0,0	6,8	50,0	43,2

Regarding the "Form for the Implementation and Evaluation of the Creative Reading and Writing Workshop", Table 4 presents the results of the first question of the questionnaire for the self-confidence skill.

Table 4. Was the workshop implemented as described in the Programme?

Yes	No
95.8%	4.2%

As can be seen from the results presented in Table 4, the vast majority of teachers stated that the workshop on self-confidence was implemented in the way described in the programme at 95.8%.

Regarding the "Form for the Implementation and Evaluation of the Creative Reading and Writing Workshop", most teachers stated that their students understood the main goal of the workshop on self-confidence (Table 5).

Table 5. Did the students understand the main goal of the workshop?

The majority, yes	Some yes, some no	The majority, yes
79.2%	20.8%	0.0

Regarding the "Form for the Implementation and Evaluation of the Creative Reading and Writing Workshop", the majority of teachers said that the workshop on self-confidence was effective as a whole (Table 6).

Table 6. How effective was the workshop as a whole?

Effective	Neutral	Ineffective
87.5%	12.5%	0.0

Regarding the "Form for the Implementation and Evaluation of the Creative Reading and Writing Workshop", the vast majority of teachers said that they would use the workshop techniques again to boost confidence (Table 7).

Table 7. Would you use the techniques of the workshop again?

Yes	No
95.8%	4.2%

Discussion

The present study showed that self-confidence was enhanced by creative reading and writing activities to a greater extent in the Intervention Group students compared to the Control Group students.

The above findings are consistent with many studies (Akkaya, 2014. Chandler, 1999. Fair et al., 2012. Nicolini, 1994) that show the strong relationship between self-confidence and creative writing, describing the latter as an act of personal empowerment. In fact, these studies state that writing in the context of collaborative writing activities is an affirming experience for the individuals that enables them to access themselves and their 'voice'.

In the study by Rizzi and colleagues (2020), 12 students aged 12 to 15 years old took part in a creative storytelling workshop over three consecutive days, creating stories and then recording them. Key elements of the workshop included positive psychology, collaborative experience of small successes, experiential learning, creating a safe environment and the encouraging attitude of the teacher/facilitator. The results showed that various components of self-confidence could be positively influenced by the creative writing workshop with participants reporting not only concrete outcomes (e.g., producing stories), but also enhancing their self-confidence (e.g., overcoming any shyness).

Limitations of the study

A first limitation is the inclusion of students in the Intervention and Control Group, which was done in a non-randomized manner. This is due to the fact that 44 teachers in the Intervention Group asked to participate and implement the programme in the first year, while on the other hand, 27 teachers in the Control Group also expressed from the very first moment their wish not to participate in the intervention, but to “run” the programme in the next school year.

Moreover, the dual role of the teachers who implemented the programme, i.e. as observers and evaluators of their students' skills, was also a limiting factor. These evaluations were carried out by teachers who participated in the intervention, so the presence of a subjective element is evident.

Finally, a further limitation of the study is the lack of repetition of the evaluation (follow-up) in order to investigate the sustainability of the results. The non-execution of the study is also due to the high cost, but mainly due to the difficulty of following the students of the 6th grade in the high schools they would have gone to, as well as the difficulty of evaluation by other teachers in the following school year.

Conclusions/Recommendations

The results of the present study evidence the use of creative reading and writing as an effective tool for enhancing children's self-confidence. Statistical analysis of the results showed that teachers assessed the self-confidence of students in the Intervention Group to a statistically greater extent than the self-confidence of students in the Control Group. It should of course be emphasized that creative reading and writing activities are not intended to enhance children's self-confidence skills in the short term, but to contribute to long-term improvements, provided, of course, that they are the subject of systematic school programme from primary to university level.

It is, however, important to examine further whether and to what extent pupils who appear to have enhanced their existing self-confidence will maintain it over time compared to those pupils who did not participate in the implementation of creative reading and writing activities. Finally, it is important to emphasize that these activities, if implemented in the context of an organized school programme, have the important advantage of being low cost, so they can be used from primary school age and continue throughout the children's academic career, contributing to their academic, social and emotional learning.

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Correlation between the vocabulary level and the psychosocial adjustment of children with Autism Spectrum Disorder (level 1)

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Kastamoniti Dimitra
Speech and Language Therapist, MSc, PhD
kastamonitidimitra@gmail.com

Kafka Maria
Speech and Language Therapist, M.Ed.
mariakafka.slp@gmail.com

Kapogiannopoulou Chrysa
Speech and Language Therapist, B.Sc.
chrysakapogiannopoulou@gmail.com

Abstract

Children with Autism Spectrum Disorder (ASD) level 1, primarily have difficulties with psychosocial adjustment. However, they often experience language deficits which have been associated with a decline in their social, emotional and academic competence, as well as with the presence of behavioral problems. The present study presents correlation data between the individual domains of psychosocial adjustment and the two types of vocabulary, perceptive and expressive. The research sample consists of 6 pre-school age children with level 1 ASD diagnosis, who were assessed in the two - under study - domains with standardized, in the Greek-language, tools. The results showed that there is a very strong correlation between perceptive vocabulary and social competence of children with ASD as well as between word definition ability and school competence. However, a strong negative correlation between behavioral problems and word definition ability was demonstrated.

Key words: receptive vocabulary, expressive vocabulary, psychosocial adjustment

Introduction

Children with Autism Spectrum Disorder (ASD), in addition to significant impairment in social interaction, verbal and non-verbal communication difficulties, as well as stereotyped and repetitive behaviors, also present notable difficulties in individual areas of psychosocial adjustment (American Psychiatric Association, 2013).

More specifically, with regard to language deficits, depending on the level at which a child with ASD is clarified, one or more language subsystems are affected. Focusing on the area of vocabulary, both receptive and expressive, conflicting literature has emerged. However, the majority of these, agree that both types of vocabulary fall short in this diagnostic category (Hojjati & Khalikhaneh, 2014).

Apart from the deficits in the two types of vocabulary that observed in children with ASD, there are also deficits in their psychosocial adjustment which includes social, emotional and academic competence, as well as the behavioral problems, that these children manifest (Nader-Grosbois & Mazzone, 2014).

Regarding the association between vocabulary domains and the individual domains of psychosocial adjustment, very little literature is reported. At the same time, the majority of them concern an English-speaking population and a wide age range. Consequently, the purpose of the present study is to investigate the correlation between the vocabulary level of children with level 1 ASD, at early school age, with the sub domains of psychosocial adjustment i.e. social, emotional and school competence, as well as the presence of behavioral problems.

Conceptual definitions

ASD levels

It is reported that ASD is divided into three subtypes, based on the severity of symptoms and the children's need for support. Specifically, level 1 includes individuals who need mild support, level 2 includes individuals who need substantial support and level 3 includes individuals who need highly enhanced support (American Psychiatric Association, 2013). A further characteristic of children with ASD is impaired social communication functioning across the lifespan, which affects their emotional competence and thus, their adjustment to the school environment (Weiss et al., 2013).

Receptive vocabulary

A person's receptive vocabulary is the set of words whose meaning he or she knows, and therefore understands (Maskor & Baharudin, 2016). In particular, children with a poor receptive vocabulary have difficulty in understanding complicated orders and sentences, as well as in combining information, in order to reach logical conclusions about a social situation (Archodi, 2017).

Expressive vocabulary

A person's expressive vocabulary is the set of words whose meaning he or she knows and which he or she produces orally or in writing. It is a linguistic domain, like the receptive vocabulary, that continues developing throughout a person's life. The interaction of perceptive and expressive vocabulary leads to the creation of a complete "picture" of words (Maskor & Baharudin, 2016).

Psychosocial adjustment

The psychosocial adjustment of a school-age child is determined by his or her levels of social, academic and emotional competence, as well as the behavioral problems he or she exhibits (Doobay, 2014· Hsiao et al., 2013).

Using the term "social competence", we mean the development of behaviors and specific skills that enable the individual to function effectively within a social group, to meet social expectations and to be able to establish healthy social relationships (Ukasoanya, 2013).

Similarly, "academic competence" refers to a student's ability to perform academic tasks effectively, understanding and applying knowledge and skills in various learning areas. In addition, a student who is proficient, is able to organize and manage his or her time to complete his/her tasks (Vestad et al., 2021).

In addition, the ability of a person to manage and use his or her emotions in a way that facilitates his or her social interaction, as well as his or her personal well-being, constitutes "emotional competence" (Mortazavizadeh et al., 2022).

"Behavioral problems" are defined as children's unwanted and socially unacceptable behaviors. Behavioral problems are divided into externalized and internalized. Externalized behavioral problems include obvious behaviors such as aggression, while internalized behaviors include less obvious behaviors such as anxiety (Martineli et al., 2018).

Deficits of children with ASD level 1

Vocabulary

In terms of receptive vocabulary, children with ASD hear or see a word without being able to accurately understand its meaning, thus having difficulty in understanding larger language units such as sentences and commands (Camilleri & Botting, 2013). By extension, they have difficulty in understanding and following instructions, understanding questions, identifying objects and pictures or having constructive conversations. In addition, there are also difficulties in expressive vocabulary, i.e. the ability to describe something, to convey information, thoughts, ideas and feelings. These deficits have major impact on the way the

child functions either socially or academically, which has a negative effect on his or her psychological state (Hojjati & Khalikhaneh, 2014· McDaniel et al., 2018).

Comparing the two types of vocabulary, there is a belief that children with high–functioning ASD have fewer deficits in expressive vocabulary compared to perceptive vocabulary. However, the research that has been conducted on these two areas of vocabulary has come up with conflicting results. Research focusing on deficits in the receptive and expressive vocabulary of children with ASD has not found a significant difference between the two vocabulary domains (Hojjati & Khalikhaneh, 2014· Kwok et al., 2015).

Kover et al. (2013), who studied the development of receptive and expressive vocabulary in boys 4-11 years old with ASD, found that in this specific group of children, receptive vocabulary followed a slower development than expressive vocabulary. However, it is reported that the difference between receptive and expressive vocabulary varies during the children's development (Arutiunian, 2021· Brignell et al., 2019).

Psychosocial adjustment

As mentioned above, in addition to deficits in vocabulary, children with ASD have significant difficulties in psychosocial adjustment (Weiss et al., 2013).

The deficits in psychosocial adjustment of children with ASD are confirmed by the available literature. In particular, children with ASD are perceived as having low conscientiousness, less open to new experiences and to try new things, less outgoing and agreeable (Serrat, 2017). They also show reduced emotional stability and sometimes become more nervous than typically developing children. However, the better they regulate and control their emotions the easier it is for them to achieve social competence (Nader-Grosbois & Mazzone, 2014).

In addition, the social competence deficits exhibited by children with ASD, are associated with poor academic performance, negative attitudes towards schoolwork, teachers and peers and also, behavioral problems in the school environment. These phenomena often result in poor treatment of these children by both their peers and society at large (Weiss et al., 2013).

More generally, there is a concern about how students with ASD see themselves in the school environment, where many of them experience social marginalization. These students perceive themselves as different from their typically developing peers. This arises from the difficulties they experience in their interpersonal relationships and especially in their interactions with their peers (Williams et al., 2017).

Correlation between vocabulary – psychosocial adjustment of children with ASD level 1

In children with ASD, social competence and their language and cognitive profile are inextricably linked. Children with ASD who show a better language profile including receptive and expressive vocabulary, as well as a higher level of intelligence and intellectual efficiency, are considered to have better psychosocial adjustment. It is worth mentioning that in the aforementioned difficulties of psychosocial adjustment, language deficits of children with ASD, such as poor vocabulary, contribute. This is something that deprives them of the possibility to conduct constructive discussions and effective communication (Williams et al., 2017).

Methodology

Participants

To answer the research questions, the criterion for participation in the study was the possession of level 1 ASD diagnosis for all children in the sample, without comorbidity, from a public institution or qualified physician. Specifically, the research sample consisted of six Greek-speaking children, three boys and three girls, with ASD, who had just completed the first grade of primary school (ages 6;11-7;00).

Table 1. Participants

Disorder	Sex	Age
Level 1 ASD	Male	6;11
Level 1 ASD	Male	7;0
Level 1 ASD	Male	6;11
Level 1 ASD	Female	7;0
Level 1 ASD	Female	6;11
Level 1 ASD	Female	6;11

Tools

Two tools were used to collect data on the variables under study: the "Logometro" (Mouzaki et al., 2023) and the "Psychosocial Adjustment Test" (Chatzichristou et al., 2008).

The "Logometro" is a psychometric tool that assesses both oral language and literacy skills, suitable for preschool and early primary school-aged children (4-7 years). It is a valid and reliable tool standardized in Greek and available in digital format. The tool includes 24 tasks evaluating five language subsystems (phonology, semantics, syntax, morphology, and pragmatics), auditory comprehension of oral language, as well as literacy skills (Mouzaki et al., 2023).

For the purpose of the present study, the tests administered to the participants were test 1, concerning receptive vocabulary, test 15 concerning word definitions and test 16 concerning picture naming.

Specifically, test 1 consists of 30 questions. In each question, four images are displayed, and the child is asked to indicate the correct picture according to the spoken request. In test 15, which consists of 28 words, the child is asked to provide a brief definition for each word that is heard from the app. In test 16 which consists of 20 pictures, the child is required to name each image shown on the computer screen.

The "Psychosocial Adjustment Test" is an assessment scale that evaluates social and emotional skills and deficits, school adjustment, as well as intrapersonal and interpersonal adaptation difficulties. This standardized test includes three scales, of which two are for preschool (4-6 years) and school-age children (7-12 years), and the third scale is for children aged 10-12 years. The first two scales are completed by the teacher, while the last one, which is a self-report scale is completed by the student. These three scales include five subscales which are social competence, emotional competence, behavioral problems and self-perception. Each scale is divided into sub-dimensions (Chatzichristou et al., 2008).

The test is completed by educators who must have known the child for at least 2-3 months. A 5-point Likert-type scale from 1 (not at all) to 5 (very much) is used, with scoring at the dimension level and subscale level (Chatzichristou et al., 2008).

Data collection procedure

Written consent was obtained from the parents of all participants before starting the assessment process. The data for both assessment tools were collected in a therapy center room, free from distractions, during the afternoon.

More specifically, the first tool administered was the "Logometro." As mentioned above, Tests 1, 15, and 16 were administered and each one of them lasted approximately 20 minutes per child.

In test 1, assessing receptive vocabulary, the child viewed four different images on a computer screen and had to select the correct one based on a verbal prompt. The application

scored the test automatically during administration. In test 15, expressive vocabulary was assessed by asking the child to define each word heard, with responses recorded for later transcription and scoring by the examiner. Finally, in test 16, word recall and production were assessed, requiring the child to name each image displayed. Scoring was conducted automatically during this test as well. Clear instructions and one example were provided orally to the child before each test, and all tests were administered via computer.

Following the "Logometro," the "Psychosocial Adjustment Test" was completed by the clinician, using the appropriate scoring sheet for the sample's age range. Initially, individual information for each child was recorded on the scoring sheet, which consisted of 112 questions for school-aged children. After completing and scoring the questions, the clinician transferred the results to summary tables, compared the initial scores with standard scores, and filled out psychodiagnostics diagrams for each child. Based on the categorized results in the tables and diagrams, the clinician interpreted the results to determine the area of psychosocial adjustment in which each child falls short.

Data analysis procedure

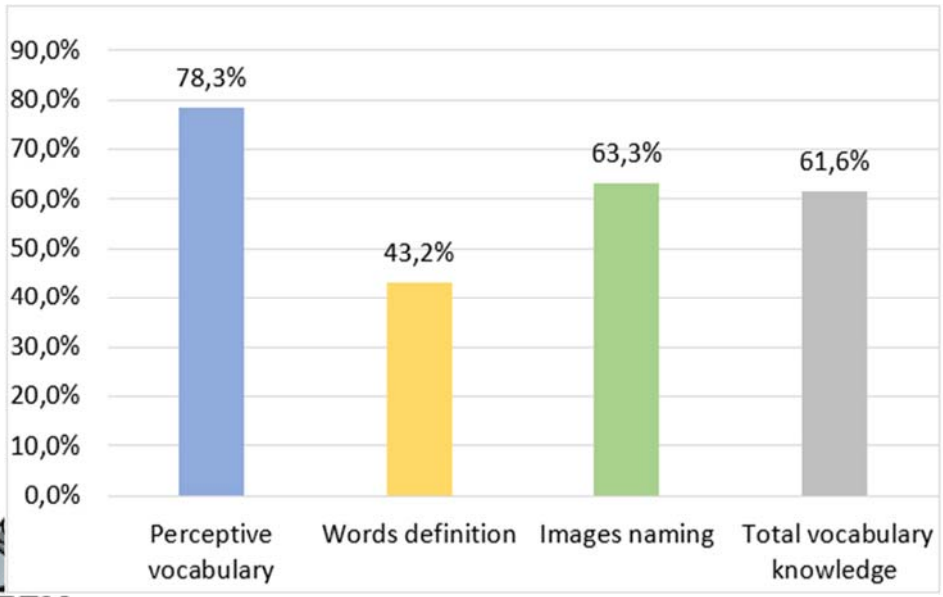
Data analysis was conducted using Microsoft Excel and SPSS IBM Statistics. Quantitative results from both the "Logometro" and the "Psychosocial Adjustment Test" for each child were recorded in two Excel sheets. For the "Logometro," the average performance for each task (receptive vocabulary, word definitions, picture naming) and the total sample performance were calculated. The percentage of children scoring low, average, borderline, or high was also determined. A similar process was followed for the "Psychosocial Adjustment Test," with averages calculated for each scale and dimension.

Data distribution was checked using SPSS to select the appropriate correlation coefficient for variable analysis. Hypotheses for variable correlation were formulated as follows: H0: "The correlation between the studied variables is zero," and H1: "The correlation between the studied variables is not zero." Finally, correlations were performed between each vocabulary domain and each psychosocial adjustment scale.

Results

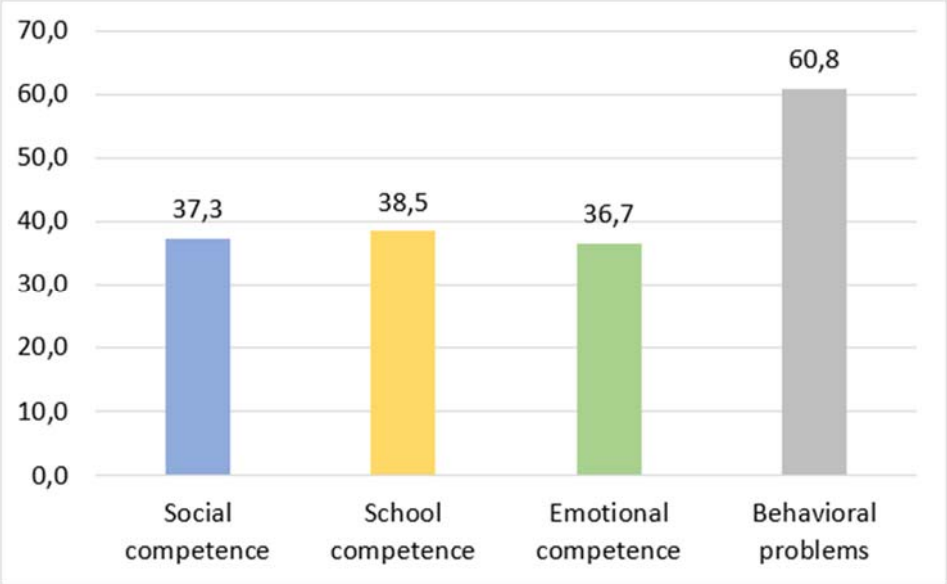
Through analysis of the data collected from the administration of the "Logometro," it was found that participants achieved, on average, a borderline performance in the receptive vocabulary test (M=78.3%, SD=0.05) as well as in the word definition test (M=43.2%, SD=0.06). In the image naming test, the sample showed, on average, low performance (M=63.3%, SD=0.09), while the participants' overall vocabulary knowledge was found to be borderline (M=61.6%, SD=0.04)

Table 2. Vocabulary knowledge results



The results of the "Psychosocial Adjustment Test" indicated that the study participants demonstrated, on average, low social (M=37.3, SD=1.37), academic (M=38.5, SD=0.5), and emotional (M=36.7, SD=1.6) competence, while significant behavioral problems were also identified (M=60.8, SD=2.64).

Table 3. Psychosocial adjustment results



From the SPSS data analysis, it was found that the data did not follow a normal distribution, so the non-parametric Spearman's correlation coefficient (ρ) was chosen. Regarding the results of the variable correlations, it was found that there was a correlation between all the domains compared, though this was not statistically significant in all cases. Specifically, a very strong positive correlation (ρ=0.818) was found between receptive vocabulary and social competence, which was statistically significant (p-value=0.047).

Table 4. Correlations between perceptive vocabulary – social competence

Correlations

			Προσληπτικό	Κοινων_Επαρ
Spearman's rho	Προσληπτικό	Correlation Coefficient	1,000	,818*
		Sig. (2-tailed)	.	,047
		N	6	6
	Κοινων_Επαρ	Correlation Coefficient	,818*	1,000
		Sig. (2-tailed)	,047	.
		N	6	6

*. Correlation is significant at the 0.05 level (2-tailed).

Additionally, a very strong positive correlation (ρ=0.926) was found between the ability to define words and school competence, which was statistically significant (p-value=0.008).

Table 5. Correlation between words definition – school competence

Correlations

			Ορισμός	Σχολ_Επαρ
Spearman's rho	Ορισμός	Correlation Coefficient	1,000	,926**
		Sig. (2-tailed)	.	,008
		N	6	6
	Σχολ_Επαρ	Correlation Coefficient	,926**	1,000
		Sig. (2-tailed)	,008	.
		N	6	6

**. Correlation is significant at the 0.01 level (2-tailed).

Moreover, a very strong negative correlation (ρ=-0.812) was found between the ability to define words and the presence of behavioral problems, which was also statistically significant (p-value=0.050).

Table 6. Correlation between words definition – behavioral problems

Correlations

			Ορισμός	Προβλ_Συμπερ
Spearman's rho	Ορισμός	Correlation Coefficient	1,000	-,812*
		Sig. (2-tailed)	.	,050
		N	6	6
	Προβλ_Συμπερ	Correlation Coefficient	-,812*	1,000
		Sig. (2-tailed)	,050	.
		N	6	6

*. Correlation is significant at the 0.05 level (2-tailed).

Therefore, based on the aforementioned results, as the receptive vocabulary of the sample decreases, social competence also decreases, and vice versa. The same relationship is observed between the ability to define words and school competence. Finally, the presence of a strong negative correlation between the ability to define concepts and behavioral problems indicates that as this specific linguistic ability decreases, behavioral problems increase.

Conclusion

Through the administration of tools standardized in Greek, reliable and valid data were obtained regarding the vocabulary knowledge of the sample, as well as their levels of psychosocial adaptation. The findings of the present study align with the available literature, as the early school-aged children with ASD who participated in the study showed borderline performance in receptive vocabulary and concept definition tests and low performance in the image naming test, according to the "Logometer." The existence of deficits in both receptive and expressive vocabulary is also confirmed by the study of Kover et al. (2013), who studied the receptive and expressive vocabulary of children with ASD of a similar age range as the sample of this study.

However, contrary to data supporting that receptive vocabulary falls short compared to expressive vocabulary in cases of children with ASD (Brignell et al., 2019), the sample of this study showed lower performance in expressive vocabulary tests compared to receptive vocabulary.

In terms of psychosocial competence, children with Level 1 ASD who participated in the study showed, on the one hand, low social, school, and emotional competence and, on the other, significant behavioral problems, according to the "Psychosocial Adjustment Test." These findings are corroborated both by the ASD definition included in the DSM-V and by studies investigating this domain (Nader-Grosbois & Mazzone, 2014).

Regarding the relationship between the two factors under study—vocabulary and psychosocial adjustment—this study provides more detailed data to the existing literature, which notes that the poor vocabulary displayed by a proportion of children with ASD affects their ability to communicate effectively with peers and adults and, consequently, their adjustment to various social situations, as well as their emotional state (Williams et al., 2017).

Specifically, through analysis of the present data, statistically strong correlations were revealed between specific vocabulary domains and psychosocial adjustment. More analytically, the strong correlation found between receptive vocabulary and the sample's social competence suggests, that the lack of knowledge children with ASD have about the meanings of words, negatively impacts their ability to meet their social obligations and develop healthy social relationships.

Additionally, the reduced ability to define words (expressive vocabulary) shown by the sample was found to be significantly correlated with the school competence of students with ASD (Cascia & Barr, 2017). Consequently, the poor expressive vocabulary of these students negatively affects their ability to organize and execute academic tasks effectively. Also, a strong negative correlation was found between this domain of vocabulary and behavioral problems, indicating that the poorer the expressive vocabulary of children with ASD, the more behavioral problems they exhibit (Afzal, 2019).

Finally, it is worth noting that the findings of this study provide data that could be used for a more comprehensive assessment of early school-aged children with ASD, a period of transitions that each child is asked to manage. A detailed assessment of the needs, difficulties, and strengths of students with ASD increases the chances of creating a personalized and more effective intervention program, improving the child's daily functioning and quality of life in the long term.

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School-Family Collaboration in Cases of Students with Emotional and/or Behavioral Disorders. The Perspective of Secondary Education Teachers

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Theofili Panagiota
M.Ed. Secondary Education Teacher, specialized in Special Education
giouligirl@hotmail.com

Pardali Maria
PhD, Special Educator, Scientific Collaborator European University Cyprus
parmar06@hotmail.com

Abstract

This research aimed to document the views of secondary education teachers on the issue of school-family collaboration in cases of students with emotional and behavioral disorders. Specific research objectives included understanding how teachers approach the concept of school-family collaboration, their strategies, and the factors they consider pivotal for school-family relationships. The researcher used qualitative research methods, and interviews were conducted with eight secondary school teachers who were experienced in managing students with learning difficulties. The findings revealed a notable trend: while there was a narrow and limited perception of the concept of school-family collaboration, indications of a desire to cultivate more profound and substantial collaborative relationships between schools and families also emerged. This finding signifies a promising trajectory towards creating genuinely open schools collaborating with students' families and local communities, aiming for students' overall well-being.

Keywords: school-family collaboration, emotional disorders, behavioral disorders, secondary education, teachers

Introduction

Emotional and behavioral disorders constitute a form of disability that is challenging to identify due to societal and subjective perceptions, differing scientific approaches, and co-occurrence with other disabilities or learning difficulties. Children with such disorders, however, face significant challenges in learning, socialization, and emotional expression, leading to social withdrawal, aggressive behaviors, and low self-esteem. Early identification and intervention are crucial to prevent extreme behaviors, while communication between school and family plays a central role in supporting these children.

Literature Review

Emotional and behavioral disorders refer to a broad spectrum of challenges and difficulties individuals face in managing their emotions and behaviors. Societal changes, scientific differentiation, and evolving approaches to these disorders have led to adopting a multifaceted perspective. Within this framework, emotional and behavioral disorders are typically categorized into externalized (e.g., aggression, delinquency) and internalized (e.g., social withdrawal, depression) types (Heward, 2011; Smith & Tyler, 2019; Kourkoutas, 2017).

