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Contents

Innovative Approaches in Medical Education for Family Medicine: Trends, Challenges, and Perspectives in Romania.....	5
Increasing the Level of Education of the Younger Generation through Theatre.....	17
Mapping TikTok Adoption in Romanian Universities: A Comparative Analysis of Social Media Communication Strategies Across Public and Private Universities.....	32
Adapting Students' Learning Styles Using Artificial Intelligence in Learning Computer Science Concepts and Developing Educational Robots.....	51
Communication Barriers in Technical Faculties.....	60
Perceived Stress, Basic Psychological Needs, and Quality of Life among Romanian School Counselors: A Mixed-Methods Study.....	74
Online Teaching Strategies for Nursing Students: Challenges and Opportunities.....	89
Optimizing EFL Listening Proficiency Through Technology-Mediated Instruction.....	125
Developing Research Skills of Students.....	134
Directions and Emerging Trends in Teacher-Led Research on the Development of Communication Competences in Early Childhood and Primary Education.....	150
Inclusive Learning: The Antipa Museum for Neurodiverse Children.....	164
Arduino as an Educational Tool for Exploring Medical Signals.....	180
An Exploratory Study on the Use of Augmented Reality (AR) in Medical Education.....	195
Combat Mindset (CoMind): from an innovative project to a mandatory discipline.....	207
Kioi Seidō – The Architecture of Education: A Building that Teaches Without Teaching.....	218
A New Approach to Interactive Education: Game Engine-Based Frameworks for Teachers to Develop Interactive Lessons.....	238



Innovative Approaches in Medical Education for Family Medicine: Trends, Challenges, and Perspectives in Romania

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Abstract

Family Medicine represents a cornerstone of healthcare delivery, requiring a solid educational foundation that integrates clinical knowledge, communication, prevention, and continuity of care. In Romania, the continuous evolution of academic requirements and healthcare needs has stimulated a reassessment of medical education approaches, particularly in the context of European integration and global health challenges.

This study evaluates current trends in Family Medicine education in Romania, with a focus on competency-based curricula, digital platforms, and interprofessional training, aiming to identify innovative directions and existing challenges.

A mixed-methods approach was adopted, consisting of a review of national curricula and policy documents, analysis of European recommendations, and a cross-sectional survey involving 126 family medicine residents and 42 academic trainers from five Romanian medical universities.



Quantitative data were analysed descriptively, while qualitative responses underwent thematic coding to identify recurrent patterns.

The results highlight a gradual but steady transition towards competency-based training, with an increasing emphasis on clinical reasoning, patient-centered care, and preventive strategies. E-learning platforms and case-based simulations were perceived as valuable, especially during and after the COVID-19 pandemic. Respondents stressed the necessity of integrating telemedicine, health promotion, and communication skills into teaching. However, significant barriers were noted, such as uneven access to digital infrastructure, limited simulation resources, and insufficiently structured mentorship programmes.

Family Medicine education in Romania is currently aligning with European standards while addressing local healthcare realities. To enhance the preparedness of future physicians, investment in digital competencies, interprofessional learning, structured mentorship, and continuous assessment tools is essential. By bridging these gaps, Family Medicine can remain a dynamic discipline, capable of responding effectively to the evolving health needs of patients and communities.

Keywords: Family Medicine, medical education, competency-based curriculum, digital learning, Romania, interprofessional training.

1. Introduction

Family Medicine is the foundation of modern health care systems, as it represents the initial contact between the patient and the medical profession. It derives its strength from continuity, comprehensiveness, and a person-centred approach. The specialty demands a wide range of clinical and interpersonal competencies across preventive, diagnostic, and therapeutic areas. In Romania, Family Medicine (FM) occupies a unique role within the healthcare structure, serving both urban and rural communities. Over the last two decades, educational reforms and European integration have prompted significant shifts in medical education, with increased attention to



competency-based learning, digital tools, and interprofessional collaboration. Yet, the transition remains incomplete, facing structural, pedagogical, and logistical barriers.

2. Background

The global shift towards competency-based medical education (CBME) has transformed curricula in most of Europe. The World Federation for Medical Education (WFME) and European Academy of Teachers in General Practice (EURACT) have made guidelines that emphasize evidence-based decision-making, ethical conduct, communication skills, and practical competencies. In Romania, FM residency programmes have more and more incorporated these principles. The Ministry of Health and the medical universities have introduced modules that encourage active learning, reflective practice, and problem-solving.

The COVID-19 pandemic expedited the transition to digital and hybrid learning modalities even further. Digital consulting, remote assessment, and simulation-based training are now essential tools. The period brought to light the potential as well as the limitations of digitalisation in medical education, especially where direct patient contact is involved as well as communication sensitivity, like in the case of Family Medicine.

3. Methodology

A mixed-method study between January and June 2024 was conducted. The study combined a documentary review with a cross-sectional survey in order to explore the status and attitudes towards FM education in Romania. The study design integrated documentary review and cross-sectional survey elements to reflect the training trends from both institutional and participant viewpoints. Documentary review consisted of national curricula, official Romanian Ministry of Health regulatory documents, and European guidelines relevant to the field (EURACT, WFME) to extract current standards and competencies required in FM training.

The quantitative section was a standardized online survey distributed to 126 FM residents and 42 academic trainers from five Romanian medical schools (Bucharest, Cluj-Napoca, Iași, Timișoara,



and Craiova). The instrument assessed perceptions about curriculum content, pedagogic methods, digital learning environments, mentoring, and innovation barriers. The data were examined via descriptive statistics (SPSS v.25), Triangulation across data sources ensured validity and added interpretive depth.

4. Results and Discussions

4.1 Curriculum and Competency-Based Approaches

Findings from both survey of participants and documentary analysis reveal a consistent shift towards Competency-Based Medical Education (CBME) within Romanian Family Medicine (FM) residency programs. Respondents consistently acknowledged that the shift came palpable within the last five years, particularly in the modules on clinical reasoning, preventive medicine, and patient-centered communication. The areas align with global models, starting with EURACT (2011), including World Federation for Medical Education (WFME, 2020) and WONCA Europe's European Definition of General Practice/Family Medicine (2022).

Educational Element	Percentage of Respondents (%)
Structured feedback on communication and decision-making	78%
Exposure to problem-based learning and clinical cases	65%
Integration of patient-centred care modules	59%
Reflective practice and portfolio-based learning	32%
Assessment via OSCEs or structured performance evaluation	21%

Table 1. Perceived Implementation of CBME Elements in Family Medicine Training in Romania (n = 126)

The evidence suggests that competency-based reforms are being piloted incrementally into Romanian FM education (Romanian Ministry of Health, 2022). While the majority of programs have integrated new pedagogic modalities, namely PBL (problem-based learning) and formalized feedback, innovation in assessment has not been forthcoming (Băban et al., 2023).



4.2 Digital and Simulation-Based Learning

The integration of learning technologies into Family Medicine (FM) in Romania has gone far more quickly after the post-pandemic era. The COVID-19 pandemic was a stimulus to reassess traditional teaching habits, with universities shifting to implement online portals, virtual case discussions, and blended teaching methods.

Survey results showed that the vast majority, 84% (n = 141) of all participants (residents and trainers), welcomed online clinical case simulations, interactive webinars, and computer-based learning modules as very useful tools to develop clinical reasoning and independent learning. Participants revealed that e-learning provided more flexibility with asynchronous access to content and independent learning. Some respondents also noted that online case-based discussions helped in developing diagnostic thinking, especially where direct patient interaction was restricted.

Digital Learning Element	Percentage of Respondents (%)
Online case simulations and webinars valued as effective	84%
Access to functional simulation laboratories	43%
Use of standard e-learning platforms (Moodle, Teams, Zoom)	76%
Integration of digital assessments and feedback tools	52%
Preference for hybrid learning model (online + clinical)	68%

Table 2. Use and Perceived Value of Digital Learning Tools in Family Medicine Training

These findings confirm a growing digital literacy and tolerance toward e-learning among both residents and teachers.

4.3 Interprofessional and Community-Based Training

Interprofessional learning (IPL) and community orientation are central to Family Medicine (FM) training, facilitating teamwork, leadership, and a holistic vision for care for the patient needs within the broader context of healthcare (Frank et al., 2010). The evolution in Romania towards



team-based and community-oriented medical education is underway but disjointed and highly uneven among universities.

The survey showed that 68% (n = 114) of residents reported participating in one or more interprofessional educational activities, such as health promotion services, immunization campaigns, or community screening events hosted in conjunction with nurses, public health professionals, or pharmacists. These activities were particularly appreciated for enhancing communication between professions and increasing the level of awareness of social determinants of health.

From the trainers' perspective, IPL's benefits extend beyond collaboration. Educators observed that community-based experiences—e.g., rotations in rural environments or multidisciplinary primary care units—maximize residents' skills in empathy, adaptability, and resource management. Logistic constraints, e.g., low budget, poor field supervision, and poor coordination between academic and community organizations, typically restrict numbers and quality of these experiences.

Type of Activity or Opportunity	Percentage of Respondents (%)
Participation in interprofessional health promotion projects	68%
Access to structured interprofessional learning modules	41%
Interest in expanding IPL workshops and case discussions	52%
Community outreach or public health campaigns during residency	61%
Rural or underserved area training experiences	46%

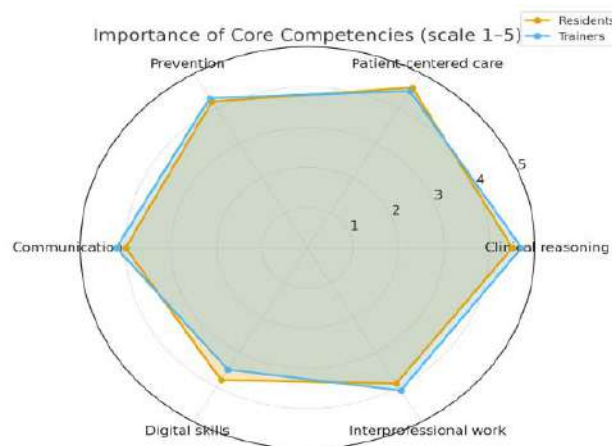
Table 3. Engagement in Interprofessional and Community-Based Activities among Family Medicine Residents

The evidence highlights a growing recognition of the worth of interprofessional education in FM, consistent with European and WHO policy for team-based primary care (Gruppen et al., 2022). Community projects and informal collaborations are very common, however, whereas formal interprofessional curricula are still underdeveloped at Romanian universities.

Residents and teachers together recognized that shared working and joint decision-making are critical in modern primary care, particularly for managing long-term disease and health literacy.

Yet there is a lack of regular measurement of team proficiency, interprofessional feedback systems, and organizational incentives for collaborative education.

The following radar chart is showing the Importance of Core Competencies (scale 1–5) as rated by Residents and Trainers in Family Medicine.



The graph demonstrates a uniformly high perceived importance of all core competencies among both Family Medicine Residents (orange line) and Trainers (blue line), with most ratings clustering around the maximum value of 5 or slightly below (4 to 5). This suggests a strong, consensual recognition of the broad spectrum of skills required for effective Family Medicine practice in the Romanian context (Popescu et al., 2023).

4.4 Mentorship and Professional Identity

Mentorship is one of the cornerstones of Family Medicine (FM) education, spanning theoretical education and professional identity formation (Harden et al., 1999). Mentorship improves clinical competence, reflective practice, and personal development. Residents and academic teachers both acknowledged the ability of change through effective mentorship. Qualitative responses emphasized that continuous mentoring enhanced self-esteem, clinical competence, and stamina for challenging or emototional cases.

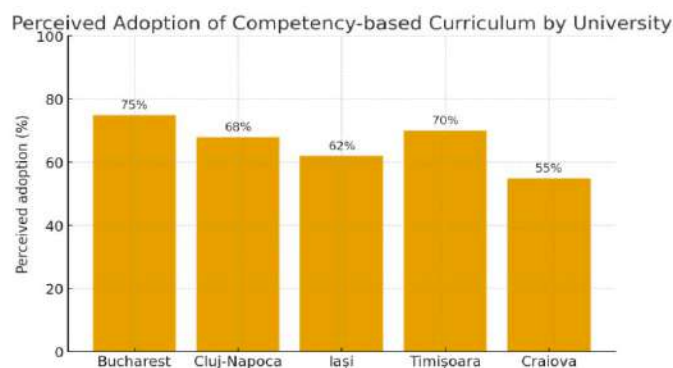
Mentorship Element	Percentage of Respondents (%)
Formally assigned mentor throughout residency	39%



Occasional or informal supervision during rotations	47%
No consistent mentorship received	14%
Regular feedback and reflective discussions with mentor	34%
Participation in institutional mentorship programme	22%

Table 4. Mentorship and Supervision Patterns in Family Medicine Residency Training

The next bar chart displays the perceived adoption of Competency-based curriculum (CBC) in Family Medicine education across five major university centers in Romania: Bucharest, Cluj-Napoca, Iași, Timișoara, and Craiova.



The data provides a critical snapshot of the self-reported progress in modernizing the Family Medicine residency training framework within Romania.

4.5 Barriers and Challenges

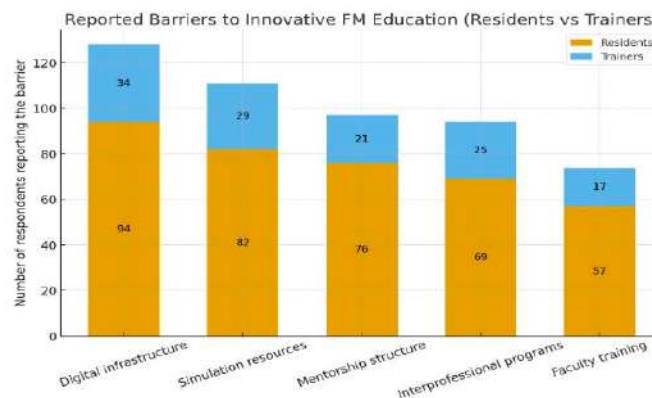
Despite significant progress made thus far in getting Family Medicine (FM) education in Romania up to European standards, implementing innovative teaching and learning approaches (Sandars et al., 20121) continues to face massive structural and institutional challenges. Analysis of survey data, coupled with qualitative accounts of residents, as well as academic trainers, revealed a complex dynamics of intertwined constraints of resources, institution inertia, and uneven adoption of technology.



Reported Barrier	Percentage of Respondents (%)
Inadequate digital and simulation infrastructure	72%
Lack of structured mentorship and supervision	63%
Institutional inertia / resistance to pedagogical reform	58%
Time constraints for educators and trainees	54%
Insufficient training in digital and interactive teaching	49%

Table 5. Key Barriers to the Implementation of Innovative Educational Strategies in Family Medicine Training

The stacked bar chart illustrates the reported barriers to innovative FM education as perceived by FM residents and trainers in Romania.



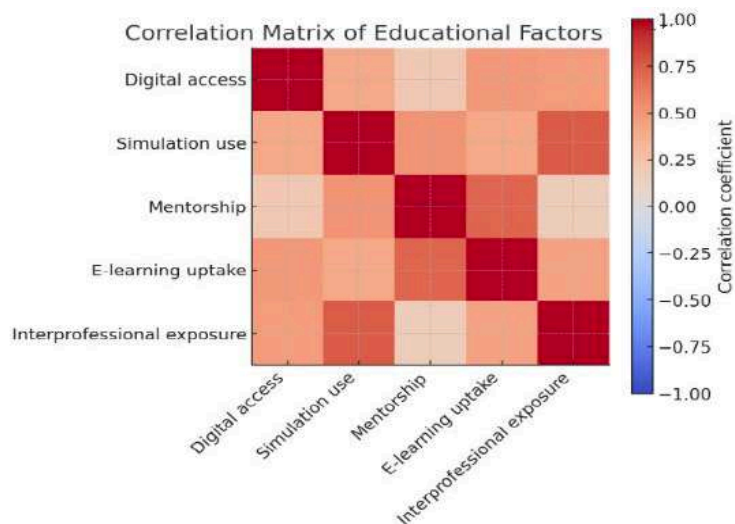
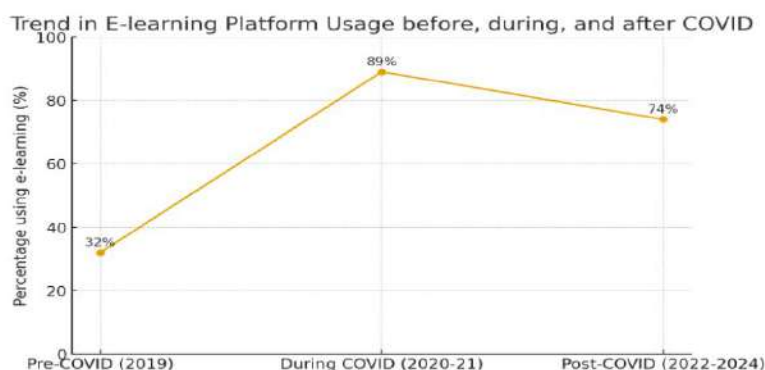
The findings confirm a progressive evolution of FM education in Romania in line with European expectations, albeit in heterogeneity of the universities. Growing integration of CBME and computer facilities is a sign of national dedication to modernisation (Dornan et al., 2019), but the sustainability of such reforms depends on adequate investment and policy consistency.

A significant majority of the responders accepted a favorable trend in CBME, especially in modules for clinical reasoning, preventive medicine, and patient-centered care. 78% of the



Romanian International Conference for Education & Research

residents reported receiving formal feedback about communication and decision-making skills. And 65% reported seeing problem-based learning sessions and clinical case discussions. E-learning and digital technology gained huge speed post-pandemic: 84% of participants valued online clinical case simulations and webinars. However, just 43% enjoyed access to well-equipped digital simulation labs.



This heatmap displays the correlation matrix of educational factors, showing the linear relationship (correlation coefficient) between five key components of FM education.



5. Conclusions

Romanian Family Medicine education stands at a juncture of change. In spite of significant steps taken towards competency-oriented and technologically enabled learning, there are still disparities in infrastructure, mentorship, and integration with other professions. The profession must keep changing by way of collaborative innovation, investment in digital and human capital, and alignment with international best practices.

This article provides a comprehensive overview of the state, evolution, and challenges of Family Medicine (FM) education in Romania, emphasizing the innovative trend towards competency-based, technologically supported, and patient-centered training.

This research contributes to the growing literature on Central and Eastern European reform in medical education, offering a case study of innovation through adaptation within a transitioning system. It highlights that true educational innovation requires more than investment in technology, but rather cultural shift toward reflective, student-focused pedagogy (Ellaway et al., 2020).

In Romania, training in Family Medicine is at crossroads, sitting between the inheritance of traditional medical pedagogy and the necessities of competency-based, digitally supported, and patient-centered practice. Mentorship development, infrastructure improvement, and pedagogic innovation are the pillars for ensuring this change becomes a reality. By combining these pillars, FM education in Romania can be aligned to European standards while being responsive to local healthcare realities. It is not only a question of producing competent clinicians but also reflective, empathetic, and responsive professionals who are able to adapt to communities' changing health needs.



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Increasing the Level of Education of the Younger Generation through Theatre

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Abstract

Theatre is an integrative art form, with the capacity to support human development and the process of building skills for personal fulfilment and growth. The provision of theatrical education has been demonstrated to facilitate social integration and active participation in society. Furthermore, it has been shown to promote the formation of a concept of life based on humanistic and scientific values, national and universal culture, and the stimulation of intercultural dialogue, respect for dignity, tolerance, and fundamental human rights and freedoms. Theatre has been demonstrated to engender sensitivity to human issues, moral and civic values, and the promotion of sustainability and respect for the natural, social, and cultural environment.

In the contemporary educational landscape, the integration of theatre in education has emerged as a compelling strategy to cultivate a well-rounded, dynamic learning environment. Theatre, with its rich tapestry of creativity, collaboration, and critical thinking, offers unique opportunities to enhance traditional educational methodologies. The integration of theatrical practices into the curriculum has been demonstrated to enhance the learning experience and address the holistic development of students, preparing them for the complexities of modern life.

The initiative to educate young people through theatre is a welcome one. It is aimed both at universities and faculties that offer programmes in theatre and the performing arts in Romania, as well as theatres that may have educational programmes dedicated to teenagers. The recent



introduction of theatre education in high schools, in conjunction with music and visual education, will facilitate the employment of graduates from relevant faculties in pre-university education. Furthermore, the enhancement in the level of education of adolescents will be evident through their engagement with theatre.

The present paper sets out the hypothesis that an increase in the level of education of the younger generation is to be achieved through the medium of theatre.

1. Introduction

Theatre is an integrative art form, with the capacity to support human development and the process of building skills for personal fulfilment and growth. The provision of theatrical education has been demonstrated to facilitate social integration and active participation in society. Furthermore, it has been shown to promote the formation of a concept of life based on humanistic and scientific values, national and universal culture, and the stimulation of intercultural dialogue, respect for dignity, tolerance, and fundamental human rights and freedoms. Theatre has been demonstrated to engender sensitivity to human issues, moral and civic values, and the promotion of sustainability and respect for the natural, social, and cultural environment.

2. Literature Review

In the contemporary educational landscape, the integration of theatre in education has emerged as a compelling strategy to cultivate a well-rounded, dynamic learning environment. Theatre, with its rich tapestry of creativity, collaboration, and critical thinking, offers unique opportunities to enhance traditional educational methodologies. The integration of theatrical practices into the curriculum has been demonstrated to enhance the learning experience and address the holistic development of students, preparing them for the complexities of modern life.

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well as theatres that may have educational programmes dedicated to teenagers. The recent introduction of theatre education in high schools, in conjunction with music and visual education, will facilitate the employment of graduates from relevant faculties in pre-university education. Furthermore, the enhancement in the level of education of adolescents will be evident through their engagement with theatre.

Theatre for young people is a form of theatre that is defined by and for its audience, since the use of the preposition, which indicates the attribution of the artistic object – the young audience (or for children and adolescents, for young people) – is absent in the definition of other forms of theatre. On the one hand, there is the theatre for young audiences, which reveals a very attentive concern for the spectator, for the way in which the artistic message is conveyed, but also for its pedagogical stakes. The name itself is indicative of the target audience, which is clearly defined, important and appropriately perceived. Furthermore, the mission of this type of theatre is unique and special. Conversely, this name has been argued to contribute to a devaluation of the meaning and value of the artistic act. For young audiences, it is often translated as "lower quality" or even "a minor genre of theatre". This may be attributed to the historical context in which theatre for young people was predominantly regarded as an educational instrument, with artistically significant performances emerging subsequently. The fundamental premise of the article is that young people require a theatrical education that is distinct from that provided to adults, particularly in the context of youth theatre. The argument is that the artistic act should be different for young people. These objectives can be achieved through a variety of cultural activities, communication strategies, and promotional initiatives.

The role of cultural activities in society has been extensively discussed in terms of their economic impact, with little consideration given to their impact on social life. A considerable number of studies have sought to ascertain the impact of diverse leisure activities on educational capital.



3. Methodology

The present article is an examination of the concept of cultural marketing, which may be defined as the process and art of offering the artistic product to the target audience by combining it with tools such as price, placement, promotion and staffing of organisations in order to achieve management objectives. In contrast to the conventional marketing paradigm within the contemporary market economy, artistic products do not merely respond to expressed consumer demands; rather, they identify the appropriate audience for an existing product or service, thereby establishing a framework of expectations. Concurrently, the objective of cultural marketing is to establish a mutually beneficial relationship between the organisation and the consumers.

The cultural institution is the entity that facilitates the act of creation, in addition to providing the resources necessary to create a unique experience for the audience. The theatrical performance, as a work of art contingent on its audience, is a social and participatory event. In this sense, the reality of the artists and that of the audience become one.

The objective of this paper is to identify strategies through which theatrical institutions could educate the younger generation, an activity that is only reluctantly practised in cultural organisations. The present study proposes an encounter between organisational thinking and consumer behaviour, with a view to providing performing arts institutions with practical guidance specific to cultural marketing.

4. Main Results

The literature review has outlined a number of theoretical perspectives that aim to identify the social impact attributed to participation in cultural activities. These perspectives analyse aspects related to active citizenship, civic engagement, social integration and democratic participation.¹ To illustrate this point, the following example is provided: For instance, the European Parliament's resolution of 11 December 2018 on the New European Agenda for Culture

¹ M. Sharon Jeannotte, *The Social Effects of Culture. A Literature Review* (Centre on Governance, University of Ottawa, 2017).



highlights the pivotal function of culture and the cultural and creative industries in accomplishing the objectives of cohesion and social inclusion policies. This assertion underscores the distinctive contribution of cultural life in fortifying a democratic society.²

The 2022 Cultural Consumption Barometer report indicates that the situation in Romania has shown signs of improvement compared to 2021, though it remains below the levels recorded in 2019. Carmen Croitoru, who occupies the position of Director General of the National Institute for Cultural Research and Training in Bucharest, is the subject of this text.³

The findings of the 2022 consumption trends report, representing the initial post-pandemic study, indicate a gradual return of Romanians to theatres and cinemas. Concurrently, they persist in their online activities, seeking both information and entertainment.⁴ For the first time, the Barometer establishes a correlation between cultural consumption and democratic citizenship, demonstrating that Romanians who are frequently exposed to cultural practices tend to be more involved in community life. With regard to attendance at theatre performances, data indicates a 9% decrease compared to 2019, when the proportion of Romanians who stated they attended the theatre at least once a year was 29%. It is noteworthy that in 2021, a year characterised by social restrictions, the proportion was a mere 7%, thereby indicating that the new barometer is indicative of a gradual return to pre-pandemic behaviours.

Furthermore, cinema attendance has decreased from 35% of respondents in 2019 to 26%, although this figure has increased by 12% compared to 2021. Furthermore, the proportion of individuals who visit museums, galleries or art exhibitions at least once a year has decreased by 8 per cent since 2019, from 38 per cent to 30 per cent. However, it is projected that this figure will increase by 6 per cent from 2021. The survey also demonstrates how young people are engaging with culture. It is an established fact that, even prior to the advent of the pandemic, the

² EU Commission, European Parliament Resolution of 11 December 2018 on the New European Agenda for Culture, 2018.

³<https://www.radioromaniacultural.ro/emisiuni/timpul-prezent/timpul-prezent-barometrul-de-consum-cultural-2022-carmen-croitoru-situatia-e-ceva-mai-buna-decit-in-2021-dar-ceva-mai-proasta-ca-in-2019-id40493.html>, accessed on September 23.

⁴<https://culturaladuba.ro/84-dintre-romani-nu-au-incredere-in-oameni-de-alta-nationalitate-arata-barometrul-cultural-2022/>, accessed on September 25.



younger generation exhibited a keen interest in the possibilities offered by the Internet, particularly for those with limited material means. Furthermore, they demonstrated a higher level of comfort in analysing specific cultural aspects on the Internet when compared to the 50+ generation. It is indeed the case that this generation, which has been termed 'the generation that grew up with television', has been exposed to a plethora of information since childhood, with no concomitant effort to interpret or decipher the messages. Consequently, their relationship with the Internet has been characterised by a similar process of passive reception, whereby images are presented alongside pre-determined messages. The absence of cultural infrastructure, such as performing arts venues or cultural centres, has been demonstrated to have a detrimental effect on cultural consumption, with consumers turning to the internet as a means of escapism. The Barometer study has revealed that the most significant cultural barrier pertains to education, in the sense that while individuals may perceive, observe and listen, they often fail to comprehend the underlying nuances.⁵

This predicament is also faced by producers of cultural content, who must reconsider their modes of expression and the gradual education of their audience. However, the present discussion pertains not to the domain of artistic education, encompassing disciplines such as dance, painting and music, which are typically pursued in school classes. Those who demonstrate aptitude are then selected to attend vocational schools. The focus is on facilitating enhanced accessibility and comprehension of cultural artefacts from the moment of their genesis. This is a concern that is on the public agenda not only in Romania, but in all European countries, where the level of understanding of cultural products is falling quite dramatically.

An examination of the period during the pandemic reveals an increase⁶ in the consumption of entertainment and everyday products, while consumption of products that question man's place in society or raise certain issues has decreased. In the aftermath of the pandemic, the cinema industry has also not yet regained the level of performance that it exhibited in 2019. The

⁵ <https://www.radioromaniacultural.ro/emisiuni/timpul-prezent/timpul-prezent-barometrul-de-consumcultural-2022-carmen-croitoru-situatia-e-ceva-mai-buna-decit-in-2021-dar-ceva-mai-proasta-ca-in-2019-id40493.html>, accessed on September.

⁶ <https://www.culturadata.ro/tendinte-ale-consumului-cultural-in-pandemie-editia-i/>, accessed on September.



phenomenon has evolved, albeit in a restrained manner, and has not yet attained a proportion of 35% of cinema consumption. One potential explanation for these results is the impact of the pandemic on the emotional state of the population and the use of leisure activities as a form of stress relief or relaxation in crisis situations, as demonstrated by the studies cited at the beginning of this article. Another potential explanation for this phenomenon is the paradigm shift in cultural management, which, in the desire to attract new audiences, has moved towards a more leisure and entertainment-oriented offer, with a greater focus on entertainment and enjoyment and a reduced emphasis on functional and symbolic benefits.

The 2022 and 2023⁷ cultural consumption barometers demonstrate a gradual recovery following the pandemic. In 2022, cultural participation remained low; however, in 2023, there was an increase in visits to museums, exhibitions and historical monuments. It is anticipated that a gradual recovery will be observed by the year 2025.

In 2022, we observe that:

- A decline in the number of individuals attending theatrical and cinematic establishments has been observed in comparison with the year 2019;
- Visits to museums and exhibitions are to be encouraged. ~30%;
- The number of visits to historical monuments and sites was found to be 59%;
- A notable escalation has been observed in the consumption of digital cultural content, manifesting predominantly through streaming and online platforms.

In 2023:

- Visits to historical monuments are an integral component of the educational experience. 67%;
- Visits to museums and exhibitions are to be encouraged. 45%;
- Cinema attendance: 34%;
- The following data pertains to theatre attendance: ~25%;
- Attendance at classical music events and performances ~24%;

⁷ https://www.culturadata.ro/wp-content/uploads/The_Cultural_Consumption_Barometer_2022_full.pdf.



- The perpetual augmentation of digital platforms is a phenomenon that merits consideration.

5. Conclusions

Recent studies have indicated that young people are returning to cultural consumption at a faster rate than older generations. One conclusion of this analysis would be that between 2022 and 2023, there will be a noticeable recovery in public cultural consumption, particularly at museums and historical monuments. Attendance at both theatres and cinemas has increased, although it remains below pre-pandemic levels. By 2025, cultural consumption will be characterised by a combination of traditional and digital experiences.

Trends until 2025:

- A rise has been observed in public cultural consumption, encompassing activities such as attending theatre and cinema performances and visiting museums;
- The persistence of urban-rural differences is a matter of note;
- A rise has been observed in both digital and hybrid consumption, encompassing both online and offline activities;
- Cultural education is elevated to a position of priority;

The necessity for a cultural policy in this area is therefore imperative. Commencing with a definition of specific objectives, the ways in which these objectives can be achieved, and the impact that achieving them would have on young theatre audiences and others, two perspectives have been outlined by the present authors:

1. Externally, national theatres could have programmes dedicated to young people.
2. Internally, a series of activities could be developed to support the education of young people.

It is recommended that the cultural consumption of the young generation be increased and diversified by offering a real and original landmark, both historically and culturally, at the local level (and subsequently extended to the national level).



Prospective avenues for future research include:

- The objective of this project is to create a series of performances that will bring to young audiences, in chronological order, the great dramatic creations of the world. These performances will be staged in the cultural, economic and social context of the time in which they were created. The project will begin with ancient theatre. In essence, the objective is to undertake a historical reconstruction of the plays in the repertoire, meticulously detailing aspects such as costumes, sets and texts.
- In order to function within an environment that fosters creativity and innovation, it is essential to enhance young people's access to and involvement in cultural activities.

Pathways:

- It is vital to facilitate access to an environment that will stimulate the creativity and innovation of young people.
- The implementation of a youth loyalty programme, encompassing monthly subscriptions and matinee programmes, is recommended.

In consideration of the research's limitations, it is important to acknowledge that the analysis was primarily informed by data from the Cultural Consumption Barometers for 2022 and 2023. This methodological approach limits the temporal scope of the study and should be taken into account when interpreting the findings. The absence of comprehensive data for 2024 impedes the ability to draw definitive conclusions regarding the evolution of cultural participation until 2025. Furthermore, the research did not address in depth the socio-demographic and regional dimensions of cultural consumption, such as urban-rural differences, level of education, or income, factors that can significantly influence the degree of participation.

In light of these findings, a number of future research directions are beginning to emerge. Firstly, it would be beneficial to conduct longitudinal studies to track the evolution of cultural consumption habits in the post-pandemic period. Secondly, comparative analyses between urban and rural areas are required in order to identify the structural barriers affecting access to culture. It is further recommended that the impact of digitisation and hybrid forms of participation on young audiences be investigated in greater depth. In addition, the effectiveness of cultural



education and loyalty programmes in increasing long-term cultural participation should be evaluated.

The expansion of these directions will enable future research to provide a more comprehensive and nuanced understanding of the transformations in the field of cultural consumption. This, in turn, will contribute to the formulation of evidence-based cultural policies that are tailored to the needs of contemporary audiences.

- The promotion of the concept of "theatre education" for young people is recommended.

The conclusion drawn is that it would be opportune to implement a project with the aim of bringing the world's great dramatic creations, staged in the cultural, economic and social context of the era in which they were created, in chronological order, starting with ancient theatre, to young audiences and only to young audiences. The project will entail a historical reconstruction of the plays in the repertoire, with meticulous attention to detail afforded to costumes, scenery and text. The initiative will commence at the local level, with the objective of extending the project to a national level.

From an alternative standpoint, the issue at hand could be the education of young people through theatre. The enhancement of the educational attainment of the younger generation through theatre involves the integration of theatrical practices and principles into educational curricula with a view to improving learning outcomes and personal development. The following methods may be employed to achieve this:

1. The Enhancement of Engagement and Motivation

The integration of theatre into educational settings is widely acknowledged to be a highly beneficial strategy, with one of its primary advantages lying in its capacity to transform passive learning models into active, engaging processes. Conventional educational practices frequently entail a substantial reliance on rote memorisation and lecture-based instruction, a pedagogical approach that has been observed to result in student disengagement. Conversely, theatre demands active participation through various means, including acting, directing, and stagecraft. This experiential approach has been shown to engender a more interactive and enjoyable learning



environment, thereby fostering a deeper connection with the material. The engagement of both the mind and body is a fundamental aspect of theatre, which has been demonstrated to facilitate more effective information retention and the development of a passion for learning among students.

2. The Development of Soft Skills

Theatre education has been shown to excel in the nurturing of essential soft skills that are often overlooked in traditional curricula. Communication is of pivotal importance in the field of theatre; students are taught to articulate their thoughts with clarity, to listen actively, and to interpret non-verbal cues. These skills are considered to be of inestimable value in any professional context. Furthermore, the nature of theatre is such that it requires teamwork and collaboration. It is imperative that students collaborate to ensure a successful performance, and in doing so, they will learn to negotiate, compromise, and support each other. The aforementioned collaborative experiences have been shown to foster the development of interpersonal skills and to instil in students a comprehension of the value of collective effort.

Creativity and critical thinking are also considered to be fundamental components of theatre education. Theatre fosters innovative thinking and problem-solving skills, whether in the development of characters, the interpretation of scripts, or the resolution of technical challenges. The students are taught to approach problems from multiple perspectives and to think outside the box, skills that are crucial in today's rapidly changing world.

3. Cultural Awareness and Empathy

Theatre provides a distinctive perspective through which students can explore diverse cultural phenomena, historical periods, and social issues. By adopting the perspectives of characters from a variety of backgrounds and historical periods, students cultivate a more expansive comprehension of the world and its intricacies. It is evident that exposure to different cultures has the capacity to engender cultural awareness and sensitivity, which are essential qualities in an increasingly globalised society.

Furthermore, theatre fosters empathy. In order to portray a character in a convincing manner, it is essential for students to delve into their motivations, emotions, and experiences. The process of



comprehending and personifying diverse viewpoints has been demonstrated to facilitate the development of heightened empathy and compassion in students, thereby enhancing their social and emotional intelligence.

4. The Impact of Theatre on Academic Performance

The integration of theatre into education has been demonstrated to result in enhanced academic performance. Engagement with dramatic texts and scripts has been demonstrated to enhance literacy skills, including reading comprehension, vocabulary, and interpretative abilities. The process of writing and performing plays has been shown to have a positive effect on the development of creative writing skills and to encourage a deeper understanding of narrative structures and literary devices.

Furthermore, theatre fosters interdisciplinary learning opportunities, thus contributing to a holistic educational experience. A notable illustration of this phenomenon is the utilisation of historical plays in the pedagogy of history, a strategy that has been demonstrated to enhance the relatability and memorability of historical events and figures. Science concepts can be explored through creative dramatisations, which have been shown to facilitate the comprehension of complex ideas through visual and experiential learning (Smith, 2019). This interdisciplinary approach not only reinforces academic content but also highlights the interconnectedness of different fields of knowledge.

5. Personal Growth and Confidence

It is evident that personal growth and self-confidence are significant by-products of theatre education. Theatre functions as a secure environment in which students can articulate their thoughts, investigate their sense of self, and undertake artistic endeavours that involve a certain element of risk. The performance of an act before an audience has been demonstrated to have a beneficial effect on students, fostering the development of confidence and the alleviation of public speaking anxiety. The attainment of success in a performance, frequently accomplished through diligent effort and perseverance, engenders a sense of accomplishment and self-worth. Furthermore, the discipline and time management skills that students acquire through rehearsals and performances are conducive to the development of important life skills. They learn to



balance multiple responsibilities, work under pressure, and meet deadlines — skills that are transferable to any future career path.

6. Real-World Applications and Career Readiness

The skills developed through theatre education have broad real-world applications (Smith, 2019). In the professional context, communication, collaboration, creativity, and critical thinking are considered to be of significant value. In the contemporary business world, employers in diverse sectors are actively seeking individuals who possess the ability to think creatively, function effectively within teams, and communicate with clarity and purpose. The integration of theatre into educational curriculums has been demonstrated to equip students with the skills necessary to thrive in both academic and professional contexts.

Conclusion

The integration of theatre into educational settings has been demonstrated to have a substantial positive impact on the learning experience of younger generations. The programme has been developed to promote a holistic approach to student development, combining cognitive, emotional and social growth to prepare students for both academic success and personal fulfilment.

The enhancement of the education of young audiences through theatre has been demonstrated to be a tool for achieving social and economic goals, and has a dynamic and cross-sectoral value. The response to the needs of the younger generation is not at the expense of other generations, who are still able to satisfy their own needs.⁸

The establishment of development-research-education-innovation poles, inclusive of entrepreneurship in the cultural and creative sectors, represents a significant challenge and a crucial component of the educational process for the young generation through theatre. Consequently, the financial burden of development centres will be a catalyst for the attraction of new theatre productions and the enhancement of investment activity. The return on investment will generate cash flow.

⁸ Mucică, Delia, prof.univ.dr. - Cultural policies and strategies (course), 2017.



The process of human development is not, however, often identified correctly as being distinct from increasing material well-being or a high standard of living. However, it should be noted that there are a number of other equally important dimensions to this issue. Firstly, it is evident that the skills of the young people involved will be improved by the training period. Secondly, it is reasonable to hypothesise that the young people will acquire new skills as a result of the training. Thirdly, it is predicted that, depending on the number of hours allocated to each participant, this will ultimately lead to better results and greater public satisfaction.

Human development is defined by the expansion of individuals' options for a prolonged and salubrious life, encompassing the pursuit of education, that is to say, the acquisition of a level of knowledge that meets their evolving needs, and access to resources that ensure a satisfactory standard of living. In addition to the aforementioned choices, there are others that relate to political freedoms and the exercise of other fundamental rights and freedoms.

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Mapping TikTok Adoption in Romanian Universities: A Comparative Analysis of Social Media Communication Strategies Across Public and Private Universities

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Abstract

This study analyses the adoption of TikTok as a communication tool among Romanian universities, addressing a gap in understanding how Romanian universities use the social media platform preferred by Z Generation for institutional communication and student engagement. We conducted a systematic review of a total of 85 accredited higher education institutions (52 public and 33 private), aiming to map TikTok adoption rates, identify content strategies, and evaluate engagement metrics across different institutional types. Our analysis targeted official university TikTok accounts, where we categorized content types and we measured engagement indicators including views, likes, and comments. We further compared engagement levels between public and private institutions to highlight differences in visibility and communication style.

Our findings reveal that while TikTok adoption remains uneven, institutions that adapt to platform culture (e.g., use of trending audio, short storytelling, or humorous formats) achieve higher engagement. The results underline TikTok's growing role in higher education branding, recruitment, and digital visibility, while also revealing opportunities for more structured



strategies in Romanian academia. Findings provide practical insights for university administrators developing social media strategies and theoretical implications for understanding institutional communication in the digital age.

Keywords: TikTok, Romanian universities, higher education, communication, social media marketing, students' engagement

1. Introduction

Latest available Gen Z statistics show that this digital-native generation has determined structural changes in commerce and forced brands to rethink their sales, engagement, attrition and marketing strategies. The future adults already have highly different consumer habits compared to their predecessors, Gen Z focuses on social platforms, Instagram and TikTok, as main information sources (Fitzgerald, 2025). This means the new generations are taking decisions based on the content discovered or provided by the social platforms of their interest. Search engines like Google or Bing seem to be soon forgotten by Gen Z, who is shifting to visual platforms looking for information on Instagram (30.4%) and TikTok (23.2%) while Google is third (18.8%) (Fitzgerald, 2025).