The development of such disorders is influenced by both biological factors (e.g., genetic predispositions or neurodevelopmental differences) and environmental factors (e.g., family,

school, and societal influences) (Amaro et al., 2021; Azman et al., 2021; Behere et al., 2017). Research has demonstrated that these factors interact cumulatively (Walker & Sprague, 1999). For instance, genetic or neurological issues may predispose children to emotional or behavioral challenges (Heward, 2011) and parenting styles, school environment, and socioeconomic conditions can exacerbate or mitigate these disorders (Azman et al., 2021; Mackenbach et al., 2014).

Children with emotional and behavioral disorders often face significant challenges in forming and maintaining healthy relationships. These difficulties may arise from their struggles with emotional regulation, confrontational or aggressive behaviors, and inability to follow social norms. As a result, they may experience social isolation, rejection, and conflicts with peers (Heward, 2011; Smith & Tyler, 2019). These children often feel alienated from their peers, hindering their ability to build social skills. They may also experience impulsive behaviors that exacerbate negative interactions with others (Heward, 2011; Vallis, 2015).

Academically, these children are often characterized by poor performance due to difficulty concentrating or adhering to classroom rules, problems managing time or completing tasks (Reid et al., 2004) and behavioral problems (e.g., aggression or withdrawal) that disrupt the learning environment (Achilles et al., 2007). These challenges often result in disciplinary measures that further hinder their academic progress. Without appropriate interventions, children with emotional and, behavioral disorders are at an elevated risk of engaging in delinquent activities due to limited self-regulation and difficulty adhering to social norms (Doren et al., 1996; Dória et al., 2015).

Recent studies from the Centers for Disease Control and Prevention (2023) and other researchers highlighted a rising prevalence of mental health disorders, including emotional and behavioral disorders, among children and adolescents (Sacco et al., 2022; WHO, 2021). The increased prevalence of mental health disorders is attributed to various factors, including societal changes and heightened stress levels. However, many of these disorders remain undiagnosed due to fear of stigma as parents and educators often hesitate to seek help because they fear societal judgment and difficulty recognizing symptoms; for instance, teachers and parents may lack the training to identify mental health issues, and limited access to resources since diagnostic and support services may not be readily available to all communities (Loades & Mastroyannopoulou, 2010; Reardon et al., 2017).

The relationship quality between parents and educators plays a pivotal role in a child's development. Research has shown that when parents and teachers understand the profound impact of their collaboration, the child's educational journey becomes academically enriching and emotionally and socially empowering (Barnard, 2004; Epstein, 2018; Hill & Craft, 2003). However, studies also indicated that during the transition from primary to secondary education, adolescents feel decreasing levels of support from both family and school. The above reduced perceived support correlates with diminished parental involvement and weaker school-family relationships during the secondary education years (Antonopoulou et al., 2011; Gonida & Cortina, 2014). Therefore, adolescents are particularly vulnerable to emotional and behavioral disorders due to significant developmental transitions. The lack of a supportive network during this critical period can lead to severe emotional dysfunction and deviant or aggressive behaviors (Kourkoutas & Thanos, 2013). This risk increases when adolescents associate with peers exhibiting similar delinquent behaviors.

Statement of the Problem

In the last twenty years, several studies have been conducted on the issue of school-family-community communication in the Greek and Cypriot education system, most of which either concern primary education (Angelides et al., 2006; Beazidou & Spathis, 2019; Mylonakou - Keke, 2017), or generally investigate the relationships between parents and teachers (Brouzos, 2002; Rembatsoulea, 2021), or concern the communication of teachers with parents

of students with disabilities or learning difficulties (Gioka & Salmond, 2016; Eleftheriadou & Vlachou, 2022; Tsimbidaki, 2022).

Helpful information regarding secondary education teachers' views and experiences on collaboration and communication with parents of children with emotional or behavioral disorders can enrich the scientific discourse and inform future research efforts that investigate relevant educational practices and policies. In addition, practical implications for educational institutions, especially in developing training programs related to communication issues - school-family cooperation.

Purpose of the Study

The primary aim of this research was to explore the views of secondary education teachers in Greece regarding the crucial issue of collaboration between schools and the families of students with emotional or behavioral disorders. Specifically, the study focused on the following three key dimensions.

The Concept of Collaboration

This study aimed to investigate how secondary education teachers understand and define collaboration with parents of students facing emotional and behavioral challenges. It achieved this goal by examining their interpretations, definitions, and perspectives on the nuances of collaboration.

Methods of Collaboration

The study aimed to explore the strategies and channels through which schools and teachers communicate and collaborate with parents in general, specifically with parents of students with emotional or behavioral disorders.

Factors Influencing Collaboration

This study aimed to identify and distinguish the factors that facilitate or hinder collaboration between schools and the families of students with emotional or behavioral challenges. It achieved this goal by highlighting challenges and uncovering facilitators for effective collaboration.

Research Questions

Based on the above dimensions, the following three research questions were formulated:

1. What are the views and experiences of secondary education teachers regarding the concept of school-family collaboration in the case of students with emotional and/or behavioral disorders?
2. What are the views and experiences of secondary education teachers regarding the methods of collaboration between schools and families in such cases?
3. What are the views and experiences of secondary education teachers about the factors influencing Communication and collaboration between schools and families in these situations?

Methodological Approach

Research Method

This study employed qualitative research to better understand teachers' perspectives on the issue.

Sampling Strategy

A flexible sampling strategy was used, employing the snowball sampling or chain referral method to recruit participants.

Sample Size

The sample size was not predefined. Recruitment continued until theoretical saturation was achieved.

Data Collection Method

Data were gathered through in-person, semi-structured interviews, allowing participants to express their thoughts freely while ensuring the collection of relevant information.

Challenges in Data Collection and Ethical Considerations

Several objective challenges emerged during the data collection process. Among these was recruiting participants who met the inclusion criteria—active secondary education teachers with experience teaching students with learning difficulties and emotional or behavioral disorders. This dual requirement considerably narrowed the eligible participant pool and necessitated a targeted and persistent recruitment strategy. The snowball sampling method was employed to address this, enabling access to suitable participants through existing professional networks and referrals. Even so, potential participants frequently encountered time constraints, felt overwhelmed by their professional responsibilities, or hesitated to commit to an in-depth qualitative interview, further delaying the recruitment process. Consequently, researchers conducted interviews after hours or during school breaks to accommodate participants' schedules better.

In addition, the sensitive nature of the subject matter prompted hesitation among some potential participants, even before the start of the interviews. Concerns about discussing personal experiences were common. To mitigate this, the researchers ensured strict confidentiality, emphasized the voluntary nature of participation, and conducted interviews in a respectful and psychologically safe environment. Participants received comprehensive information about the study's objectives and procedures, including their right to withdraw at any time without penalty. Responses were anonymized using unique identifiers, and all data were securely stored, being used exclusively for research purposes.

A further challenge arose during the interviews due to the emotional depth of the narratives shared. Many participants recounted complex and personally significant experiences, which at times proved emotionally intense. The researcher responded by maintaining a neutral, non-judgmental stance and fostering a supportive atmosphere that encouraged authentic expression while avoiding any form of psychological pressure. These measures helped safeguard participants' emotional well-being and upheld the ethical standards and integrity of the research process.

Finally, although the emotional weight of the interviews enriched the data, it also required the researchers to manage the delicate balance between empathetic listening and maintaining professional neutrality. There was an inherent risk of researcher bias, particularly in interpreting emotionally charged narratives. Reflective journaling and peer debriefing were employed throughout the analysis phase to mitigate this. Additionally, the researchers remained mindful of emotional

transference, striving to create a compassionate yet ethically grounded interview environment.

Research Tool

The primary research tool was a semi-structured interview guide, which included open-ended questions to capture the complexities of teachers' views and experiences.

Data Analysis

The collected data were analyzed using thematic analysis, a method for identifying, organizing, and interpreting patterns (themes) within qualitative data. This methodology ensures a comprehensive and in-depth exploration of the research questions while providing flexibility to adapt to the nuances of participants' responses.

Key Findings

Sample Profile

The sample consisted of seven women and one man. The participants' specialties included philologists (Participants S1, S5, S8), a chemist (S2), an economist (S3), a mathematician (S4), a theologian (S6), and a physicist (S7). Four participants were special education teachers (S1, S3, S4, S5). Participant S1 held two postgraduate degrees, while S2, S7, and S8 had postgraduate qualifications in general education. Participant S8 also held two bachelor's degrees, and S6 had only an undergraduate degree. None of the participants had a doctoral degree. Participants S2, S5, and S8 reported attending relevant training programs or seminars regarding communication skills or school-family collaboration.

Concept of Collaboration

The analysis revealed three models of understanding school-family collaboration. The Hierarchical Model of Communication, the Partnership Model of Communication, and the Holistic and Collaborative Model of Communication. A synopsis of the findings for each model follows.

The Hierarchical Model of Communication

In the hierarchical approach to school-family collaboration, teachers perceive their role as the decision-makers regarding children and are primarily responsible for communicating with parents. On the contrary, they consider that parents play a secondary, supportive role, not participating in decision-making and acting as passive listeners. In this context, the teacher-parent relationship is strictly hierarchical. The primary function of parent-teacher communication is to serve the educational agenda determined by the teachers, with little importance given to satisfying the individual emotional and social needs of students and exploiting the information that parents can provide about the particularities, capabilities, and skills of each child.

The Partnership Model of Communication

In the partnership model of communication, teachers perceive the relationship between teachers and parents as a more dynamic and partnership-based relationship. The key characteristics of this relationship are shared decision-making, mutual support, and commitment to common goals. According to this approach, communication between teachers and parents is characterized by honesty, transparency, and mutual respect. It becomes the springboard for creating a supportive environment conducive to the holistic development of students.

The Holistic and Collaborative Model of Communication

Finally, the holistic and collaborative parent-teacher communication model represents a perception of the school-family relationship as part of a comprehensive interdisciplinary collaboration between all stakeholders involved in education. The aim is the all-round development of children and their effective support in all areas of development (cognitive, emotional, and social). In this model, communication extends beyond traditional boundaries, encompassing interdisciplinary collaboration and the substantial commitment of all stakeholders to support the holistic development of students.

Themes Based on the Above Findings.

Based on the above collaboration models, a stable equation of cooperation with the concept of communication emerged, as defined by Nwogbaga et al. (2015). On one hand, this fact indicated the recognition of communication as a fundamental aspect of practical cooperation and, on the other hand, it shows a limited and narrow perception of the concept of school-family cooperation, which is in line with the findings of other studies, which show that in Greece, cooperation between the family and school environment is typical and often problematic (Antonopoulou et al., 2011; Artinopoulou et al., 2016; Matsagouras & Poulou, 2009; Poursanidou, 2016).

Thus, the second conclusion of the research emerges that in the participants' responses, elements from all three aforementioned communication approaches coexist, confirming the view of the contradictory perceptions of Greek and Cypriot teachers regarding the issue of school-family relations. On the one hand, they recognize that it is important for schools and families to be in constant contact and interaction in order to achieve the greatest possible results for children. However, on the other hand, they adopt outdated attitudes and perceptions, according to which the teacher-parent relationship is considered either hierarchical, formal and strictly structured or a relationship between two partners who co-determine common goals and expectations for children, without, however, taking into account the opinion of other experts (Lazaridou, 2022; Matsagoura & Poulou, 2009; Beazidou & Spathis, 2019; Brouzos, 2002; Mylonakou – Keke, 2017; Repatsulea, 2021; Symeou, 2002).

Regardless of the controversy in the above finding, the overall indications about school and family cooperation are not entirely pessimistic. Adopting perceptions of school-family communication as a hierarchical and delimited process reveals a deficiency in the collaborative practices adopted in Greek schools. It highlights the persistent challenges of the Greek educational system. However, perceptions and attitudes regarding the partnership between parents and teachers signal a trend towards more participatory approaches to school-family cooperation. Moreover, the emergence of the holistic and collaborative communication model as an alternative way of approaching school-family communication issues shows that a new trend of expanding cooperation beyond the boundaries of the school is beginning to emerge in Greek schools, with the opening of school communities to both students' families and the wider society, as also shown by the research of Mylonakou – Keke (2017, 2019).

Methods and Channels of Communication Between School and Family

Nature of Communication

Regarding cognitive issues, a pattern was observed in the participants' responses, according to which communication with teachers and parents occurs mainly during the grading period, with increased parental interest usually before the end of the first four months. However, this interest tends to wane thereafter. On the other hand, behavioral issues emerged as the main discussion topics in the extraordinary teacher-parent meetings. Specifically, participants believe they should communicate with the student's parents when they observe significant changes in the children's behavior, unjustified absences, or violations

of school rules. Finally, some participants emphasized the importance of communicating with parents not only in adverse incidents but also in recognizing positive achievements and behaviors.

The above findings are consistent with the existing literature, which finds a tendency for teachers to communicate with parents to provide them with information about the curriculum, grades, and achievements of students and to inform them of incidents of "indiscipline" without seeking feedback from them (Matsagouras & Poulou, 2009; Beazidou & Spathis, 2019). Again, it is found that teachers have a limited understanding of school-family cooperation, within the framework of which any teacher-parent communication is transactional, focused mainly on the school performance of students and on disciplinary issues. Especially about the management of students with emotional and/or behavioral disorders, it seems that according to teachers' perceptions, their role is simply to inform parents so that they can take on the responsibility of admonishing their children. In other words, teachers recognize the importance of communicating with parents of students with emotional and behavioral specificities, and they approach the issue in a way that falls far short of meaningful collaboration to help the children truly.

Ways of Communication

The investigation of teachers' perceptions regarding school-family collaboration methods showed that participants mainly adopt formal forms of communication with parents and rarely resort to informal forms of communication (Mylonakou–Keke, 2019). Participants also tend to prefer direct communication channels with students' parents, such as face-to-face meetings, telephone conversations, and email correspondence, which aligns with the findings of other studies (Matsagouras & Poulou, 2009). In addition, participants referred to teacher-parent communication through diary recording, a method of communication more appropriate for students with special educational needs and learning difficulties, and to the importance of parental participation in school initiatives aimed at preventing and managing children's emotional and behavioral difficulties. These initiatives include various actions, such as comprehensive information meetings for parents at the beginning of the school year, parenting schools, information activities on delinquent behaviors, and other important social issues, such as gender-based violence.

These findings are in line with the findings of the study by Sidiropoulou (2016), according to which teachers in Greece prefer more forms of cooperation - communication with parents, through which parenthood is supported, two-way communication is cultivated, and a standard line is formed, and they choose to a lesser extent actions that expand cooperation between the school community - family - local community and actions that dynamically involve parents in the decision-making process. Again, it seems that teachers' understanding of the concept of school-family cooperation is limited. They tend to choose one-sided forms of communication, through which they simply convey information to parents without developing an honest and meaningful dialogue with them.

Frequency of Communication

The qualitative analysis of secondary school teachers' views on the frequency of communication between teachers and parents reveals a lack of standardized frameworks. While schools set specific times for parent-teacher meetings, participants expressed a willingness to collaborate with parents outside of these times, reflecting a more flexible approach to the issue, which recognizes the different needs and preferences of parents. The increased frequency of contact between teachers and parents of children with special educational needs and learning difficulties is also noteworthy, which is also found in other research (Tsimbidaki, 2022).

Therefore, teachers are aware of the special nature of school-family cooperation and that rigid schedules can hinder rather than facilitate communication. This finding is encouraging since, by recognizing and accommodating parents' diverse needs and preferences, educators demonstrate a willingness to adapt their communication practices to serve the interests of students and families better. On the other hand, however, this finding may simply indicate a potential discrepancy between the perceived level of collaboration and the actual depth of engagement between schools and families. While the increased frequency of contact between educators and parents may indicate increased parental involvement, it does not necessarily guarantee collaboration between the two parties or shared decision-making, particularly regarding students with emotional and/or behavioral disorders.

Factors Influencing Collaboration

Regarding family factors, the participants referred to the family's willingness to cooperate, issues of trust between teachers and parents, the issue of accepting children's difficulties, the issue of parental intervention, family structure and parents' time, as well as issues of educational level and cultural background of the parents. Regarding school factors, the participants considered that the school culture, the management, the school level, the type of education, and the accessibility of the school play a decisive role in the quality of school-family relations. Regarding factors related to the teachers themselves, the participants referred to the knowledge and skills of the teachers, their communication skills, and their overall personality. Finally, regarding social factors, the participants referred to the role of parapodia. They also underlined the influence that the local community plays in forming a positive or negative climate between parents and the school.

These reports are in line with the existing literature, which has highlighted the multifaceted nature of school-family relationships and the wide range of factors that influence these relationships (Ambroso et al., 2021; Bakker et al., 2007; Capps et al., 2004; Epstein et al., 2019; Guo & Kilderry, 2018; Montemayor, 2019; Petrone, 2016; Schmitz, 1999; Bonia et al., 2008; Brouzos, 2009; Mylonakou – Keke, 2019; Pnevmatikos et al., 2008). It is worth noting that the participants did not mention at all the role of the digital divide, which can separate teachers from parents, which has emerged as an important parameter in teacher-parent relationships in recent research (Dolan, 2016; Guernsey & Levine, 2017; Noguerón-Liu, 2017).

It is also important that the participants recognize, on the one hand, the complex interaction of factors that shape school-family collaboration and, on the other hand, the potential limitations of this collaboration, which depends on both individual factors and broader social factors, which can be the starting point for promoting authentic collaboration between school and family by developing strategies to remove communication barriers. On the other hand, it is observed that teachers tend to overlook their responsibilities and to be indifferent to the cultural gap that separates them from the parents. That is, they recognize that many parameters negatively affect their relationship with the parents of children with emotional and/or behavioral disorders. However, they seem not to realize that part of these obstacles is due to the cultural and social differences between them and their students' parents.

Additional Findings

In addition to the above findings, study participants consistently emphasized the importance of effective communication and collaboration between schools and families for the well-being of students, especially those with emotional or behavioral difficulties, which is also confirmed by the existing literature (Barnard, 2004; Epstein, 2018; Hampden-Thompson & Galindo, 2017; Hill & Craft, 2003; Lee & Bowen, 2006; Levin & Nolan, 2014; Smith et al., 2020; Smolkowski et al., 2017; Stavrou & Kourkoutas, 2017; Thompson et al., 2017; Vásquez-Colina, 2023; Wills et al., 2014; Mylonakou – Keke, 2019).

Furthermore, participants noted the emotional toll teachers experience when managing difficult situations and stressed the need for adequate support and information from the school and parents. Research on the psychological burnout of teachers working with students with special educational needs and learning disabilities has shown similar findings (Park & Shin, 2020).

Final Thoughts

Children struggling with emotional and behavioral disorders walk difficult paths within the educational landscape. They constitute a vulnerable group, constantly under the fear of isolation, low school performance, or even a turn to delinquency. In this light, it becomes imperative for schools and families to forge a strong alliance, a collaborative front aimed at helping and supporting these students.

Unfortunately, the investigation of secondary education teachers' views on school-parent collaboration of students/children with emotional and behavioral disorders revealed a disappointing reality. Despite recognizing the importance of collaboration, the research showed a dominant limitation in teachers' perceptions. Teachers often consider that their role, in terms of their collaboration with parents, is primarily informative on school performance and problematic behaviors. However, this perception cannot help teachers understand the deeper causes of children's problematic behaviors or identify possible underlying emotional insecurities, which put young students at much greater risk than directly observable problematic behaviors.

However, a ray of hope emerges within the shadows of this limitation. There is a discernible change in teachers' perceptions, a trend toward deepening communication, and an expansion of school-family cooperation. This development is underlined by teachers' increasing flexibility and receptivity to communicating with parents, combined with an increased awareness of the obstacles that hinder effective dialogue.

However, the question remains: What measures can be taken to translate this trend into tangible change? The answer lies in the adoption of appropriate policies, which are also the proposals of this study:

- Integrated teacher training programs.
- Initiatives to promote parental involvement.
- Interdisciplinary support groups.
- Community partnerships.
- Cultivating a culture of empathy and inclusion.

Future Research

The journey toward effective school-family collaboration to address students' behavioral and emotional challenges requires a collective commitment fueled by empathy, understanding, and determination to pave a brighter path for our most vulnerable students. Through this collective effort, we can not only mitigate the scourge of youth delinquency and violence but also cultivate an educational ecosystem where every child thrives. In this direction, exploring additional research topics that can deepen our understanding and strengthen our practices can provide valuable assistance. Thus, the following suggestions for future research are proposed:

- Investigating the long-term outcomes of school-family collaboration programs
- Investigating the effects of cultural and socioeconomic factors on school-family collaboration
- Investigating the effectiveness of teacher training programs
- Investigating the role of technology
- Evaluating the effectiveness of interdisciplinary support groups

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Game - based activities in learning process

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Bosmos Fotios
Department of Informatics and Telecommunications, University of Ioannina, Arta, Greece
mposmos@uoi.gr

Abstract

This study presents ways to utilize activities with game elements in the educational process. Initially the theoretical background of the object of our research is presented. More specifically the effect of game activities on reducing anxiety in a learning environment is presented. Moreover, researches related to the basic principles that must be observed when designing a game-based educational activity and when using it in learning is recorded. In our research, through an example of a digital quiz that incorporates assessment and self-assessment elements, the effectiveness of game activities when they complement learning is emphasized. Finally, the contribution of such activities to creating a lighter and more pleasant climate in the classroom is highlighted, which refers to familiar recreational environments for students from their everyday lives.

Keywords: Gaming, Learning, Participation

Introduction

Gaming as a means of entertainment is available to people from an early age. Beyond its entertaining character, it also contains educational elements that play an important role in the learning development of children. Modern education is called upon to incorporate more familiar practices to students, which transform the learning process from formal to a creative and innovative process that attracts the interest of children and at the same time utilizes experiential elements from extracurricular life.

Over time, gamification has evolved into a rapidly growing field of research with broad applications in the design of information systems in various fields, such as education, healthcare, and marketing. Gamification plays a key role in enhancing user engagement and involves the design of systems, services, organizations, and activities that aim to provide positive experiences, similar to those offered by games, thereby influencing users' behavior and cognitive processes (Jia et al., 2024).

This research studies the learning elements contained in the game through the creation and use of specific gaming activities as well as their degree of acceptance by students, in order to make the learning process and the school experience more effective and enjoyable.

Through a specific example of creating and using a digital Kahoot! quiz in a secondary education IT course, the aim is to identify and document the basic design principles and the impact of digital quizzes on the learning process, and in particular on the element of fun through learning as well as on the element of evaluation and self-assessment. Through this specific case study use, the possibility of using similar gaming activities in other lessons such as history, literature, arts, culture, music and others is highlighted. At the same time, through the possibility of individual and at the same time participatory response, the effectiveness of digital quizzes in collaborative learning is documented.

Theoretical background

The impact of games in learning

In recent years, gamification has attracted the interest of professionals and researchers, as it offers a way to achieve various emotional, cognitive and social goals, while guiding people's behavior with the aim of promoting innovation and productivity (Blanco et al., 2023).

In education, a major challenge is adapting teaching methods to students' needs. This allows students to progress at their own pace, participate in discussions with their peers through online tools, and enables teachers to gain information about students' difficulties and strengths (Alt, 2023). The learning process becomes more interesting and engaging, enhances students' enthusiasm, promotes their initiative, and contributes to better memory and understanding (Fu et al., 2024). Furthermore, when students are enthusiastic about their studies, they are more likely to memorize information (Nair, 2022).

Gamification-based learning enhances familiarity with the content and increases performance expectations, events that directly influence knowledge acquisition (Alt, 2023). Overcoming the various levels and challenges encourages players, which can enhance their satisfaction, making them feel that they are actively participating in the experience. This can be achieved either through narrative or through rewards, elements that are crucial to the game experience (Murillo-Zamorano et al., 2023).

For example, after evaluating the results of a digital game designed to promote numeracy skills in primary school students, it was found that the game had a positive effect on various types of numeracy skills and knowledge (Alt, 2023). The phenomenon of creating game-related experiences can be linked to aspects that are embedded in human behavior, such as pleasure (Liu et al., 2024). In addition, games often offer the possibility of interacting with others, which can help reduce feelings of isolation and loneliness that often accompany symptoms of anxiety (Alsswey & Malak, 2024).

The impact of gaming on stress management in learning

Anxiety is a common issue that affects, among other things, the learning process. It is associated with a variety of symptoms, such as physical reactions that include sweating, trembling, fainting or dizziness, as well as psychological difficulties such as inability to concentrate, increased heart rate, feeling overwhelmed, sleep problems, difficulty focusing on tasks, inability to make decisions, etc. Anxiety symptoms can have a negative impact on the learning process. For example, physical symptoms of anxiety may prevent concentration and focus on a task, resulting in reduced learning performance. In addition, they can cause difficulties in memorizing information and assimilating new knowledge. In addition, feelings of anxiety and fear can often cause procrastination or even avoidance of tasks that are considered difficult. For this reason, it is crucial to create a supportive learning environment for students so that tasks seem more manageable (Alsswey & Malak, 2024).

One of the elements that has helped reduce anxiety is the filming or recording of lessons. This allows students who are taking lessons later, e.g. via a platform, to gain more confidence to comment, ask questions or participate in discussions in the course forums. Thus, they have the opportunity to expand the learning process beyond the physical classroom (Padilla-Zea et al., 2024).

Other research has shown that gamified learning, with tools such as Kahoot! digital quizzes, can lead to a reduction in anxiety symptoms. This is consistent with the findings of other studies, which have shown that gamification can be an effective means of reducing anxiety symptoms (Alsswey & Malak, 2024).

The main elements of a game, such as rewards, grades, levels, and leaderboards, can also contribute to reducing anxiety symptoms by offering students a constant sense of control and accomplishment (Alsswey & Malak, 2024). Users who receive, for example, virtual medals and official certificates usually feel more satisfied (Bi et al., 2024).

Creating enjoyable tasks or activities that encourage the user to focus on something other than what usually causes them stress can also significantly contribute to coping with emotions related to fear, such as fear of failure or fear of the unknown (Alsswey & Malak, 2024).

The most effective teaching methods are those that align with learning objectives while also taking into account the students' perspective (Lee, 2023). In addition, the effect of gamification on active student participation is highlighted. Participating in competitive

challenges creates pleasure and enhances user engagement. At this stage, attention is focused on the connection between engagement and knowledge, as it has been observed that there is a positive correlation between engagement in the learning process and knowledge acquisition (Murillo-Zamorano et al., 2023).

The contribution of games to creating motivation

Courses often utilize interactive and experiential platforms to facilitate the delivery of theoretical knowledge. However, some major problems associated with online courses include lack of motivation, social isolation, reduced student engagement, distractions, lower attention span, and ultimately a weak learning experience. These issues can be effectively addressed if the course content and presentation are designed in a creative manner (Nair, 2022).

Several studies offer evidence on the benefits of gamification in improving the quality of online courses, affecting factors such as student engagement and participation, motivation, creative learning experience, etc. These assumptions are useful for educators and educational policy makers in order to develop innovative and engaging learning activities, as well as to prepare digitally and professionally competent graduates who will be able to serve sectors such as tourism (Nair, 2022).