Social media channels are popular latest data showing that in January 2025 in Romania, there were registered 13.0 million social media user identities, representing 68.6% of the total population (We Are Social & Meltwater, 2025). The figure is valid for the beginning of 2025 and considers all user accounts active and not unique individuals. Nevertheless, a clear majority of 75.5% accounts belong to an adult population, aged 18 and above (11.6 million accounts out of 13.0 million in total). According to the study, Romania ranks second in Central Europe in terms of the number of users on the TikTok platform: 8.97 million users and has the highest percentage of TikTok accounts compared to population in the entire European Union. Approximately 47% of Romanians have TikTok accounts, being followed by Ireland (46%), Latvia (39%) and Greece with 37% (Diaconu, 2024). Also, it is notable that Romanians spend an average of 32 hours and 30 minutes per month on TikTok, compared to 30 hours on YouTube and 13 hours on Facebook. The same study shows that TikTok ads have reached 47.7% of the local internet user base in Romania, regardless of age.

The demographics presented above support the universities' strategies to shift and adapt their communication styles on social media, considering the most popular platforms and the average time spent



by youngsters. TikTok is one of the leading social networks and has determined organisations targeting especially Gen Z to produce and distribute content on this platform.

This paper makes a comparative analysis of existing TikTok accounts in Romanian universities and identifies the volume of content published online, making a correlation with the time since the account has been set-up. Two questions arise in this context: (1) Are Romanian universities using social media channels popular among Gen Z? and (2) How many universities have official TikTok channels and what is the volume of content published?

2. Literature Review & Theoretical Framework

Recent studies show that 87% of prospective students (undergraduate, graduate or adult learners) are searching information about academic programs and institutions about on multiple platforms (Manaferra, 2025). However, according to same data, 63% of them use search engines like Google at the beginning, looking for relevant results during the first stage of decision-making. Afterwards, their attention is shifting on social media channels, 60% of prospective students using TikTok, Instagram, and YouTube to explore universities and programs (Manaferra, 2025). It is worth mentioning that 88% of these users engage intentionally with the content related to educational topics, showing that social media channels are validated as search and evaluation channels, rather than a digital entertainment environment, as they initially started.

Nearly 40% of Gen Z prefer searching on TikTok and Instagram over Google Search (Liam, 2024), and 74% of U.S. college students use TikTok daily for search (Ellis, 2025). Gen Z is using TikTok as a search engine to get authentic, peer-generated content about university experiences. TikTok allows students to see colleges through other students' eyes, providing access to parts of college life that previous generations discovered only after enrolment. Students can tour dorms, judge food quality, and get a feel for daily life through authentic student-created content rather than polished institutional marketing.

A recent survey revealed that TikTok is actively present in the daily routines of Romanian adolescents, with over 80% of users aged 14 to 19 accessing it every day. They spend an average of 2.5 hours on TikTok, and 43% of them consider the information encountered on TikTok as



highly trustworthy, underscoring the platform's growing influence in shaping youth perceptions and information habits (World Vision Romania, 2025).

The literature on TikTok's educational potential highlights its rapid evolution from an entertainment platform to a tool for informal learning, particularly among younger users. TikTok's short-form video format aligns with contemporary fast-paced information consumption habits, enabling effective conveyance of key concepts (Yang, 2019). Preliminary studies suggest TikTok enhances engagement through attention-grabbing features and accessibility, with 44.5% of students viewing it as beneficial for educational activities, 45.8% noting its ability to capture attention, and 53.6% emphasizing ease of use compared to other platforms (Sari et al., 2022). Challenges include its informal communication style, with emoticons and colloquialisms, which may not suit academic contexts, though it could complement traditional methods by leveraging external cognitive processes (Yang, 2019). Overall, the literature points to TikTok's promise for interactive, real-time learning but calls for more empirical investigation into content quality, privacy, and distractions to transform it into a reliable educational aid. The literature acknowledges the educational potential of TikTok and also that it is a popular platform among Gen Z, representing its consumption habits of online content.

A mixed-methods study evaluated the effectiveness of West University of Timișoara's social media communication strategy for promoting cultural events during Timișoara's 2023 European Capital of Culture designation (Bader et al., 2025). The researchers analysed 143 posts each on Facebook and Instagram, combining quantitative engagement metrics with qualitative content analysis. Despite Generation Z's preference for visual platforms, Facebook proved remarkably effective for institutional cultural communication due to established trust and community strength (55,000+ followers). The study found that guest speaker prominence, high-quality visual content, and interactive giveaway campaigns significantly enhanced engagement. Posts featuring renowned literary figures achieved the highest organic reach without paid promotion, suggesting authenticity and speaker credibility outweighed promotional investment. Instagram showed modest growth (593 followers) with lower engagement metrics, though post-event content featuring photographs consistently outperformed pre-event announcements. The research



revealed that 3,000–4,000 students participated in cultural events, demonstrating successful digital-to-physical conversion. The authors recommend incorporating dynamic formats (reels, stories), developing platform-specific strategies, and recognizing that Facebook remains viable for university communications despite not being Generation Z's preferred social platform for personal use. Although this research is not focused on TikTok channels, its results show the appetite of Gen Z for social media platforms and in a way, sets the path to a smooth transition to content similar or created in the style of TikTok.

In the other corner of the world, in Malaysia, a quantitative study surveyed 101 students from four Malaysian universities to assess perceptions of TikTok's educational utility (Xavierine et al., 2024). While 95% of respondents maintained TikTok accounts primarily for entertainment (86%), they recognized the platform's learning potential. Mean scores indicated students perceived TikTok as superior to traditional learning methods with features facilitating teaching and learning, ease of use, and effective objective communication. Students acknowledged advantages including attention capture and greater interactivity compared to other social media platforms. However, they identified significant disadvantages: lack of education-specific features discouraging academic use, and entertainment content prioritization undermining educational effectiveness. The 76.2% of respondents aged 21–23 predominantly held bachelor's degrees (91.1%), with most attending Universiti Teknologi MARA (UiTM) (47.5%). Despite positive perceptions, only 10% reported using TikTok primarily for educational purposes. The authors recommend developing education-specific features enabling instructors to create engaging content, establishing official subject-specific TikTok accounts, and conducting longitudinal research on learning outcomes and cross-cultural effectiveness variations to better understand TikTok's educational integration potential. If students see TikTok as an educational platform, this means that TikTok might be their first option in searching information about universities' educational programs.

A group of researchers examined how universities' posting strategies affect engagement on social media platforms. They conducted a comprehensive content analysis of over 90,000 social media posts from 70 top-ranked universities across Europe, the United States, and Latin



America, focusing on Twitter, Facebook, and LinkedIn (Capriotti et al., 2023). Their findings show that universities posted an average of 7.04 times per day across platforms, but the general engagement rate was very low (0.237), significantly below recommended benchmarks (e.g., $\geq 1\%$ for Facebook, $\geq 0.5\%$ for Twitter, $\geq 2\%$ for LinkedIn). Contrary to expectations, increased posting frequency did not lead to higher engagement. In fact, there was an inverse correlation, more frequent posting often resulted in lower interaction rates. The authors argue that University Created Content (UCC) tends to yield higher engagement than University Shared Content (USC), and that increased posting frequency does not necessarily correlate with higher interaction rates. Their review identifies a gap in comparative, multi-platform studies and calls for integrated analysis of activity and presence dimensions.

Apparently, universities are not keeping the pace with Gen Z and must rethink their social media strategies. Simply increasing posting volume is insufficient; instead, institutions should focus on producing original, audience-relevant content and tailoring their presence to the strengths of each platform.

3. Methodology

This study used a comprehensive cross-sectional analysis to examine TikTok adoption patterns among Romanian higher education institutions, combining website analysis with social media metrics collection. The research population covered 85 Romanian universities officially recognized by the Ministry of Education, including 52 public institutions (with 7 universities that have a military profile) and 33 private institutions. Data collection occurred in 27 – 28 September 2025, ensuring temporal consistency across all measurements.

The data collection process involved four primary phases. First, a systematic website analysis was conducted for each university's official homepage to identify the presence of social media platform buttons/links for five major platforms: Facebook, Instagram, LinkedIn, YouTube, and TikTok. Each platform's visibility was coded as binary (present/absent).

Second, direct platform verification was performed by searching for official university accounts on TikTok. For institutions with TikTok presence, additional metrics were collected including



total follower count, total likes count, total number of posts, and date of first post. Posting frequency was calculated as the average days between posts, based on the time elapsed between the first post and data collection date, divided by the total number of posts.

Third, comprehensive engagement metrics were extracted using Phlanx.com, a social media analytics platform that provides detailed TikTok account statistics and engagement analysis. Phlanx enables researchers to extract performance metrics without requiring direct API access, making it particularly useful for academic research on public social media accounts. Through Phlanx, the following metrics were collected: comments per post (2025), likes per post (2025), and engagement rate (2025 posts).

Fourth, a qualitative content analysis was conducted on high-performing TikTok videos from Romanian universities. The sample comprised 19 videos that exceeded 800,000 views, representing the most viral content produced by these institutions. Each video was analysed for multiple dimensions: primary thematic content (admissions, student life, humour, academic programs, campus features), video structure, duration, tone and format, visual elements, and hashtag strategy.

Total student enrolment data, including both undergraduate and master's degree students, were sourced from the Government of Romania's open data platform (*Data.gov.ro Open Data Portal*, 2020a, 2020b).

Statistical analysis was performed using SPSS Statistics. Descriptive statistics characterized overall adoption patterns across platforms and institution types. Given the small sample sizes, non-parametric alternatives were utilized. Specifically, Mann-Whitney U tests examined differences in follower counts, engagement rates, and posting frequency between public and private universities.



4. Results

The analysis of TikTok adoption by ownership type revealed no statistically significant differences between public (54%) and private (45%) universities, suggesting that ownership structure does not represent a determining factor in institutions' decisions to adopt this platform. In contrast, university size proved to be a significant predictor of TikTok presence (Linear-by-Linear Association: $\chi^2=6.178$, $p=.013$), with a clear increasing trend: small universities (under 1,000 students) show an adoption rate of only 40%, while large institutions (over 10,000 students) reach a rate of 76% (**Table 1**). This positive association suggests that available resources and organizational capacity associated with institutional size play a crucial role in adopting new digital communication channels.

Category		TikTok Adoption Rate
Total (n=85)		51%
By Ownership Type	Public institutions (n=52)	54%
	Private institutions (n=33)	45%
By Field of Study	Theological/Religious (n=6)	0%
	Military/Security/Public Order (n=7)	0%
	Arts (music, theatre, visual arts, design) (n=7)	29%
	Medicine & Pharmacy (n=7)	43%
	Economics/Business/Administrative Sciences (n=8)	50%
	Private Multidisciplinary Universities (n=19)	58%
	Agronomy/Life Sciences/Veterinary (n=5)	60%
	Public Multidisciplinary Universities (n=16)	75%
	Technical Universities (n=9)	89%
By Institution Size	Under 1,000 students (n=20)	40%
	1,000-4,000 students (n=23)	39%
	4,001-10,000 students (n=22)	59%
	Over 10,000 students (n=17)	76%

Table 1. TikTok Adoption Rate Among Romanian Universities

Field of study also represents a significant factor in TikTok adoption, with substantial variations between different types of institutions. Technical universities lead with an impressive 89%



adoption rate, followed by public multidisciplinary universities (75%), while theological/religious institutions and military/security institutions have no platform presence (0%). This distribution likely reflects differences in organizational culture, target audience, and openness to digital innovation specific to each type of institution. Universities with technical specialization and multidisciplinary ones appear to recognize more quickly TikTok's potential to reach the young generation of students, while institutions with traditional profiles or those specialized in sensitive fields show evident avoidance toward this social media platform.

The high contrast between TikTok's actual adoption rate (51% of universities have accounts) and its website integration (only 2% include TikTok buttons on their websites) reveals a significant discrepancy in Romanian's universities social media strategies (**Figure 1**). While traditional platforms like Facebook (88%) and Instagram (62%) enjoy prominent placement on university websites, TikTok's near-absence suggests deliberate institutional caution. This pattern aligns with global trends but appears more pronounced in Romania. We also analysed the world's top 20 universities, and we noticed that 60% maintain TikTok accounts while only 35% display TikTok buttons on their websites. Top universities still show hesitancy to formally promote the platform, but to a lesser degree than Romanian institutions. This widespread hesitancy likely reflects concerns about TikTok's controversial aspects such as data privacy issues (Juned et al., 2023), content moderation challenges (Liu, 2024), and geopolitical tensions surrounding the platform (Lin & Kloet, 2023), leading universities to maintain a presence on TikTok without formally recommending it through website integration. The complete absence of TikTok buttons on Romanian public university websites (0%) particularly suggests increased sensitivity to reputational risks, while the fact that even elite global universities show similar (though less extreme) patterns indicates that these concerns transcend national boundaries and institutional prestige levels.

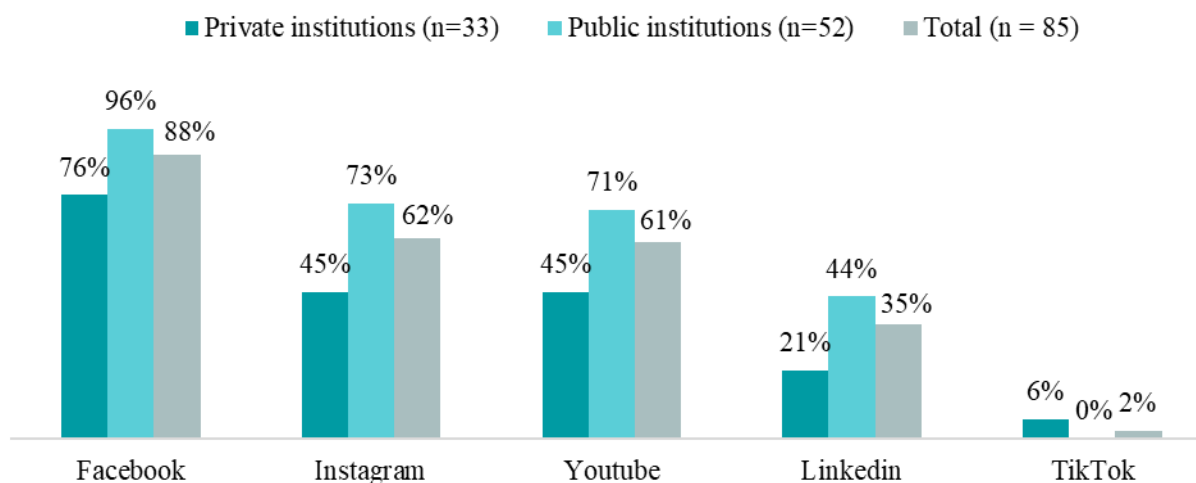


Figure 1. Social Media Button Integration on University Websites by Institution Type

The temporal analysis reveals a striking disparity in TikTok adoption between public institutions (28 accounts) and private ones (15 accounts) by 2025. The COVID-19 crisis clearly catalysed digital platform adoption, with both institution types showing accelerated growth beginning in 2020-2021 as universities tried to maintain student engagement during remote learning. Notably, many private universities created their TikTok accounts during June-July or September periods, directly coinciding with Romania's university admission cycles. We can see this as a strategic timing when prospective students actively search for university information and make enrolment decisions. This is in line with what other studies show as well: TikTok is being leveraged as a marketing tool by higher education institutions to enhance brand awareness and engage prospective students (Dali & Aziz, 2023). The sustained post-pandemic growth indicates that what might have begun as an emergency response has evolved into a recognized tool for engaging Generation Z students in their preferred digital spaces.

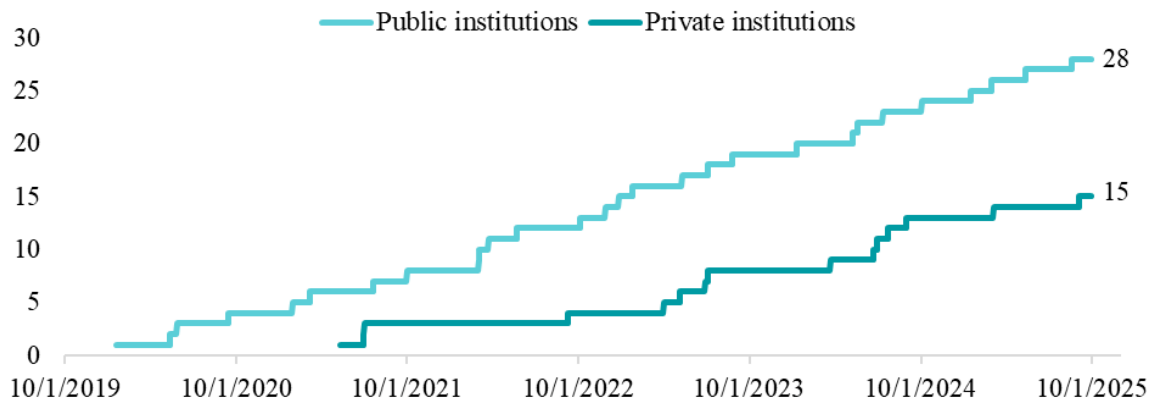


Figure 2. TikTok Adoption Timeline: Public vs. Private Universities. Cumulative number of accounts created (2020-2025)

The comparative analysis of TikTok engagement metrics reveals that public universities maintain significantly larger audiences than private institutions (Mann-Whitney $U = 119.00$, $p = .020$), with a median of 1,742 followers compared to only 310 followers for private universities. However, this substantial and statistically significant advantage in follower count does not translate into significantly different engagement outcomes, as all other performance metrics showed no statistical differences between institution types (all $p > .05$).

While numerical differences exist in the data, such as public universities having higher total profile likes (median: 10,850 vs. 3,665) and private institutions posting more frequently (median: 7 days vs. 9 days between posts), these variations did not reach statistical significance. These patterns suggest that despite public universities' significant advantage in audience size, both institution types achieve comparable engagement outcomes, indicating that follower count alone does not determine TikTok success.



	Averages per account			Medians per account		
	Private institutions (n=15)	Public institutions (n=28)	Total (n=43)	Private institutions (n=15)	Public institutions (n=28)	Total (n=43)
Followers	1,313	3,167	2,520	310	1,742	1,060
Posts count	123	182	161	116	105	108
Likes on profile	23,606	49,073	40,189	3,665	10,850	10,249
Posting interval	14 days	23 days	20 days	7 days	9 days	7 days
Likes per Post	163	256	224	55	179	159
Comments per Post (2025)	1.2	1.9	1.6	0.5	1.5	1.3
Likes per Post (2025)	30	15	20	12	11	12
Engagement Rate (2025 posts)	30%	15%	20%	12%	11%	12%

Table 2. Comparative Analysis of TikTok Engagement Metrics: Public vs. Private Universities

The correlation analysis reveals a statistically significant positive relationship between university size (student enrolment) and TikTok followers ($r = .421$, $p = .005$, $n = 43$). This moderate correlation indicates that larger universities tend to have more TikTok followers, though the relationship explains only about 18% of the variance ($r^2 = .177$) (**Figure 3**). This moderate correlation suggests that while institutional size provides some advantage in building TikTok audiences (likely due to larger potential student bodies, alumni networks, and marketing resources), it is far from deterministic. The success stories of smaller institutions and the underperformance of some larger ones indicate that strategic factors, such as content quality, posting consistency, early adoption timing, or targeting specific niches, may be equally or more important than institutional size in determining TikTok success. Several smaller institutions significantly outperform expectations, such as Iasi University of Life Sciences (with almost 14,000 followers despite having around 4,000 students) or the "Vasile Goldiş" Western University of Arad (with 8,600 followers despite having around 4,000 students). The finding reinforces that both small and large universities can build substantial TikTok followers with the right approach, though larger institutions have a statistical advantage.