Gamified practices, although not games, are designed to exploit human psychology in a similar way to games. The use of games in environments traditionally considered non-gaming, such as education, is one of the main goals of gamification (Aguiar-Castillo et al., 2021). When gaming elements are incorporated as a well-designed and executed experience, they act as factors that enhance student motivation and satisfaction (Murillo-Zamorano et al., 2023).The motivation of each student is considered a crucial element of the educational process. This is due to the significant impact that motivation has on learning, both in the process itself and in its results. (Aguiar-Castillo et al., 2021).

Motivations can be either intrinsic or extrinsic. Some students choose to study for the pleasure that knowledge gives them or to satisfy their desire to learn, while others have a specific reward in mind, such as a good job or financial benefits (Nair, 2022). Researches present the dual approach that results from the distinction between intrinsic and extrinsic motivations. The psychological dimension of these elements can be understood through two distinct characteristics: intrinsic, where a behavior or action is performed due to its connection to an internal value, and extrinsic, where external rewards, such as money or social status, are offered in exchange for a specific behavior (Aguiar-Castillo et al., 2021).

Furthermore, another study identifies four important capabilities of gamification (competitiveness, success, interactivity, and self-expression) that contribute to the achievement of external goals by activating users' intrinsic motivations (Liu et al., 2024).

Intrinsic motivation comes from within people and motivates individuals to act for the sake of the activity itself. In contrast, extrinsic motivation comes from factors outside the individual and leads to actions that offer rewards or help achieve other goals, acting as a means to achieving their purpose. In fact, when designing an application, it is critical to use incentives, both intrinsic and extrinsic, in order to enhance the likelihood of achieving the desired behavior (Aguiar-Castillo et al., 2021).

Gaming in personalized and collaborative learning

Humans, as rational beings who methodically analyze available information, utilize their knowledge to shape their intention to exhibit or avoid a specific behavior. The alignment of an instructor's teaching style with students' expectations is a critical factor in the learning process (Kauppinen & Choudhary, 2021).

As more and more games leverage AI technology, gamification offers personalized experiences that significantly impact the individual learning process. Compared to traditional

approaches, game-based activities make it easier to assess and support each individual (Nair, 2022).

Gamification-based education should be designed to support personalized learning, as each student has a unique learning style and ability level. When designing a gamified educational process, the diversity of students in learning or other backgrounds should be taken into account. By providing personalized learning paths and challenges that reflect their individual differences, students can more effectively meet their learning needs and enhance their motivation to learn. Personalized learning design can include a variety of learning content, different difficulty levels, and teaching methods for each lesson, as well as adjustments and optimizations based on student progress and performance. This design allows each student to progress at their own pace, facilitating the comprehension of knowledge (Fu et al., 2024).

Gamification has been shown to promote acceptance of diversity and enhance inclusion in the classroom, as demonstrated by studies in various multicultural and multilingual classrooms. Education that promotes acceptance of diversity, including all students and striving for equality, is crucial to creating an inclusive environment and society. The term "education for diversity" refers to the process of recognizing and accepting different aspects in school classrooms. Inclusive education presupposes acceptance of this diversity (Nair, 2022)

In addition, personalized learning can lead to enhanced collaboration and communication among students, giving them the opportunity to learn from each other and encourage each other during their participation (Fu et al., 2024).

The use of gamification can contribute to changing behaviors within the classroom. Specifically, it can enhance students' interest, active participation, and engagement in the learning process. It can also enhance the participation of less active students. In other words, gamification promotes engagement, which, in turn, contributes to improving the knowledge acquisition process (Murillo-Zamorano et al., 2023). The possibility of interactivity enhances social relationships and a sense of belonging, facilitating interactions and communication with others through tools such as messaging and dialogues (Liu et al., 2024).

Gamification elements, such as storytelling and role-playing, stimulate curiosity and promote engagement, encouraging users to participate in self-directed activities. At the same time, social elements of the game, such as conversation, sharing, and interaction, enhance communication and community building, thus strengthening the sense of belonging of users (Bi et al., 2024).

Designing a game – based learning activity

The design of game-based education should ensure that the elements of gamification are inextricably linked to the learning objectives, in order to ensure that students can achieve the desired learning outcomes (Fu et al., 2024).When designing learning and assessment activities, educators should consider a variety of learning activity options that challenge students (Alsofyani, 2023). There are a number of game processes that need to be designed that are critical to enhancing each student's motivation (Aguiar-Castillo et al., 2021). Game-based education should offer immediate feedback and incentive mechanisms so that students receive positive recognition and rewards when they complete tasks or achieve specific goals, thereby enhancing their learning motivation and enthusiasm (Fu et al., 2024).

By introducing game elements and mechanisms, such as reward systems and role-playing games, it is sought to enhance students' interest and motivation for learning in order to improve their learning outcomes. This approach can make the learning process more lively and attractive, allowing students to acquire knowledge and develop skills in a pleasant and relaxed environment. Immediate feedback can support students in accurately understanding their learning status and level, allowing them to timely adjust their strategy, correct their mistakes, and maximize learning outcomes (Fu et al., 2024).

Key features of gamification include levels, points, leaderboards, avatars, missions, graphs, and other elements (Bi et al., 2024). Points allow players to track their progress, providing satisfaction, while the dissemination of these to other players through leaderboards can lead to recognition (Murillo-Zamorano et al., 2023).

The game tools incorporated into gamified applications guide the user through a flow process, which, by its nature, encourages the learner to repeat behaviors that promote learning. Thus, a habit is formed as a result of gamification (Aguiar-Castillo et al., 2021). The educational method of gamification can offer a variety of difficulties and challenges, adapted to the different grades and abilities of students, allowing them to develop their skills through continuous efforts (Fu et al., 2024).

To this end, modern training programs should incorporate, as much as possible, the following principles: repetition (continuous practice), feedback (receiving frequent, immediate and reliable comments), adaptation (distribution of tasks according to the level of difficulty), conciseness (complex tasks structured into short and specific exercises that cover the general topic), freedom of choice (regarding the exercises and the order in which they are performed), as well as recognition and reward (awards and rewards) (Alt, 2023).It is also particularly important to determine whether the learning content and game elements are perfectly combined (Nair, 2022).

Emotional value is an important factor for individuals, and game designers should incorporate emotional elements, such as pleasure and flow mechanisms, to enhance participation in game activities. Thus, designers have the opportunity to increase player engagement by adding fun elements that transform daily routines into pleasant and exciting experiences, facilitating entertainment and enjoyment (Jia et al., 2024).

In addition, the design of game-based education should carefully consider the interests and abilities of students to ensure that game activities are appropriate to their cognitive development level. Teaching activities should be adapted to the cognitive development level of students. It is also necessary to avoid games that are too simple or too complex to ensure that students experience challenges in the learning process, as well as a sense of accomplishment (Fu et al., 2024).

Educational assessment processes and the provision of individual or even overall feedback are time-consuming and demanding. The use of gamification, such as through quizzes, offers significant assistance to educators in various ways (Nair, 2022). Kahoot! is an innovative learning platform that is redefining the way people acquire knowledge. Designed to enhance student engagement and motivation, this platform promotes more active participation and interaction with educational materials, encouraging students to invest more in the learning process. Kahoot! allows students to answer questions and compete with each other in a funny and engaging way. At the same time, it offers teachers a variety of options for customizing their quizzes, allowing them to create content that meets their specific needs. For example, they can incorporate images, videos or audio clips, as well as determine the level of difficulty of the quizzes, ensuring that they are appropriate for the students in their class (Alsswey & Malak, 2024).

Additionally, the app provides teachers with detailed information about their students' performance. This information can be used to identify areas where students are struggling and to track their progress over time. A prime example is Kahoot!'s reward system, which offers points and notifications for completing tasks, as well as leaderboards that compare participants' performance. This encourages friendly competition, motivating students to try harder and achieve better results. Kahoot! can also be used to design more effective lessons and provide personalized feedback to each student (Alsswey & Malak, 2024).

Students participate in the quizzes via their smart devices or computers, using pseudonyms. Their devices are connected to the quiz via a network. After recording students' answers to each question, an important pedagogical benefit is that the game immediately

displays the correct answers on the screen, allowing the teacher to explain them to the students (Kauppinen & Choudhary, 2021).

In Kahoot!, the application sets a default response time for each question, which can be modified by the instructor. After each game, instructors have the ability to obtain results reports, which are provided in spreadsheet format. These reports include information about each player's performance, analyzing correct and incorrect answers (Kauppinen & Choudhary, 2021).

When using Kahoot! in the classroom, it is important to consider that it offers two types of scores for each participant's performance: Kahoot! scores (where a high score results from answering correctly and quickly) and correct answers (where a high score results from simply providing a correct answer). The scoring factor that allows top-performing students to answer slowly to confirm the correctness of their answers, or to answer quickly in order to outplay their peers in the game, may also have negative consequences (Kauppinen & Choudhary, 2021).

Our research: An example of using gamification in learning process.

Purpose of our research

The purpose of our research is to identify and record the possibilities of integrating playful learning activities into the learning process. This is pursued through the use of a digital Kahoot quiz that contains game elements such as interaction, automation, reward, etc., which is used in the assessment and self-assessment process of students in junior High School. The students' opinion on the effectiveness of this digital resource in the lesson is then recorded in electronic Google format. What we seek to record is whether an innovative practice such as the above can be experienced by students as a more pleasant and entertaining experience. An experience that serves the cognitive and learning goals of a unit but is at the same time free from negative elements contained in the traditional learning process, such as the absence of participation of some students, lack of motivation, anxiety, indifference and others.

Materials and Methods

Our research presents findings from the use of a digital Kahoot quiz for the evaluation and self-evaluation of 56 junior High School students in a computer science lesson in 2025. The quiz was solved in the school's computer lab. An interactive whiteboard was used to display the questions, while the laboratory computers were used for the students' answers. Its content concerns basic knowledge regarding the use of the repeat command in the creation of geometric constructions through the Scratch visual programming environment. The Kahoot digital quiz contains basic gamification elements such as rewards, comments, completion time, participatory solving, final ranking, etc. During the implementation of the process, no technological problems were encountered that could arise from the low speed of the internet.

After completing the digital quiz, the students themselves evaluated the process by answering 12 questions in an electronic Google form to identify and record their degree of satisfaction with the course evaluation process through the digital quiz, the extent to which the process was referred to them as a more playful process rather than a traditional learning process, their motivation to achieve high performance, their intention to use such quizzes in other courses, etc.

After the introductory teaching of the concept of repetition through the creation of programs in Scratch and the deepening of the concept of repetition through appropriately structured activities for this purpose, the students visited the link of the kahoot.it website and solved the playful digital activity individually but while being present in a participatory group action among their classmates.

Initially, the home screen of the quiz was presented. The home screen shows its title given by the teacher, which is related to the section and the content of the questions (Figure 1). Students or players visit the kahoot.it page on their computers and enter the game pin.

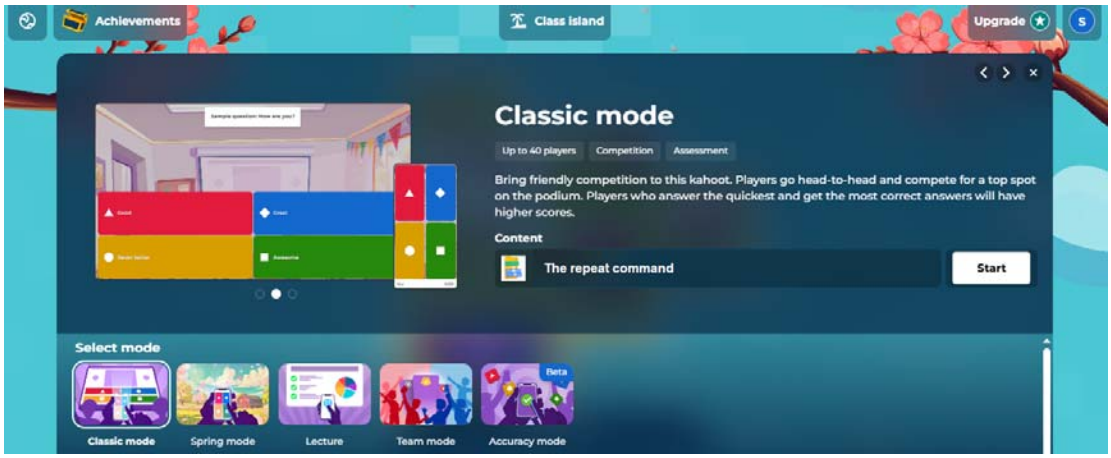

Figure 1. The home screen of the quiz

Then they are asked to create a nickname and choose their personal avatar from the kahoot application collection (Figure 2). The group of players is presented on the quiz screen shortly before the solving process begins. The questions are then presented sequentially.

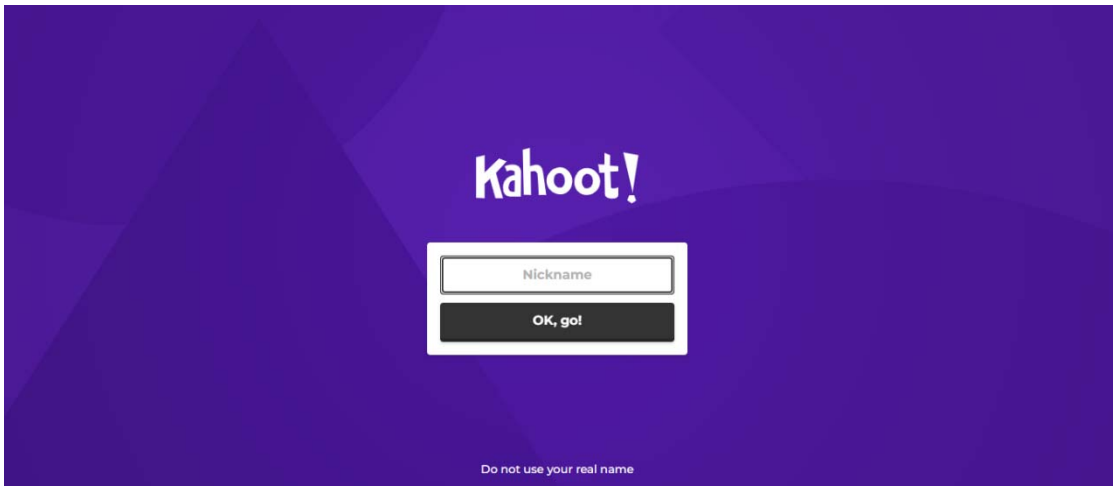

Figure 2.Players create their nicknames

Figure 3 shows a snapshot during the quiz solving process. As we can see in the figure, after each question, each player is presented with the points he earned in case of success. A corresponding message is also displayed in case of an incorrect answer, which contributes to the self-assessment of each student.

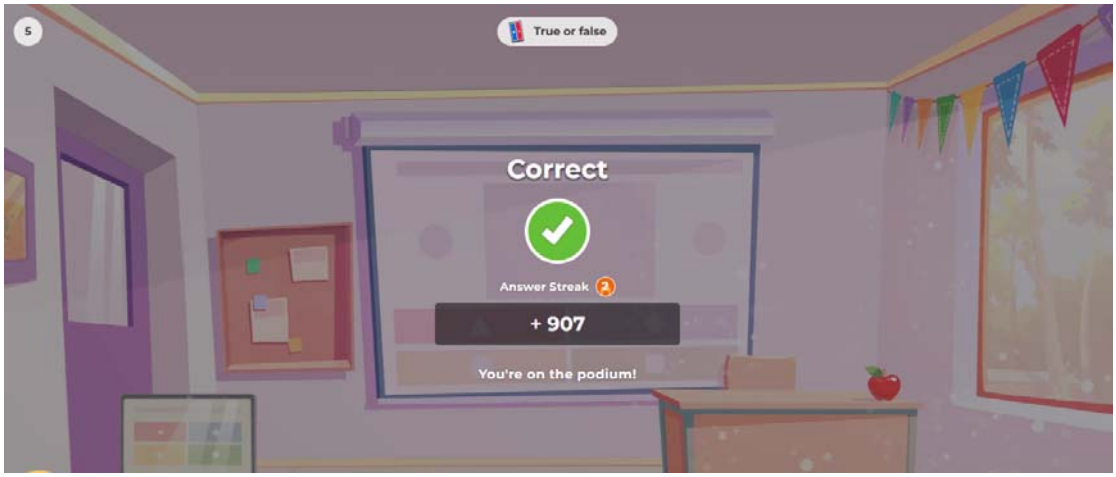

Figure 3. Individual points earned from a student after their correct answer

After completing each question, a graph is displayed with the number of total correct and incorrect questions by all players, which helps each student to see the level of their knowledge in relation to the entire class and the teacher to see the degree of acquisition of new knowledge by his/her students.

After the end of each question, the overall ranking of the group of players is presented in combination with the speed of the answer. The continuous rotation of positions as well as some messages from Kahoot regarding the performance of individual players that are presented to the entire class activate the players' motivation to become better in order to improve their position. Finally, the winners' podium with students' animation is shown, as well as the players who came close to making it to the podium. Note that kahoot allows the teacher to create classes that solve each quiz.

Following the process after completing the quiz, students answered an electronic Google form anonymously and individually in order to submit and record their assessment of the entire process and the degree of acceptance of the digital quiz in learning progress.

Evaluation and results

The procedure for completing the electronic questionnaire is then presented and the statistical results are recorded. Regarding the axes of the questionnaire, there was an introductory section that explained the purpose of the research, information regarding the protection of the anonymity of the respondents and then the questions on the topic under investigation. The scale used allowed the participants to express their degree of agreement or disagreement with each question. Most multiple-choice questions had the options Not at all, Moderate, Quite, Much, Very much.

Regarding the validity of the questionnaire, the wording of the questions is adapted and understandable to junior high school students. The selection of the sample is objective as all the students who participated in the process have responded. The number of respondents is satisfactory for drawing safe conclusions that reflect the reality of the school classrooms. The answers of the questionnaire are presented in detail in the research part of this work.

Regarding the reliability of the research, it is high as students participated in the playful process in groups and evaluated it immediately after its completion. This fact indicates that the students' experience was recent and thus their answers were spontaneous and objective. Also, high homogeneity was observed in the students' answers by groups, which indicates greater reliability in drawing the conclusions of the research.

Regarding ethical issues, the participants took part in the process within the context of teaching Informatics courses and voluntarily answered the evaluation questionnaire. The answers were recorded anonymously and the personal data of the participants were

protected. It was made clear that the findings of the research are used for educational purposes only.

The diagrams and statistical analysis of the students' responses are then presented. More specifically, Figure 4 shows their degree of satisfaction with the use of the quiz in the assessment of new knowledge. The vast majority (a total of 89.2%) find the use of the quiz in knowledge assessment Much and Very much satisfactory.

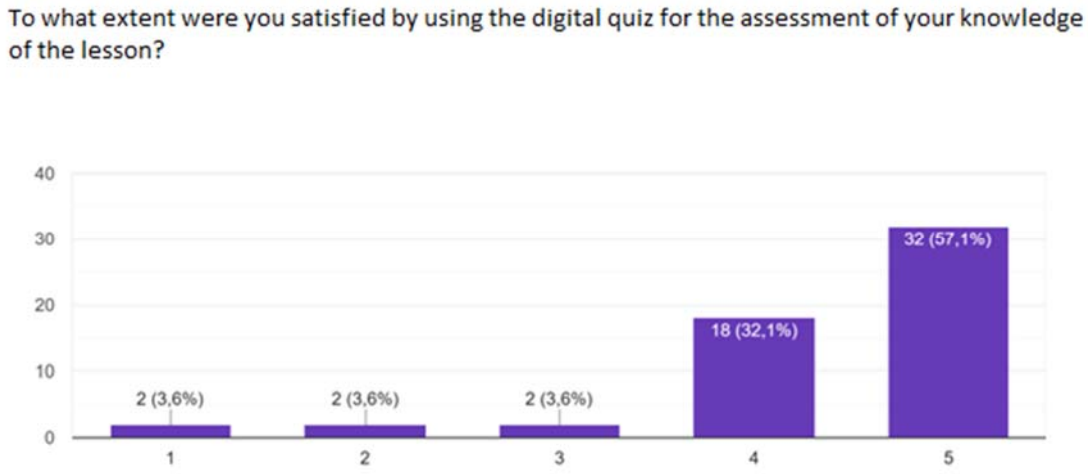

Figure 4. The degree of student satisfaction from the use of the quiz in assessing new knowledge

Figure 5 shows the extent to which the process of answering the digital quiz seemed to students funnier and more playful than the traditional lesson. A large percentage, 85.7%, found that the entire process referred to a Much and Very Much extent to a game process.

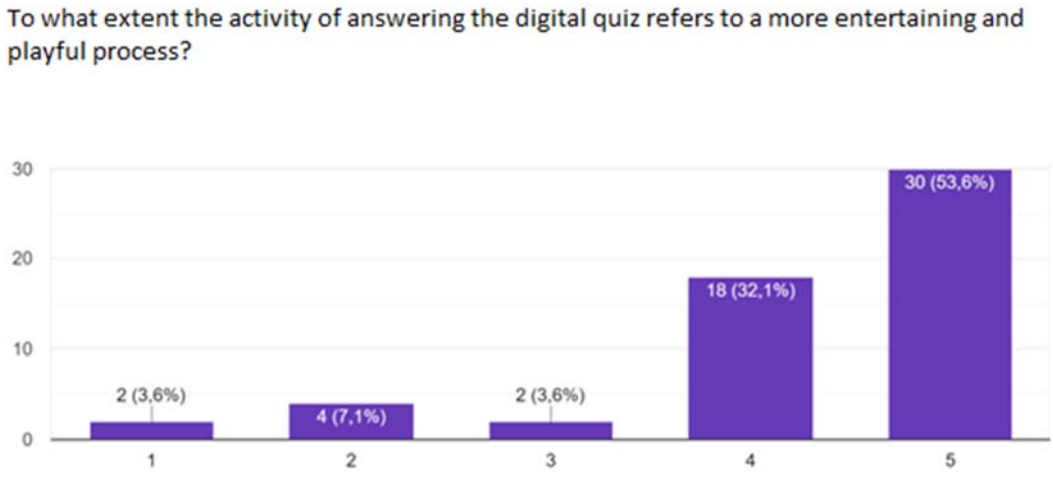

Figure 5. The acceptance of the activity as a playful process

Figure6 shows a graphical pie chart with the emotions that were created in the students throughout the process. It is important that half of them felt anguish while only 10.7% felt stress. A fairly large percentage of the students felt competition and curiosity.

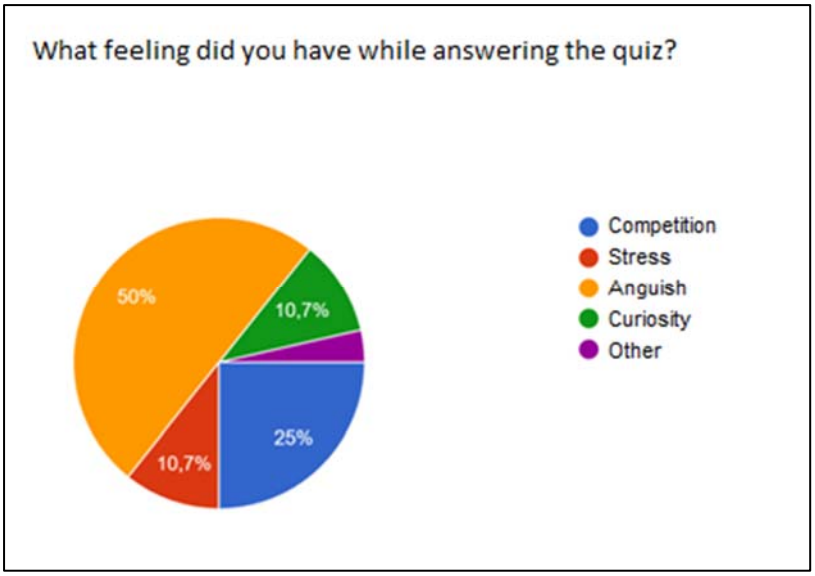

Figure 6. The emotions during the process

When students were asked whether they considered the existence of a time limit for answering each question to be positive or negative, 85.7% considered the existence of a time limit to be positive.

Figure 7 presents findings regarding the activation of students' motivation by the digital quiz. It depicts the respondents' opinion on whether the fact that if they answer correctly and quickly, they will earn more points makes them want to try answering the quiz again in order to collect more points this time. The 82.1% say that to a Much and to a Very Much extent, they would like to answer the quiz again in order to collect more points this time.

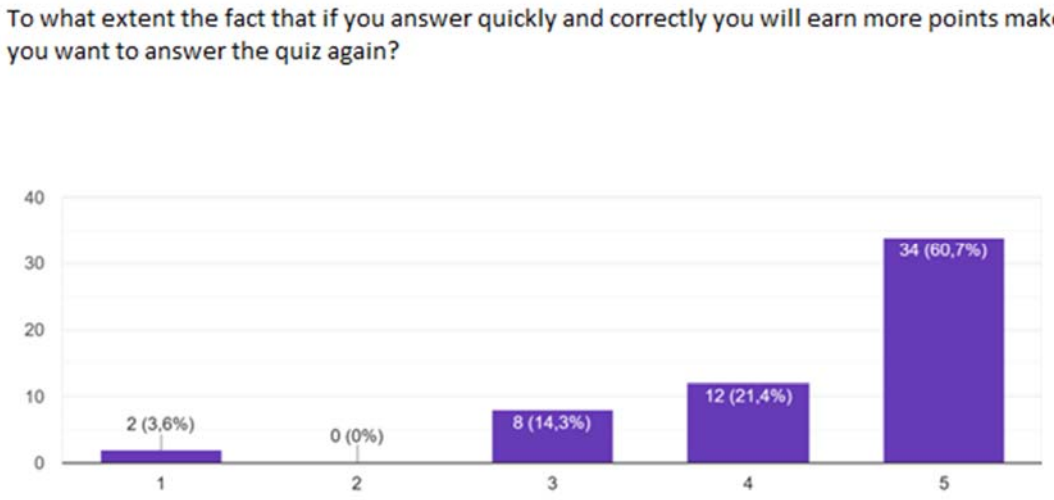

Figure 7. Repetition of the quiz due to the fact that if they answer correctly and quickly they will earn more points.

By recording the extent to which solving the quiz activates students' motivations to want to accumulate more points, more points than their classmates, and to win first place, we observe that their motivations in all three cases are activated to a Much and Very much degree at high percentages such as 82.1%, 89.2% and 82.2% respectively.

The following figures presents additional statistical pie charts related to the technical capabilities provided by Kahoot as well as the possibility of extending the use of digital quizzes

in the learning process. More specifically, in Figure 8, respondents evaluate the operation of the application that shows a player the points he earns immediately after each correct answer. Approximately nine out of ten find positive the fact that they learn immediately if they answer correctly positive.