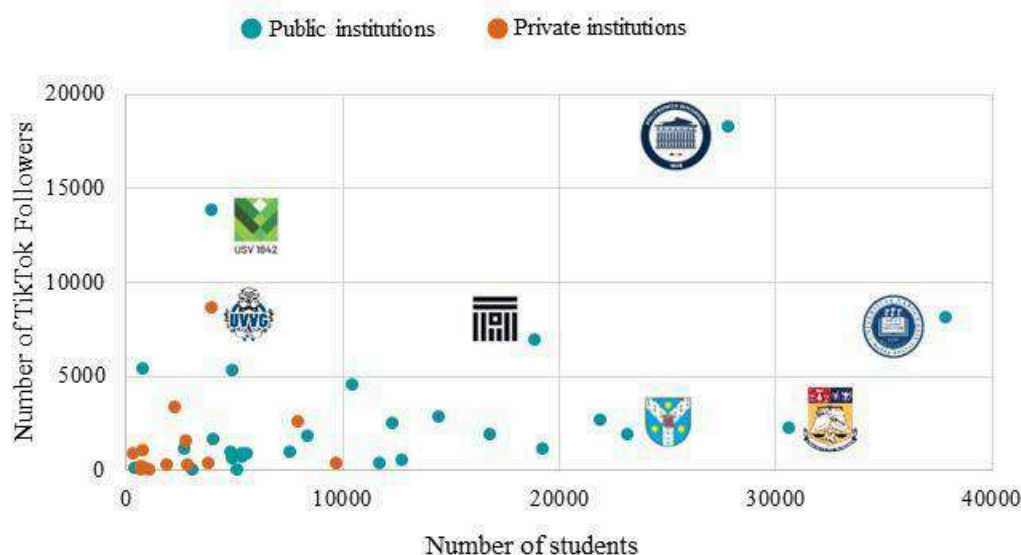


Figure 3. Relationship Between Student Enrolment and TikTok Followers Among Romanian Universities

Regression and correlation analyses reveal fundamental dynamics of TikTok success for Romanian universities that challenge conventional social media assumptions. The regression model demonstrates that content volume, not longevity, drives follower growth: each additional post is associated with approximately 14 new followers ($\beta = .771$, $p < .001$), while account age shows no significant impact. This finding, combined with the negative correlations between account age and all 2025 engagement metrics ($r = -0.35$ to -0.40), suggests that simply maintaining a long-term presence offers no advantages and may actually harm engagement rates as accounts mature. Universities cannot rely on passive accumulation of followers over time but must actively produce content to grow and maintain their audiences.

A critical trade-off emerges between reach and engagement quality. While larger follower counts correlate strongly with absolute metrics like total profile likes, they also have a weak negative correlation with engagement rates ($r = -0.27$), indicating that followers' growth might come at the cost of audience quality. Universities with more students achieve higher absolute engagement ($r = 0.67$ for likes per post) but not necessarily better engagement rates in 2025.

The content analysis of the top-performing TikTok videos (each exceeding 800,000 views) published by Romanian universities reveals a predominantly informative and promotional



orientation. Rather than relying on humour or entertainment, these videos emphasize clarity, institutional credibility, and concrete benefits. Thematic distribution shows that approximately 42% of the viral content directly addresses university admissions, while 37% focuses on student life and campus culture, and only about 10% employs humour as a primary engagement strategy. Overall, the most viewed posts promote career prospects, affordable living costs, and international opportunities. Complementary themes include the advantages of specific programs (dual studies, scholarships, modern laboratories) and the accessibility or uniqueness of certain campuses (e.g., Alba Iulia, Braşov, Arad).

Most viral videos begin with an institutional hook, followed by enumerated benefits and a clear call to action. The average video duration ranges from 25 to 60 seconds, consistent with TikTok's optimal engagement span for informational content. Shorter videos (under 30 seconds) tend to focus on admission deadlines and pragmatic details, whereas longer ones introduce visual storytelling elements such as laboratory activities, student testimonials, or campus imagery.

In terms of tone and format, most viewed videos adopt an informative style, combining lists of advantages, emoji-based bullet points, and direct appeals to prospective students. The sample of 19 videos we have analysed integrate hashtags, the majority of which are generic (#studentlife, #facultate, #admitere2025, #universitate) or institutional (#PolitehnicaBucuresti, #UAB, #UNITBV). Only a minority use topic-specific hashtags (e.g., #Robotica, #Energetica, #Erasmus), which suggests a strategy aimed at maximizing general visibility rather than targeting niche audiences.

5. Conclusions and Practical Recommendations for Universities

Our findings indicate that TikTok success requires active, strategic management rather than organic growth. With 72.6% of follower variance explained by just two variables - posts and number of students - the path to growth appears straightforward: post consistently and leverage institutional size. TikTok account age is irrelevant, reinforcing that success on this platform is not about longevity but about activity. However, the correlation matrix warns that this growth



trajectory leads to declining engagement rates, forcing universities to choose between maximizing reach or maintaining community quality. For Romanian universities entering TikTok or reassessing their strategies, the message is clear: success demands continuous content creation, as each post ads approximately 13 new followers regardless of how long the account has existed. The data suggests that rather than hoping for organic growth over time, universities must commit to sustained content production while accepting the inevitable trade-off between audience size and engagement intensity.

Universities must move beyond viewing TikTok as merely another social media channel. The viral content analysis reveals that successful posts emphasize institutional credibility and concrete benefits rather than entertainment. Universities should create informative videos of 25-60 seconds focusing on career prospects, program advantages, and campus life. A potential successful TikTok strategy for universities could be adopting a 40-30-20-10 content mix (student life, career outcomes, admissions, humour). Universities should prioritize authentic student voices over institutional messaging, address specific anxieties about employment and costs, and fully embrace platform-native features including trending audio and vertical format optimization. The significant disconnect between TikTok adoption (51%) and website integration (2%) highlights the need for a clear social-media policy within universities. This hesitancy, while understandable given privacy and content moderation concerns, may limit universities' ability to fully leverage TikTok's potential for reaching Generation Z students who increasingly use the platform for educational research. Institutions should develop formal social media guidelines that address platform-specific risks, while still enabling creativity and innovation in communication. Also, Universities should establish internal approval protocols for TikTok content that balance institutional caution with the platform's demand for authenticity, ensuring that official messaging remains both credible and engaging for younger audiences.

This comprehensive analysis of TikTok adoption among Romanian universities reveals a platform in transition from emergency pandemic tool to strategic communication channel. Our findings demonstrate that while 51% of Romanian universities have embraced TikTok,



significant disparities exist based on institutional characteristics rather than public/private ownership.

6. Limitations and Future Research

Our study has several limitations that should be mentioned. First, our content analysis examined only top-performing videos (over 800,000 views), potentially overlooking valuable insights from moderate-performing content that may more accurately reflect typical university TikTok strategies. Future research should therefore employ stratified sampling across performance tiers to capture the full spectrum of content approaches. Second, while our regression model explains 72.6% of follower variance, it notably excludes content type as a predictor variable. Third, the engagement metrics used (Comments per Post, Likes per Post, and Engagement Rate for 2025 posts) were calculated only for the 2025 dataset, restricting longitudinal interpretation; future research would benefit from access to analytics tools capable of tracking engagement across different time frames. Finally, further studies should explore the actual impact of TikTok presence on enrolment decisions through student surveys, assess the return on investment of varying content strategies, and analyse how platform algorithm changes influence institutional visibility and user engagement over time. Additionally, our study lacks data about the way the TikTok content is produced by universities: whether they have “social media department”, they rely on ad-hoc content creators, or they outsource content production to external agencies. A further study could analyse the relationship between the success/popularity of the TikTok account and the existence of an internal or external dedicated team. Another valuable topic that could be covered is whether published content is decided based on information collected via surveys, is based on a communication strategy or is rather a spontaneous content without a strategic framework.



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Adapting Students' Learning Styles Using Artificial Intelligence in Learning Computer Science Concepts and Developing Educational Robots

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Abstract

By integrating artificial intelligence, this paper presents a method designed to help students learn more efficiently, benefiting from personalized education in algorithms and educational robot programming, which has enhanced the potential of each student. Adapting to current learning needs as well as for the baccalaureate exam, artificial intelligence was used as a study support to provide educational information, detailed explanations, and guide students through the steps to obtain clearer, more learning-oriented answers.

Keywords: artificial intelligence, computer science concepts, educational robots, haptic devices, personalized active learning

JEL Classification: C63, C69, I21, I26, I29.

1. Introduction

To enhance the quality of the teaching and assessment process in fields such as computer science, information and communication technology (ICT), or educational robotics, it is essential



to use modern, technology-based methods. Especially in learning algorithms and programming robots, students require a large number of individual tasks, interactive exercises, and personalized assessment items that help develop their logical thinking and technical skills.

The manual creation and correction of these activities involve a significant workload for teachers, which becomes difficult to sustain in the context of an already busy schedule. A viable and efficient solution is the integration of artificial intelligence into the educational process (Karsenti, 2019). By using AI systems, teachers can be assisted in the automatic generation of exercises tailored to each student's level, in providing instant feedback, and in assessing performance in real time.

This approach is further supported by the automatic import of generated materials and tests into e-Learning platforms, where students can revisit learning and self-assessment sessions as often as needed. Thus, the educational process becomes more flexible, personalized, and efficient—for both students and teachers.

2. Literature Review

Although there are risks such as cheating, the educational benefits of AI are significant and justify the need for further research (Ayala-Pazmiño, 2023). The implementation of artificial intelligence in education is becoming increasingly important, driven by technological advancements and the rapid digitalization of educational systems. To support the effective integration of AI technologies and promote a better understanding of them, Owoc, Sawicka and Weichbroth (2021) tested a five-stage strategic implementation model in three higher education institutions, analyzing both the benefits and the challenges of using AI in education.

Vakhabova, Kosulin, and Zizaeva (2025) highlight the benefits of artificial intelligence in education, including personalized learning, task automation, and increased access to knowledge. At the same time, they emphasize key risks such as ethical concerns, digital inequality, and algorithmic bias. Their study explores how AI can contribute to transforming education in alignment with the Sustainable Development Goals, particularly SDG 4 (quality education) and SDG 10 (reduced inequalities). Through a systematic analysis, the research provides a valuable



contribution by examining the relationship between AI adoption in education and sustainable development.

Chen and Liu (2007) conducted a study on 165 fourth-grade Taiwanese students, analyzing the effects of a computer-assisted, personalized problem-solving program in mathematics. The results showed that students who used the personalized program performed significantly better and had a more positive attitude toward mathematics compared to those who used a non-personalized program. These differences were reflected in both post-test scores and students' perceptions of learning.

3. Methodology

The working methodology used was personalized active learning with Artificial Intelligence (AI). This involved the direct engagement of students in the process of learning algorithms and programming educational robots, while providing them with continuous feedback and personalized resources.

The study was conducted over the course of two academic years and included 52 students (67.31% boys, 32.69% girls) specializing in mathematics and computer science.

The first year was considered the control group, while during the second year, AI was integrated and the group was considered the study group. Students were informed that they could compare their own answers with those generated by AI and analyze them; they were not required to wait for AI-generated solutions. They were encouraged to use AI for:

- explanations and step-by-step guidance;
- checking their own solutions;
- rewriting or optimizing their ideas with the help of AI.

Throughout the two years, the activities followed the mandatory national curriculum in subjects such as Computer Science, Information and Communication Technology (ICT), and robotics lessons available on the platform Resurse educaționale și activități didactice (Coșniță).

The computer science curriculum in the Romanian educational system includes topics such as algorithms and programming, cybersecurity, artificial intelligence, robotics, web development,



educational and utility software, networking, and information and communication technologies (ICT).

3.1. The aim of the research

The study aims to analyze students' performance over the course of two consecutive academic years in the subjects of Computer Science, Information and Communication Technology (ICT), and Robotics, highlighting the impact of using personalized active learning based on Artificial Intelligence in the second year. The focus was on how the natural integration of artificial intelligence contributes to the development of computational thinking, reduces students' tendency to cheat, and leads to positive outcomes in the learning process.

3.2. The objectives of the research

O1. Analyze the impact of using personalized active learning supported by AI on students' performance in the subjects of Computer Science, ICT, and Robotics.

O2. Study how the integration of artificial intelligence can support the development of computational thinking among students.

O3. Compare students' results from the two academic years, following the implementation of personalized active learning.

3.3. Implementation

A Moodle platform with AI extensions (*Resurse educaționale și activități didactice*), an AI-based educational engine for adaptive learning (*NextLab.tech*), and the “Study Mode” function integrated into the *ChatGPT* interface, selected with the “Study and learn” option, were used. *ChatGPT* provides a personal educational assistant called “study mode.” This usage module can generate quiz questions, create exercise sheets, or training problems.

In a preliminary stage, the teacher:

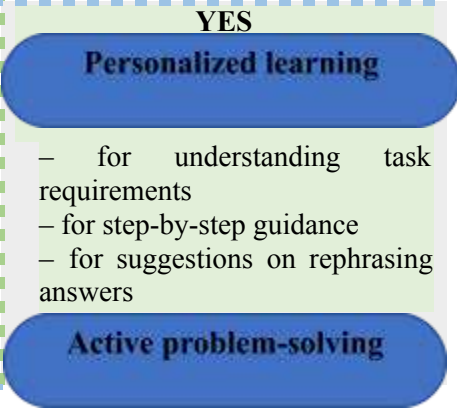
- created model problems that define a class of problems;



- built “problem classes” using artificial intelligence, which allowed for the automatic generation of different problems belonging to the same class and having the same level of difficulty.

In the first stage, the initial test was administered and completed by students on the *Resurse educaționale și activități didactice* platform, which is based on the Moodle learning management system and is used by both teachers and students for task delivery and assessment (Cosniță). During this stage, *ChatGPT* was used exclusively by the teacher for planning and support purposes, while students were required to solve the test independently, without access to the internet or artificial intelligence tools (OpenAI).

In the second stage, worksheets and training tests were used, with the objective of acquiring and consolidating knowledge through practical activities. The platforms *NextLab.tech* and *Resurse educaționale și activități didactice* were used by both the teacher and the students during the working and evaluation process (NextLab.tech; Cosniță), while the *ChatGPT* platform was employed by students as a support tool in carrying out personalized active learning activities (OpenAI).

STAGE		Using AI	
		Teacher	Students
1		YES – for adapting the difficulty level – for generating problems within the same class	NO
2		YES – for adapting lesson content based on training test results – for suggesting additional exercises – for automating testing	YES 

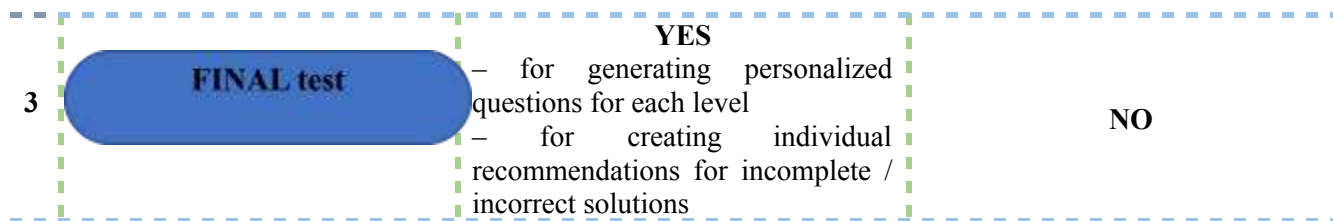


Figure 1. Design of the implementation

During the "personalized active learning" phase, students worked on problem classes using artificial intelligence, which enabled them to explain concepts step by step, receive immediate feedback, generate summaries or learning sheets, and rephrase complex information.

The automatic grading and correction system on the educational platform *Resurse educaționale și activități didactice* (Cosniță) allowed the teacher to monitor how long each student took to complete tasks, the number of attempts made, and whether the student submitted a correct or partial solution. The platform enables objective assessment, provides instant results, and eliminates the risk of subjectivity in grading.

In the third stage, the final test was administered on the *Resurse educaționale și activități didactice* platform, which was used by both the teacher and the students for test delivery and completion (Cosniță). To diversify the evaluation items, the teacher used *ChatGPT* as a tool for generating and adapting assessment content (OpenAI). To reduce the risk of cheating, students were allowed to use AI tools only during the "personalized active learning" phase and did not have access to artificial intelligence during testing on the *Resurse educaționale și activități didactice* platform (Cosniță).

4. Results and Discussions

The study lasted 2 years and involved 52 students from grades 11 and 12, 35 boys (67.31%) and 17 girls (32.69%) specializing in mathematics and computer science, with an intensive focus on computer science.



The method of “personalized active learning” was applied in the subjects of Computer Science, Information and Communication Technology (ICT), and Robotics, involving the use of AI and “problem classes.”

Competences		Computer Science	ICT	Robotics
Control group (First Year)	Means scores	8.895	8.894	7.897
	Stand.dev.	16.339	13.896	68.642
Study group (Second Year)	Means scores	9.076	9.007	9.089
	Stand.dev.	18.66	19.002	17.038
Pearson coef. (R)		0.0971	0.0554	-0.0877

Table 1. Pearson Coefficient Calculated by Subject

For Computer Science, the R coefficient (0.0971) indicates a very weak positive correlation, leading to a very weak and almost insignificant relationship. For ICT, the R coefficient (0.0554), although a positive correlation, is extremely weak and nearly nonexistent. For Robotics, the R coefficient (-0.0877) signals an almost nonexistent correlation, with a value very close to zero.

For each of the three subjects, the relationship between the use of personalized active learning supported by AI and the use without AI is very weak, almost insignificant, and the two implementations are not clearly linearly related.

5. Conclusions

Personalized active learning using AI provided real-time feedback, allowing students to adjust their solutions. The method adapted the learning process to the specific needs of each task, improving student performance over time. In programming educational robots, students developed skills such as autonomous decision-making.



During the pandemic, students strengthened their online learning habits. Online learning from 2020 to 2022 established the practice of seeking explanations, being guided, and obtaining information from Open Educational Resources (OER), turning first to a browser, then to an educational platform, and finally to a teacher.

The study proposes expanding e-Learning platforms by integrating AI-assisted learning. For students, this approach:

- accelerated their progress,
- optimized personalized learning,
- allowed them to explore complex ideas through step-by-step AI assistance,
- provided a way to receive quick feedback, develop their passions, and break out of daily routines.

- They obtained solutions when they were NOT able to find their own,
- They provided a different approach to solving a problem,
- They managed to solve more complex problems, even unexpectedly difficult ones,
- They became more autonomous and gained greater self-confidence.

Artificial intelligence has the potential to improve education through personalized learning (Ayala-Pazmiño, 2023). Intelligent technologies have provided students with new perspectives.

For teachers:

- It reduced the time required to prepare teaching materials, as confirmed by Ayala-Pazmiño (2023);

- They were able to create multiple problems/exercises within the same “problem class”;
- They succeeded in engaging students to work more;
- They were able to train students more effectively in teamwork.

During the study, it was observed that NOT all students can use AI to complete practice sheets in an educational and responsible manner. There is a high risk of cheating. Students who are NOT interested in the subject are much more likely to copy and not actively learn through interaction with AI. These students do NOT consider AI as a mentor, but rather as a “solution generator.”



For students who showed interest in the subject studied, an improvement in performance at school competitions and academic olympiads was observed. The use of artificial intelligence tools enabled high-achieving students to refine their skills, test their own solutions more efficiently, and receive prompt feedback that either confirmed or refuted their approaches.

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Communication Barriers in Technical Faculties

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Abstract

Effective communication is a fundamental skill in all sectors and is very important for academic and professional success. In higher education, especially in technical fields, it faces unique challenges. This paper investigates and analyzes the main communication barriers experienced by students from a technical faculty, both in their interactions with teachers and with their colleagues. A custom-designed questionnaire was applied to 125 students from different domains from a technical faculty. Beyond general comfort and frequency of communication, the instrument included questions to identify their problems from multiple categories: linguistic barriers, environmental barriers, perceptual/positional barriers (fear of judgment, status differences), and conceptual barriers (preconceptions, misinterpretation of messages). These options were based on classic models of communication breakdown and adapted to the academic context. The analysis revealed that many students do not feel fully comfortable engaging in dialogue with their teachers and there are many barriers in this process. In contrast, in the case of their colleagues, communication is much easier and more relaxed, with fewer obstacles. This paper highlights the importance of addressing communication barriers not only as interpersonal issues but as structural challenges in the educational process. These not only affect the quality of academic performance and collaboration but also influence students' confidence and motivation to participate actively in learning experience.



Keywords: communication barriers; higher education; student-teacher interaction; student-student interaction technical faculty

1. Introduction

Communication is fundamental in all areas of personal and professional human activities. Practically it is a real help in making a better life, because we can build relationships, we can express our needs or emotions, we can solve conflicts, we can transmit our ideas efficiently to our family or to our coworkers. Therefore, communication is not just about transmitting information, it is a powerful method for change, collaboration, understanding and evolution. Many people or students are educated in the specialization they choose (economics, healthcare, management or engineering etc.), but in most cases they do not receive explicit training in communication (Barevičiūtė et al., 2023; Genç, 2017; Radovic Markovic & Salamzadeh, 2018; Sanchis-Giménez et al., 2023). In today's world, these skills are no longer optional, they are mandatory for modern society (Barevičiūtė et al., 2023).

In education, effective communication is very important if we want a successful educational process, functioning as an essential bond between teachers and students. In addition to the transfer of knowledge, it is essential for students to be educated in an environment where mutual understanding, questions and debate are encouraged. Teachers can adapt teaching methods to the diverse needs of students, provide constructive feedback and stimulate curiosity. On the other hand, students who feel comfortable expressing their ideas, concerns or even admitting their mistakes will have a deeper and more relevant learning experience. Quality communication transforms the classroom from a simple training space into a laboratory of ideas and an active learning community, preparing individuals capable not only of knowing, but also of relating and collaborating (Ragusa et al., 2022).

In technical education, the importance of communication takes on a practical and immediate dimension, as career success depends as much on interpersonal skills as on technical knowledge. An engineer, technician, or IT professional must be able to accurately communicate project specifications, explain complex solutions to non-technical clients, and work in a team to solve



the problems (Genç, 2017; Kakepoto et al., 2022). Despite its importance, communication is often undervalued or taken for granted in technical faculties, where the primary focus remains on developing specialized skills and domain-specific knowledge. As a result, many students in engineering and technology programs graduate with limited experience in navigating the complexities of academic and professional communication.

In every process and type of communication, there are some elements who can block or affect the information transmitted between the emitter and the receiver. These are called barriers and there are in fact, any factor, be it physical (noise, faulty technology etc.), psychological (prejudice, strong emotions...) or semantic (jargon, language differences...), that prevents accurate understanding (Kakepoto et al., 2022). Their appearance transforms communication from a straightforward process into an unproductive one (Khairdi et al., 2024), regardless of whether we are talking about the educational process or a work situation. Understanding and identifying these barriers is the first essential step towards improving the quality of our interactions (Bratchuk & Smith, 2023).

This paper investigates the communication barriers perceived by students in a technical faculty, based on a structured questionnaire distributed to undergraduate and master's students. The object is to analyze the students' experience communication with both teachers and colleagues, highlighting areas that require pedagogical or institutional attention. The instrument was applied to 125 students from various engineering specializations, and it is structured in three sections: demographic data (gender, year of study and specialization), barriers in student-teacher communication and barriers in student-student relations. The results showed that students feel significantly more comfortable communicating with their colleagues than with their professors. Fear of being judged is one of the strongest experienced barriers. There are no gender-based differences in the type of communication barriers reported. Students who perceive their professors as less available are more likely to report communication barriers.

2. Communication Barriers

Communication in technical higher education should not be limited to transmitting information; this process is a complex one and it should be about knowledge construction, feedback, and relationship-building among teachers and students. Different models of communication were proposed to improve technical communication, adapted and applied then in other sectors. Among them, one of the most influential is Berlo's SMCR Model, which conceptualizes communication as a process involving: source, message, channel, and receiver (Rubino et al., 2022). Its structure is represented in **Figure 1**. The "source" can represent the teacher, while the "channel" can include face-to-face lectures and virtual classrooms.

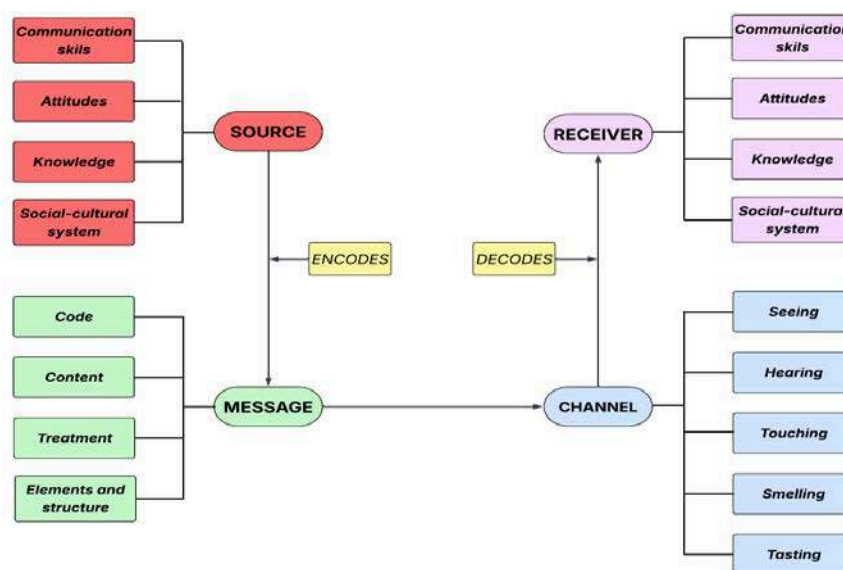


Figure 1. Berlo's SMCR model (Kashikar, 2024)

In the academic context, this model helps educators analyze how information flows within the classroom, emphasizing that communication effectiveness depends on the teacher's clarity, knowledge, and attitude, as well as the student's ability to interpret and respond. Therefore, Berlo's framework provides a systematic foundation for understanding how teaching and learning function as communicative acts. The model focus on the interdependence of



communication skills, attitudes, and cultural awareness is especially relevant in today's diverse and globalized classrooms. Effective educators in today's teaching must not only design clear messages but also consider students varied technological access, digital literacy, and socio-cultural backgrounds to ensure equitable learning experiences. There are several factors that can affect the entire process of communication: the personal context of both the sender and the receiver, disposition toward the topic, existing knowledge, or cultural lens (Rubino et al., 2022).

The aforementioned aspects can be called barriers in communication. These can obstruct or distort the transmission of information between the sender and the receiver. There are numerous types of communication barriers, each affecting the clarity and effectiveness of interpersonal exchanges. Semantic or linguistic barriers refer to issues such as unclear phrasing, words with multiple interpretations, inadequate translations, unspoken assumptions, or the excessive use of technical jargon. Interpersonal barriers appear when the intended message is not received or interpreted as intended by the sender. Fear of criticism/judge, including ridicule, mockery, or laughter can discourage students from participating actively and expressing their opinions. Psychological barriers, such as ego, prejudice, closed-mindedness, status dynamics, or daydreaming, can disrupt attention and understanding. Physical barriers include environmental and behavioral issues like poor listening skills, ineffective non-verbal cues, mental fatigue, background noise, and limitations imposed by time or distance. Emotional barriers, such as anger, pride, anxiety, distrust, or depression, can heavily influence how a message is delivered or perceived. Perceptual barriers refer to individual differences in values, attitudes, tone, or voice modulation. Additionally, cultural barriers may affect communication through differing norms, behaviors, or expectations regarding etiquette and interaction. Stress, low self-confidence, and past negative experiences can severely hinder communication, particularly among students in technical education environments. Cognitive barriers, meanwhile, surface when the linguistic or conceptual demands of information exceed the reader's capacity to process or integrate it effectively (Kakepoto et al., 2022; Maaß & Rink, 2024). All of these can occur and have a meaningful impact on students' access to learning and active participation in educational act.



3. Methodology

This paper used a quantitative descriptive research design aimed at identifying communication barriers experienced by students in technical faculties. The study explored both student-teacher and student-student relations, highlighting how various types of obstacles may interfere with educational interactions. Usually, in technical faculties, where curricula are often dense and interactions are heavily content-focused, effective communication plays a critical role not only in academic performance but also in social integration, collaborative learning, and psychological well-being. By identifying and classifying the barriers that students perceive in these interactions, the study could help to improve communication practices. The approach is diagnostic in nature, designed to capture both the frequency of reported obstacles, grouped into classic categories such as linguistic, environmental, perceptual, and conceptual barriers.

The research instrument used in this study was a structured questionnaire designed for students enrolled in technical higher education. Its purpose was to identify perceived communication barriers and differences in how students interact with professors and colleagues. It was structured into four main sections, totaling over 20 items, combining both closed-ended and open-ended questions:

- Section 1 – Demographics: gender, year of study, and field of specialization.
- Section 2 – Teacher-student communication: included Likert-scale questions measuring comfort in communication and perceived teacher availability, followed by multiple-response items to identify barriers: fear of judgment, lack of time, language issues (technical vs. accessible), conceptual misunderstandings, environmental noise, lack of openness of teachers, barriers of perception or position (status differences).
- Section 3 – Colleagues barriers: analogue with Section 2, focusing on students' interactions with their colleagues, including a similar list of potential obstacles adapted for peer relationships: lack of trust, fear of judgment, lack of listening skills, lack of clarity in expression, differences in opinions or values, language barriers (e.g., technical terms, vague expression), environmental barriers (e.g., large groups, time pressure,



inadequate platforms), perceptual/positional barriers (e.g., dominant informal leaders, different academic status), conceptual barriers (e.g., assumptions, misinterpretations).

- Section 4 – Open suggestions: students were invited to provide suggestions for improving communication with both professors and colleagues.

The Likert-type items were coded on an ordinal scale (1 = Never, 5 = Always / Very much), while the multiple-response questions were transformed into binary variables (0 = not selected, 1 = selected) for each barrier. The Likert-scale questions were: “Do you feel comfortable communicating with your teachers?”, “Do you think teachers are available for questions or clarifications?” and “In general, do you feel comfortable communicating with your colleagues?”. The instrument was administered online. Participation was completely voluntary. All responses were anonymous, and no personal data was collected that would allow the identification of respondents. A total of 125 valid responses were collected and prepared for statistical analysis using SPSS.

The participants were undergraduate students enrolled in different programs within a technical faculty: electronics, telecommunications and information technologies – named IETTI, electrical engineering – called IE, electrical engineering and computers (IEC), and systems engineering (AIA). Participants were distributed across three years: I, II and III. Basic demographic information such as gender, year of study, and field of specialization was collected. Their distributions are represented in **Figure 2**.

The hypotheses formulated for this study are:

H1. Students feel significantly more comfortable communicating with their colleagues than with their professors.

H2. First-year students report more communication barriers with professors compared to students in higher years.



H3. There are gender-based differences in the type of communication barriers reported.

H4. Students who perceive their professors as less available are more likely to report communication barriers.

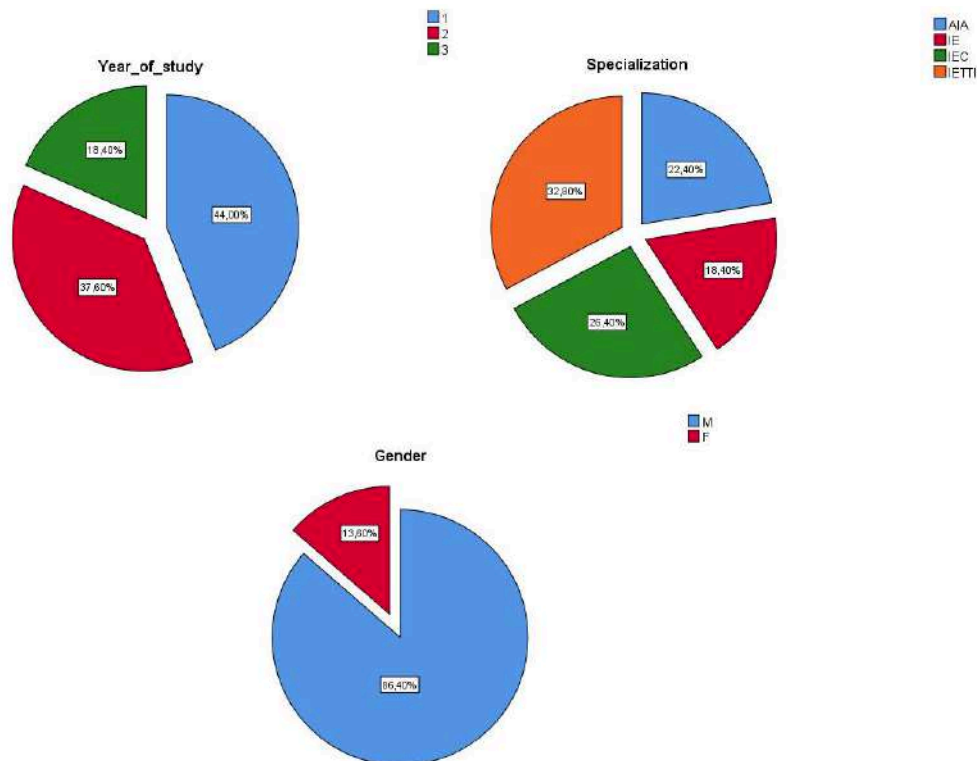


Figure 2. Participants distribution

4. Results

This section presents the statistical analysis of the data collected through the applied questionnaire, used for testing the hypotheses formulated in previous paragraph. This was realized with IBM SPSS Statistics.

H1. To test hypothesis H1, a Wilcoxon Signed-Rank Test was conducted to compare students' self-reported communication comfort with their professors versus their colleagues. Both variables

were measured on a 5-point Likert scale ranging from 1 (Never) to 5 (Always). The results are presented in **Figures 3a, 3b** and **3c** and reveal a statistically significant difference between the two conditions, $Z = 5.662$, $p < 0.001$. The test statistics were 2827.00 (SE = 206.01), based on a total sample of 125 students. These confirm H1 and indicate that students feel significantly more comfortable communicating with other students than with their professors.

H2. To evaluate hypothesis H2, a Kruskal-Wallis H test was applied to determine whether the number of communication barriers reported in interactions with professors differs depending on the year of study.

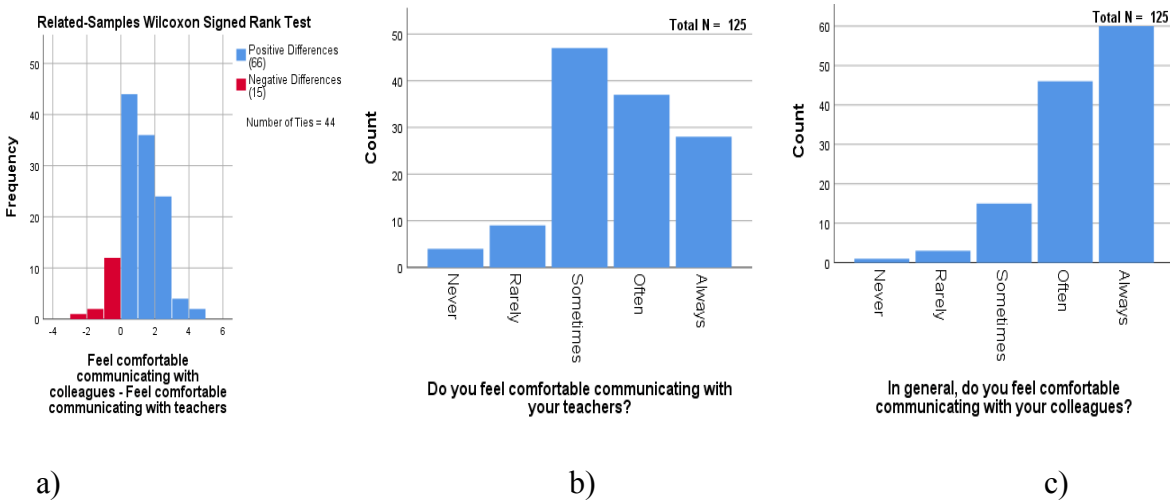


Figure 3. Wilcoxon Signed-Rank Test

H2. The sample included 125 students: 55 in the first year, 47 in the second year, and 23 in the third year. The test revealed no statistically significant differences in the total number of reported barriers among the three groups, $\chi^2(2) = 5.111$, $p = 0.078$. Although first-year students had slightly higher average ranks, the result did not meet the conventional threshold for statistical significance. Therefore, H2 is not confirmed. While some descriptive trends suggest that early-year students may face more communication difficulties, these differences are not strong enough.



H3. To examine H3, a Mann–Whitney U test was conducted to determine whether there are significant gender differences in the number of communication barriers reported in interactions with professors. The analysis included 125 participants, with males and females as the two comparison groups. The test revealed no statistically significant difference between the two groups, $U = 1102.000$, $Z = 1.406$, $p = 0.160$. While the median number of reported barriers was slightly higher among female students, the difference is not significant. So, H3 is not confirmed.

H4. To test Hypothesis H4, a Spearman rank-order correlation was conducted between students' perception of their professors' availability and the total number of communication barriers they reported. The results revealed a weak but statistically significant negative correlation ($\rho = -0.178$, $p = 0.047$, $N = 125$). In this case, the hypothesis is confirmed, indicating that students who perceive their professors as less available tend to report more communication barriers. Although the effect size is small, the statistical significance suggests a meaningful association. It highlights the potential impact that perceived availability and approachability of professors can have on students' willingness to engage in open communication.

In order to explore the frequency and nature of communication obstacles, students were asked to indicate the presence or absence of specific types of barriers in their interactions with both professors and other students. The analysis results are presented in **Table 1**.

Barrier type	With teachers		With colleagues	
	Frequency	Percent (%)	Frequency	Percent (%)
Fear of judgment	49	39,2	18	14,4
Lack of time	47	37,6	-	-
Language issues (technical vs. accessible)	19	15,2	18	14,4
Conceptual barriers	28	22,4	27	21,6
Environmental barrier	8	6,4	12	9,6



Lack of openness of teachers	30	24	-	-
Barriers of perception or position	27	21,6	14	11,2
Lack of trust	-	-	23	18,4
Lack of listening skills	-	-	10	8

Table 1. Barrier's frequency in technical faculties

For visual and intuitive representation, **Figure 4** illustrates the comparative distribution of communication barriers reported by students in a technical faculty when interacting with professors versus their colleagues. The results clearly indicate that students perceive significantly stronger barriers in communication with professors. The most frequently reported obstacle in the teacher–student relationship is fear of judgment (49 responses), followed closely by lack of time (47) and lack of openness (30). These suggest a dominant perception of asymmetry and limited access, which may inhibit open dialogue in formal academic settings. Additionally, barriers of perception/position and conceptual misunderstandings were reported at similar frequencies (around 22–27 responses), reflecting issues related to status differences or abstract, misunderstood content.

In contrast, communication with colleagues appears more fluid. While some barriers persist, such as lack of trust (23 responses) and conceptual misunderstandings (27), the overall frequencies are consistently lower. Moreover, aspects like lack of listening skills or language issues appear marginal, indicating a more informal and psychologically safer communication context among colleagues. This contrast highlights the need to militate for a more inclusive and empathetic communication culture between professors and students, while also recognizing the relative ease with which students relate to their colleagues. Institutional strategies could address both structural (e.g., time availability) and emotional (e.g., fear of being judged) barriers to improve the overall learning experience.



Figure 4. Communication barriers in a technical faculty

In addition to the structured items, the questionnaire included open questions that invited students to share their personal suggestions for improving communication, particularly with professors and colleagues. A thematic review of the responses revealed several recurring ideas, such as the need for professors to be more approachable and empathetic, the importance of an environment where students feel safe to express opinions without fear of judgment, and the call for clearer, less technical language in teaching. Students also suggested more interactive teaching styles, regular feedback sessions, and increased informal contact opportunities.

5. Conclusions

This paper investigates the communication barriers experienced by students in a technical faculty, both in their interactions with professors and those with colleagues. Quantitative data reveal that students have more obstacles when communicating with academic staff, particularly due to fear of judgment, lack of time, and limited openness from teachers. In contrast, communication with colleagues appears to be more relaxed, with some problems with trust and conceptual barriers. Two of the four formulated hypotheses were confirmed, with significant



differences: students communicate easier with their colleagues than with their professors and a lower perceived availability of professors is associated with a higher frequency of reported communication barriers among students. The other two were not supported by data, so gender and year of study have no influence on the type and frequency of communication barriers perceived by students.

The results suggest that professors have to encourage dialogue without fear of judgment, that greater availability, trust, and openness on the part of professors are essential for improving communication with students. Additionally, the open-ended responses highlight the value of empathy, non-judgmental attitudes, and interactive teaching approaches.

Some solutions to improve communication in technical faculties can include: training for teachers on empathetic communication, active listening and constructive feedback; promote activities such as brainstorming, free discussions in small groups; formative assessments (without grades) that encourage communication without pressure; constructive and personalized feedback provided to students regarding their progress; mixed work groups that encourage collaboration and horizontal communication, informal extracurricular activities.

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Perceived Stress, Basic Psychological Needs, and Quality of Life among Romanian School Counselors: A Mixed-Methods Study

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Abstract

School counselors face daily complex situations, such as abuse, trauma, and the emotional and relational difficulties of students, as well as pressures from other educational actors (parents, teachers, and the wider school community). These factors can generate high levels of stress, reduce both professional and personal quality of life, and may even lead to suicidal thoughts. The present study investigates the relationship between perceived stress, the satisfaction of basic psychological needs, and quality of life among school counselors. A mixed-methods design was employed. The quantitative, correlational component included 43 school counselors from several counties, recruited through the Regional Centers for Resources and Educational Assistance. The qualitative component consisted of semi-structured interviews with three school counselors. Perceived stress was negatively associated with quality of life ($r = -0.36, p < .05$) and positively associated with frustration of psychological needs ($r = 0.39, p < .001$). Satisfaction of psychological needs showed a strong positive association with quality of life ($r = 0.85, p < .001$), explaining 73% of its variance. School counselors exhibit high levels of stress that significantly impact their quality of life. The satisfaction of basic psychological needs is an essential factor for maintaining well-being and professional balance. Study limitations include the small sample size and the subjective nature of self-report measures.



Keywords: school counselor; stress; basic psychological needs; quality of life; mixed-methods design.

1. Introduction

This research originated from the practical experience gained during the first year of activity as a novice school counselor. In 2024, the author of this study was employed as a substitute school counselor within the County Center for Educational Resources and Assistance Braşov, working in the counseling office of a public middle school. Throughout this period, the counselor was confronted with a large number of urgent and complex cases, including situations of abuse, trauma, aggressive behaviors, and family or educational difficulties.

The time allocated to direct interventions often proved insufficient due to the high number of students and the multiple demands coming simultaneously from children, parents, and teachers. These conditions led to a heightened level of perceived stress and raised important questions regarding the effectiveness of interventions, the adequacy of professional competences, and the actual impact of the counselor's role on beneficiaries.