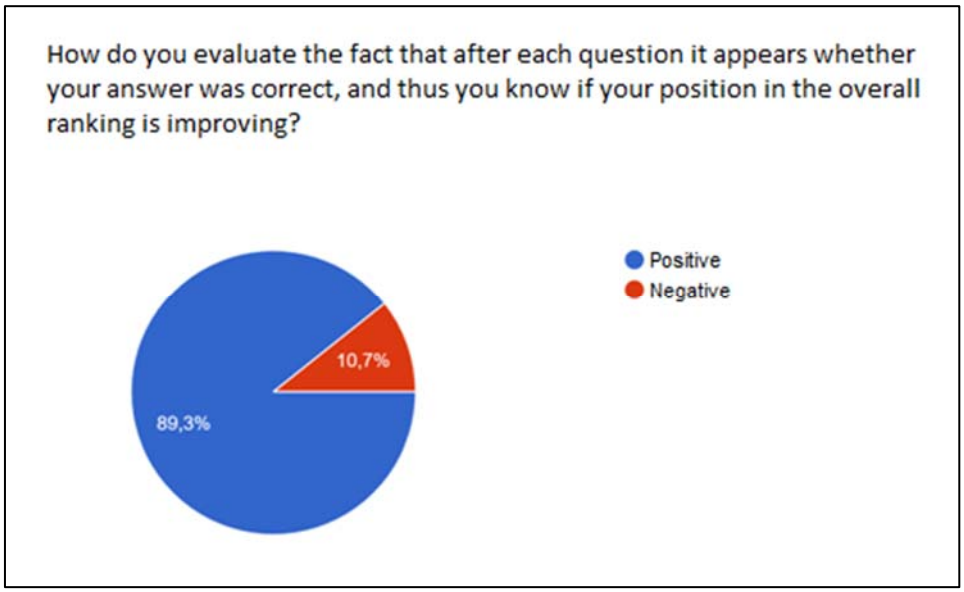

Figure 8. Immediate display of points for each respondent

It is also observed that 92.9% consider it positive that there is the possibility for someone to answer the quiz under a pseudonym, in order to maintain their anonymity.

A very large percentage of respondents (89.3%) in Figure 9 state that they would find it interesting to use similar quizzes in the assessment of knowledge in other courses.

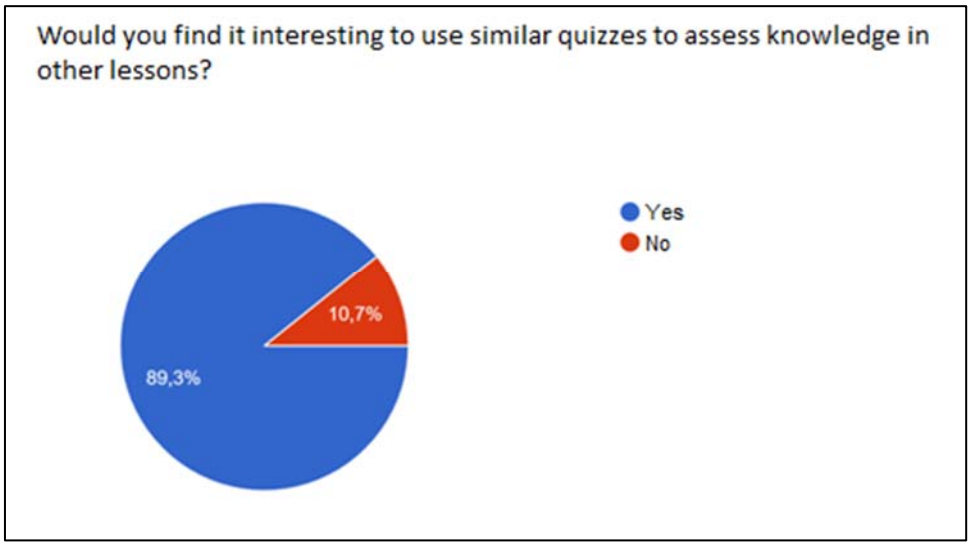

Figure 9.Using quizzes in other lessons

Analysis and discussion

What is recorded after the evaluation of the process by the respondents is that the acceptance of alternative ways of assessing knowledge in a teaching unit, for example through kahoot quizzes, is particularly popular. This is largely contributed by the fact that the process

refers to a game and is more enjoyable and funnier for students. Procedures that students are used to following in a positive way, such as games, are the goal of educational policies for their integration into the classroom, as their acceptance by students also means acceptance of the educational process in general.

It is also important that such playful procedures do not create anxiety in students, but anguish, competition, curiosity and other emotions that they usually feel when playing. This fact seems to be led by the fact that there is a time limit for someone to answer a question. Besides, as emphasized by Alsswey & Malak (2024) overall, a significant reduction in stress symptoms was observed after using the games.

The fact that if someone answers correctly and quickly, accumulate more points is considered positive by students. Students' motivation seems to be largely activated to accumulate more individual points by answering the quiz again, which indirectly leads to a repetition of the key concepts of the unit.

However, competition is also stimulated as the process is not only individual but also participatory since the kahoot quiz is completed with all the students in the class. This is also demonstrated by the fact that the students' motivation is activated to accumulate more points than their classmates and to manage to take first place at some point. We conclude from the above that the involvement of all students in the lesson is stimulated as they now have clear individual goals.

Besides, as emphasized by Nair (2022) the elements of role-playing and competition add an engaging dimension that, when implemented correctly, makes learning more efficient and enjoyable. Fun enhances motivation, which has a decisive effect on what people learn, as well as how much of them they manage to memorize. If the process is enjoyable, students will maintain their curiosity and return for more knowledge.

A key factor in the acceptance of the integration of digital quizzes in learning is the fact that they receive immediate feedback from the application in case they answer correctly or incorrectly, as well as being informed about the points they earn from their general ranking. The correct answer here also brings a reward for a student which is required to encourage students. What teachers should be concerned with here is to include questions of various difficulty levels so that all students can succeed and be rewarded according to their knowledge. This way, the process, beyond being participatory, also acquires a personalized character.

Obviously,the fact that the students are given the possibility of participation using a pseudonym and an avatar, removes the fear of failure from the process since only they know their general ranking and only if they wish, they reveal their identity perhaps at the end of the process and after getting a good ranking or even a position on the podium. The points that students accumulate and their performance also help teachers evaluate the degree of assimilation of knowledge by their students and the degree of success of their lesson.

At a learning level, the kahoot quizzes can be used again and again by students to repeat basic concepts of a unit. They can also be used in other courses that do not have such a modern technological profile such as the more theoretical courses. After all, most classrooms have an interactive whiteboard with an internet connection and every teacher can use the school's computer lab to do their lesson, whatever it may be.

However, the existence of only one IT laboratory can be limiting for the generalized use of similar activities in all subjects. At the same time, responsible teachers should know how to design and use quizzes with pedagogical criteria and how to guide students in their response process.

Looking the future, some challenges of using gamification in the classroom should also be explored. For example, incorporating game elements into educational materials can have negative consequences for students, such as distracting them from the game elements (Alt, 2023). Future research should determine the optimal combination of traditional and gamified

methods in order to improve learning while maintaining critical thinking and decision-making skills (Kim et al., 2024).

Conclusion

In conclusion, our research records the acceptance of modern methods that incorporate elements of gamification in the assessment and self-assessment of knowledge of students. A more relaxed and pleasant environment in the classroom helps students feel less negative emotions that they usually experience in the traditional classroom. After all, basic elements of games such as rewarding, collecting points, ranking, etc. activate motivations, interests and consequently the involvement of students in the lesson. However, teachers must design quiz questions with learning criteria that engage students of all levels and ultimately serve the objectives of learning.

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Meta-learning for students: The ultimate skill to becoming independent lifelong learners in the era of technology and AI. An application in Mathematics

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Papadaki Maria
Mathematician, Int. Master, MSc | PhD c. at NTUA | Maths Teacher at Secondary Education
maria.papadaki.ntua@gmail.com

Abstract

In this article, the way students learn and the meta-learning skills and techniques needed for them to become independent lifelong learners in 2025 are being studied. Some of these meta-learning techniques are priming, mind maps and effective note-taking. It is important to understand that, from the one side, the way our brains like or, in other words, tend to learn has been thoroughly studied and understood during the past years and different meta-learning mental models have gradually emerged. On the other side, the new framework of today's life due to the rise of technology and artificial intelligence (AI), with several chatbots such as ChatGPT, has inevitably inserted more perplexity in the aforementioned issue. In this new setting, according to the scientific community in the specific education field, meta-learning techniques are the ultimate key to enabling students to take the initiative of their learning, to pursue learning experiences that transform their lives and finally to acquire more conscious, self-directed as well as self-motivated learning. Lastly, an application of the aforementioned meta-learning techniques in Mathematics is presented, regarding the resolution of first-degree linear equations, in order to implement these techniques in real learning circumstances. The specific mathematics application was used by a first-year student of Greek upper secondary school (A Lyceum), under the researcher's guidance, in order to resolve a specific first-degree linear equation. Our case study indicated that the procedure proposed in the application had positive results to the student's level of understanding and self-motivation.

Keywords: meta-learning, priming, mind maps, effective note-taking, AI, ChatGPT

Introduction

Aristotle had said that the desire of human beings to learn constitutes a natural tendency. However, it is quite often that students complain that the way they are called to learn in school does not motivate them, or even causes difficulties, obstacles and finally problems to their learning. This fact, in turn, makes students feel that they cannot sufficiently take the control of their learning process, something that ends in students' loss of desire to study, to learn and to get accustomed to constantly expanding their learning horizons while simultaneously feeling pleased and joyful within the learning process (Drigas et al., 2023).

In order students to become independent lifelong learners in their adult lives after school, it is essential for them to understand the way their minds like or tend to learn and how the learning process itself takes place indeed. This is the so-called "meta-learning skill", i.e. the skill of metacognition of learning (Biggs, 1985; Jackson 2004). It is essential to state that there is much debate regarding the term of meta-learning, among the researchers nowadays (Lemke et al., 2015). The definition that is the most cited in literature and encompasses all the following definitions is the one of Biggs (1985), where meta-learning is described as the state where someone is aware of and takes control of their own learning (Biggs, 1985).

In fact, meta-learning techniques enable students not only to become more aware of the learning process itself but also to learn effectively to choose the appropriate and effective study techniques that foster the mind's functioning during the learning process (Biggs, 1985;

Jackson 2004). In other words, meta-learning refers to "*a set of mental meta-processes by which learners consciously create and manage personal models of learning*" (Drigas et al., 2023) and is also known as "learning to learn" (Wang, 2021).

It is essential to recognize that the terms metacognition, meta-learning, and meta-learning strategies are often used interchangeably, leading to potential conceptual ambiguity. Metacognition refers to the awareness and regulation of one's own cognitive processes, encompassing both knowledge about cognition and the ability to control learning activities (Flavell, 1979). Meta-learning, while related, specifically denotes the process through which learners become aware of and manage their learning strategies, adapting them as needed across different contexts (Pintrich, 2002). Meta-learning strategies, in turn, are the concrete methods or techniques employed by learners to regulate their cognitive processes effectively and optimize learning outcomes (Pintrich, 2002). Thus, metacognition provides the overarching framework of self-awareness in cognition, meta-learning focuses on the adaptive regulation of learning itself and meta-learning strategies represent the actionable tools applied within this regulation (Flavell, 1979; Pintrich, 2002).

Finally, it is undeniable that contemporary student learning paradigms have undergone a profound transformation, largely driven by advancements in technology and the emergence of Artificial Intelligence (AI). Indeed, not only the way students learn has changed but also the skills needed during the learning process have also changed in comparison to the ones that were needed in the past years. Currently, smart technologies and AI have altered the learning's conditions and have given students the opportunity to pursue transformative learning experiences which are more conscious, self-directed and self-motivated (Drigas et al., 2023).

Meta-learning techniques for students

Priming

Priming is the technique through which the student's prior knowledge on a subject is linked to the new knowledge that is going to be acquired by them on the same subject. It is also known as pre-conditioning and it constitutes the core meta-learning technique which focuses on the learner's existing knowledge and also how to trigger their attention mechanism (Qin et al., 2021).

Indeed, it is a fact that priming has been used, in terms of meta-learning techniques, for catching the learner's attention. Indeed, prior knowledge gives the student the opportunity to perform in higher level of representations using their attention mechanism, to reduce their cognition burden and finally to successfully focus on the elements that are essential for deep understanding of the new knowledge (Qin et al., 2021). Apart from fostering knowledge acquisition and attention, it has been found that priming also can be a predictor of the learner's performance. Specifically, the prior knowledge on a field is positively correlated to the knowledge gains on the same field (Simonsmeier et al., 2021).

The use of priming in learning has been studied in various fields such as the linguistics field. More precisely, the syntactic priming is a methodology where students learn grammar and specifically syntax by using prior knowledge on the same. The procedure of recognizing the presence of syntactic knowledge fosters learning new grammar phenomena. It is important to state that, according to Kumarage et al. (2024), who conducted a meta-analysis of syntactic priming studies in children, it has been found that there was a medium-to-large syntactic priming effect (Kumarage et al., 2024).

Not only in linguistics, but also in mathematics, the learner's prior knowledge on a mathematical topic is of utmost importance. It has been known that effective teaching of any mathematical concept has to take the learner's prior knowledge in consideration and build up from there (Foster, 2021).

However, it is important to understand that priming has to be used appropriately as it can become an obstacle to the learning process, under some circumstances. For instance, in cases when the learner has misunderstood or learned something in the wrong way in the past, then this wrong or misunderstood part of "knowledge" can inhibit the learning process (Foster, 2021; Kumarage et al., 2024).

Also, in case the learner has prior knowledge to a mathematical problem, this can cause difficulties in problem solving, as the learner no longer perceives the problem as new and they just apply the solving techniques they already know, even when these are incorrect or inappropriate (Foster, 2021; Kumarage et al., 2024).

In order to overcome the latter problem, the teacher can either discuss the misunderstood linguistics concept or ask the students whether they remember an approach for solving the specific mathematical problem giving emphasis on the assumptions of the approach and whether these are fulfilled, rather than focusing on a specific solving method. By this, the students approach the new knowledge in a correct way and they use their prior knowledge on their advantage (Foster, 2021; Kumarage et al., 2024).

Mind maps

Mind maps are a meta-learning technique which enables learners to construct conceptual understandings of the knowledge. Specifically, a mind map is a dynamic visual tool that gives the learner the opportunity to organize the ideas or the learning material and to create dynamic links between and among ideas or concepts in a non-linear way. This representation, in turn, enables the learner to use their personal connections, as well as their experiences, and creativity, in a way that the learning process becomes meaningful for them (Abi-El-Mona & Adb-El-Khalick, 2008; Jones et al., 2012).

The way the mind maps are organized is hierarchical, which in turn means that the main concepts are placed in the main branches of the mind map structure and the other concepts are grouped in the next levels of the "tree" as being the details of the main concepts (Hidayati et al., 2023). Moreover, these representations not only link different ideas and concepts, but they also build hierarchical relationships among concepts, as mentioned above, all of which are of great importance in learning (Abi-El-Mona & Adb-El-Khalick, 2008).

The way that mind maps work is through taking information from several sources and integrate them into a dynamic visual representation by using keywords in a bright, colorful, vivid and creative manner that keeps the mind interested and active (Edwards & Cooper, 2010; Hariyadi et al., 2023).

It is important to mention that the traditional mind maps are drawn by hand but they can also be digital, known as electronic mind maps (e-mind maps), due to the emergence of specialized software, something that makes students be more active in creating the visual representations of the concepts and take the initiative of their learning process (Hidayati et al., 2023; Mohaidat, 2018). According to the experts, the e-mind maps are more efficient in the field of education than the traditional mind maps, as the e-mind maps are more attractive to the learners and include graphics (Mohaidat, 2018). There exist nowadays a lot of applications on mind maps' creation by their user, such as the mindmup application (at https://app.mindmup.com).

It is worth noting that the visual representations, that are created in mind maps, are student-created and they foster the long-term retention of information, they increase the comprehension of text, and also the link between and among the different ideas and concepts (Hidayati et al., 2023). This meta-learning technique is effective in improving the students' cognitive processes as well as their long-term memory of facts (Mohaidat, 2018).

It is well known among the researchers that mind maps are effective meta-learning techniques for learning written material. The specific meta-learning technique can be used in a lot of ways. First, mind maps can be used as an effective note-taking method. Second, they can be used as a problem-solving technique as well as a prompt or even as a revision tool.

Finally, mind maps are an excellent tool for engaging students and making them involve in the learning process by enabling them to express their ideas and then encompass them on the mind map (Edwards & Cooper, 2010; Hariyadi et al., 2023). Mind maps have been shown to enhance students' motivation, engagement, imagination, and creativity (Hariyadi et al., 2023), while also contributing to improved academic performance, even among lower-achieving students (Jones et al., 2012; Mohaidat, 2018).

Apart from learning written material, the mind maps constitute a meta-learning technique that can be used effectively in the STEM (Science, Technology, Engineering, Mathematics) field, as it has been known among the researchers that it enables students to foster their critical thinking skills as well as their problem-solving skills and even improve their science literacy (Hariyadi et al., 2023).

Effective note-taking

It is a fact that note-taking is considered by educators to be a critical part of learning in formal classroom settings. The results from the previous research have shown that students who take more course notes during the lectures at school achieve higher grades. However, the way the notes must be taken or even their real effectiveness has been an open research topic, among the experts on the field. No one can deny that note-taking is totally personalized as a task. The latter means that note-taking inevitably depends on the individual differences of every student which makes its study more complicated (Stacy & Cain, 2015).

However, there is always the challenge, for students, to keep effective notes from the lecture. More precisely, it is very demanding for the students to record all the vital information and concepts in an accurate way. In order for students to keep accurate notes that represent all essentials points of the lecture, they need a lot of skills· cognitive skills, information processing skills, information encoding into notes format, sufficient working memory, critical thinking skills, active listening and writing skills (Salame & Thompson, 2020; Stacy & Cain, 2015). It is a fact that training students on how they can take systematic and effective notes can become very helpful for them in encoding and thus studying large amounts of learning content (Stacy & Cain, 2015).

Especially for encoding, it is important to mention that it refers to the procedure during which the information is translated, organized and stored for future use, in the form of notes. The encoding process is a process that has been studied thoroughly by the experts on the field. One point that many researchers have reached to is that students who used note-taking while attending a lecture and then studied their own notes had a better performance than students who did not use the note-taking technique during their attending the lecture, even when they were provided with the educator's notes of the lecture (Beck, 2014). So, it becomes clear that note-taking is a meta-learning technique which is beneficial for students and also fosters their performance (Beck, 2014; Salame & Thompson, 2020).

Technology, Artificial Intelligence (AI) and ChatGPT

The researchers, nowadays, have pointed out that the way students learn, as well as what they learn and, also, the skills required for them during the learning process, have changed dramatically and are even to be transformed radically in the years to come. More precisely, the technology is changing all the conditions of the learning process for students, as it has already come into the specific field. It is important to mention that, according to the experts, technology is able to provide students with new opportunities in order for them to enjoy transformative learning experiences, as well as more conscious, self-directed and self-motivated learning, as also mentioned in the introductory section of this article and in fact revolutionize the whole field of education (Drigas et al., 2023; Singh, 2023).

First of all, the access to information comes without limits for students nowadays, something that in turn comes with both advantages and disadvantages. From one side, the limitless access to information provides students with the opportunity to adjust their learning

to their personal pace of learning, their personal learning style and to align the learning material with their individual needs and specific learning goals. From the other side, the information that is available through technology can become overwhelming for students. It takes skills and concise strategies for students in order to harvest the opportunities of technology used in learning (Daniela, 2018; Drigas et al., 2023).

Moreover, the rise of AI has affected meta-learning techniques radically and vice versa. More analytically, neuroscience, through its mental models regarding the meta-learning techniques, offers unique insights to the AI community, while AI algorithms in turn offer neuroscience new tools to foster students' meta-learning skills (Wang, 2021). Also, large language models (LLMs) such as ChatGPT have given new perspectives in the students' learning process. Especially in mathematics, ChatGPT has been used for tasks involving logical and arithmetic reasoning, but not to a great extent so far (Taani & Alabidi, 2024).

No one can deny that mathematical problems are of crucial importance and also, they consist essential educational tools for the evaluation of the students' logical and problem-solving abilities. However, ChatGPT can assist students in automatically generating pre-university math questions and it is important to acknowledge that the model's performance depends greatly on both the instructional prompts given by its user and the mathematics' topic (Pham et al., 2024; Wardat et al., 2023). However, ChatGPT's performance has surpassed 80% accuracy in all primary fields of mathematics education (Taani & Alabidi, 2024).

It is also interesting that researchers during the past two years have pointed out that ChatGPT demonstrates potential for improving how students engage and understand material. Apart from that, it is important to highlight that chatbots, such as ChatGPT, are regarded as tools for fostering interactive e-learning environments, delivering immediate answers to common questions, and reducing teachers' burden of answering repetitive queries, as well as personalizing the learning material. In mathematics, ChatGPT could be used effectively in the flipped classroom setting of teaching (Taani & Alabidi, 2024).

Apart from the benefits that AI can bring to a lot of domains in the education field, it is important to state that there exist also concerns about its potential for misuse, particularly in relation to providing inappropriate or harmful safety-related information (Fugate et al., 2023). The ethical and regulatory challenges of chatbots, such as ChatGPT, especially regarding the dissemination of disinformation, are also highlighted by Glorin & Shaliet (2024). The integration of AI tools such as ChatGPT into educational contexts raises significant concerns regarding misinformation and ethics. One key issue is the generation of inaccurate or misleading information, often referred to as AI "hallucinations", which can negatively affect students' understanding and academic integrity (Yang et al., 2024). Additionally, ethical challenges related to data privacy, algorithmic bias, and the responsible use of student data highlight the need for carefully developed regulatory frameworks (Reiss, 2021).

Case study: Application in Mathematics. Resolution of the linear equation "2(3x–1) –2(2x–1) = 4"

In this section, we apply all the meta-learning techniques discussed in this paper as well as the AI's capabilities in crafting an application in mathematics and using it for a case study. More precisely, a first-year student of Greek upper secondary school (A Lyceum) was called to resolve a specific first-degree linear equation following specific steps in order for the meta-learning techniques to be implemented. The researcher and the student were present in the same physical location, using a personal computer with an internet connection. Under the guidance of the researcher, the student solved the equation in Microsoft Word, utilizing both the mindmup application and ChatGPT as supplementary tools. The entire procedure lasted approximately thirty minutes.

First of all, in accordance with the principles of priming, it was deemed essential to activate the student's prior knowledge before introducing the concept of first-degree linear equations and their solution methods. Specifically, the student first:

1) discussed simpler numeric balancing problems, such as “5 + x = 12, x a real number”, where the student was guided to recall the fundamental idea that an equation remains balanced when the same inverse operations are applied to both sides,
2) solved every day contextual problems, such as: "A number is doubled, and then 3 is added. The result is 11. What is the number?" which results in the formulation of a linear equation, in our example, 2x+3 = 11.
3) recalled the distributive property of multiplication over addition, for instance in case of 3(4x-2).

Secondly, the use of mind maps was proposed to facilitate the visual deconstruction and conceptual linking of the key elements within the mathematics topic under study. After encouraging the student to create a personal mind map in the mindmup application for the specific first-degree linear equation, ChatGPT was employed as a supplementary tool to facilitate further understanding and problem-solving. More precisely, ChatGPT was effectively prompted to reconstruct a visual mind map focused on the specific first-degree linear equation.

Regarding the effective note-taking meta-learning technique, throughout the entire learning process, the student was actively encouraged to take effective notes independently, which was divided into consecutive steps: identifying the linear equation, rewriting the equation isolating the unknown parameter “x” on one side of the equation (if applicable), performing all the necessary inverse operations which are applied to both sides in order to keep only “x” on the left side of the equation and, finally, solving and then checking the solution.

The entire step-by-step application described above was subsequently employed in the resolution of the linear equation “2(3x–1) –2(2x–1) = 4” and is presented below. In the following section, the application is presented in a general form, without reference to a specific equation, so that interested mathematics teachers may adapt and use it in their own real teaching contexts.

Resolution of the linear equation “2(3x–1) –2(2x–1) = 4”

Priming

Step 1: Solve the following equation: 5 + x = 12, x a real number.

x = 12 – 5

x = 7

Step 2: Solve the following problem, by identifying the correct first-degree linear equation:

“A number is doubled, and then 3 is added. The result is 11. What is the number?”

Let x be the requested number (variable).

2·x is the number when doubled.

2·x + 3 is the doubled number when 3 is added.

The result of 2·x + 3 is 11 which, in mathematics, means that it is equal to 11.

Thus, the first-degree linear equation which describes the given problem is:

2·x + 3 = 11 or simply 2x + 3 = 11.

Step 3: Use the distributive property of multiplication over addition for 3(4x-2).

3(4x – 2) = 3 · 4x – 3·2 = 12x – 6

Mind maps

Construct a mind map illustrating the resolution of the linear equation 2(3x–1) –2(2x–1) = 4, using the mindmup application (at https://app.mindmup.com).

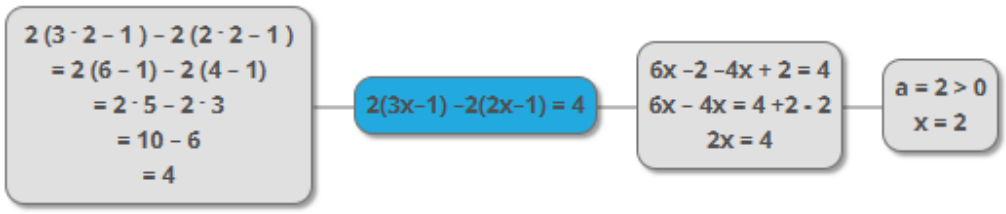

Figure 1: Mind map on the resolution of the linear equation 2(3x-1)-2(2x-1) = 4, using the mindmup application (at https://app.mindmup.com).

ChatGPT

Provide ChatGPT with the prompt: "Can you give me a visual mind map on the resolution of the first-degree linear equation 2(3x–1) –2(2x–1) = 4*?" and then paste its response.*

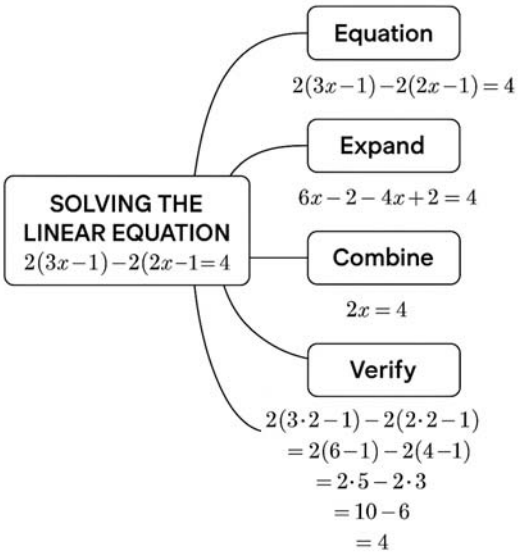

Figure 2: Mind map on the resolution of the linear equation 2(3x–1) –2(2x–1) = 4, using ChatGPT.