Building on this experience, the present study aims to investigate the relationship between perceived stress, the satisfaction of basic psychological needs, and the quality of life of school counselors, providing both theoretical and practical insights into a highly relevant educational issue.

2. Literature Review

Building on this practical experience, the present study aims to analyze the relationship between perceived stress, the satisfaction of basic psychological needs, and the quality of life of school counselors, providing a scientific perspective on an issue with direct impact in the educational field.

School counselors represent an essential professional category within the Romanian educational system, having the role of supporting the personal, emotional, social, and educational



development of students, as well as facilitating their relationship with family, school, and community. Their main responsibilities include psychological and educational counseling, school and career guidance, prevention of risk behaviors and school dropout, as well as constant collaboration with parents and teachers (Centrul Județean de Resurse și Asistență Educațională Brașov, 2024).

Practical experience shows that professionals in school counseling often face complex situations, including cases of abuse, trauma, aggressive behavior, family and educational difficulties, as well as pressures from other educational stakeholders – parents, teachers, and the school community. The high workload, diversity of issues, and limited time allocated to direct interventions frequently generate high levels of stress, exposing counselors to risks of emotional exhaustion and diminished quality of both professional and personal life.

Specialized literature confirms that educational staff involved in psycho-pedagogical support activities are among the most vulnerable professional categories to occupational stress, particularly in the context of inadequate institutional resources and multiple responsibilities (Maslach & Leiter, 2016). For school counselors, perceived stress tends to be persistent and intense, negatively affecting job satisfaction and potentially leading to burnout or even suicidal ideation (Wilkerson, 2009; Fantilli & Folkman, 2009). The pressure is amplified by the need to manage emotional crises within limited time frames and to collaborate efficiently with teachers, parents, and external institutions.

A useful theoretical framework for understanding these mechanisms is Self-Determination Theory (Deci & Ryan, 2000), which highlights the importance of satisfying three basic psychological needs – competence, autonomy, and relatedness – in maintaining mental health and intrinsic motivation. For school counselors, meeting these needs contributes to stress reduction and supports both professional and emotional balance.

Quality of life in the professional domain is influenced by factors such as work-life balance, perceived stress at work, professional recognition, autonomy in decision-making, and organizational support (Sirgy et al., 2006). Recent studies confirm that psycho-pedagogical support professions are exposed to high levels of stress, while the satisfaction of basic



psychological needs plays a central role in maintaining well-being and professional quality of life (Ryan & Deci, 2000; Vansteenkiste & Ryan, 2013).

In Romania, during the 2023–2024 academic year, one school counselor was responsible for approximately 800 students, and starting from 2025 this number was reduced to 500 (Ministerul Educației, 2023). Even with this reduction, the ratio remains high compared to the international standard, where one counselor should work, on average, with 250 students (American School Counselor Association, 2019). This discrepancy highlights the additional pressure faced by Romanian school counselors, who must respond to a large volume of requests with limited resources. In the absence of well-structured organizational support and supervision programs, the risk of chronic stress, burnout, and decreased professional quality of life remains significantly high. Therefore, analyzing the relationship between perceived stress, satisfaction of psychological needs, and quality of life of school counselors is essential both for advancing research in educational psychology and for supporting educational policies aimed at protecting the mental health and efficiency of this professional category.

Moreover, specialized literature shows that the entry into the profession is one of the most demanding stages for school counselors, being associated with high levels of stress and emotional vulnerability. Mentorship and supervision programs can facilitate professional adjustment and reduce the intention to leave the educational system (Smith & Ingersoll, 2004). However, in Romania, the formal support provided to novice counselors often remains limited or focused mainly on bureaucratic aspects, without sufficiently addressing their psychological and emotional needs.

3. Methodology

Objectives

The present study aims to examine the relationship between perceived stress, the satisfaction and frustration of basic psychological needs, and the quality of life among school counselors, using a mixed-methods design that combines quantitative and qualitative data.



Hypotheses

- H1. Perceived stress is negatively associated with quality of life among school counselors.
- H2. The frustration of basic psychological needs is positively associated with perceived stress.
- H3. The satisfaction of basic psychological needs predicts quality of life among school counselors.
- H4. There are significant differences in the satisfaction of psychological needs depending on counselors' level of professional experience.

Research Design

This study employed a mixed-methods design, integrating both qualitative and quantitative approaches.

The qualitative component consisted of in-depth semi-structured interviews, analyzed using an inductive thematic approach. Interviews were transcribed and coded, allowing for the identification of recurring domains and patterns relevant to school counselors' professional experiences.

The quantitative component involved statistical analysis of data collected through standardized questionnaires that assessed perceived stress, the satisfaction and frustration of basic psychological needs, and quality of life. This approach enabled the exploration of associations between variables and comparisons based on counselors' professional qualifications.

Participants

For the quantitative data collection, an online questionnaire was distributed via Facebook, Instagram, and email to several County Centers for Educational Resources and Assistance, which were asked to forward it to their employees. A total of 43 school counselors participated (39 women – 90.7% and 4 men – 9.3%), with ages ranging from 22 to 64 years ($M = 38.58$, $SD = 11.85$).

The qualitative component included semi-structured interviews with three school counselor colleagues, conducted by the researcher. Participants were informed that participation was voluntary and anonymous, and that they could withdraw at any time without consequences.



Regarding professional qualifications, 3 participants (11.5%) held the first professional degree, 2 (7.7%) held the second degree, 14 were substitutes (53.8%), and 1 participant was tenured (3.8%).

Instruments and Materials

This study employed both qualitative and quantitative methods, using semi-structured interviews and online questionnaires (Google Forms).

Three online interviews were conducted via Google Meet in April 2024, each with an average duration of 20 minutes. For confidentiality purposes, participants were anonymized. The interview included questions about professional expectations, challenges encountered, perceptions of the school counselor's role, and coping strategies. The data were analyzed through inductive thematic analysis (Braun & Clarke, 2006), with codes and major themes being extracted.

To assess the study variables, three standardized psychological instruments were used:

Perceived Stress Scale (PSS-14; Cohen & Kamarck, 1983), consisting of 14 items rated on a 5-point Likert scale, with higher scores indicating higher levels of perceived stress. The instrument has demonstrated good internal consistency, with Cronbach's alpha values ranging from .84 to .86.

WHOQOL-BREF (World Health Organization, 1996), a 26-item short questionnaire measuring four dimensions of quality of life: physical, psychological, social, and environmental. Scores are transformed to a 0–100 scale, where higher values reflect better quality of life. Reported internal consistency in the literature ranges from $\alpha = .66$ to $\alpha = .84$.

Basic Psychological Need Satisfaction and Frustration Scale (Chen et al., 2015), comprising 24 items grouped into six subscales corresponding to the three basic needs—autonomy, competence, and relatedness—evaluated both in terms of satisfaction and frustration. Items are rated on a 5-point Likert scale, with reported internal consistency ranging from $\alpha = .71$ to $\alpha = .89$.



4. Results

All data were analyzed using IBM SPSS Statistics 23.

H1. It was hypothesized that perceived stress is associated with quality of life among school counselors.

To test this hypothesis, Pearson's correlation was conducted. The results are presented in **Table 1**.

	Physical Domain	Psychological omain	Social Domain	Environmental omain
Stress	-.16	-.34*	-.42**	-.42**

Note. $N = 43$. * $p < .001$, ** $p < .05$

Table 1. Pearson Correlation between Stress and Quality of Life

The findings indicate that perceived stress is negatively associated with quality of life in the psychological, social, and environmental domains. Qualitative data obtained through interviews support this negative association. Participants reported experiencing intense emotional states such as anxiety, stress, guilt, frustration, and confusion. For example, one participant explained:

"...anxiety because I didn't know how to do it, what to do, if I was doing it right, and I wanted to do as many things as possible; it was taking a lot of time from my personal life." (T)

The feeling of guilt was also present:

"If I did something else, the feeling of guilt appeared." (T)

The main sources of stress identified by participants included insufficient time allocated for counseling, difficulties adapting to the first job, uncertainty regarding job continuity (as many were employed as substitutes), heavy workload, bureaucratic activities (e.g., reports, meetings), and the frustration caused by the lack of immediate visible effects of counseling on students' behavior.

As one participant expressed:

"I feel frustrated because I think the time allocated is not enough and that I am just one person for



too many. Somehow I feel that I have to choose between them... Who needs counseling more? Who am I to decide?" (A, 76–80).

H2. It was hypothesized that the frustration of basic psychological needs is positively associated with perceived stress.

	Autonomy Frustration	Relatedness Frustration	Competence Frustration
Total stress	.39**	.27	.26

*Note. N = 43. * $p < .001$*

Table 2. Pearson Correlation between Need Frustration and Perceived Stress

The results indicate that autonomy frustration was significantly and positively associated with perceived stress, suggesting that counselors who felt less control over their activities reported higher levels of stress. While relatedness and competence frustration did not reach statistical significance, qualitative data provided valuable insights into how these unmet needs may still exacerbate stress. For example, one participant described a lack of control over daily activities due to unexpected demands, highlighting frustration of autonomy and work organization:

"Ad-hoc meetings without prior scheduling." (A)

Another counselor expressed doubts about the effectiveness and impact of their work, reflecting frustration of competence:

"That's when the questions appear: what is my role here? Do I have an impact? Am I really helping anyone?" (T)

Difficulties in collaborating with teachers were also reported as barriers to fulfilling the need for relatedness:

"They send the child as if to detention." (T)

"Lack of support from colleagues." (T)



Although statistical confirmation was lacking, these narratives suggest that unmet psychological needs can heighten professional stress and reduce counselors' sense of efficiency and belonging.

H3. It was hypothesized that the satisfaction of basic psychological needs predicts quality of life among school counselors.

To test this hypothesis, a simple linear regression was conducted. The results are presented in **Table 3**.

Variable	<i>B</i>	<i>SE B</i>	β	<i>t</i>	<i>p</i>
<i>R</i> ²	.73				
<i>F</i>	110.85				
Constant	5.65	8.62		.65	
Total satisfaction	1.96	.18	.85	10.52	.000

Note. Dependent variable: Quality of life. *N*=43

Table 3. Simple Linear Regression Predicting Quality of Life from Need Satisfaction

The regression analysis showed that the satisfaction of basic psychological needs predicted 73% of the variance in quality of life, confirming the hypothesis.

Qualitative data supported this relationship. Participants emphasized that fulfilling psychological needs—particularly competence, positive relatedness, and autonomy—was essential for experiencing a high quality of professional life. One counselor explained:

“I see them, I see their reactions on their faces, that they are happy, that they enjoyed it, and that’s where I recharge with energy, that’s where I get my satisfaction.” (T)

Others highlighted the joy of meaningful relationships at work and the fulfillment of working with children:

“At the end of the day, I do what I love, which is working with the children.” (B)

Moments of genuine connection were described with emotion:

“The moment when they come and hug me when they see me in the schoolyard” ... “They hug you and give you so much in return.” (A, 146)



These testimonies clearly illustrate that satisfying fundamental psychological needs in the workplace contributes to a more positive perception of quality of life.

H4. We hypothesized that there are significant differences in basic psychological need frustration between school counselors depending on their employment status (substitute vs. tenured).

Employment status	<i>M</i>	<i>N</i>	<i>SD</i>	<i>t</i>	<i>df</i>	<i>p</i>
tenured	31.13	23	6.06	-.79	41	.43
substitute	32.50	20	7.32			

Table 4. Independent Samples t-Test Results

To test this hypothesis, an independent samples t-test was conducted. Results showed no statistically significant difference in basic psychological need frustration between tenured counselors ($M = 31.13$, $SD = 6.06$) and substitutes ($M = 32.50$, $SD = 7.32$), $t(41) = -.79$, $p = .43$. Therefore, the hypothesis was not supported (**Table 4**).

However, qualitative findings provide valuable nuance. The three interviewed participants were first-year substitutes without tenure, and they consistently described challenges such as excessive bureaucracy, limited autonomy, and lack of genuine institutional support. For example, one counselor noted:

"So much time is spent on paperwork and planning that it takes away from the time I could dedicate to students and preparing activities for them." (R)

Frustration regarding competence was also reflected in how participants perceived mentoring activities, which they considered superficial and insufficient:

"I only remember one useful activity from the mentoring program... the rest I learned on the go." (R).

Support from school leadership was described as formal and bureaucratic, failing to address the real needs of novice counselors:

"Many things are done just to be checked off, not because they actually help me in practice." (R).

These accounts suggest that, even if not statistically significant in the quantitative data, employment status may still shape how counselors experience need frustration in practice.



5. Discussion and Conclusions

The findings of this study align with previous research indicating that professionals in school counseling and psycho-pedagogy are frequently exposed to high levels of occupational stress, which negatively affect their quality of life (Maslach & Leiter, 2016; Van Horn et al., 2004). Quantitative analyses showed that perceived stress was negatively associated with the social and environmental domains of quality of life, partially confirming Wilkerson's (2009) observations about the relational and organizational consequences of stress.

By contrast, differences between tenured and substitute counselors were not statistically significant. Nonetheless, qualitative accounts revealed that novice substitutes frequently experienced excessive bureaucracy, lack of genuine support, and limited autonomy—echoing Mullen and Gutierrez's (2018) findings about the vulnerabilities of early-career professionals. This discrepancy between quantitative and qualitative results suggests that while employment status may not systematically predict need frustration, it remains an important contextual factor shaping counselors' lived experiences.

In conclusion, satisfaction of basic psychological needs stands out as a critical predictor of quality of life and a buffer against burnout among school counselors. The partial confirmation of hypotheses highlights the complex interplay between stress, needs, and professional context. The lack of adequate institutional support, particularly for novice counselors, increases vulnerability and undermines the effectiveness of psycho-pedagogical interventions. These findings underscore the urgency of developing mentoring and supervision programs that move beyond formality and address the real psychological and professional needs of school counselors.

Practical Implications

Based on the results, several concrete directions for intervention can be outlined. First, the integration of continuous training modules focused on stress management, emotional self-regulation, and resilience-building among school counselors is essential for strengthening professional competence and preventing exhaustion. Second, regular access to psychological supervision and peer consultation should become an institutionalized practice, providing school



counselors with a safe framework for professional reflection, emotional support, and the exchange of best practices.

Furthermore, simplifying bureaucratic tasks and clarifying the counselor's role within schools may enhance professional autonomy and reduce frustration. Special emphasis should be placed on developing authentic mentoring programs for novice counselors, moving beyond formalism and including practical support, concrete examples of individual and group counseling, and applied feedback.

This study can serve as a starting point for the development of national educational policies aimed at preventing burnout and promoting guidelines for best practices, thereby enhancing the professional quality of life of school counselors and, implicitly, the effectiveness of the services offered to students and the school community.

Study Limitations and Future Directions

Although both quantitative and qualitative methods were employed, this study presents several important limitations. First, the relatively small sample size and its restriction to certain regions limit the generalizability of the findings at the national level. Second, the cross-sectional design allows for the identification of associations but does not establish causal relationships between variables.

Additionally, the reliance on self-report measures may introduce subjectivity, and certain contextual factors—such as organizational climate, administrative support, case load, or material resources—were not systematically analyzed, despite their potential significant influence on stress and quality of life.

Future research should employ longitudinal designs with larger and more diverse samples, integrating these contextual variables. Expanding the qualitative dimension through focus groups or interviews with a broader range of counselors from different regions could provide a more nuanced and comprehensive understanding of professional realities. Moreover, comparative studies with other educational systems could highlight transferable best practices relevant to the Romanian context.



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Online Teaching Strategies for Nursing Students: Challenges and Opportunities

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Abstract

The COVID-19 pandemic has transformed global education systems, with nursing education being among the most affected disciplines due to its dual reliance on theoretical instruction and clinical practice. This study examines the challenges and opportunities associated with the accelerated adoption of online teaching for nursing students. Through a mixed-methods literature review published between 2020 and 2025, the paper highlights both the potential and the limitations of e-learning in nursing.

Key advantages of e-learning include accessibility, flexibility, and innovation which enable continuity of learning regardless of geographical location or time constraints. The integration of digital tools, such as virtual patient simulations and online case studies, has provided innovative opportunities to strengthen both theoretical and clinical knowledge. Nevertheless, there're significant reductions in opportunities for direct clinical practice, unequal access to digital resources, and diminished interpersonal interaction.

The findings suggest that blended learning an-approach combining online education with supervised, clinical training-offers the most effective and sustainable model for nursing education in the post-pandemic era. Recommendations include expanding investment in digital infrastructure, incorporating high-quality simulation technologies into nursing curricula, and ensuring comprehensive faculty development in e-learning pedagogies. Ultimately, online learning should be



regarded not as a replacement but as a complementary strategy that enhances traditional nursing education.

Keywords: online teaching, nursing education, virtual simulation, blended learning, clinical skills.

1. Introduction

The onset of the COVID-19 pandemic in 2020 created unprecedented disruptions in global education, forcing universities and colleges worldwide to adopt online teaching models. While many academic disciplines were able to make a relatively smooth transition, nursing education faced unique challenges due to its reliance on both theoretical knowledge and clinical practice (Nuuyoma et al., 2023; Alfaleh et al., 2023). Nursing students not only require exposure to academic content but also to direct patient care experiences, supervised clinical practice, and the development of professional communication skills.

2. Literature Review

The sudden shift to online platforms tested the resilience of nursing schools, faculty members, and students alike. For many, this transition highlighted the transformative potential of technology in education, but it also revealed systemic inequalities and pedagogical limitations (Chambers & Whitfield, 2025; Pozzi et al., 2023; Sutoi et al., 2023). Romania was compelled to redesign its nursing curricula almost, relying heavily on digital tools, infrastructure and the pedagogical level of teachers in different regions (Alfaleh et al., 2023). At the same time, other nations demonstrated both positive outcomes and significant shortcomings of this rapid digitalization process (Mojarad et al., 2023; Kumar et al., 2021; Falahati-Marvast et al., 2025).

This review contributes to highlighting the effectiveness of incorporating online learning into traditional nursing education. Virtual simulation technologies have emerged as effective strategies to enhance communication, problem-solving, professional competence, and nursing process application, but attention needs to be paid to equitable access to technology, instructor competence, and blended models that align with the digital transformation of healthcare and patient-centered



nursing (Alsharari et al., 2025; Hara et al., 2021; Du et al., 2022; Păstae, 2023). The study draws on a mixed-methods literature review published between 2020 and 2025, highlighting trends, benefits, challenges, and future recommendations.

Objectives

The primary objective of this study is to examine the opportunities and barriers associated with online teaching in nursing education. Specifically, the study aims to:

1. identify the benefits of online teaching for nursing students, particularly in terms of accessibility, flexibility, and innovation.
2. explore the barriers and limitations, including challenges related to student engagement, digital infrastructure, and e-learning pedagogies.
3. propose recommendations for implementing blended learning models that balance theoretical instruction with clinical practice.

3. Methodology

Study design

This paper is based on a mixed-methods literature review published from 2020 to 2025. The following electronic databases were searched: PubMed, Scopus, CINAHL, ERIC, and Web of Science. The search terms included: online teaching, nursing education, virtual simulation, blended learning, and clinical skills were conducted following the 2020 Preferred Reporting Items for Systematic Reviews and Meta-Analysis (PRISMA) guidelines (Page et al., 2021; Liberati et al., 2009).

The synthesis and integration of findings across diverse study designs were conducted following the Joanna Briggs Institute (JBI) Convergent Integrated Approach (Lizarondo et al., 2020). This approach facilitates the integration of qualitative and quantitative evidence within a single synthesis by transforming data into a compatible format and developing unified, overarching themes. The convergent integrated method ensures that both qualitative insights and quantitative



outcomes contribute equally to the interpretation of results, thereby providing a more comprehensive understanding of the research phenomenon.

In parallel, the methodological guidance of Bettany-Saltikov & McSherry (2016) was applied to ensure the rigor of systematic searching, critical appraisal, and evidence management within a mixed-methods review framework. This combined approach enabled the systematic inclusion, evaluation, and synthesis of multiple forms of evidence while maintaining transparency and methodological consistency throughout the review process. Additionally, the integration of these two frameworks strengthened the credibility of the synthesis and facilitated the development of evidence-based, contextually grounded recommendations derived from the full spectrum of available research.

Eligibility criteria

This study followed the Joanna Briggs Institute (JBI) Methodology for Systematic Reviews. The PICO framework which defines the Population, Phenomena of Interest, and Context was used as the basis for systematically identifying and selecting both qualitative and quantitative studies, as well as for establishing the inclusion and exclusion criteria (Stern et al., 2020).

Inclusion criteria: peer-reviewed studies published between 2020 and 2025, studies focusing on nursing students or nurses engaged in online learning, and both qualitative and quantitative research designs.

Exclusion criteria: non-English publications, studies without empirical data, and research focusing on non-nursing health professions. Additionally, the eligibility criteria were conducted following **Table 1**.



Inclusion criteria	Exclusion criteria
Peer-reviewed studies published between 2020- 2025 Studies focusing on nursing students or nurses engaged in online learning English publications, empirical studies Qualitative or quantitative research designs and both.	Not peer-reviewed studies published between 2020- 2025 Research focusing on non-nursing health professions Non-English publications, studies without empirical data Not qualitative or quantitative research designs and neither.

Table 1. Eligibility criteria

Study strategy: This systematic search was conducted across PubMed, Scopus, CINAHL, ERIC, and the Web of Science databases. The reference lists of all articles were searched for additional studies. Studies published in English from 2020 to 2025 were searched to identify relevant articles on e-learning and nursing students. This research period spans the Covid-19 period to the present, when online learning has become an important element in the international teaching and learning landscape. The initial keywords used in the review were "nursing education" OR "clinical skills"; "online teaching" OR "virtual simulation, OR "blended learning". The complete search strategy implemented is presented in **Table 2** of Supplement appendix.

Study selection: This paper applied inclusion and exclusion criteria throughout the selection process. After removing duplicates, the titles and abstracts of the remaining articles were screened to exclude irrelevant studies. At this stage, 53 articles were identified as potentially eligible and underwent full-text review according to the pre-defined inclusion and exclusion criteria. After full-text screening, 12 primary research articles met the eligibility criteria and were included in the initial review synthesis. The selection process, including the reasons for exclusion at each stage, is detailed in the PRISMA 2020 flowchart (Page et al., 2021). The PRISMA flowchart for the initial search are available in **Figure 1**.

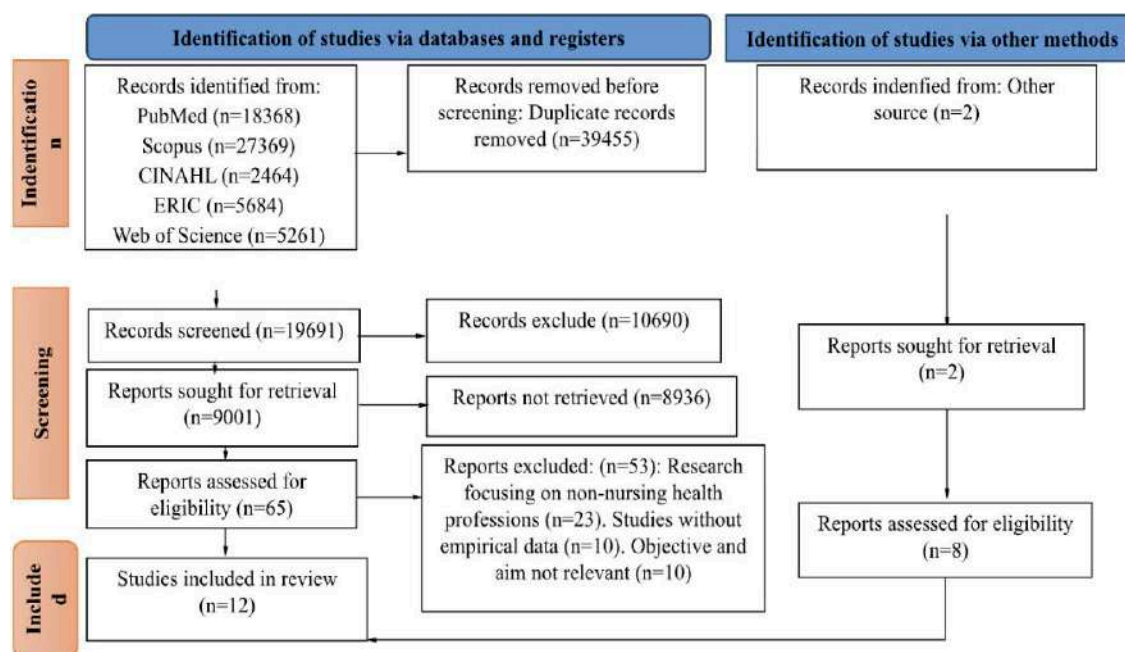


Figure 1. Preferred Reporting Items for Systematic reviews (PRISMA) (Page et al., 2021)

Quality assessment

For Randomised Controlled Trials (RCTs), the quality appraisal was conducted using the Joanna Briggs Institute (JBI) Critical Appraisal Checklist for Randomised Controlled Trials (JBI, 2020) and specify the criteria or scoring system applied in this study.

Assessing the Quality of 12 articles involves the following five specific steps: 1) Scoring and Classification: The total score is calculated by counting the number of “Yes” responses. Commonly accepted classification thresholds are: 11–13 = High quality, 8–10 = Medium quality, and ≤ 7 = Low quality. 2) Addressing “Unclear” or Missing Information: State the reason for the “Unclear” rating in the “Notes” column (e.g., the randomization method was not described). Do not automatically mark “No” if the information may be located elsewhere in the article—check the appendix or supplementary material first. If it is still not found, keep the “Unclear” label. 3) Impact on Overall Evidence: Considers conducting sensitivity analyses, excluding low-quality studies to test the robustness of the results. 4) Transparent Presentation: Include the full assessment table in the **Appendix** and summarize the quality findings in the Methods or Results



section. Report the number of studies in each quality category, the most common weaknesses, and their potential impact on the overall conclusions. 5) Practice Recommendations: If there are a number of studies scoring low on key criteria, caution should be exercised when interpreting the findings, and future studies should be recommended using more rigorous designs. Quality assessment based on 12 studies of the systematic review in **Table 3** of Supplement appendix.

The quality assessment of 12 randomized controlled trials (RCTs) using the Joanna Briggs Institute (JBI) Checklist found that most studies were of moderate to high methodological quality. Overall strengths included clear randomization procedures, reliable outcome measures, and appropriate statistical analysis. However, some limitations remained regarding blinding of participants, adequacy of follow-up, and transparency of reporting. Overall, five studies were classified as high quality (scores 11-13), while the remaining seven were of moderate quality (scores 8-10). No studies of low quality were identified, suggesting that the included RCTs provided a solid evidence base for synthesis.

Data extraction

This paper conducted data extraction using a standardized template developed in accordance with the guidelines by Stern et al. (2020). This template was created in Microsoft Word (2019) to facilitate systematic extraction and ensure consistency across all included studies. Data items included the general characteristics of each study (author(s), publication year, study aim, sample, and research design), participant demographics (gender, age, years of experience), data collection tools (instruments used, components relevant, and data analysis techniques), and the findings. A digital reflective record was maintained to document decisions, uncertainties, and reasons for inclusion or exclusion. All extracted data were compiled into a summary of extracted data **Table 4** in Supplement appendix, which was then used to support thematic synthesis and integration of findings.

Data analysis and synthesis

A thematic narrative synthesis was conducted to summarize the challenges and opportunities of online teaching on nurses' learning, following the Guidelines for Conducting a Narrative



Synthesis in a Systematic Review (Popay et al., 2006). The thematic analysis followed the six steps outlined by Braun and Clarke (2006): familiarization with the data, initial coding, theme identification, theme review, definition, and naming. The synthesis was structured around the research objectives of the study outlined above.

Data were synthesized using the Joanna Briggs Institute (JBI) convergent integration method to integrate qualitative and quantitative findings (Lizarondo et al., 2020). In this method, quantitative findings are qualified, where data are converted into textual descriptions, to facilitate thematic integration with qualitative data. Although this method allows for comprehensive thematic synthesis, it also requires subjective interpretation of numerical findings, leading to the possibility of bias in interpretation. Therefore, to minimize this risk, the process was guided by Sandelowski et al. (2006), which aims to avoid the possibility of misinterpretation due to assigning numerical values to narrative data.

After data transformation, an inductive process by Thomas & Harden (2008), which three-stage thematic synthesis method, was applied to analyze the data in the synthesized study findings. In the first stage, initial codes were generated from all study findings through line-by-line text coding. This process was manually recorded and organized using Microsoft Word (2019). In the second stage, codes were grouped into descriptive categories based on patterns and similarities within and between studies. The third stage involved interpreting these categories to generate analytical themes that captured commonalities and differences between the studies reviewed. Codes and themes were reviewed multiple times to ensure consistency, coherence, and relevance to the review question. Preliminary themes and their supporting data were reviewed to ensure coherence, clarity, and relevance to the review objectives.

4. Results

Characteristics of the included studies

Two studies used qualitative methods (Mojarad et al., 2023; Nuuyoma et al., 2023). Two studies used quantitative methods (Kumar et al., 2021; Sutoi et al., 2023). Five studies used mixed

methods (Alsharari et al., 2025; Chambers & Whitfield, 2025; Du et al., 2022; Păstae, 2023; Pozzi et al., 2023). One study pretest–posttest controlled trial/experimental study (Falahati-Marvast et al., 2025). One study cross-sectional, multicentric study (Alfaleh et al., 2023). Methodological study/descriptive study (Hara et al., 2021). The selected studies were conducted in Saudi Arabia ($n = 1$), England ($n = 1$), China ($n = 1$), Iran ($n = 2$), Brazil ($n = 1$), India ($n = 1$), Namibia ($n = 1$), Italy ($n = 1$), Australia ($n = 1$), and Romania ($n = 2$). The main characteristics of each paper are summarised in **Table 4** of Supplement appendix.

Integrated findings

The thematic analysis identified three main themes related to online teaching for nursing students in education: the main benefits, barriers, and recommendations. Each theme included one or more subthemes that highlighted specific aspects of advantages, limitations, and future recommendations for online teaching. A summary of the themes, categories, and related subthemes are presented in a thematic map (**Figure 2**).



Figure 2. Thematic map of the benefits, barriers, and proposed recommendations for e-learning

Synthesis of Findings

Benefits



Across the analysis of 12 articles, three main benefits of the effectiveness of online teaching for nursing students were found: accessibility, flexibility, and innovation. Each advantage has many aspects that are described in detail in each article.

The general consensus highlights that online and blended teaching have become integral and effective components of modern nursing education. Studies consistently reported that virtual platforms supported continuity of learning during the COVID-19 pandemic, ensuring academic progression even amid institutional closures. It still ensures flexibility, convenience, accessibility of learning materials, and time efficiency (Pozzi et al., 2023; Alfaleh et al., 2023; Kumar et al., 2021).

The primary advantage reported across studies was flexibility; students could learn anytime, anywhere, allowing for personalized pacing. Online platforms enhanced accessibility, particularly for remote learners and those balancing study with employment (Chambers & Whitfield, 2025).

Quantitative findings (Kumar et al., 2021; Sutoi et al., 2023) showed that most nursing students expressed high satisfaction with online learning. They rated online learning as generally effective and considered it a valuable educational approach. Online learning is not a replacement but a complement to traditional teaching methods, and it accommodates innovation and adaptation.

Qualitative findings (Mojarad et al., 2023; Nuuyoma et al., 2023) support the appreciation of flexibility and accessibility. These reviews have impressed virtual simulation such as LMS, online case study, video conferencing, forums, and social media. The technologies have emerged as effective strategies, enhancing communication, problem-solving, innovative skills, professional competence, and nursing process application.

Meta-analysis and mixed-methods underscore the importance of inclusive, flexible, and human-centered e-learning strategies in nursing education. Additionally, the review found that blended learning is more effective than traditional teaching in enhancing nursing students' knowledge, skills, and satisfaction. (Chambers & Whitfield, 2025; Du et al., 2022).

Technological tools such as virtual reality simulations, serious games, and e-learning modules created safe, interactive environments for students to practice without risking patient safety. The



technology has the potential to bridge the gap between theoretical training and real patient interactions. Furthermore, these tools improved student engagement, confidence in theoretical concepts, and readiness for evidence-based practice. Additionally, the virtual simulations, realistic games, and interactive modules enhance nursing students' clinical reasoning, communication, and creativity skills. Overall, the results suggest that blended learning models outperform online or face-to-face learning formats, achieving a balanced integration of digital and practical competencies. Ultimately, these studies were showed significant improvements in theoretical knowledge, problem-solving ability, and critical thinking in students exposed to virtual simulation or blended e-learning environments (Alsharari et al., 2025; Hara et al., 2021; Falahati-Marvast et al., 2025).

In Romania, these studies concluded that online teaching was generally effective, with students perceiving it as a valuable educational approach. The stronger pre-pandemic digital strategies fared better in ensuring continuity of nursing education. Online learning offers several benefits, including flexibility, accessibility, and time efficiency (Alfaleh et al., 2023; Sutoi et al., 2023).

Other benefits included cost savings, efficient use of teaching resources, and the ability to record and revisit lectures. Some studies also reported that online learning fostered self-directed learning, reflective thinking, and digital literacy-essential competencies for future healthcare professionals (Chambers & Whitfield, 2025; Pozzi et al., 2023).

Barriers

Despite the advantages, all studies acknowledged persistent challenges that hindered the full potential of online nursing education. The most frequent issues included challenges related to student engagement, digital infrastructure, and e-learning pedagogies.

E-learning was the only viable solution during the COVID-19 pandemic, but it posed significant challenges in resource-constrained settings when introduced abruptly. The findings emphasize the need for structured support systems, better training, and innovative methods to address practical, assessment, and digital literacy challenges (Nuuyoma et al., 2023). Lack of clinical practice opportunities (Sutoi et al., 2023; Du et al., 2022), which reduced the development of



psychomotor and interpersonal skills. Technological barriers, including poor internet connectivity, limited access to devices, and inadequate IT support (Mojarad et al., 2023). In addition, the barriers included poor voice clarity, connectivity issues, and physical strain (eye problems), negatively influenced the experience (Kumar et al., 2021). Reduced interaction between students and instructors, leading to isolation, lower motivation, and diminished sense of community. Inexperienced educators, some of whom lacked training in digital pedagogy, were affecting the quality and engagement of e-learning sessions. The review reveals that while online collaboration is increasingly recognized as valuable for nursing education, its actual implementation often falls short of best pedagogical practices (Păstae, 2023).

The digital inequality between urban and rural learners exacerbated existing educational disparities. In Romania, the transition to online learning exposed gaps in digital infrastructure, especially in rural areas where connectivity was weak. Faculty members were often unprepared for digital teaching, lacking both technological skills and pedagogical training for online platforms (Sutoi et al., 2023).

Additionally, this study has certain limitations. First, the systematic review was restricted to English-language publications, which may have excluded valuable evidence from non-English-speaking countries. Second, the included studies were heterogeneous in design, making direct comparisons difficult. Finally, the review did not assess long-term outcomes of online learning, leaving questions about its sustained effectiveness unanswered.

Recommendations

All authors agreed that blended learning should become the standard pedagogical model for nursing education. Recommendations for e-learning in nursing education emphasized:

Institutional investment in digital infrastructure to ensure reliable internet access and modern learning management systems. Faculty development programs focused on digital teaching competencies, instructional design, and virtual assessment strategies. Integration of virtual simulations, 3D serious games, and case-based e-learning as supplements to real clinical practice. Ongoing evaluation and quality assurance to align digital education with nursing



accreditation standards. Encouraging student-centered approaches that balance autonomy with interactive, collaborative learning environments.

Furthermore, a recurring theme was the need for policy-level reform to formally recognize e-learning components in nursing curricula and to fund innovation in simulation-based and hybrid teaching methodologies. Ultimately, longitudinal studies are needed to assess the long-term impact of e-learning on nursing competencies and patient outcomes.

5. Conclusion

The findings suggest that online education has become an essential component of nursing education, particularly in times of crisis. Its greatest strength lies in its flexibility, accessibility, and innovation which enables uninterrupted learning during disruptions such as pandemics. Additionally, the use of digital simulations and case studies can enhance clinical reasoning skills and provide exposure to diverse clinical scenarios.

However, online education has clear limitations when applied exclusively to nursing. The absence of hands-on clinical training remains the most pressing concern. Nursing is inherently practical, requiring students to develop not only cognitive but also psychomotor and affective skills through direct patient interactions. Without supervised clinical practice, students risk graduating with incomplete competencies.

Another important issue is digital inequality. Students from low-income backgrounds or rural regions often lack access to stable internet connections and suitable devices, leading to disparities in learning opportunities. Furthermore, the reduction in face-to-face interaction can weaken peer collaboration and limit the development of soft skills such as empathy and teamwork.

From a Romanian perspective, the integration of online learning into nursing education must align with the broader goals of the European Higher Education Area (EHEA), which emphasizes inclusivity, digital innovation, and quality assurance. Investment in infrastructure and faculty training is therefore critical to bridging the gap between policy and practice.



In conclusion, online teaching has emerged as both a challenge and an opportunity for nursing education. While it has ensured continuity of learning during the COVID-19 pandemic, its limitations underscore the need for a hybrid approach. Blended learning, combining online theory with face-to-face clinical practice, offers the most sustainable and effective pathway forward. The study concludes that e-learning should not be viewed as a replacement for traditional nursing education but rather as a complementary tool that can enrich teaching, enhance accessibility, and prepare students for the realities of an increasingly digital healthcare environment.

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Supplement Appendix of the Paper:

Online Teaching Strategies for Nursing Students: Challenges and Opportunities

Database	Search terms
PubMed n=18368	1, nursing education,, "in the last 5 years, Full text, English", ("education, nursing"[MeSH Terms] OR ("education"[All Fields] AND "nursing"[All Fields]) OR "nursing education"[All Fields] OR ("nursing"[All Fields] AND "education"[All Fields]))
	2, nursing education,, "in the last 5 years, Full text, English", ("education, nursing"[MeSH Terms] OR ("education"[All Fields] AND "nursing"[All Fields]) OR "nursing education"[All Fields] OR ("nursing"[All Fields] AND "education"[All Fields])) AND ((y_5[Filter]) AND (fft[Filter]) AND (english[Filter]))", "62,253", 10:31:00, 2025/10/04
	3, virtual simulation,, "in the last 5 years, Full text, English", (("virtual"[All Fields] OR "virtuality"[All Fields] OR "virtualization"[All Fields] OR "virtualized"[All Fields] OR "virtualizing"[All Fields] OR "virtuals"[All Fields]) AND ("computer simulation"[MeSH Terms] OR ("computer"[All Fields] AND "simulation"[All Fields]) OR "computer simulation"[All Fields] OR "simulation"[All Fields] OR "simul"[All Fields] OR "simulate composite resin"[Supplementary Concept] OR "simulate composite resin"[All Fields] OR "simulate"[All Fields] OR "simulated"[All Fields] OR "simulating"[All Fields] OR "simulates"[All Fields] OR "simulation s"[All Fields] OR "simulational"[All Fields] OR "simulations"[All Fields] OR "simulative"[All Fields] OR "simulator"[All Fields] OR "simulator s"[All Fields] OR "simulators"[All Fields])) AND ((y_5[Filter]) AND (fft[Filter]) AND (english[Filter]))", "20,156", 10:31:49, 2025/10/04
	4, blended learning,, "in the last 5 years, Full text, English", (("blend"[All Fields] OR "blend s"[All Fields] OR "blended"[All Fields] OR "blending"[All Fields] OR "blends"[All Fields]) AND ("learning"[MeSH Terms] OR "learning"[All Fields] OR "learn"[All Fields] OR "learned"[All Fields] OR "learning s"[All Fields] OR "learnings"[All Fields] OR "learns"[All Fields])) AND ((y_5[Filter]) AND (fft[Filter]) AND (english[Filter]))", "2,646", 10:32:30, 2025/10/04
	5, clinical skills,, "in the last 5 years, Full text, English", ("clinical competence"[MeSH Terms] OR ("clinical"[All Fields] AND "competence"[All Fields]) OR "clinical competence"[All Fields] OR ("clinical"[All Fields] AND "skills"[All Fields]) OR "clinical skills"[All Fields]) AND ((y_5[Filter]) AND (fft[Filter]) AND (english[Filter]))", "50,001", 10:40:33, 2025/10/04
	1. TITLE-ABS-KEY (online teaching) AND PUBYEAR > 2019 AND PUBYEAR < 2026 AND (LIMIT-TO (LANGUAGE , "English")) AND (LIMIT-TO (DOCTYPE , "ar"))