Effective note-taking

Step 1: Problem – Identify the equation:

2(3x–1)–2(2x–1) = 4

Step 2: Rewrite the equation (if applicable), with the goal to isolate "x" on one side of the equation.

2(3x–1)-2(2x–1) = 4

6x – 2 – 4x + 2 = 4

6x – 4x = 4 + 2 – 2

2x = 4

Step 3: Perform all the necessary inverse operations, which are applied to both sides of the equation, in order to keep only "x" on the left side of the equation.

$x = \frac{4}{2}$

Step 4: Solve the equation.

x = 2

Step 5: Check the solution.

2 (3 · 2 – 1) – 2 (2 · 2 – 1) = 2 (6 – 1) – 2 (4 – 1) = 2 · 5 – 2 · 3 = 10 – 6 = 4 ✓

The mathematics application on the resolution of first-degree equations

Priming

Step 1: Solve the following equation: ……, x a real number.

_____

_____

Step 2: Solve the following problem, by identifying the correct first-degree linear equation: .....

_____

_____

Mind maps

Construct a mind map on the resolution of the linear equation ……., using the mindmup application (at https://app.mindmup.com).

_____

_____

ChatGPT

Provide ChatGPT with the prompt: "*Can you give me a visual mind map on the resolution of the first-degree linear equation ……..?*" and then paste its response.

_____

_____

Effective notetaking

Step 1: Problem – Identify the equation:

_____

_____

Step 2: Rewrite the equation (if applicable), with the goal to isolate "x" on one side of the equation.

_____

_____

Step 3: Perform all the necessary inverse operations, which are applied to both sides of the equation, in order to keep only "x" on the left side of the equation.

_____

_____

Step 4: Solve the equation.

_____

_____

Step 5: Check the solution.

_____

_____

Conclusion

In this article, meta-learning techniques have been studied in terms of their significance on the way students learn and how they could foster their learning procedure enabling them to become self-directed lifelong learners. The processes by which the human mind acquires knowledge have been extensively studied in recent years and several mental models have been created based on neuroscience (Biggs, 1985; Jackson, 2004; Wang, 2021).

More precisely, in this article meta-learning techniques such as priming, mind maps and effective note-taking have been extensively studied. Priming is a meta-learning technique that links a student's existing knowledge of a subject to the new knowledge they are expected to gain in that domain. This is a technique which triggers the student's attention mechanism, catches the student's attention and enables the student to focus on the essential parts and achieve deep learning, while their cognition burden reduces. It is a fact that the student's prior knowledge on a subject is positively correlated to the knowledge gains on the same subject

and also to better learning performance. The priming meta-learning technique has been used in many areas, such as linguistics and mathematics, with important gains for the students, when used appropriately and on their advantage (Foster, 2021; Qin et al., 2021; Kumarage et al., 2024; Simonsmeier et al., 2021).

Mind maps is another meta-learning technique that has been studied in this article. The specific meta-learning technique gives students the opportunity to understand conceptually the new knowledge by creating a visual representation of the ideas and/or concepts as well as all the links between them, in a way that keeps them active, creative and engaged. Through a visual representation that resembles a tree, where the main concepts are placed in the main branches and then next levels as being the secondary branches, students understand the new learning material, build hierarchical relationships between its concepts, keep it in their long-term memory. In contemporary educational settings, students have access to a variety of digital tools and techniques to construct electronic mind maps· either by using chatbots e.g. ChatGPT or free online applications such as the mindmup application (at https://app.mindmup.com) [Abi-El-Mona & Adb-El-Khalick, 2008; Edwards & Cooper, 2010; Hariyadi et al., 2023; Jones et al., 2012; Mohaidat, 2018].

Effective note-taking is another effective meta-learning technique. Mind maps may also be considered a form of structured note-taking (Edwards & Cooper, 2010; Hariyadi et al., 2023). Note-taking constitutes a meta-learning technique that is considered crucial in formal educational environments, as it involves the real-time encoding of newly presented information by students. Empirical studies have found a positive correlation between effective note-taking and higher grades. However, the task of accurately capturing all critical information and conceptual content can be cognitively demanding for students. In order students to keep accurate notes that represent all essentials points of the lecture, they need a lot of skills· cognitive skills, information processing skills, information encoding into notes format, sufficient working memory, critical thinking skills, active listening and writing skills (Salame & Thompson, 2020; Stacy & Cain, 2015). Research findings indicate that students require explicit training to develop the skills necessary for effective note-taking during the learning process (Beck, 2014; Salame & Thompson, 2020).

Apart from the most essential meta-learning techniques that have been studied in this article, it is important to mention that technology and AI have transformed radically the students' whole learning process and revolutionized the whole field of education. The advent of advanced technologies and AI within the educational landscape has profoundly transformed pedagogical approaches, empowering students to engage in deep, transformative learning experiences. This paradigm shift supports the cultivation of heightened metacognitive awareness, fostering autonomous, self-regulated, and intrinsically motivated learners (Drigas et al., 2023; Singh, 2023). First of all, the access to information comes without limits for students nowadays, something that in turn simultaneously offers numerous opportunities and poses distinct challenges (Daniela, 2018; Drigas et al., 2023). Especially in mathematics, chatbots, such as ChatGPT, have been used for tasks involving logical and arithmetic reasoning, but not to a great extent so far. More precisely, ChatGPT can assist students by automatically generating pre-university math questions. However, it is important to note that the model's performance depends significantly on both the quality of the instructional prompts provided by the user and the specific mathematics topic. Nevertheless, its accuracy can exceed 80% under optimal conditions (Pham et al., 2024; Taani & Alabidi, 2024; Wardat et al., 2023). Lastly, chatbots such as ChatGPT, are regarded as tools for fostering interactive e-learning environments, delivering immediate answers to common questions, and reducing teachers' burden of answering repetitive queries, as well as personalizing the learning material. Within the context of mathematics education, ChatGPT has the potential to be employed as a supportive tool in flipped classroom settings, facilitating student-centered and self-paced learning (Taani & Alabidi, 2024).

Finally, the present study integrates the meta-learning techniques investigated, together with technological and AI tools, into an applied framework in mathematics education, specifically addressing the solution of first-degree equations. More precisely, the mathematics application was initially used for the case of the first-degree linear equation "2(3x–1) –2(2x–1) = 4". The specific application was employed in a case study involving a student from the Greek upper secondary education level (A Lyceum), who was tasked with solving the aforementioned first-degree linear equation. Throughout this application, all procedural steps were presented with conceptual clarity. Subsequently, the application has been made available in a generalized form, without restriction to a specific equation, allowing interested mathematics teachers to adapt and implement it within their own authentic teaching contexts. Although the mathematics topic addressed is relatively straightforward, the key objective is for interested mathematics teachers to grasp the application of meta-learning techniques and employ them in the instruction of more complex mathematical concepts.

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Collaborative Decision-Making in Primary Education: The Symbiosis of AI and School Leadership

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Raptis Nikolaos
Assistant Professor, Aegean University, Greece
nraptis@rhodes.aegean.gr

Psyrras Nikolaos
PhD Candidate, Aegean University, Greece
psed24012@aegean.gr

Koutsourai Sevasmia Aikaterini
PhD Candidate, Aegean University, Greece
koutsourai@sch.gr

Abstract

The study explores school leaders' attitudes and perceptions regarding the role of artificial intelligence in decision-making within primary education, focusing on how AI is understood and evaluated across key dimensions. A quantitative survey was conducted among 238 public primary school leaders in the South Aegean region (Cyclades and Dodecanese) using simple random sampling. Data were analyzed through descriptive statistics, Mann-Whitney U test, and reliability analysis. Participants showed positive views on AI in automation, data analysis, and predictive assessment. Gender-based differences appeared in levels of agreement and neutrality. Human judgment remains central in complex decisions. Findings are limited to one regional context; broader and mixed-method research is recommended. The research highlights the need for better AI training and ethical governance in school leadership, providing new evidence on how AI in decision-making is perceived by school leaders in a localized educational context.

Keywords: School leadership, Artificial intelligence, Decision-making, Primary education

Introduction

School leadership and artificial intelligence (AI) are two areas that are increasingly combining to improve the quality of education and the management of educational institutions. The combination of these two areas can offer significant opportunities and challenges. In particular, artificial intelligence (AI) is one of the most powerful tools that can transform school leadership, management, and other educational organizations. Combining AI with school leadership can lead to improved strategies, more effective management, and a more personalized and targeted educational experience (Anas, 2025).

Artificial intelligence has been actively integrated into the field of education in recent years through the use of various technological applications. These include intelligent tutoring systems, adaptive learning platforms, dynamic assessment models, predictive modelling, predictive analytics, learning analytics, and educational games using virtual and augmented reality (Ramirez & Esparrell, 2024). In addition, new forms of AI-enhanced teaching are constantly being developed to personalize the learning experience and enhance educational effectiveness (Guan et al., 2025).

The application of Artificial Intelligence (AI) in school leadership has highlighted significant developments in school administration, enhancing operational efficiency, reshaping administrative processes, and improving decision-making (Fullan et al., 2024; Karakose & Tülübas, 2024). AI-based solutions offer school leaders high-tech tools to analyze student

data, allocate resources more efficiently, and support strategic interventions based on scientific evidence (Khairullah et al., 2025).

Recent developments in big data and analytical learning have become integral components of modern education policies, playing a crucial role in enhancing educational efficiency and informing strategic decision-making (Dai et al., 2024). The application of learning analytics, also known as educational data mining, enables the systematic collection and monitoring of data generated from students' educational activities, allowing for the identification of trends and the taking of corrective or proactive, data-driven actions. This ability to analyze learning progress allows school leaders to monitor students' learning outcomes through AI and provide timely, targeted instructions to teachers, enabling them to tailor instruction to each student's individual needs (Richardson et al., 2021).

Collaborative decision-making in School Leadership

Wang (2021) asserts that the key component of school leadership is decision-making. More precisely, individual leaders' choices and those of the organization's members who are influenced and under the principal's authority are what primarily shape leadership in education. Leaders make decisions based on a variety of factors, including social influence, data and information available at the time of the decision, personal preferences, and core values (Putri et al., 2024). Furthermore, organizational outcomes like learning outcomes, school performance, and staff job satisfaction are influenced by the behavioural patterns of school leaders, which are conceptualized as leadership styles.

For many reasons, including time, expertise, and the inherent limitations of educational policies, school principals are not always in a position to make all of the decisions in the organization by themselves. In that case, school leaders can empower other people in the organization and make decisions collaboratively to create decision-making to a higher order of thinking (Hao et al., 2024). That is, recognizing the responsibility to delegate authority for participatory decision making can be in direct contradiction to one's fundamental psychological needs for independence, control, and power (Lammers et al., 2016). To empower members of an organization to make high-quality decisions, leaders must identify the limits of their own need for independence, control, and power (Song et al., 2025). Furthermore, individual decision-making and quality decision-making are inextricably linked (Kozioł-Nadolna & Beyer, 2021). Once one is aware of the deliberative nature of decision-making in school leadership, their thinking can progress by considering how AI connects with school leaders' decision-making (Pawar & Dhumal, 2024).

AI and decision-making

One of the key areas where AI can have a positive impact on the school context is data analysis for decision-making. According to Al-Bayed et al. (2024), AI allows school leaders to quickly and accurately process large data sets, facilitating the understanding of student needs and the adaptation of educational programs in real time. This leads to more targeted and effective strategies for managing and developing the school environment. But how can AI actively contribute to a school principal's decision-making?

Through its efficiency in collecting, processing, and analyzing data and providing real-time results, AI can assist school leaders in their decision-making process. Large amounts of data (e.g., test scores, students' demographics, grades, and teachers' performance evaluation feedback) are collected each year by educational institutions at various administrative levels, including national, regional, and local authorities (Wang, 2021). School leaders are often faced with similar complex situations that require them to process large amounts of information and consume large amounts of cognitive capacity (Michael et al., 2024). However, making large numbers of decisions and recalling detailed information requires the consumption of increased human cognitive resources, turning decision-making into a mentally process for

school leaders. In such cases, limited human cognitive capacity can be enhanced by artificial intelligence with superior quantitative, computational, and analytical capabilities.

Also, school principals can use AI to reduce uncertainty to some extent (Osegbue et al., 2025). Uncertainty cannot be eliminated at the time of decision making. When uncertainty is too great, such as when an organization is facing an unprecedented crisis, making decisions based on data and evidence can be an inefficient process for school leaders.

Furthermore, AI is not limited to educational decision-making processes and has the potential to automate many of the administrative processes related to school management (Aldighrir, 2024). For example, automating resource allocation and human resource management can reduce the workload of school leaders, allowing them to focus on the strategic development of their schools.

Many decisions in education today are not made technologically or mechanically, but are often related to moral values and require human judgment, the responsibility of which lies with individual school leaders (Dai et al., 2024; Wang, 2021). The symbiosis and coexistence of humans and AI in decision-making can be enhanced in two ways. First, AI can process and analyze large amounts of data and act as an augmented brain to make decisions based on data and evidence (Arar et al., 2024). Second, the advantages of AI can free up time for people to focus more on making ethical, values-based decisions (Arar et al., 2024).

The use of machine learning in decision-making at the management level is not a feature exclusive to educational institutions. Other institutions have also employed it to support their leaders. Jarrahi (2018), Wang (2021), and Shrestha et al. (2019) studied the relational modes of human and AI in decision-making contexts. Jarrahi (2018) found that AI systems are more effective at complex problems in analytical decision-making cases, while humans should direct intuitive decision-making cases that involve uncertain and ambiguous circumstances. Wang (2021) states that AI systems are better to use when making data based or evidence-based decisions, while humans should be used for value-based decision-making. Shrestha et al. (2019) propose that AI systems can work without human participation in decision-making contexts where there are clear outcomes.

The goal of these AI-human collaboration models is to examine how AI could enhance human performance with extensive computing power for data recognition while ensuring that humans retain the ultimate authority in decision-making. Machine learning can draw on large datasets and effectively define complex patterns, giving AI systems the ability to analyze data without limits (Wang, 2021). Even cognitive analysis is reshaping frameworks for cognition and behaviour when considering the administrative nature of their contribution (Gulson et al., 2022). In order to understand what these leaders appear to be doing when collaborating or coexisting with them while making decisions, we need to look closely at the contexts and ways that machine learning may be enabling human leaders. Perhaps clarifying the specific roles and responsibilities of each AI leader and human leader, through the decision process, can demonstrate how the two might complement each other.

Although there are a number of studies examining different modes of AI-human collaboration in decision-making, the distinctions between the roles and remedy of AI and human leaders in the decision-making process have not been sufficiently researched and explained, having regard to the school environment and educational leadership. This paper seeks to address this gap by developing a synergistic collaborative framework between AI and school leaders to illustrate how they can coexist within the decision-making process of educational administration in the school system by clarifying their different roles and responsibilities.

Research method and approach

This study adopted a quantitative research approach to systematically investigate school leaders' perceptions of the role of artificial intelligence (AI) in decision-making within primary

education (elementary schools and kindergartens). A quantitative approach was deemed appropriate for this research, as it enables the collection of measurable data from a large sample, thereby facilitating the identification of patterns, trends, and potential correlations (Cohen et al., 2013; Creswell & Creswell, 2017). Through the use of structured data collection instruments and statistical analysis, the study aimed to ensure objectivity and the reproducibility of results.

The use of a structured questionnaire provided consistency in the responses and allowed for efficient analysis of key variables related to leadership, experience, and attitudes towards the integration of AI in the educational context.

Research tool and reliability analysis

To assess its usefulness and validity, the created research instrument was modified and tested on a small group of school principals. The final version of the online questionnaire was reformulated and optimized using the input gathered during this pilot phase. The research questions, which were developed and recorded in the study's introduction, were intended to be adequately addressed by the research instrument. To systematically examine the important aspects of the phenomenon being studied, the research tool comprised 30 questions in total, divided into three sub-themes (see Table 1). In order to quantitatively evaluate the participants' degree of agreement, their opinions were recorded using a 5-point Likert-type scale, where 1 represented total disagreement and 5 represented total agreement.

Table 1. Sample questions included in the online questionnaire

Demographic data	Attitudes on AI abilities in decision-making	Decision-making
Gender, Age, Education, Years of Service, Years in Management Positions	AI facilitates rapid decision-making by automating data processes.	When I make a decision, I rely on my instinct.
	AI enhances decision-making through its advanced big data processing capabilities.	I postpone decision-making whenever possible.
	The ability of AI to apply predictive risk analysis aids in making significant decisions.	When I make important decisions, I usually need the help of others.
		I often procrastinate when I have to make important decisions.
		When I have to make an important decision, I need someone else to guide me.

Regarding the reliability of the research tool, that is, the accuracy of its measurement (Gray, 2018), Table 2 shows that the Cronbach's Alpha reliability coefficient exceeded 70%, which meets the necessary criteria as it is greater than 0.7.

Table 2. Reliability Analysis

Sections of the Questionnaire	Cronbach's Alpha Coefficient	Number of Variables
Attitudes on AI abilities in decision-making	0.858	8
Decision-making	0.773	17

Data analysis

The collected data were analyzed using descriptive statistics to give an overview of the sample and summarize participants' views on the role of artificial intelligence (AI) in decision-making in primary education (elementary schools and kindergartens). Frequencies, percentages, means, and standard deviations were used to show the demographic profile of the participants and their attitudes toward using AI in school leadership.

These results helped support further analysis to explore possible links between school leaders' characteristics and their views on AI. In addition, the Mann-Whitney U test was used to compare responses between male and female participants, checking for any significant gender-based differences. This approach helped provide a clearer picture of how school leaders in the region understand and evaluate the use of AI in education. All statistical analyses were conducted using SPSS (Version 25.0), ensuring rigor and reproducibility in data handling.

Sample and methods

To capture diverse perspectives, simple random sampling was employed. The research sample consisted of school leaders from public primary units (elementary schools and kindergartens) in the South Aegean region, including both the Cyclades and Dodecanese islands for the 2024-2025 academic year. A complete list of schools in the region was used to randomly select participants, ensuring that each school had an equal chance of being included. This probability-based sampling method enhances the representativeness of the sample and strengthens the generalizability of the findings (Babbie et al., 2022; Bryman, 2017).

An email invitation was sent to 445 primary school units across the South Aegean region, including also small-sized multi-grade primary schools, institutions for special education, and the final sample comprised 238 school leaders, which falls within the benchmarked range that was set by this study. Simple random sampling provided a systematic and unbiased method for capturing context-specific data from school leaders in the South Aegean region (Cyclades and Dodecanese), supporting future comparative analyses with findings from urban educational settings. Data collection took place from early October 2024 to mid-January 2025, and the participants were made aware of their rights, including that their involvement was entirely optional and that their answers would be kept confidential.

The response rate was about 53.5%, with 238 out of 445 school leaders taking part. This means more than half of those invited answered, which is good for this type of study. The estimated margin of error is around ±4.5% at a 95% confidence level. This means the results from the sample are likely close to reflecting the views of school leaders in the South Aegean region (Cyclades and Dodecanese).

To further clarify the sample characteristics, the demographic data for the respondents are illustrated in Table 3, presenting information such as school principals' gender, age, years of service, education, and years in management positions.

Table 3. Demographic characteristics

	n	%
Gender		
Male	68	28.6
Female	170	71.4

Age		
Under 29	4	1.7
30-39	47	19.8
40-49	61	25.6
50-59	96	40.3
Over 60	30	12.6
Years of service		
0-10	21	8.8
11-20	77	32.4
21-30	86	36.1
Over 30	54	22.7
Education		
Pedagogy studies	58	24.4
Other bachelor's degrees	16	6.7
Master	156	65.5
PhD	8	3.4
Years in management positions		
0-10	187	78.6
11-20	37	15.5
Over 20	14	5.9

Findings

The Likert-type reactions ranged from 1 (Strongly Disagree) to 5 (Strongly Agree), allowing us to identify the typical response for each statement (Table 4). The analysis of school leaders' reactions regarding the three key decision-making capabilities of Artificial Intelligence (AI) in the context of primary education was conducted using the median as the central tendency measure (Table 5).

Table 4. School leaders' perceptions of AI's ability in decision-making

AI Ability	Disagree Absolutely (%)	Disagree (%)	Neutral (%)	Agree (%)	Agree Absolutely (%)
AI facilitates rapid decision-making by automating data processes.	11 (4.6%)	25 (10.3%)	65 (27.5%)	110 (46.2%)	27 (11.4%)
AI enhances decision-making through its advanced big data processing capabilities.	5 (1.9%)	20 (8.4%)	52 (21.8%)	134 (56.5%)	27 (11.4%)
The ability of AI to apply predictive risk analysis aids in making significant decisions.	5 (2.3%)	27 (11.5%)	74 (30.9%)	116 (48.9%)	16 (6.4%)

Table 5. Key decision-making capabilities of AI

c	M	Mdn	SD	Min	Max
AI facilitates rapid decision-making by automating data processes	3.50	4.00	0.99	1	5
AI enhances decision-making through advanced big data processing	3.57	4.00	0.92	1	5
AI aids in making significant decisions through predictive risk analysis	3.46	4.00	0.96	1	5

The data presented in the tables highlight school leaders' perceptions regarding the three core capacities of Artificial Intelligence (AI) in supporting decision-making: data analysis, automation, and predictive risk assessment. Each of these dimensions reveals varying degrees of acceptance, confidence, and familiarity among leaders in the primary education context.

AI and big data analysis in decision-making

The first statement recorded a mean of 3.50, a median of 4.00, and a standard deviation of 0.99, indicating a positive perception among school leaders. The majority of participants (57.6%) responded positively (agree or strongly agree), while only 14.9% expressed disagreement. A considerable share of respondents (27.5%) remained neutral, suggesting that while data analysis is recognized as a strength of AI, there may still be knowledge gaps or implementation barriers that prevent widespread confidence in this area.

The Mann-Whitney U test showed that it was statistically significant only for the gender variable. More specifically, the test between the question "AI facilitates rapid decision-making by automating data processes" and the gender variable revealed that there is a statistically significant dependence between the answers to the question and the gender of the school leaders. Specifically, male principals showed much lower than expected frequencies in the response "neither agree nor disagree", while their female colleagues showed much higher than expected frequencies. The opposite pattern was observed for the response "agree" or "strongly agree". It suggests that male principals tended to avoid neutral answers, preferring to take a clear position. Whereas female school leaders were more inclined to choose a more reserved or neutral stance, perhaps showing more inhibition or reflection on this issue.

AI and rapid decision-making through automation

The second statement yielded the highest mean (3.57) and lowest standard deviation (0.92) among the three statements, with a median of 4.00. A total of 67.9% of respondents agreed or strongly agreed, the highest agreement rate in the set. Fewer participants were neutral (21.8%) or negative (10.3%). These findings suggest that automation is the most understood and widely accepted function of AI among school leaders, likely due to its visible role in administrative and routine operations. The Mann-Whitney U test between the question "AI enhances decision-making through advanced big data processing" and the demographic variables showed that it was not statistically significant for all of them.

AI and predictive risk assessment in decision-making

The third statement received the lowest mean score (3.46) but retained a median of 4.00 and a standard deviation of 0.96, indicating some divergence in views. While 55.3% of school leaders agreed or strongly agreed, 30.9% chose a neutral response, and 13.8% disagreed. This implies that predictive modeling is a less tangible or less familiar concept for many school leaders in primary education. It may also reflect a lack of practical experience or exposure to how predictive analytics can inform educational policy, resource allocation, or student support.

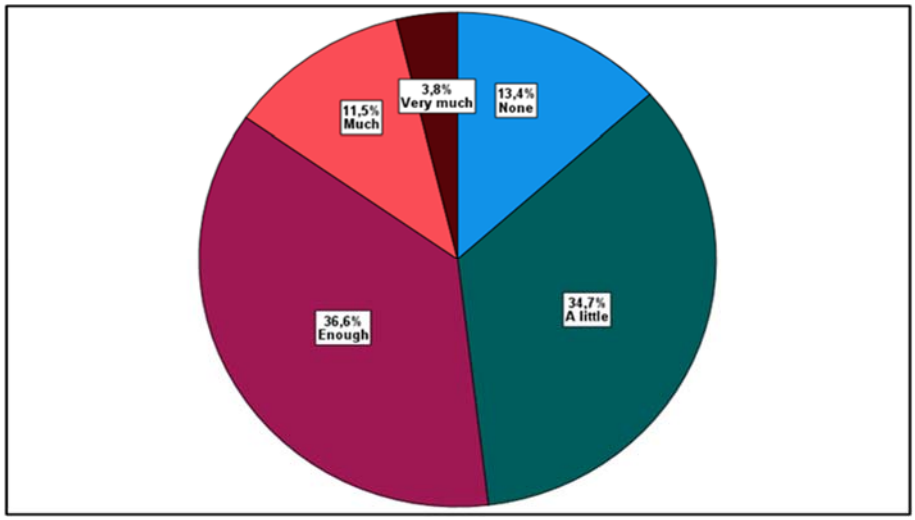
The Mann-Whitney U test showed that it was statistically significant only for the gender variable. More specifically, the Mann-Whitney U test between the question "AI aids in making significant decisions through predictive risk analysis" and the gender variable showed that male school leaders chose the response "neither agree nor disagree" significantly less often than expected, while their female colleagues chose this neutral response significantly more often. In contrast, in the "agree" or "strongly agree" response category, male managers showed significantly higher than expected frequencies, while female managers showed lower frequencies.

These findings suggest a gender-related difference in how leaders perceive the role of AI in decision-making. Male school leaders appear to be more resolute in expressing their agreement with the proposal, while women school leaders tend to adopt a more reserved or neutral stance. This gender variation may reflect differences in familiarity, confidence, or attitudes towards new technologies such as AI, or may be influenced by social or organisational factors that shape behavioural responses.

The analysis reveals a moderate-to-positive attitude toward AI's potential in educational decision-making overall, with the greatest confidence in automation and a relatively low level of familiarity with predictive functions. Neutral responses, particularly in more complex AI functions, indicate a need for additional training, awareness, and implementation strategies to better prepare school leaders for an AI-enhanced decision-making landscape. Even though the median score of 4.00 across all items suggests a general tendency toward agreement, this finding highlights the importance of further refinement.

The following graphs illustrate school leaders' perspectives, highlighting key aspects of the relationship between Artificial Intelligence (AI) and human involvement in decision-making.

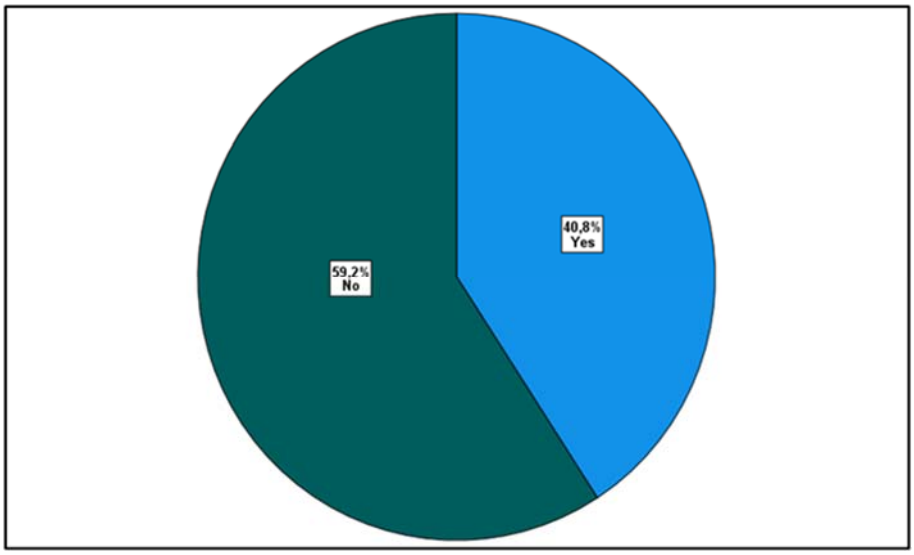
• In response to the question, "To what extent do you believe AI can replace human judgment in the decision-making process?", the largest group of school leaders, 87 respondents (36.6%), answered "Enough". A similar number, 83 individuals (34.7%), responded "A little". Meanwhile, 32 school leaders (13.4%) stated "None", 27 (11.5%) answered "Much", and finally, 9 participants (3.8%) indicated "Very much".



Graph 1. To what extent do you believe AI can replace human judgment in the decision-making process?

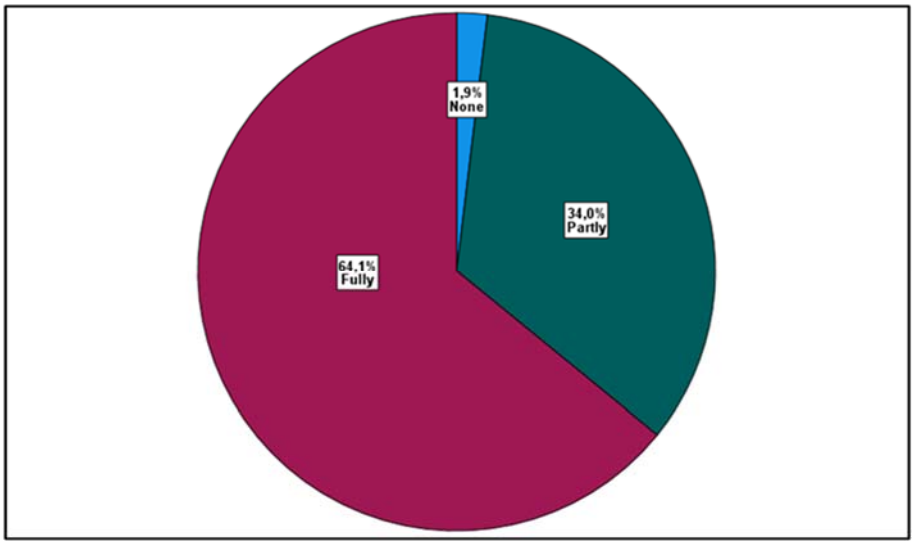
• Regarding the question, "Do you believe AI algorithms can be more objective than human judgment when assessing situations?", 141 respondents (59.2%) answered "No", indicating that the majority of school leaders are sceptical about the objectivity of AI over human judgment. Meanwhile, 97 school leaders (40.8%) stated "Yes", suggesting that a significant

minority acknowledge AI's potential to bring a level of impartiality to assessments that human decision-makers might struggle to maintain due to personal biases or emotional influence.



Graph 2. Do you believe AI algorithms can be more objective than human judgment when assessing situations?

• In response to the question, "To what extent should humans retain the final decision in processes fully supported by AI?", the overwhelming majority of school principals in the sample, 152 participants (64.1%) answered "fully". An additional 81 principals (34.0%) chose "partially", while only 5 respondents (1.9%) stated that humans should not retain any final decision-making authority.



Graph 3. To what extent should humans retain the final decision in processes fully supported by AI?

Discussion

The use of Artificial Intelligence (AI) to enhance decision-making in primary education is not about entirely replacing machine-based judgment for human-based judgment, but is an emerging and symbiotic relationship that relies on the combined strengths of both (Dai et al., 2024; Jarrahi, 2018; Shrestha et al., 2019; Wang, 2021). The implications of this study demonstrate that school leaders are trying to balance the prioritization of human oversight

but still value the potential that AI can serve as a helpful and supporting tool in some areas, such as data analysis, automation, and predictive modeling (Himeur et al., 2023; Zong et al., 2024).

However, a significant number of school leaders maintained their neutrality, even though AI's capacity to handle and analyze large data was also well-received. This implies either a lack of experience with complex data interpretation or a lack of confidence in the use of data-driven outputs for strategic or pedagogical objectives. This finding is in line with Wang et al. (2023), who found that a lack of conceptual clarity and data literacy leaves many school leaders feeling unprepared to interpret AI-generated insights in a meaningful way.

Predictive risk assessment was the topic of the most cautious opinions. The high percentage of neutral and negative answers raises questions about probabilistic reasoning and the ethical implications of AI-based forecasting. People who are used to making decisions based on human judgment and context might find predictive analytics hard to trust because it often relies on unclear algorithms and data that lacks context (Beckley, 2025; Zekos & Zekos, 2021).

Additionally, this study indicates that school leaders do not see AI as a replacement for human decision-makers, but as a partner in a symbiotic process of deliberation. This is consistent with the symbiotic decision-making theory, which supports that humans are still in charge of interpretation, moral reasoning, and final judgment while AI handles computational support (Almeida & Senapati, 2024; Wang, 2021). This model is especially useful in education since decision-making frequently involves interpersonal, affective, and subjective factors that are impossible for modern AI systems to replicate (Dai et al., 2024). AI can find patterns and problems in data well, but it doesn't have the moral judgment, empathy, or understanding of context needed to make the best decisions for principals and schools (Holmes & Tuomi, 2022; Pham & Sampson, 2022).

Recent studies support the notion that human-centered, rather than fully autonomous, AI deployment in education is the most effective approach (Kayyali, 2025; Mena-Guacas et al., 2023; Ramadevi et al., 2023). In this approach, AI helps to uncover insights, identify possible problems, and produce forecasts, but humans decide how to react based on their values, empathy, and work experience (Bankins et al., 2022; Zimmerman et al., 2024).

This framework is reflected in the study's results, especially the strong support for human-led decision-making and the low support for fully autonomous AI. School leaders are open to using AI for analysis and routine tasks, but they keep the more morally complex decisions for humans to make. Indeed, many decisions in education today are not made technologically or mechanically, but are often related to ethical values and require human judgment, the responsibility of which lies with the respective school leaders.

Implications

This study contributes to the theoretical body of knowledge on the relationship between artificial intelligence and school leadership, particularly in the context of decision-making. According to the findings, school leaders face artificial intelligence (AI) as a useful tool for making decisions, but not as a replacement for human judgment. Although AI's ability to automate data processes and analyze complex information is widely supported, there is still doubt about its capacity to take the place of human judgment in morally or contextually complex decision-making. This suggests a definite preference for a symbiotic model of decision-making, in which humans maintain control over interpretation, values-based reasoning, and final judgment while AI handles analytical tasks.

School leaders urgently need to receive focused professional development in data literacy and AI competency to support this model. It is imperative that educational developers and policymakers make sure AI systems are transparent, human-centered, and built to support expert knowledge. Governance frameworks should define ethical limits, protect human

accountability, and make sure AI tools advance educational values and equity rather than undermine them.

Limitations and future research

Despite efforts to ensure a representative sample through simple random sampling, several limitations should be acknowledged. First, the response rate of 53.5%, while acceptable, means that nearly half of the invited school leaders did not participate, which could introduce some non-response bias if the views of non-respondents differ from those who responded. Second, the study focuses exclusively on school leaders from public primary units in the South Aegean region, which may limit the generalizability of the findings to other educational levels, private schools, urban areas or regions with different socio-cultural contexts. Third, as the data collection relied on self-reported responses via email surveys, there is a risk of social desirability bias or inaccurate reporting. Finally, the design captures perspectives at one point in time (2024-2025 academic year), which may not reflect changes in attitudes or conditions over time.

A more representative and varied sample of school leaders from various institutional, cultural, and geographic contexts, including urban and global ones, should be included in future studies. A deeper comprehension of the distinctions underlying school leaders' attitudes toward AI may be possible through mixed-methods research that combines qualitative interviews and quantitative surveys. The existing body of evidence would also be greatly enhanced by studies on the real-world applications of AI tools in decision-making processes and their effects on academic results.

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Implementing the S.M.A.R.T. Framework in Preschool Nutrition Programs using AI-Generated Educational Materials

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Vlachou Maria
Lecturer, Metropolitan College
mvlachou1@mitropolitiko.edu.gr

Abstract

The Mediterranean diet is among the most extensively researched and renowned dietary patterns globally. It is characterized, among other food intakes, by high consumption of fruits. Low fruit and vegetables consumption in young children is a considerable health burden in developed countries worldwide. Preschool children are an ideal group for acquiring healthy eating habits, as this is when dietary and physical activity habits are shaped, potentially impacting lifelong health. In the present study a combination of the Specific, Measurable, Achievable, Relevant, Time-Bound (S.M.A.R.T.) framework, as a new and innovative method, along with a non-restrictive dietary model in preschool populations was implemented. The S.M.A.R.T. intervention aimed to increase daily fruit consumption during snack time at school, supported by AI-generated visual materials designed to promote engagement and multisensory exploration. Thirty-two preschool children participated in the intervention for a total of 10 weeks. The results of the present study revealed that fruit consumption rates during snack time at the preschool context were higher four and eight weeks after a specially designed program using the S.M.A.R.T. framework, thus showing that the implementation of this method for nutrition programs in preschool settings, along with a non-restrictive dietary model could bring beneficial effects for targeted educational interventions in the preschool.

Key words: preschool, Pre-K, fruit consumption, S.M.A.R.T. framework, guilt-free approach

Introduction

According to Zapata et al. (2025) childhood obesity is a global health problem, with its prevalence having tripled since 1975. Proper nutrition plays a significant role in a child's development. Healthy eating contributes to appropriate physical and mental growth as well as emotional and psychological balance. Eating habits and shared meals serve as a form of communication and connection within the family, school, and other social settings (Lagstrom et al., 1999). In preschool education, nutrition is incorporated into the school's "routine" and is mentioned in the curriculum at various points as a learning framework. Thus, dietary habits can become a subject of experiential learning and be connected to all thematic axes of the preschool education curriculum. During the preschool years, children's nutritional education is influenced by both family and school, establishing a critical foundation for their future body weight (Cummingham et al., 2014). Moreover, preschool children are an ideal group for acquiring healthy eating habits, as this is when dietary and physical activity habits are shaped, potentially impacting lifelong health (Institute of Medicine, 2002).

Nutrition in Preschool-Aged Children

As preschool-aged children grow and gradually gain more autonomy, they start making more choices about their diet, which affects their health and well-being, even though much of their behavior remains under adult control. Due to the developmental characteristics and limitations of this age, young children often either do not know or are not aware of the choices they make. When children do not know how to make choices or do not understand the consequences of their choices, the decisions they make regarding their personal diet can

include unhealthy options (Feinstein et al., 2008; Institute of Medicine, 2002). The early years of life are crucial for encouraging the consumption of appropriate foods through specific behavioral techniques such as repeated exposure to certain flavors, sensory learning, and the overall promotion of fruit and vegetable intake in preschool-aged children (Nekitsing et al., 2018). Findings from the study of Dazeley and Houston-Price (2015) suggest that interactive, hands-on exposure to fruits and vegetables can improve children's willingness to try them, highlighting the value of such activities in promoting healthy eating behaviors. It is well recognized that the family environment significantly influences children's health, as it can encourage healthy behaviors and lifestyle habits. Family members can serve as influencing role models for their children (Kanellopoulou et al., 2021; Natale et al., 2014). A more recent review showed that strategies like taste tests, combined with non-taste exposures, such as learning about a food's origin, its role in a balanced diet, are more effective in encouraging children to try, eat, and enjoy unfamiliar foods (Johnson & Johnson, 2025). By encouraging diverse multisensory explorations, children may develop greater openness and self-awareness, thereby expanding their range of food experiences (Coe et al., 2024).

The Mediterranean Diet – Conceptual Definition and Key Components

The Mediterranean diet was first defined by Ancel Keys as being low in saturated fat and high in vegetable oils, observed in Greece and Southern Italy during the 1960s (Davis et al., 2015). The Mediterranean diet is among the most extensively researched and renowned dietary patterns globally. Its traditional roots lie in the civilizations around the Mediterranean Sea, making this diet closely linked to the social customs and lifestyles of that area. UNESCO has acknowledged the Mediterranean diet as an intangible cultural heritage, emphasizing its deep connection to its geographical origin and its environmentally responsible agricultural and dietary practices.

It is characterized, among other food intakes, by high consumption of fruits (Guasch-Ferré & Willett, 2021). The Mediterranean diet has been shown to prevent the development of various diseases such as cardiovascular disease, depression, diabetes and obesity (Jay Widmer et al., 2015).

The Effect of Fruit Consumption on Developing Organisms

Fruit consumption is a significant component of recommended healthy dietary patterns and is associated with the prevention of chronic diseases that may affect social and cognitive function. According to Halkjelsvik and Bere (2023), fruits contain not only essential nutrients but also valuable dietary elements that are unique. Specifically, the nutrients and secondary metabolites contained in fruits affect molecular systems and cellular processes that are essential for maintaining cognitive function, and this is also true for young organisms. Flavonoids (a polyphenol abundant in fruits) improve cognitive performance. Also, fruit consumption helps maintain a healthy gut microbiome, which is also responsible for efficient cognitive function (Halkjelsvik & Bere, 2023). Additionally, the antioxidants (polyphenols, flavonoids), as well as the numerous vitamins and trace elements obtained from various foods, particularly fruits, contribute to the increase in school performance (Esteban-Comejo, 2016).

Snack Time at School - Research on Preschool Children

Across various studies, preschoolers' diets are consistently characterized by low fruit and vegetable intake and high consumption of sweets and energy-dense, nutrient-poor foods (Androutsos et al., 2023; Hutchinson et al., 2021; Min et al., 2021). These patterns have been linked to increased risk of overweight and obesity (Lee et al., 2021; Roe et al., 2022). Offering a greater variety of healthy foods in childcare settings and integrating nutrition education may

support healthier eating habits from an early age (CDC, 2017; Control CfD, Prevention, 2014; Fox et al., 2010).

Nekitsing et al. (2018), in a review of the literature on childhood obesity in the USA, observed that the most effective strategy for adopting healthy eating at school is repeated exposure to the target food and the active involvement of parents and students throughout the process. The strategy of repeated exposure works through the process of familiarization. According to the mere exposure theory, even a single exposure is enough to create a positive attitude towards a stimulus. Thus, interventions involving repeated exposure to taste-testing a food contribute to positive acceptance over time (Rioux et al., 2018), and when repeated exposure is combined with increased fruit intake during snack time and the implementation of multiple strategies (active involvement of parents and children, experiential multisensory activities, clearly defined goals), the results are more immediately visible and have a stronger impact (Roe, 2022). Hausner et al. (2012) have shown that children increase their fruit and vegetable consumption after approximately five exposures to the food; however, on average, children usually need between eight and ten exposures at regular intervals, e.g., once a week.

A systematic review of the relevant literature has shown that not eating enough fruit and vegetables is a considerable health burden in developed countries. Eating adequate amounts of fruit and vegetables is associated with a reduced risk of future non-communicable diseases (such as heart and circulatory disease). Early childhood represents a critical period for the establishment of dietary habits that track into adulthood. Interventions to increase consumption of fruit and vegetables in early childhood may therefore be an effective strategy to reduce this disease burden (Hodder et al., 2020).

Additionally, a recent research on the fruit and vegetable consumption of toddlers showed that future research should investigate the time factor regarding continued fruit consumption after the end of the research intervention and the need to include the involvement of microsystems (peers, parents, teachers) in the process of changing dietary attitudes (Hasan et al., 2023).

Finally, research by Lee et al. (2021) highlights significant differences in fruit and vegetable consumption by primary school students at home compared to extra-family systems such as school. This research emphasizes the need not only for active parental involvement but also for the establishment of fruit consumption, especially during the school snack.

School-Family Collaboration - The Ecological Theory Model

A comprehensive theory supporting school and family collaboration is that of Urie Bronfenbrenner's ecological perspective (1989). According to ecological theory, human development is perceived as a result of individuals interacting with the alternating, dynamic environment in which they live (see Figure 1).

Figure 1: The structure of the environment according to the Ecological Systems Model

The environments of individuals are considered as multiple systems of the:

- Immediate environment (such as parents, educators, and peers)
- Indirect environment (such as culture and society).

This specific model was developed by Bronfenbrenner (1989) and is based on a systemic approach. Its fundamental principle is the view that throughout life, individuals participate in many different systems that are in continuous interaction and interdependence, influencing their development. Specifically, individuals participate in five different systems. In this study, we focused on the following 2 subsystems: microsystem and mesosystem, with the dominant mediator of interaction between the family and school microsystems being the participants of preschool age. According to ecological theory, they are defined as:

- Microsystems, systems that belong to the immediate environment of the child, such as family, school, and neighborhood. At this level, interactions are direct, and their impact on the individual is strong and decisive. Additionally, the interaction of microsystems increases as the child grows and participates in more microsystems.
- Mesosystem, the system where relationships and interactions between microsystems occur (e.g., the relationship between educators and parents). It is considered the target of intervention to improve and change children's behavior, as the quantity and quality of interactions operating within it determine the system's effectiveness for the positive development of the child.

Significance of Present Research

According to the World Health Organization (WHO), the Mediterranean diet is no longer prevalent among children in Greece, Spain, and Italy where over 40% of children aged nine are overweight or obese. These Mediterranean countries, once the epitome of healthy eating, now face the highest rates of childhood obesity in Europe (Lopez-Gil et al., 2023). Recent research has shown that adherence to the Mediterranean diet, which emphasizes the daily consumption of fruits, contributes to the prevention and management of obesity in both children and adults (Manzano-Carrasco, 2020). Given that preschool age is a period of rapid development and a particularly important phase for the development and establishment of dietary habits mainly through interaction during snack time, the implementation of an intervention program becomes necessary.

Starting from Bronfenbrenner's ecological theory (1979), the present research was designed with the aim of contributing within the framework of child-centered values not only in terms of acquiring knowledge and skills but also in terms of transforming attitudes of preschool children so that they willingly and independently include the consumption of fruits during snack time. The purpose of the study was to test an educational intervention within the school context as a self-contained microsystem (Bronfenbrenner, 1979). In order to attain this goal, the S.M.A.R.T. framework was implemented, as a completely new and innovative method for preschool populations.

Definition of the S.M.A.R.T. Framework

The S.M.A.R.T. framework incorporates all the criteria that assist in the attainment of specific goals within a given timeframe. The acronym S.M.A.R.T. stands for Specific, Measurable, Achievable, Relevant, and Time-bound. S.M.A.R.T. goals help define specific, achievable, and measurable objectives, as well as set a timeframe for their accomplishment.

Specific

A S.M.A.R.T. goal must be clear and well-defined. Vague or generalized goals are not useful as they do not provide sufficient direction.

Measurable

It is vital to have specific criteria for measuring progress toward the goal. If a goal is not measurable, it is difficult to determine progress or to know when it has been achieved.

Achievable

Goals must be realistic and attainable. While an ambitious goal can be motivating, if it is perceived as unattainable, it can lead to frustration and decreased morale.

Relevant

The goal should align with personal preferences and needs so that it harmonizes with what feels familiar and meets our desires.

Time-bound

A goal should have a clear, defined timeline that includes a start date and a target date. The timeline creates a sense of commitment to the goal.

Methodology

Research Aim

The present research aims to investigate the impact of a S.M.A.R.T. intervention on preschool children's consumption of fruits during school snack time. The study follows a quasi-experimental, one-group pretest–posttest design, which allows for the observation of changes over time in the absence of a control group.

Research Question

Are there significant differences in the scores of fruit consumption during snack time at school before and after participation in a S.M.A.R.T. intervention program in preschool participants?

Sample

The program involved 32 preschool children (aged 4-6 years) and their parents. Participants came from an urban area in Northern Greece. The sample was randomly chosen.

Ethical Considerations

Due to ethical considerations, a control group was not used, as it would involve withholding a health-promoting intervention from children. Instead of using a control group, we employed a pre-post test design to observe changes over time within the same group, allowing us to assess shifts in behavior while respecting ethical considerations.

Participation was entirely voluntary. Researchers obtained informed and written consent from parents, participant teachers, and the school director. Oral consent was obtained from each child individually, with each child making the decision to take part based on their own interest and willingness. Information on the research's content and procedures was provided in appropriate language. All participants were free to quit the program any time they wished.

Moreover, and in order to ensure the privacy and confidentiality of the participants, the research was conducted anonymously, since no personal data of the children was utilized or disclosed during the study. The study collected neither information that could identify the informants nor data that was sensitive.

All participants were informed that they are entitled to receive information about research findings.

Research Tools

Snack Checklist: the food consumed during snack time at school was written down.

Application of S.M.A.R.T. Goals

Specificity: Encourage preference for fruit consumption during snack time.

Measurability: Measure the first goal using a checklist writing down the food consumed during school snack time.

Attainability: Snack time occurs daily at a specific time within the school curriculum.

Relevance: The quality of diet concerns all members of the school community (teachers, parents, children).

Time-bound: The program runs throughout the second half of the school year, with a total duration of 10 weeks.

Procedure

Phase 1 - Time 1: Pre-test - *Duration of measures:* 1 week

At the end of the first trimester, parents were informed that their children would independently choose their snacks for school without parental involvement. Snacks are not provided by the school and are consumed at approximately 10:00 a.m. During pre-test, for five consecutive days, the type of snack each participant consumed was recorded. If the snack included fruits and these were consumed, one point was given. In all other cases, no point was given. A point is equal to .20. The maximum points each participant could collect was five and were equal to 1.

Phase 2 – Intervention - Duration: 10 weeks

The intervention aimed to activate students, encourage voluntary participation in experiential-multisensory activities, and involve them exclusively in decision-making. The role of the researcher and parental participation was supportive, while participants acted as mediators in the interaction between family and school (the mesosystem according to Bronfenbrenner's ecological theory).

Day 1:

The intervention, titled *"Can You Eat a Rainbow?"*, was developed with reference to Suen's (2011) work.

Days 2 to 6:

All images used in the present study were created using the generative Artificial Intelligence tool "Image Creator from Microsoft Designer". These images were used as educational aids to enhance the multisensory, child-led activities, serving as visual stimuli in support of the intervention. Participants observed images of rainbows, where each color corresponded to fruits of the same color (Images 1 and 2). Using their existing experience, children brainstormed other known fruits for each of the five rainbow colors or shared past relevant past experiences so that a vivid interaction took place.

Image 1: fruit rainbow

Image 2: fruit rainbow

With the participants' consent and willingness, an agreement was made to consume a fruit of their choice each day for five consecutive days. Each day focused on a different color of the rainbow (see Images 3–7), and participation was entirely voluntary. The selection of the fruit was a personal decision, emphasizing autonomy and responsibility. Since the success of the process relied on the participants' active engagement, they were responsible for independently choosing a fruit that matched the color of the day to include in their snack.

At the end of each school day, a colored card corresponding to the next day's rainbow color was given to each participant. This served as a visual reminder at home when preparing their snack. Participants were also free to include other foods alongside the designated fruit.

During the activity, participants presented the fruit they had brought and explored its properties using all five senses. This sensory investigation was followed by a discussion about the nutritional benefits of the fruit. Time was also dedicated to personal expression and reflection, allowing participants to share their thoughts and experiences.

Image 3
Day 1: Red Fruits

Image 4
Day 2: Orange Fruits

Image 5
Day 3: Yellow Fruits

Image 6
Day 4: Green Fruits

Image 7
Day 5: Blue Fruits

Thinking Routines – the Concept of Balanced / Non-restrictive Nutrition

An exculpatory approach to dietary habits, one that avoids a dichotomous classification of foods as strictly "good" or "bad", can positively influence individual food choices (Contois, 2015; Yu, 2020). In line with this perspective, children were encouraged to reflect on and redefine their dietary perceptions without criticism, particularly regarding the concept of non-restrictive eating. This process took place alongside the fruit-tasting activities and was facilitated through structured thinking routines. To support this reflective engagement, a series of five images, one for each day of the 5-day intervention, was used. These are presented below (Images 8 to 12):

Image 8
Day 1 of Intervention

Image 9
Day 2 of Intervention

Image 10
Day 3 of Intervention

Image 11
Day 4 of Intervention

Image 12
Day 5 of Intervention

Thinking routines are one of the cores of a method called "Visible Thinking", developed by Project Zero at Harvard Graduate School of Education. It is defined as: *"a flexible and systematic research-based conceptual framework, which aims to integrate the development of students' thinking with content learning across subject matters"* (Project Zero, 2011a). They are called routines because they are structured steps of thinking designed to foster deep understanding, critical thinking, and metacognitive skills and make thinking visible.

In the present research, the thinking routine "See-Think-Wonder" was chosen, along with relevant images (Images 8-12), because it is useful to elaborate prior beliefs through observation and interpretation. The routine was used as a group discussion technique which is broken down into smaller steps of thinking. While participants observe a visual source, in our case the set of Images 8-12, specific questions were addressed in the following order:

1. **See:** What do you see?
2. **Think:** What do you think about that?
3. **Wonder:** What does it make you wonder?

(Project Zero, 2011b)

As part of a multimodal learning approach, each activity concluded with a music and movement session related to healthy nutrition. Additionally, at the end of each of the five days, participants colored the corresponding section of a rainbow worksheet to match the color of the fruit they had consumed that day. Upon completion of the entire process, participants received tangible, positive reinforcement in the form of a rainbow-themed sticker and enjoyed tasting fruit in an alternative form, freshly squeezed orange juice.

Skill Stabilization

Duration: 2nd-10th week of the program

Second week: Over the course of five days, participants were encouraged, voluntarily and independently, to include fruits of their own choice in their snack, alongside any other foods they wished to consume. After snack time, during circle time, participants were invited to voluntarily draw the fruits they preferred and to associate them with the benefits they offer. These personal preferences were then shared with the group, leading to a guided discussion that promoted critical thinking around healthy eating habits.

On the fifth and final day, a reflective group discussion was held. As a result, participants collectively designated two days of the week as "Rainbow Days," during which a fruit of their choice would be consumed at snack time for a period of eight weeks.

Weeks 3 to10: Parents were informed and encouraged to support the initiative by providing verbal reminders, encouragement, and praise at home. On each "Rainbow Day," participants who consumed a fruit of their choice were invited to stamp a dot-to-dot rainbow, using a stamp color that corresponded to the fruit they had eaten. This served as a fun and visual reminder of their progress. Upon completing the entire process, participants received tangible positive reinforcement in the form of a certificate celebrating their achievement in the challenge: *"Can You Eat a Rainbow?"*

Phase 3

Time 2: Post-test 1: 4 weeks after intervention completion

Duration of measurement: 1 week

Time 3: Post-test 2: 8 weeks after intervention completion

Duration of measurement: 1 week

Upon completion of the 10-week intervention program, participants' snack intake was recorded over a five-day period on two separate occasions:

- **Time 2 (Post-test 1):** Four weeks after the conclusion of the intervention
- **Time 3 (Post-test 2):** Eight weeks after the conclusion of the intervention

As in the pre-test phase, the type of snack consumed by each participant was recorded daily. If a snack included fruit, the participant was awarded one point; if not, zero points were given. Each point corresponded to a value of 0.20. Therefore, the maximum number of points

a participant could earn during each post-test period was five, equating to a total score of 1.00.

Results

Participants attended a specially designed program for fruit consumption during snack time at school for 10 weeks, using the S.M.A.R.T. framework. Their consumption of fruits was measured before the special program, after 4 weeks and after 8 weeks.

A repeated-measures ANOVA was conducted to evaluate the effect of time on fruit consumption during snack time at school. The means and standard deviations for fruit consumption at each time point are presented in Table 1.

Table 1: Descriptive statistics for Fruit Consumption School Snack

Time	M	SD
Pre-test	.2984	.35344
Post-test time-point 1	.5359	.35098
Post-test time-point 2	.5309	.40357

Mauchly's test indicated that the assumption of sphericity was not met, $\chi^2(2) = 6.84$, $p = .03$ (Table 2). Therefore, degrees of freedom were corrected using Huynh-Feldt estimates of sphericity ($\varepsilon = .87$). The effect of time on fruit consumption was statistically significant, $F(1.74, 54.04) = 9.22$, $p = .001$, partial $\eta^2 = .229$ (Table 3).

Table 2: Mauchly's Test of Sphericity[b]

					Epsilon[a]		
Within Subjects Effect	Mauchly's W	Approx. Chi-Square	df	Sig.	Greenhouse-Geisser	Huynh-Feldt	Lower-bound
Time	.796	6.848	2	0.033*	.830	.872	.500

Tests the null hypothesis that the error covariance matrix of the orthonormalized transformed dependent variables is proportional to an identity matrix.

a. May be used to adjust the degrees of freedom for the averaged tests of significance. Corrected tests are displayed in the Tests of Within-Subjects Effects table.

b. Design: Intercept

Within-Subjects Design: Time

Table 3: Tests of Within-Subjects Effects

Source		Type III Sum of Squares	df	Mean Square	F	Sig.	Partial Eta Squared
Time	Sphericity Assumed	1.179	2	.589	9.222	.000	.229
	Greenhouse-Geisser	1.179	1.661	.710	9.222	.001	.229
	Huynh-Feldt	1.179	1.743	.676	9.222	.001**	.229
	Lower-bound	1.179	1.000	1.179	9.222	.005	.229
Error (time)	Sphericity Assumed	3.962	62	.064			
	Greenhouse-Geisser	3.962	51.491	.077			
	Huynh-Feldt	3.962	54.048	.073			
	Lower-bound	**3.962**	**31.000**	**.128**			

a. Computed using alpha = .05

Post-Hoc Tests

Post-hoc pairwise comparisons with a Bonferroni adjustment indicated that fruit consumption was significantly higher at both time 2 ($p < .001$) and time 3 ($p = .01$) compared

to baseline. There was no significant difference between fruit consumption at time 2 and time 3 (p = 1.00) (Table 4).

Table 4: Post-hoc tests

Eat fruits Time (I)	Eat fruits Time (J)	Mean Difference (I-J)	Std. Error	Sig.[a]	95% Confidence Interval for Difference[a] Lower Bound	Upper Bound
Time 1	Time 2	-.238**	.051	.000	-.367	-.108
Time 1	Time 3	-.232*	.075	.013	-.424	-.041
Time 2	Time 1	.238**	.051	.000	.108	.367
Time 2	Time 3	.005	.061	1.000	-.148	.158
Time 3	Time 1	.232*	.075	.013	.041	.424
Time 3	Time 2	-.005	.061	1.000	-.158	.148

* The mean difference is significant at the 0.05 level.

[a] Adjustment for multiple comparisons Bonferroni

Discussion

The findings of the present study revealed that fruit consumption during snack time in the preschool context increased significantly four weeks after the implementation of a specially designed program based on the S.M.A.R.T. framework. Notably, fruit intake remained significantly higher even eight weeks after the conclusion of the intervention, indicating a degree of behavioral persistence. These results suggest that the application of the S.M.A.R.T. framework in preschool nutrition programs can be effective in promoting and maintaining healthy dietary behaviors over time.

This aligns with previous research demonstrating the efficacy of the S.M.A.R.T. framework in enhancing outcomes in educational settings (Lawlor, 2012; Li & Wong, 2019; Poe et al., 2021). In the present study, the intervention lasted for 10 weeks and involved repeated exposure to a variety of fruits. Consistent with this approach, Nekitsing et al. (2018) found that repeated exposure is a safe and effective method for influencing food preferences and increasing fruit and vegetable intake in preschool children.

Children in this study were also independently and actively engaged in the program, particularly in decision-making regarding snack preparation. Similar findings have been reported in earlier research. Repeated taste-testing has been shown to increase acceptance of unfamiliar foods over time (Rioux et al., 2018). Moreover, when repeated exposure is combined with strategies such as active involvement of children and parents, multisensory experiential activities, and clearly defined goals, interventions yield stronger and more immediate effects (Hodges, 2020; Roe, 2022). Supporting this, Hausner et al. (2012) reported that fruit and vegetable consumption in children increases significantly after approximately five exposures.

Limitations

This study has several limitations. First, due to the small sample size, the findings reflect correlations rather than causal relationships. As such, the results should be interpreted with caution, and generalizability to broader populations is limited. The constrained sample and the focus on a single urban preschool reflect real-world limitations commonly encountered in school-based intervention research.

Conclusions

This study addressed the issue of fruit consumption during snack time in a preschool setting. The findings revealed that fruit intake increased significantly at both four and eight weeks following the implementation of a structured program based on the S.M.A.R.T. framework. These results suggest that applying the S.M.A.R.T. framework, in combination with a non-restrictive dietary approach, can yield beneficial outcomes for targeted nutrition education interventions in early childhood settings.

Future Research

A documented shift away from the traditional Mediterranean diet, particularly among younger populations, has been reported (Martimianaki et al., 2022), raising concerns about potential long-term health implications. This underscores the critical importance of implementing effective nutrition programs starting in the preschool years. As an exploratory pilot study, the present research prioritized depth over breadth, offering preliminary insights into the feasibility and potential impact of an innovative intervention within a specific educational microsystem. Future studies should involve larger, more diverse samples across multiple sites or regions to enhance external validity and enable comparative evaluations of different intervention models.

Parental involvement was another element of this study. While parents participated in a supportive but non-intervening role during snack preparation, their influence as role models remains significant in shaping children's dietary habits (Kosti et al., 2021). Future research should explore the effects of more active parental engagement, including informational components and joint activities, to better understand their role in reinforcing healthy eating behaviors. This could involve initiating the intervention at the start of the academic year and systematically tracking fruit consumption both at school and at home. Additionally, future study designs should incorporate comparison groups to assess the relative effectiveness of the S.M.A.R.T. framework against alternative intervention strategies.

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Enhancing Creativity and Problem-Solving Skills Through 3D Printing in Greek Education

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Tsiastoudis Dimitrios
PhDc, Physics Department-School of Science-Aristotle of Thessaloniki
tsiastoudis@auth.gr

Polatoglou Hariton
Professor, Physics Department-School of Science-Aristotle of Thessaloniki
hariton@auth.gr

Maidou Anthoula
Dr, Educational Consultant of Architects, Civil Engineers and Topographers
anthoula.maidou@gmail.com

Abstract

This study examines the integration of 3D printing (3DP) technology in Greek education and its effects on creativity and problem-solving skills. The research designed and implemented a national CAD and 3DP contest and online asynchronous courses for teachers and students, aiming to demonstrate best practices and foster multidisciplinary integration of 3DP. Using Project-Based Learning (PBL) and Design Thinking (DT) frameworks, the study assessed through the process the creativity and problem-solving skills with adapted VALUE rubrics. Data from 358 students in 66 teams across 42 schools showed significant improvements in creativity and notable problem-solving abilities. The diverse participation highlights 3DP's potential to modernize education and bridge educational gaps. This research underscores the importance of innovative teaching methods, and the democratizing potential of emerging technologies can have in education.

Keywords: 3d Printing, creativity, problem solving.

Introduction

3D printing, also known as additive manufacturing, creates physical objects from digital designs by layering materials, unlike traditional subtractive manufacturing, which involves cutting material from a solid block. Although its origins date back to the 1980s, 3D printing has rapidly evolved and become more accessible over the past decade (Lipson & Kurman, 2013). The process starts with creating a digital model using computer-aided design (CAD) software. This model is then sliced into thin layers, guiding the printer to build the object layer by layer. Various materials, including plastics, metals, ceramics, and biomaterials, can be used (Gibson, Rosen, & Stucker, 2014). Common 3D printing technologies include Fused Deposition Modeling (FDM), Stereolithography (SLA), and Selective Laser Sintering (SLS). FDM involves extruding melted filament through a heated nozzle, SLA uses a laser to harden liquid resin, and SLS fuses powdered material with a laser, allowing complex structures to be created (Chua & Leong, 2015). The applications of 3D printing are expanding across various fields. In medicine, it is used to create custom prosthetics, implants, and bio-printed tissues. The aerospace and automotive industries use it to produce lightweight, complex parts. Importantly, 3D printing is also making significant impacts in education by providing hands-on learning opportunities that enhance creativity and innovation (Berman, 2012). Since 3D printing will be a part of many future jobs, customizing the students to the technology will promote their future carriers.

In educational settings, 3D printing enriches learning from elementary schools to universities. In primary and secondary education, it introduces students to advanced

technologies, teaching subjects like mathematics, science, engineering, and art through practical applications (Chua & Leong, 2015). For example, students can print geometric shapes to understand mathematical concepts or create models of historical artifacts to deepen their understanding of history and culture (Novak & Wisdom, 2018). In higher education, 3D printing facilitates innovative research in fields such as engineering, architecture, and medicine, allowing students to design and test prototypes or create anatomical models for study (Lipson & Kurman, 2013; Ford & Minshall, 2019). The integration of 3D printing in education supports Project-Based Learning (PBL) and Design Thinking (DT). PBL involves students in group projects where they identify an inquiry question, brainstorm solutions, and create tangible artifacts, enhancing skills like communication, collaboration, and creativity (Bell, 2010). DT aligns with constructivist theories, emphasizing hands-on, task-oriented activities. It engages students in solving real problems through empathy, ideation, prototyping, and testing, fostering a culture of experimentation and innovation (Wenger, 2009). 3D printing as an educational tool has been shown to enhance creativity, which stands as a key 21st-century skill alongside critical thinking, collaboration, and communication (Beghetto, 2007; Glăveanu, 2015; Sternberg, 2012). Studies have reported positive teachers' perceptions in using 3D printing to develop creativity (Trust, & Maloy, 2017). More research is needed on pedagogical practices as well as evidence on students' engagement that proves such development.

In this context, an important challenge is to determine which and how 3D printing activities promote creativity and problem-solving competencies. To address this, the present study proposes a structured combination of PBL, online courses, and face-to-face collaboration with support from geographically dispersed mentor teachers. This approach aims to facilitate the incorporation of 3D technologies and design thinking into school practices, build a community of students and teachers, and cultivate competencies relevant to current and future careers.

To guide this investigation, the study posed two core research questions:

1. To what extent does student participation in 3D design and printing activities improve their creativity skills when guided by a design thinking framework? and
2. How do students develop problem-solving skills through a structured 3DP design challenge, and what are the measurable outcomes?

These questions led to the formulation of two corresponding hypotheses: that students would improve their creativity skills (H1) These questions led to the formulation of two corresponding hypotheses:

- **H1**: Students would improve their creativity skills through their engagement with the 3DP activities and the design thinking approach.
- **H2**: Students would demonstrate enhanced problem-solving abilities through participation in the structured 3DP contest.

These hypotheses form the foundation of the study's design and analysis.

Methodology

Since the introduction of 3DP in the Greek educational curriculum, either as possible part of a formal education initiative and for a limited number of grades or in non-formal settings, is a new process and, in mostly an unknown territory, we had to find ways to promote its introduction to a wider audience, both geographically and for all the school grades. To this end we have designed and implemented the following two actions:

- A national CAD and 3DP Contest: This contest is addressed to all interested teachers along with their students to form groups, work on a sustainability problem at their environment, and propose a solution presented in the form of a 3D model, an analysis report and a presentation of the whole process.
- Online Asynchronous Courses: To support teachers and students willing to get involved but feeling uncomfortable due to a lack of training, we designed and offered two online

asynchronous courses of 8 weeks each, on CAD and 3DP, namely "Teachers ST3dM" and "Students ST3dM." These courses introduced CAD and 3DP. In the design this courses we followed common steps of action research, including setting goals, defining research theory, identifying research questions, collecting and analyzing data, reporting results, and identifying required improvements (Sagor, 2000).

By providing a structured training and practices, these actions aimed to simplify 3DP technology integration into educational environments and create a community of students and teachers through forum discussions. The above educational environment also highlighted the potential for 3DP to facilitate project-based learning and interdisciplinary collaboration, key components of innovative and effective education.

Study Design

The research was conducted in the context of this national 3D design and printing contest implemented over five consecutive years. Each year's implementation included asynchronous online support courses for both students and teachers, access to instructional videos, activities, and collaborative design tasks. The participants were grouped into student teams from across Greece, including rural and urban areas, general and special education schools.

The study embraced an interventionist logic, involving cycles of design, implementation, evaluation, and redesign. Data was collected from two main sources: (a) students' work within the platform and their interaction with learning resources (used primarily for creativity evaluation), and (b) final essay submissions by each team (used for problem-solving evaluation). All activities and assessments were carried out with the support of mentor teachers, under real classroom or extracurricular settings.

The study focused on two educational levels—primary and secondary—and used adapted VALUE rubrics for the assessment of the two targeted skills. Creativity was evaluated through a time-based approach, using three evaluation checkpoints across the learning process. Problem-solving was assessed using a single evaluation of the teams' final design essay.

This multilevel research approach—spanning different educational levels, school types, and geographical areas—enabled a robust triangulation of findings. The combination of qualitative and quantitative data, collected through students' digital artifacts and reflective reports, strengthened the validity of the results and provided a comprehensive understanding of how 3DP-enhanced PBL and DT practices support 21st-century skill development in real-world educational contexts.

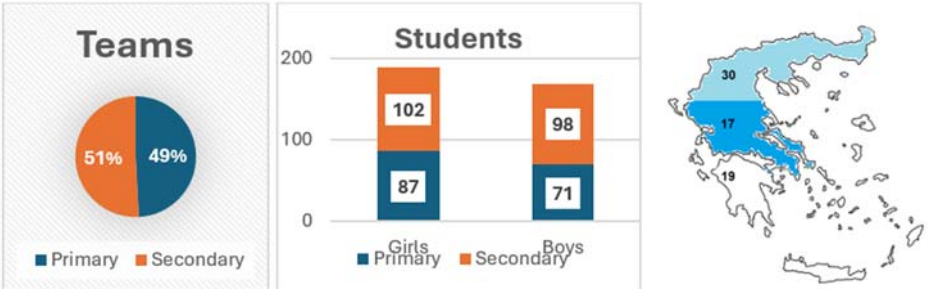
Theoretical Base

The course integrates Project-Based Learning (PBL) and Design Thinking (DT) to enhance student engagement and skill development in the 3D design and printing contest. PBL is a student-driven and teacher-facilitated approach that organizes learning into student group projects. Initially, students formulate an inquiry question, brainstorm procedures, and identify necessary materials. They actively collaborate, set project goals, and solve authentic problems, culminating in the creation of a tangible 3D printed artefact and ultimately select a way to demonstrate what they have learned through a project. This approach has been shown to cultivate 21st-century skills such as communication, negotiation, collaboration, and creativity (Bell, 2010; Karaçalli & Korur, 2014). Incorporating DT into the course aligns with the theory of Constructivism, which emphasizes hands-on, task-oriented, self-directed activities aimed at design and discovery. Constructivism suggests that learners build their own mental structures through interactions between their experiences and ideas (Piaget, 1954; Wenger, 2009). Concurrently, the DT process involves understanding user needs, defining a problem statement, generating innovative ideas, creating and testing prototypes, and iterating based on feedback. DT engages students in the solution of real problems using a human-centered approach, encouraging empathy and active participation in social communities. This method aligns with Wenger's social theory of learning, which focuses on learning as social

participation. By engaging in these practices, students develop identities related to their communities, shaping not only what they do but also who they are and how they interpret their actions. Both PBL and DT focus on key outcomes related to 21st-century skills, including teamwork, problem-solving, and creativity.

Sample

The importance of our study is highlighted by the extensive and diverse sample of students and teachers involved in the national CAD and 3D printing contest as well as in the asynchronous courses. Sixty-six teams from forty-one schools completed the course tasks and submitted their artifacts to the 3D printing contest for the 2022–2023 school year. This numerically significant and geographically diverse participation, spanning all school levels, *ensured* a good representation of various demographic and educational backgrounds, allowing us to generalize the outcomes of the impact of 3D printing in education. Our national contest included students from schools all over Greece, from primary to secondary education, from public schools, private institutions, vocational schools, and special education as presented in table 1 and table 2. Specifically, thirty teams from primary education and thirty-six teams from secondary education were involved. Of these, 30 teams were from northern Greece, 17 from central Greece, and 19 from southern Greece and the islands. Forty-one teams represented public schools, while twenty represented private institutions. The participants were boys and girls from various economic backgrounds, residing in villages, islands, or major urban centers across Greece. In primary education, 87 girls and 71 boys participated. In secondary education, the participants included 102 girls and 98 boys, resulting in a balanced sample of 189 girls and 169 boys overall. These different contexts and socioeconomic environments established a rich dataset for analysis and are illustrated in Figure 1.



(a) **(b)** **(c)**

Figure 1.α) percentage composition of participating teams. b) Total students by level and gender. c) Geographical mapping of teams origination.

Table 1. Composition of participating teams

Sector	Girls	Boys	Teams	Students
Primary	**87**	**71**	**30**	**158**
Secondary	**102**	**98**	**36**	**200**
Junior High	*60*	*47*	*16*	*107*
High School	*42*	*51*	*20*	*83*
Special Ed.	*8*	*7*	*3*	*15*
VET	*8*	*13*	*5*	*21*
Total	**189**	**169**	**66**	**358**

Table 2. Detailed Teams Origination

Origin	Teams
Northen Greece	30
Central Greece	17
Southern Greece	5
Greek Islands	14
Public School	*41*
Private School	*20*

Furthermore, the asynchronous courses were designed in a way to address a wide range of participants as shown in Table 3, including teachers from various disciplines with no prior experience in 3D printing. This multidisciplinary involvement was crucial as it provided a holistic view of how 3D printing technology could be integrated into different subject areas. Teachers from STEM fields, as well as from arts, humanities, and vocational training, all contributed their unique perspectives, experiences, and perceptions, enriching the study's findings. By involving educators from such varied backgrounds, we were able to capture a broad dataset of educational practices and the diverse ways in which 3D printing can be applied to enhance learning and creativity.

Table 3. Participating teachers by discipline

Discipline	Educators
ICT	16
Science	10
Engineer	7
Primary Teacher	8
Math	2
Kindergarten	2
Arts	2
Literature	2
TOTAL	49

This broad and inclusive sample framework not only reinforces the reliability of our findings but also sets the stage for exploring how such diversity influenced the effectiveness of the intervention, as elaborated in the following sections on evaluation tools and data analysis.

Data collection

The data collection was conducted using three different methods. Each team submit to the contest three deliverables. They had to compose an essay for their entire work during their preparation of the artifact, a presentation of their total work and a file in .stl format of their final 3D design.

1. Their essays and presentations provided a rich dataset for the research. Students were required to describe their experience participating in the 3D designing and printing contest, beginning with a brief introduction of their team and the sustainability problem they selected to find a solution, along with the reasons for their choice. They were to present their brainstorming process, sources of inspiration, and any challenges they faced, detailing how they overcame these challenges and any innovative elements they included in their design. Additionally, they described how they organized their teams, distributed

tasks, and the communication methods they used. They highlighted the biggest teamwork, technical, or design obstacles they encountered and their approaches to overcoming them, providing specific examples. They explained the new skills or knowledge acquired, the process of learning to use the 3D design software and printer, and how they handled technical difficulties. Finally, they reflected on their satisfaction with the final product, what went well, and what they would do differently if given another chance, including any feedback received from teachers, peers, or judges. They also identified the skills they developed during their participation and their thoughts on how they might use these skills in the future. They concluded by summarizing their overall experience, what they gained from it, and any final thoughts on the importance of such projects in education.

2. Third deliverable was their 3D design file in .stl format.
3. Finally, we evaluate their deliverables on assessments of the courses as also their contribution to the forum.

To evaluate the essential learning outcomes on this research, we utilized the VALUE (Valid Assessment of Learning in Undergraduate Education) rubrics, developed by the Association of American Colleges & Universities (AAC&U,2009) for Creative Thinking and Problem Solving, to assess the skill development of primary and secondary education students participating in the 3D designing and printing contest.

Specifically, for the skills that we focus we used:

a. **Creative Thinking Rubric:** The Creative Thinking rubric focuses on students' abilities to acquire new competencies, take risks, solve problems, embrace contradictions, and demonstrate innovative thinking. In the context of the contest, students were asked to submit STL files of their designs along with reflective essays and presentations. We analyzed these STL files to evaluate the complexity and originality of the designs. The essays provided insights into the students' brainstorming processes, sources of inspiration, and how they overcame challenges. By mapping these aspects to the rubric criteria, we assessed the level of creativity demonstrated by each team.
b. **Problem Solving Rubric:** The Problem-Solving rubric evaluates students' skills in defining problems, identifying strategies, proposing solutions, implementing solutions, and evaluating outcomes. Students were required to describe their project from inception to completion, including the identification of specific problems and the strategies they employed to address them. The STL files showcased the final implementation of their designs, while the essays detailed the iterative process and decision-making involved. This comprehensive approach allowed us to assess their problem-solving abilities effectively.

Adaptation

Although VALUE rubrics were initially designed for higher education, they have been effectively adapted and utilized in secondary education settings to assess various student learning outcomes (Vrioni, A. et al, 2021). To perform suitable adaptations, we employed the Delphi method to refine and validate the assessment criteria. The Delphi method is a structured communication process that gathers insights from a panel of experts through multiple rounds of questionnaires (Yousuf, M. I., 2007). In this study, we selected three experts from various fields, including STEAM education, 3D printing technology, and educational assessment. Initially, we presented the existing VALUE rubrics to the experts for feedback on their relevance and clarity. Over the first two weeks of the asynchronous course, the experts reviewed the rubrics based on student assessments and overall engagement in the course, offering suggestions for modifications and improvements. We must state that the national competition was different for elementary, middle and high school. Although the central theme was sustainable development. For the primary school concerned their school, for the middle school their neighborhood and for the high school their city. Due to that it was

suitable to use the same original rubric to all levels. These rubrics were then applied to evaluate student engagement, providing a suitable framework for assessing creativity and problem-solving skills.

Application

To apply the VALUE rubrics, we first collected all necessary data, including STL files, reflective essays, presentations, and any supporting documentation such as online course logs from forums and activities. Each project was then evaluated against the relevant rubric criteria.

For **Creative Thinking**, we looked for evidence of innovation and originality in the 3D models presented by the STL files and creativity in overcoming design challenges as described in the essays. For **Problem Solving**, we analyzed the problem identification and solution implementation processes detailed in the essays and reflected in the design iterations. Each criterion was scored on a scale of 1-4 based on the evidence provided.

Detailed feedback was provided by three judges, each an expert in a different field. The first judge was a professor in higher education specializing in the didactics of science. The second judge was a lecturer in higher education at a School of Art, with expertise in Architecture and Art and Design studies. The third judge was a secondary education science teacher and PhD candidate researching the didactics of science, with expertise in special education. Each of them provided individually and independently their evaluations considering the VALUE rubric for each skill.

Results

We analyzed the data that was collected with JASP 0.18.3. In primary level 158 students join the course and 118 complete the tasks while in secondary level 187 students joined and 131 complete the tasks. The data that collected from the course was used for Hypothesis 1. Thirty teams submit their outcomes to the contest from the primary level and thirty-six from the secondary level. We evaluate those deliverables for both Hypothesis 1 and 2.

Hypothesis 1: Students under a design thinking intervention improve their creativity skills throughout the course of the contest.

The study aimed to evaluate the development of students' creativity during a course by analyzing assessments from three evaluators at two time points: the 4th week (t1) and the 8th week (t2). Descriptive statistics indicated that the mean creativity scores increased from t1 to t2 for all evaluators and levels in table 4. In total mean score increased from 2.770 (SD=0,347) to 3,410 (SD = 0,406) for primary and 2.639 (SD=0,442) to 3,513 (SD = 0,376) for secondary education Table 4. Detailed statistics for separate evaluators are provided in Table 4. Paired t-tests confirmed that these increases were statistically significant for all evaluators ($p < 0.001$). Additionally, Cronbach's alpha was calculated to assess the internal consistency of the evaluators' scores. The results showed internal consistency, with Cronbach's alpha values of 0.772 at t1 and 0.766 at t2 for primary and 0.828 t1 and 0.841 for t2 for secondary education level.

Table 4. Descriptive statistics as also ANOVA analysis for primary and secondary evaluation in the middle t1, and at the end t2, of the supporting course.

	t1_primary	t2_primary	t1_secondary	t2_secondary
Descriptive				
mean	2.770	3,410	2,639	3,513
std	0,347	0,406	0,442	0,376
Cronbach	0.772	0.766	0.828	0.841

The p-value for the Time factor is less than .001 in table 5, indicating a statistically significant difference in the scores before and after the intervention.

Table 5. Repeated Measures ANOVA Within Subjects Effects

Cases	Sum of Squares	df	Mean Square	F	p
Time	156.615	1	156.615	652.327	< .001
Residuals	32.652	136	0.240		
Evaluator	0.097	2	0.049	0.794	0.453
Residuals	16.649	272	0.061		
Time ✻ Evaluator	0.118	2	0.059	1.092	0.337
Residuals	14.656	272	0.054		

The high F-value (652.327) suggests a strong effect of the intervention over time. The p-value for the Evaluator factor is 0.453, which is not statistically significant. This indicates that there is no significant difference in scores between the different evaluators. The p-value for the interaction between Time and Evaluator is 0.337, which is not statistically significant. This suggests that the effect of time (before vs. after the intervention) on scores does not differ significantly between evaluators.

Hypothesis 2: Students under a design thinking intervention improve their problem-solving skills throughout their engagement in the 3d contest.

This hypothesis was tested gathering data from the final essays that teams submit for the contest. Evaluators following VALUE Rubric for problem solving skills, marked specific milestones that proof, problem definition, strategies, solution proposals and evaluation of their potential, methods of implementation and the evaluation of the outcomes that was described by the students. Descriptive statistics indicated that the mean problem-solving skills that presented during these activities was evaluated as 2.67 (SD = 0,31) for primary teams and 3,28 (SD = 0,29) for secondary education level teams. Detailed statistics for separate evaluators are provided in table 6.

Table 6. Descriptive analysis for problem solving skills evaluation

	Primary				Secondary			
	A1	**A2**	**A3**	**Average**	**A1**	**A2**	**A3**	**Average**
count	30	30	30	30	36	36	36	36
mean	2,58	2,76	2,68	2,67	3,22	3,38	3,24	3,28
std	0,41	0,46	0,41	0,31	0,37	0,43	0,47	0,29
min	2,20	2,20	2,20	2,20	2,60	2,60	2,60	2,80
max	3,40	3,40	3,40	3,13	3,80	3,80	4,00	3,80

Discussion

The broad participation in the contest and the courses highlights the national interest and readiness to adopt 3d technologies in education. Schools from remote villages to bustling urban centers demonstrated their commitment to integrating 3D printing into their curricula, reflecting a nationwide movement towards modernizing education through technology. The inclusion of students from different economic environments and from special education schools emphasizes the most the accessibility and potential of 3D printing as a tool for bridging educational gaps. By providing equal opportunities for students from various backgrounds to engage with cutting-edge technology, this research highlights the democratizing potential of 3D printing in fostering creativity and skill development across Greece.

Similar initiatives at an international level reinforce these findings. In the United Arab Emirates, the integration of 3D printing in interdisciplinary STEM activities led to improved student attitudes toward science and technology, particularly when supported by trained educators (Khurma et all, 2023). The Makers Empire program in South Australia has been implemented in over 270 schools, showing measurable gains in spatial thinking and STEM engagement (Bower et all, 2018). In the United States, high school students participating in NASA's HUNCH program used 3D design to develop lunar surface tools, significantly boosting their confidence and scientific thinking (NASA, 2024). Likewise, in Japan, 3D printing was used to enhance geoscience education and produce assistive devices for children, promoting both applied learning and community service (Chenrai, 2021). These examples illustrate the global momentum toward using 3D technologies to foster creativity, inclusion, and practical skills development in education.

Hypothesis 1: Students under a design thinking intervention improve their creativity skills throughout the course of the contest. Creativity was measured by defining student actions such as acquiring competencies, taking risks, solving problems, embracing contradictions, innovative thinking, connecting, synthesizing, or transforming during the online supporting course. The increase in mean scores for both levels confirms the hypothesis that such activities support the development of creativity skills. Furthermore, both levels reach high scores at the end of the contest and a lot of them reach the capstones in the 5 categories of the Value Rubric. Even from the first evaluation, the mean score in the 4th week, which was the midpoint of the process, was high for both levels, indicating that these actions are integral to 3D designing projects. Notably, primary students' initial scores were higher than those of secondary students. This difference may be attributed to developmental and pedagogical characteristics specific to younger learners. Primary students are generally more open to imaginative thinking, less inhibited by rigid academic expectations, and more inclined to engage in playful experimentation—factors that align closely with the elements assessed in creativity rubrics. Additionally, the early educational environment often encourages exploration and non-linear thinking, whereas secondary education tends to emphasize structure, correctness, and measurable outcomes, which may constrain risk-taking and originality at initial stages.

Cronbach's Alpha values indicated internal consistency in the evaluations, highlighting the moderating effect of VALUE rubrics in the review process. This approach helped the evaluators the most, allowing them to moderate the review process effectively by identifying specific milestones in students assessments.

Hypothesis 2: Students under a design thinking intervention improve their problem-solving skills throughout their engagement in the 3d contest. The essays submitted by the teams for the contest served as valuable sources for assessing the problem-solving skills demonstrated by teams at both levels. Most essays accurately described the given problem, proposed solutions, and evaluated these proposals. Design thinking helped students form strategies and suggest methods of implementation. Secondary students appeared to be more efficient in

these procedures compared to primary students, who displayed a more playful attitude and less commitment to the goal.

Regarding Hypothesis 2, all three evaluators concurred that assessing the improvement in problem-solving skills cannot be conclusively determined at this stage of the research. The primary limitation is the one-time evaluation since the essays were the only evidence reviewed. Although problem-solving skills were evident in various aspects of their activities, proving their usefulness, measuring improvement requires a follow-up evaluation. This could be achieved by reviewing submissions in future 3D contests. The decision that we made to use the original Value Rubrics for both levels enrich our toolset for this purpose. A second limitation is that this evaluation could not be conducted for individual students but only for the entire team, as the essays were a collaborative effort.

Additionally, a critical examination of the evaluation design reveals that the structure of the final team essays may not have been ideally suited for capturing the full range of individual problem-solving processes. The open-ended nature of the assignment, while encouraging autonomy, may have allowed some students to participate passively, making it difficult to assess individual engagement. A more scaffolded assignment design—with required steps such as problem identification, brainstorming logs, prototyping sketches, and individual reflections—could provide richer data for future assessments. In contrast, creativity in Hypothesis 1 was measured using data gathered from the supporting course, which allowed us to collect data on individual engagement and improvement over time. To address this limitation, future assessments should integrate activities where problem-solving skills are used into the course. This approach can provide evidence of individual contributions and improvements.

Conclusion

The use of Project-Based Learning (PBL) combined with Design Thinking methodologies has proven to be effective in engaging students in complex 3D designing creative processes. Through structured courses and the integration of a national contest, students were encouraged to apply design thinking principles to develop innovative solutions, thus fostering a deeper understanding and practical application of their skills. This approach not only motivated students but also provided a platform for showcasing their work and receiving constructive feedback.

Creativity was notably developed during the 3D designing and printing activities across both educational levels. The findings underscore that creativity can be cultivated effectively through iterative design processes and collaborative exploration. Primary students in particular exhibited high levels of creative engagement, suggesting that early exposure to such pedagogies may be especially impactful.

While the study provides valuable insights into the use of problem-solving skills, assessing improvement remains inconclusive due to the one-time evaluation of essays. The assessment of problem-solving skills highlighted important methodological limitations—most notably the lack of longitudinal, individualized data. Addressing these limitations in future research and practice will allow for a more robust understanding of how such skills evolve over time and across learner profiles.

Beyond student outcomes, this study illustrates the broader potential of 3D printing as a democratizing force in education. Its successful application in rural, urban, and special education settings suggests that it can bridge geographical and social disparities. Policymakers and curriculum designers are encouraged to invest in infrastructure, teacher training, and accessible platforms that can support sustained integration of 3D technologies into mainstream and inclusive education.

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e-Safety Literacy of Primary School Principals

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Panetas Georgios
Primary school Teacher, Med, University of Patras
georgios.panetas@upnet.gr

Karatrantou Anthi
Assistant professor, University of Patras
akarat@upatras.gr

Panagiotakopoulos Christos
Professor Emeritus, University of Patras
cpanag@upatras.gr

Abstract

e-Safety competence is proving to be crucial for the educational community, creating a safe digital environment for students while supporting them in developing their digital skills. The e-Safety literacy of school principals ensures the safety of their students, especially in primary school. The aim of the study was to investigate e-Safety literacy related issues of primary school principals focusing on exploring what they know about e-Safety as well as what actions they are taking to promote e-Safety issues to teachers and parents and how they rate the level of knowledge and skills of teachers in their school on e-Safety issues. Ten primary school principals participated in the study answering a semi-structured interview. The results showed that all participants have a satisfactory level of knowledge about the risks of the internet, consider it important to inform parents about e-Safety, and request targeted training on e-Safety management issues in the educational community.

Keywords: e-Safety, e-Safety Literacy, school principals, primary school.

Introduction

Schools, as key pillars of education, have increasingly adopted digital tools to improve both teaching and administrative processes in the rapidly evolving digital age. These tools offer numerous benefits, such as increased efficiency and personalized learning, but they also pose significant challenges, particularly in e-Safety (Redecker, 2017).

Issues related to the use of digital technologies by young people are high on the European Commission's agenda, with topics such as mental health, cyberbullying, addiction to digital applications, and the protection of young people receiving particular attention (Dede, 2009; Gallego-Arrufat et al., 2019; Gordillo et al., 2021).

To address these challenges, frameworks such as the European Framework for the Digital Competence of Educators (DigCompEdu) and the European Framework for the Digital Competence of Educational Organizations (DigCompOrg) have been developed. The DigCompedu and DigCompOrg frameworks include competences related to e-Safety such as the protection of personal data, privacy, health and digital identity management. These frameworks provide structured guidance on the competences that teachers, school principals and institutions need to thrive in a digital environment while maintaining high standards of safety (Kampylis et al., 2015; Carretero et al., 2017; Gordillo et al., 2021).

Beyond data protection, e-safety involves creating an environment where students and staff can safely browse the internet. This includes protecting students from cyberbullying, exposure to inappropriate content, and other risks associated with digital platforms (Van Wart et al., 2019; Karatrantou & Papalouka, 2025).

School principals play an important role in empowering students to use these technologies safely, ethically, and responsibly. Ensuring e-safety in schools is a complex process that is influenced by various factors, such as technological infrastructure, staff training, and institutional culture. A lack of awareness and training among staff members often leads to poor compliance with e-safety policies (Tomczyk, 2020; Reisoğlu & Çebi, 2020; Rocha Estrada et al., 2022).

The e-safety of children and young people has become one of the research priorities of media education and school practice (Govender, Skea, 2019; Gordillo, Barra, López-Pernas, & Quemada, 2021). There is a worldwide concern for children's online safety and a growing necessity for e-safety skills to be taught to children from a very young age as part of their schooling (Nicolaidou, & Venizelou, 2020).

Education leaders, as school principals, play a decisive role in shaping the e-safety landscape in schools. As decision-makers, they are responsible for establishing policies and procedures that ensure the safe use of digital technologies. This includes establishing protocols for data protection, setting guidelines for ethical use of technology, and promoting a culture of accountability among staff and students (Sarva et al., 2022; Thuy Nguyen & Habók, 2024; Karatrantou & Stamatelos, 2025).

e-Safety

The field of e-Safety covers competences related to protecting devices and digital content, protecting personal data and privacy in digital environments, understanding risks and threats in digital environments, the appropriate use and sharing of personal data, the prevention of health risks and threats to physical and psychological well-being when using digital technologies, and understanding the environmental impact of digital technologies and their use (Tomczyk, 2021; Tomczyk, 2025).

Cultivation competences that increase the level of e-Safety supports the overall level of digital literacy and requires a holistic approach. It must consider all the important others in the process of media socialization: educators, parents and agencies that provide support in critical situations, such as cybercrime (e.g., *long-term cyberbullying, hacking, sexual abuse, addictions*).

Teachers have a strong knowledge of methods for enhancing students' critical thinking, creativity, communication, and collaboration skills, characteristics that integrate young people into contemporary society, help them use media safely, and participate in the culture mediated by social media (Tomczyk, 2020; Thuy Nguyen & Habók, 2024). However, teachers' level of knowledge and skills in e-Safety still require education and training (Rocha Estrada et al., 2022).

Furthermore, research literature shows that there is a necessity for e-safety to be taught from preschool and primary education levels. Therefore, there is a clear and urgent need to promote training activities to develop teachers' digital competence (Tomczyk, 2020; Tomczyk et al., 2023).

The holistic development of digital literacy including e-Safety literacy requires collaboration between teachers, parents and institutions to support e-Safety and respond to critical situations (Gallego-Arrufat, Torres-Hernández, & Pessoa, 2019; Karatrantou & Papalouka, 2025).

Unicef (2023) asks for '*School child protection committees'*, at school level comprised representatives from teachers, school counsellors, parents and students. The committees should be responsible for the '*School safety framework'*, policy or strategy to diagnose and prioritize safety concerns of students, teachers and parents within a school. The framework, policy or strategy should be used to develop a school safety plan to address concerns, and to monitor progress of the implementation and results of the school safety plan.

The role of school principals in e-Safety of school community.

Policy creation and effective crisis management are two key areas where school principals can make a real difference to e-safety in schools. e-safety policies set the framework for how schools work, making sure data is protected, ICT is used properly, and online threats are prevented (Redecker, 2017). School principals need to develop clear and realistic policies that meet the needs of the school community. These policies should cover critical issues such as personal data management, safe internet access, and the use of educational platforms. It is important to include guidelines for protecting students from online threats, such as cyberbullying and misinformation. Compliance with regulations such as the General Data Protection Regulation (GDPR) is at the core of these policies (European Commission, 2018; European Commission, 2020).

School principals must have soft skills and hard skills such as technological and digital literacy skills, learning innovation skills, communication & listening skills as main skills that a modern principal must cultivate and develop to inspire students, teachers and parents (Sonsaard & Darbavasu, 2019). They are expected to be able to manage crises related to e-Safety. This includes responding immediately to data violation incidents, taking measures to ensure safety, and informing the parties involved. Crisis management skills are vital, as they determine how effectively a school can limit the consequences of such incidents (Wu et al., 2019).

Safety policies must be accompanied by appropriate training and awareness-raising for users. Teachers, students, and parents must be informed about the measures taken and actively involved in their implementation.

The involvement of all members of the school community enhances the effectiveness of policies and creates a supportive environment (Van Wart et al., 2019). With proper guidance, school principals can ensure that schools are working as safe digital environments that respond to the challenges of the modern age.

Working with the wider educational community and parents is a critical part of ensuring e-safety in schools. School principals play a key role in creating a collaborative environment that promotes awareness, prevention, and response to threats in digital space (Redecker, 2017).

One of the key priorities in this collaboration is raising awareness among the school community about the importance of e-safety. Teachers, students, and parents need to understand the threats that exist online. School principals can organize seminars and workshops that focus on safe browsing practices, enhancing the knowledge and confidence of all parties involved (Wu et al., 2019; Krein, 2024; Okunlola, 2024).

Parents are important partners in this effort. School principals can provide informational materials and guidance to parents on the safe use of the internet by their children. Regular meetings between schools and parents can also facilitate the exchange of views.

Additionally, several initiatives in schools worldwide such as the "*Safer Internet Day*", since 2004, a day dedicated to raise awareness of emerging e-safety issues, that celebrated in approximately 160 countries worldwide, aim to promote the safer and more responsible use of online technologies, especially among children and young people (Nicolaidou, & Venizelou, 2020). The active participation of school communities in such events and initiatives is important and school principals ought to facilitate it.

Also, it is important to notice that aiming to protect children from online risks, there is a legislative framework that includes age restrictions prohibiting students under the age of 13 to create accounts, and nowadays a consultation of European Union member states of the European Union is active on the establishment of a European Digital Age Limit of 15 years (Hellenic Republic Ministry of Digital Governance, 2025).

Concluding, by systematically implementing best practices and providing appropriate support, school principals can play a decisive role in creating a safe and functional digital environment in schools.

Aim of the study and research questions

The study aims to explore what school principals know about e-Safety as well as what actions they are taking to promote e-Safety issues to teachers and parents.

Additionally, how they rate the level of knowledge and skills of teachers in their school on e-Safety issues as well as what teachers, parents and the State could and would do, is also discussed.

The research questions the study tries to answer are:

- *What do school principals know about e-Safety?*
- *What actions are they taking to promote e-Safety issues to teachers and parents?*
- *How do they rate the level of knowledge and skills of teachers in their school on e-Safety issues?*
- *How do they perceive the State's actions to include e-Safety issues in the educational process?*

Method

In the context of this study, a qualitative research methodology was adopted, using focused semi-structured interviews as a research tool to meet the needs of the research questions.

The semi-structured interview questions were based on the research of Tomczyk et al. (2023) and Tomczyk et al. (2025) on e-Safety.

The semi-structured interview included 28 questions:

- 8 questions concerned demographic data, knowledge background, and educational and management experience of school principals,
- 14 questions related to school principals' knowledge of the risks posed by Internet use,
- 3 questions referred to the actions taken by school principals to promote e-Safety issues to teachers and parents of students,
- 2 questions concern the perceived level of knowledge and skills of school teachers on e-Safety issues for integration into their teaching,
- 1 question concerns the promotion of the integration of e-Safety issues into the teaching framework by the State.

The validity and reliability of the semi-structured interview questions were thoroughly checked using the back-translation method, content validity review by a team of three researchers specializing in digital literacy and e-Safety issues, and face validity review through three pilot interviews with school principals, whose data were not used for analysis for the purposes of this study.

The sampling method used was purposive and convenient sampling, as semi-structured interviews were conducted with school principals to whom the researchers had easy access. To analyze the research data, the method of thematic analysis by hand was chosen, with the theme as the unit of analysis.

The code reproducibility test (Krippendorff, 2004) with the participation of two coders was used to verify the reliability of the thematic analysis codes, yielding satisfactory reliability (0.91).

Results and Discussion

Ten (10) interviews were conducted with school principals in rural (2#10), semi-urban (4#10), and urban (4#10) areas of Primary Education in Achaia.

Six (6) men and four (4) women participated in the study, ranging in age from 39 to 60, with 16 to 36 years of teaching experience and 2 to 16 years of experience as school principals.

All participants (10#10) held master's degrees, and two (2#10) participants held doctoral degrees. All (10#10) had been trained in ICT, and ICT in Education, and six (6#10) participants had been trained in e-Safety.

It is important to be noted that all participants answered the questions concerning knowledge about e-Safety issues correctly.

In tables 1, 2, 3, 4 and 5 the coded participants' answers per thematic axis and code category as they derided during the thematic analysis of the data are presented:

Table 1. School principals' knowledge concerning Cyberbullying.

Code category	Codes
Cuberbullying	• Bullies behave in a threatening (9#10), aggressive (9#10), and offensive manner (4#10). • Cyberbullying occurs by sending messages (6#10), possessing and threatening to publish photos (4#10) and videos (3#10) of victims. • Cyberbullying causes harm to victims (10#10). • Cyberbullying causes psychological (10#10), social (7#10), academic (1#10), physical (1#10), and moral (1#10) harm to victims. • Cyberbullying is a very common phenomenon (9#10). • Cyberbullying phenomenon is moderate (5#10), high (4#10) and low (1#10).
Need to act	• There is a need for teachers to take action to prevent incidents of cyberbullying (10), such as: *a) training teachers to deal with cyberbullying and online risks (5#10),* *b) informing students about the online risks (1#10),* *c) the need for communication and cooperation between teachers and parents to deal with cyberbullying incidents (1#10).* • Schools need to take action to prevent cyberbullying (6#10) organizing info sessions on cyberbullying and e-Safety for: *a) students (6#10), parents (4#10), teachers (3#10).* • There is a need for parents to take action to prevent cyberbullying (4#10): *a) informing their children about the dangers of the internet (2#10),* *b) supervising their children while they are using the internet (2#10),* *c) informing their children about cyberbullying (1#10),* *d) informing themselves about how to deal with cyberbullying (1#10),* *e) preventing their children from creating social media accounts (1#10).* • There is a need for actions by the state to prevent cyberbullying (3#10): *a) to raise awareness of the problem among the state (1#10),* *b) to inform all citizens about cyberbullying (1#20),* *c) to introduce a course on the dangers of the internet (1#10),* *d) to criminalize the phenomenon (1#10).* • Students themselves should take actions to prevent cyberbullying 1#10), such as immediately informing adults around them if they are victims.

All participants (10#10) correctly define "cyberbullying."

It is important to notice that all participants (10#10) claim that their students have social media accounts, pointing out that their students have accounts on TikTok (9#10), Instagram (6#10), Facebook (5#10), and Viber (1#10).

Table 2. School principals' knowledge concerning online threats.

Code category	Codes
cyberstalking	• A key characteristic is the stalker obsessively monitoring the victim's traces.
Pornographic material	• It is very possible for children to meet such material on the internet (10#10): *a) while browsing the internet (9#10), b) with the help of their older friends (8#10), c) through encouragement from adult family members (3#10), d) to satisfy their curiosity about their sexual development (2#10), e) through the appearance of relevant advertisements while surfing the internet (1#10), f) lack of supervision by their parents is responsible for children encountering such material (4#10)*
Meet online friends	• Primary school children do not meet online friends in person, due to (7#10): *a) their parents' supervision, prevents them meeting strangers (4#10),* *b) their young age (1#10), c) their fear of the unknown (1#10).* • In case primary school children meet online friends in person, it may be due to: *a) their desire to satisfy their needs for communication (3#10), b) their curiosity to meet strangers (3#10), c) their lack of developed critical thinking (1#10), d) the sense of neglect they feel by their families (1#10).*
Sexting	• Sexting is the online exchange of messages (7#10), videos (5#10), and photos (6#10) of a sexual nature for the purpose of sexual gratification.
"Hate speech"	• "hate speech" is a criminal offense (7#10). • Individuals use their social media accounts to attack users or groups of users and incite other users to put violence against them, targeting characteristics of users or groups of users related to (7#10): *a) religion (7#10), b) race (6#10), c) political beliefs (4#10), d) gender (5#10), e) ethnicity (3#20).*
Fake news	• The purpose of fake news is to misinform users/citizens (8#10). • There is a difficulty of recognizing fake news (8#10). • Cross-checking information from various sources as a way of recognizing fake news (8#10). • There is too much fake news that citizens are exposed to daily (7#10). • The use of artificial intelligence has led to an increase in the amount of fake news and made it more difficult to identify (6#10).
Challenge-type games	• The "Blue Whale" game has a negative impact on children (9#10), many children have committed suicide (9#10) and self-harmed (8#10). • Social media platform TikTok encourages the spread and promotion of challenge-type games among children.

Advertisement	• Personalized advertisements are promoted to users based on: *a) gender (9#10), b) age (9#10), c) searches on search engines (8#10), d) geographical location (6#10), e) cookies they have accepted (3#10), f) interests and preferences they have indicated in their social media accounts (2#10), g) data collected from their devices (2#10).*
Digital detoxification	• digital detoxification can be achieved by: *a) reducing gradually the internet use (6#10), b) limiting the use of digital devices (5#10), c) offering help to addicted individuals by psychologists (3#10), d) with appropriate medical assistance (3#10), e) with family support for addicts (2#10).*

All participants can describe correctly what cyberstalking is, how children can find Pornographic material on the internet, their tension to Meet online friends or not, the ways Sexting is appearing, what "Hate speech" is, what happens with Fake news, the dangers of Challenge-type games, the way Advertisement works and how users can achieve Digital detoxification.

Table 3. The actions of school principals to promote e-safety issues to teachers and parents of their students

Code category	Codes
Parents' action needed	• School principals consider that to ensure their children's safety online, parents should: • *supervise their children while they are browsing the internet (6#10),* • *inform their children about the risks on the internet (5#10),* • *install parental control software on their children's digital devices used to connect to the internet (3#10),* • *set time limits for their children's internet use (3#10),* • *inform themselves about the risks of internet use (2#10),* • *be able to set and adhere to limits and rules for their own internet use (1#10),* • *not allow their children to have their own personal digital devices (1#10),* • *keep a common stance as parents on the issue of their children's e-safety (1#10)* • *spend time doing sports activities with their children (1#10)* • *stop thinking that the internet is a babysitting tool (1#10)*
School principals' actions to parents	• Inform students' parents about e-Safety organizing relevant short seminars and informative meetings (5#10). • Although they organize informative activities for the parents just a few parents respond to their call (2#10). • Plan to inform parents (2#10).
School principals' actions to teachers	• Encourage teachers at their school to incorporate e-safety issues into their teaching (7#10)

School principals talk about parents' action needed to be taken by them as they consider the role of parents crucial but not all of them inform parents about e-Safety issues. Most school principals encourage teachers at their school to incorporate e-safety issues into their teaching.

Table 4. The rated level of literacy of schoolteachers on e-Safety issues for inclusion in their teaching

Code category	Codes
Sufficient literacy	• Teachers do not have sufficient knowledge and skills to incorporate digital safety issues into their teaching (8#10). • Teachers have sufficient knowledge and skills to incorporate digital safety issues into their teaching (2#10).
Need for training	• There is a strong need for additional training for teachers at their school to incorporate e- safety issues into their teaching (10#10). • Not enough relevant training opportunities are provided for teachers in their schools (7#10). • The training opportunities provided by private (3#10) and public (1#10) institutions

School principals consider that teachers do not have sufficient knowledge and skills to incorporate digital safety issues into their teaching and there is a strong need for additional training for teachers concerning e-Safety. There is a lack of training opportunities for teachers in their schools.

Table 5. State Promotion of the integration of e-Safety issues into education

Code category	Codes
The current situation	Those responsible for formulating and implementing educational policies do not substantially support the inclusion of e-Safety issues in teaching (7#10)
Action by the State	Those responsible for formulating and implementing educational policies support the inclusion of digital security issues in teaching through (3#10): *a) changes to the curriculum (1#10),* *b addition of e-Safety modules into lesson materials (1#10),* *c) teacher training opportunities (1#10).*

The State and the educational authorities should promote the integration of e-Safety issues into teaching and learning, but they do not substantially support this. Changes to the curriculum at schools, addition of e-Safety modules into lesson materials and teacher training opportunities are necessary.

Conclusion

The aim of the study was to investigate e-Safety literacy of primary school principals, exploring what they know about e-Safety as well as what actions they are taking to promote e-Safety issues to teachers and parents of their students and how they rate the level of knowledge and skills of teachers in their school on e-Safety issues.

Ten primary school principals participated in the study answering the questions of semi-structured interview concerning the level of basic knowledge in the field of e-Safety, the degree of informing parents, and the needs of teachers in digital security issues.

The thematic analysis of the participating school principals' answers offered answers to the research questions as follows:

What do school principals know about e-Safety?

School principals seem to be aware of the dangers facing their students on the Internet, particularly cyberbullying, harm caused to victims of cyberbullying, ways of dealing with cyberbullying, cyberstalking, the possibility of students coming into contact with sexual or pornographic material on the Internet, students meeting friends they have met online in person, sexting, hate speech, fake news, the impact of the "Blue Whale" game and other "challenge" games on young people, the ways in which advertisements are selected to appear on users' social networks, students' ownership of social media accounts, and digital detoxification. It is interesting to note that school principals are aware that their students have social media accounts, even though the legal framework sets age restrictions that prevent students under 13 from creating accounts, during the consultation of European Union member states of the European Union on the establishment of a European Digital Age Limit of 15 years (Hellenic Republic Ministry of Digital Governance, 2025).

What actions are they taking to promote e-Safety issues to teachers and parents?

Although school administrators outline good practices that parents can use to ensure their children's safety online, most of them are not willing to inform their students' parents about e-safety. School principals who inform the parents about e-safety do so by organizing seminars on e-safety. Most principals seem to encourage teachers at their schools to include e-safety issues in their teaching.

How do they rate the level of knowledge and skills of teachers in their school on e-Safety issues?

Most school principals rating the level of knowledge and skills of teachers on e-Safety issues for inclusion in their teaching, point out that teachers do not have sufficient knowledge and skills to do so, supporting the need for additional teacher training in their schools, highlighting that there is lack of such training.

How do they perceive the State's actions to include e-Safety issues in the educational process?

Most school principals emphasize that the State and the educational authorities do not effectively and adequately promote the inclusion of e-Safety issues in the educational process in primary schools. The State and the educational authorities should promote the integration of e-Safety issues into teaching and learning, but they do not substantially support this. Changes to the curriculum at schools, addition of e-Safety modules into lesson materials and teacher training opportunities are necessary.

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