Database	Search terms
Scopus n=27369	AND (LIMIT-TO (EXACTKEYWORD , "E-learning")) 2. TITLE-ABS-KEY (nursing education) AND PUBYEAR > 2019 AND PUBYEAR < 2026 AND (LIMIT-TO (SUBJAREA , "NURS")) AND (LIMIT-TO (DOCTYPE , "ar")) AND (LIMIT-TO (EXACTKEYWORD , "Nursing Education")) AND (LIMIT-TO (LANGUAGE , "English")) 3. TITLE-ABS-KEY (virtural simulation) AND PUBYEAR > 2019 AND PUBYEAR < 2026 AND (LIMIT-TO (LANGUAGE , "English")) 4. TITLE-ABS-KEY (blended learning) AND PUBYEAR > 2019 AND PUBYEAR < 2026 AND (LIMIT-TO (DOCTYPE , "ar")) AND (LIMIT-TO (EXACTKEYWORD , "Blended Learning")) AND (LIMIT-TO (LANGUAGE , "English")) 5. TITLE-ABS-KEY (clinical skills) AND PUBYEAR > 2019 AND PUBYEAR < 2026 AND (LIMIT-TO (DOCTYPE , "ar")) AND (LIMIT-TO (LANGUAGE , "English")) AND (LIMIT-TO (SUBJAREA , "NURS")) AND (LIMIT-TO (EXACTKEYWORD , "Article")) Filters applied: article, 5 years, English.
CINAHL (EBSCO host) n=2464	(online teaching OR clinical skills OR blended learning OR virtural simulation OR nursing education) AND (clinical skills OR blended learning OR virtural simulation OR nursing education OR online teaching)
ERIC n=5684	https://eric.ed.gov/?q=online+teaching&ft=on&ffl=dtysince_2021 https://eric.ed.gov/?q=nursing+education&ft=on&ffl=dtysince_2021 https://eric.ed.gov/?q=virtual+simulation&ft=on https://eric.ed.gov/?q=blended+learning&ft=on https://eric.ed.gov/?q=clinical+skills&ft=on&ffl=dtysince_2021
	https://mjl.clarivate.com://search-results?issn=2626-8493,2322-1291,1741-7627,2146-1732,1492-1154,1755-2273,1410-7201,2472-5749,2083-5205,2167-4779&hide_exact_match_fl=true&utm_source=mjl&utm_medium=share-by-link&utm_campaign=search-results-share-these-results



Database	Search terms
Web of Science n=5261	https://mjl.clarivate.com://search-results?issn=2194-5772,0148-4834,1536-5026,0260-6917,1471-5953,0363-3624,0022-0124,1976-1317,2528-181X,2687-6442&hide_exact_match_fl=true&utm_source=mjl&utm_medium=share-by-link&utm_campaign=search-results-share-these-results
	https://mjl.clarivate.com://search-results?issn=1687-5591,2213-7467,2059-0628,2673-4192,1460-7425,2188-5303,1049-3301,1996-3599,1876-1399,1007-5704&hide_exact_match_fl=true&utm_source=mjl&utm_medium=share-by-link&utm_campaign=search-results-share-these-results
	https://mjl.clarivate.com://search-results?issn=1941-8647,1479-4403,1443-1394,2000-7426,1541-5015,2538-1032,1492-3831,1835-5196,2146-1732,1929-7750&hide_exact_match_fl=true&utm_source=mjl&utm_medium=share-by-link&utm_campaign=search-results-share-these-results
	https://mjl.clarivate.com://search-results?issn=1940-0640,1899-5276,1594-0667,2993-7175,1710-1492,2352-8737,2330-1910,1175-0561,0002-9157,0002-9165&hide_exact_match_fl=true&utm_source=mjl&utm_medium=share-by-link&utm_campaign=search-results-share-these-results

Table 2. Search strategies for electronic databases

JBI Critical Appraisal Checklist for Randomised controlled Trials (RCT) by Joanna Briggs Institute, 2020.																
No.	Article (Author, Year)	Q1	Q2	Q3	Q4	Q5	Q6	Q7	Q8	Q9	Q10	Q11	Q12	Q13	Total Score	Quality Level
1	Alsharari, A. F., et al. (2025)	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	12	High



JBIC Critical Appraisal Checklist for Randomised controlled Trials (RCT) by Joanna Briggs Institute, 2020.

2	Chambers, A & Whitfield, C. (2025)	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	11	High
3	Du, L., et al. (2022)	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	10	Moderate
4	Falahati-Marvast F., et al. (2025)	Y/ N	Y/ N	Y/ N	Y/ N	Y/ N	Y/ N	Y/ N	Y/ N	Y/ N	Y/ N	Y/ N	Y/ N	Y/ N	9	Moderate
5	Hara, C. Y. N., et al. (2021)	Y/ N	Y/ N	Y/ N	Y/ N	Y/ N	Y/ N	Y/ N	Y/ N	Y/ N	Y/ N	Y/ N	Y/ N	Y/ N	8	Moderate
6	Kumar A., et al. (2021)	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	12	High
7	Mojarad, F. A., et al. (2023)	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	11	High
8	Nuuyoma V., et al. (2023)	Y/ N	Y/ N	Y/ N	Y/ N	Y/ N	Y/ N	Y/ N	Y/ N	Y/ N	Y/ N	Y/ N	Y/ N	Y/ N	9	Moderate
9	Oana-Maria Păstae (2023)	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	10	Moderate



JBI Critical Appraisal Checklist for Randomised controlled Trials (RCT) by Joanna Briggs Institute, 2020.																
10	Pozzi, F., et al. (2023)	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	12	High
11	Alfaleh, R., et al. (2023)	Y/ N	Y/ N	Y/ N	Y/ N	Y/ N	Y/ N	Y/ N	Y/ N	Y/ N	Y/ N	Y/ N	Y/ N	Y/ N	8	Modera te
12	Sutoi, D., et al. (2023)	Y/ N	Y/ N	Y/ N	Y/ N	Y/ N	Y/ N	Y/ N	Y/ N	Y/ N	Y/ N	Y/ N	Y/ N	Y/ N	9	Modera te

Table 3. JBI Critical Appraisal Checklist for Randomised controlled Trials (RCT) included in the study



Nr.	Author (s), year &country	Study Design	Study aim (s)	Sample	Data collection tools	Components relevant to data collection	Data analysis technique	Findings
1	Alsharari, A. F., et al. (2025), Saudi Arabia	System atic review followi ng PRISM A guideli nes.	To evaluate the effectiven ess of virtual simulation technologi es in improving nursing students' communic ation, problem-s olving ability, profession al competen	12 primary studies, with 928 nursing students (mean age 19–23).	Experiment al studies (RCTs and quasi-exper imental with pre/post-tes ts).	Nursing students and e-simulation technologies.	PEDro scale for quality assessment; effect sizes calculated (small 0.1–0.3, moderate 0.3–0.5, large >0.5).	Problem solving: 5 studies reported small–large improvements (effect size –0.2 to 0.9). Confidence and decision-making processes improved. Communication: Virtual simulation improved communication with patients, peers, and healthcare professionals (effect size 0.4–0.9). Core professional competencies: 4 studies showed improvements in clinical competence (effect size 0.3–0.9). Nursing process: Moderate improvements in assessment, diagnosis, planning, intervention, and evaluation phases (effect size 0.2–0.8). Documentation and patient education showed strong gains. Overall: E-learning posed significant challenges for nursing students, particularly in clinical training, assessment, infrastructure, and psychosocial well-being. Virtual simulation technologies have emerged as effective strategies to overcome many of these barriers, enhancing communication, problem-solving, professional competencies, and application of the nursing process. While evidence supports their integration into curricula, attention must be paid to equitable access,



Nr.	Author (s), year &country	Study Design	Study aim (s)	Sample	Data collection tools	Components relevant to data collection	Data analysis technique	Findings
			cies, and applicatio n of the nursing process.					rigorous evaluation, and blended models that align with nursing's practical, patient-centered nature.
2	Chambers, A & Whitfield, C. (2025, England	System atic review followi ng PRISM A guideli nes.	To explore and analyze the factors that affect postgradu ate nursing students' engageme nt with online learning environm ents in higher education, and to	Fifteen studies met inclusio n criteria, spannin g several countrie s (Canada , USA, UK, Japan, Australi a, South Africa,	Mixed Methods Appraisal Tool (MMAT).	Postgraduate nursing students' engagement with online learning environments.	Data were extracted and thematically analyzed using an inductive synthesis framework.	Seven major themes emerged: 1. Convenience – increased flexibility but also competing demands. 2. Curriculum design – structure and pacing influenced satisfaction. 3. Educator presence – enhanced motivation and reduced isolation. 4. Social interaction – peer collaboration supported engagement. 5. Technology issues – infrastructure and digital literacy as barriers. 6. Independent learning – encouraged autonomy but risked isolation. 7. Working with peers – collaboration sometimes caused conflict. Overall, engagement depended on balancing autonomy, educator guidance, and effective technology use. Postgraduate nurses' engagement with online learning is influenced by multiple, interdependent factors. Effective



Nr.	Author (s), year &country	Study Design	Study aim (s)	Sample	Data collection tools	Components relevant to data collection	Data analysis technique	Findings
			identify enablers and barriers to active participation and learning effectiveness.	Philippines, Turkey, Taiwan, Norway).				engagement requires a balance between independence and instructor support, strong course design, and opportunities for interaction. Investment in digital infrastructure and training for educators is critical. The review underscores the importance of inclusive, flexible, and human-centered e-learning strategies in postgraduate nursing education.
3	Du, L., et al. (2022). China	Systematic review and meta-analysis (PRISMA guidelines).	To determine whether blended learning is more effective than traditional teaching in nursing education.	25 studies (13 RCTs and 12 quasi-experiments, 2706 nursing students).	Cochrane risk-of-bias tool, MINORS, Review Manager 5.2, and Stata 14.0 for meta-analysis.	Studies on nursing students comparing blended learning.	Publication bias check: Egger's test. Sensitivity and subgroup analyses performed.	Knowledge: Blended learning significantly improved knowledge (SMD=0.64, p=0.001). Skills: Improved skill performance (SMD=0.37, p=0.010). Learning satisfaction: Increased student satisfaction (SMD=0.32, p=0.019). No significant publication bias detected. Heterogeneity: High across studies; factors like study design, sample size, intervention length, and number of blended learning components may influence results. Blended learning is more effective than traditional teaching in enhancing nursing students' knowledge, skills, and satisfaction. Despite requiring initial investment in technology and course design, it shows strong long-term potential to improve



Nr.	Author (s), year &country	Study Design	Study aim (s)	Sample	Data collection tools	Components relevant to data collection	Data analysis technique	Findings
								professional competence and optimize nursing education resources.
4	Falahati-M arvast F., et al. (2025). Iran	Pretest –posttest control led trial.	To determine whether an asynchron ous virtual training program can effectivel y enhance nursing students' intentions to engage in the Evidence- Based Practice	79 nursing students	Intentions to Engage in the EBP Process scale (Rubin & Parrish, 2010; Persian validated version, α = 0.75).	Nursing students' intentions to engage in the Evidence-Bas ed Practice (EBP) process.	SPSS 21; descriptive statistics, independen t and paired t-tests, chi-square, ANCOVA ($p \leq 0.05$).	Pre-intervention: No significant difference between groups ($p = 0.15$). Post-intervention: Significant increase in intention scores for the intervention group ($M = 44.62 \pm 3.67$) vs. control ($M = 36.56 \pm 3.53$; $p = 0.03$). Within-group analysis: Intervention group improved significantly ($p = 0.02$), while control group showed no significant change ($p = 0.06$). Covariate analysis: Demographic factors did not significantly affect EBP intention ($p > 0.05$). The study confirmed that structured virtual training can effectively enhance nursing students' intentions to engage in evidence-based practice. Integrating EBP-focused online modules into nursing curricula can strengthen students' readiness for evidence-based clinical decision-making and bridge the gap between research and practice.



Nr.	Author (s), year &country	Study Design	Study aim (s)	Sample	Data collection tools	Components relevant to data collection	Data analysis technique	Findings
			(EBP) process.					
5	Hara, C. Y. N., et al. (2021). Brazil	Metho dologic al study.	The primary objective was to design, develop, and evaluate a 3D VR serious game (Comunica-Enf) aimed at improving communication skills among nursing students and	13 nursing professo rs and 30 undergr aduate nursing students .	(VR) tool using Oculus Rift®, Heuristic Evaluation for Digital Educational Games (HEDEG).	Participants used the game and then completed the Heuristic Evaluation for Digital Educational Games (HEDEG).	Problems classified from 0 (no impairment) to 4 (urgent priority). Validation was achieved if <25% of problems were type 3–4.	None of the heuristics exceeded the 25% threshold for severe problems. Both professors and students judged the game as suitable for nursing education. Suggestions were provided, including improving avatar facial expressions, adding patient voice feedback, and adjusting usability for players wearing prescription glasses. The VR immersion provided safe, realistic, and motivating environments that supported communication learning. Comunica-Enf was validated in terms of appearance and usability. It provides a safe and engaging platform for students to practice communication skills before clinical placements. The technology has potential to bridge the gap between theoretical training and real patient interactions. However, ongoing improvements such as artificial intelligence integration and voice interaction are recommended to enhance realism.



Nr.	Author (s), year &country	Study Design	Study aim (s)	Sample	Data collection tools	Components relevant to data collection	Data analysis technique	Findings
			ensuring patient safety before real-life clinical practice.					
6	Kumar A., et al. (2021). India	Quantitative, cross-sectional survey.	To assess nursing students' satisfaction with online learning during the COVID-19 pandemic and to identify the main barriers hindering	219 nursing students	Web-based survey (Google Forms) using a self-structured, validated questionnaire.	Nursing students' satisfaction with online learning.	Descriptive and inferential statistics with SPSS v20.	Satisfaction: 67.57% of students were <i>extremely satisfied</i>; 32.42% were satisfied. No students reported dissatisfaction. Barriers: Administrative: Low voice/language clarity (highest ranked), large class size. Individual: Eye strain (highest), lack of communication with instructors, lack of support. Technological: Connectivity issues (highest), unmotivating online environment. Demographics: Age was significantly associated with satisfaction; other demographics were not. Most students expressed high satisfaction with online learning. However, barriers such as poor voice clarity, connectivity issues, and physical strain (eye problems) negatively influenced the experience.



Nr.	Author (s), year &country	Study Design	Study aim (s)	Sample	Data collection tools	Components relevant to data collection	Data analysis technique	Findings
			effective participation.					
7	Mojarad, F. A., et al. (2023). Iran	Qualitative study, conventional content analysis (Graneheim & Lundman framework).	To identify and analyze the challenges and facilitators of e-learning in nursing education during the COVID-19 pandemic from the perspectives of students,	16 individuals (8 nursing students, 6 faculty, 2 staff).	Semi-structured interviews (30–50 minutes), November 2020–February 2021.	The challenges and facilitators of e-learning in nursing education.	Coding and thematic categorization of transcripts into subthemes and categories. Trustworthiness: Triangulation, member checking, expert review, verbatim transcription.	1. Challenges of e-learning Inexperienced teachers (lack of digital skills, poor scheduling, minimal use of platforms). Ineffective learning (poor interaction, language issues, teacher-centered approaches). Academic cheating (copying assignments, group cheating in exams). System problems (poor internet access, limited devices, software issues). Inappropriate evaluation (low credibility, lack of feedback, unrealistic assessments). 2. Facilitators of e-learning Improving education (teacher training, blended methods, interactive sessions, student encouragement). Promoting online exams (better infrastructure, standardized testing, randomization of questions). E-learning became essential during the pandemic but faced serious barriers in terms of teacher readiness, infrastructure, and evaluation credibility. However, effective strategies such as teacher training, technological investment, and improved exam



Nr.	Author (s), year &country	Study Design	Study aim (s)	Sample	Data collection tools	Components relevant to data collection	Data analysis technique	Findings
			teachers, and staff.					integrity can make e-learning a sustainable supplement to traditional nursing education.
8	Nuuyoma V., et al. (2023). Namibia	Qualita tive explora tory and context ual study.	To explore and describe the challenges faced by university nursing students regarding e-learning during the early stages of the COVID-1 9 pandemic, particularl y in a	17 fourth-y ear nursing students .	Two focus groups and five individual interviews.	The challenges faced by university nursing students.	Qualitati ve content analysis following Bengtsson' s framework. Trustworthi ness: Ensured through credibility, dependabili ty, confirmabil ity, and transferabil ity.	Five main categories of challenges emerged: 1. E-learning unsuitable for practical components – inability to conduct clinical and hands-on training online. 2. Assessment-related challenges – time pressure, difficulty typing and thinking simultaneously, lack of supervision, and cheating concerns. 3. Connectivity issues – poor internet, limited data, and high costs of connectivity. 4. E-learning as a lonely journey – isolation, lack of peer support, and no group interaction. 5. Computer illiteracy and limited digital skills – lack of orientation and inadequate technical competencies among students and lecturers. E-learning was the only viable solution during the COVID-19 pandemic, but it posed significant challenges in resource-constrained settings when introduced abruptly. The findings emphasize the need for structured support systems, better training, and innovative methods to address practical, assessment, and digital literacy challenges.



Nr.	Author (s), year &country	Study Design	Study aim (s)	Sample	Data collection tools	Components relevant to data collection	Data analysis technique	Findings
			resource-constrained environment.					
9	Oana-Maria Păstae (2023). Italy	Systematic literature review guided by PRISMA principles.	To examine the extent and nature of collaborative learning practices in online and blended nursing education, identify methods and technologies used,	75 studies.	Four independent coders reviewed abstracts and full texts to ensure reliability.	Case studies, peer reviews, simulations, and role play, often mediated.	Deductive coding and cross-validation among coders.	Final dataset: 75 studies. Common approaches: discussions, peer assessments, case studies, and simulations. Technological tools: LMS, video conferencing, forums, and social media. Collaboration was often unstructured—few studies included tasks requiring joint artefact creation or collective outcomes. Limited empirical data on learning outcomes or performance improvement. Blended models often restricted collaboration to in-person components. The review reveals that while online collaboration is increasingly recognized as valuable for nursing education, its actual implementation often falls short of best pedagogical practices. Future programs should emphasize structured teamwork, authentic problem-solving, and shared outputs to strengthen digital competence and collaborative skills among nursing students.



Nr.	Author (s), year &country	Study Design	Study aim (s)	Sample	Data collection tools	Components relevant to data collection	Data analysis technique	Findings
			evaluate their educational impact, and propose future research directions for effective online collaboration in nursing training.					
10	Pozzi, F., et al. (2023). Australia	Systematic review of peer-reviewed studies	To synthesize existing evidence on nurses' perceptions and experiences	15 studies.	The 2020 Preferred Reporting Items for Systematic Reviews and Meta-Analyses	Studies on nurses or nursing students focusing on attitudes, perspectives, or	Thematic synthesis of qualitative and quantitative findings.	Positive perceptions: Flexibility, convenience, and accessibility of learning materials. Challenges: Lack of interaction with instructors/peers, technological difficulties, and insufficient practical training. Experiences: Nurses valued e-learning for continuing education, but effectiveness was often linked to the quality of platform design and institutional support. Overall: Mixed experiences, with strong support for blended



Nr.	Author (s), year &country	Study Design	Study aim (s)	Sample	Data collection tools	Components relevant to data collection	Data analysis technique	Findings
			es of e-learning , and to identify enablers and barriers influencin g its effectiven ess in nursing education and profession al developm ent.		ysis (PRISMA) guidelines (See Supplemen tary material 1), and the Joanna Briggs Institute (JBI) critical appraisal checklist for the different types of studies reviewed.	experiences with e-learning.		approaches (combining online and face-to-face training). E-learning is a valuable tool in nursing education and continuous professional development, but it cannot replace hands-on clinical training. Effective implementation requires addressing technological, pedagogical, and organizational challenges.



Nr.	Author (s), year &country	Study Design	Study aim (s)	Sample	Data collection tools	Components relevant to data collection	Data analysis technique	Findings
11	Alfaleh, R., et al. (2023). Romania	Cross-sectional, multicentric study.	To evaluate Romanian medical students' perceptions and experiences with online learning during the COVID-19 pandemic.	611 general medicine students	Self-developed, validated 58-item questionnaire.	Romanian medical students' perceptions of e-learning	Descriptive and inferential statistics using SPSS, significance level at $p < 0.05$.	Advantages of online learning: More free time (54.8%), comfort (31.4%), financial savings (12.8%). Disadvantages: Lack of interaction (59.2%), absence of practice (51.1%), loss of motivation (17.5%). Motivation: Dropped from 8.5/10 (pre-pandemic) to 5.4/10 during pandemic ($p < 0.001$). Temptation to cheat: Rose from 2.8/10 (pre-pandemic) to 7/10 (during pandemic). Medical training: Perceived training level decreased from 8/10 to 6.2/10. Self-confidence: Fell from 8.2/10 to 6.2/10. Overall impact: 75.9% of students reported a negative influence on professional development. Online learning provided some benefits (flexibility, accessibility, time efficiency), but the overall perception was negative, mainly due to lack of clinical practice, decreased motivation, lower self-confidence, and ethical concerns (cheating). While useful as a complementary tool, e-learning cannot fully replace hands-on medical training.



Nr.	Author (s), year &country	Study Design	Study aim (s)	Sample	Data collection tools	Components relevant to data collection	Data analysis technique	Findings
12	Sutoi, D., et al. (2023). Romania	Quantitative descriptive study using survey.	To evaluate: 1. Students' experience, frequency, and satisfaction with online learning. 2. Whether online teaching is an effective alternative to face-to-face instruction. 3. The	105 students (7 specializations: pharmacy assistants, nursing, midwifery, kinesiotherapy, physical education).	Questionnaire with 15 structured questions (5-point and 4-point Likert scales).	Students' perceptions of online teaching effectiveness	Descriptive statistics with SPSS 26.	Experience: 78.1% rated online learning as "good", 6.7% "excellent". Effectiveness: 61% found online learning moderately effective, 30% very effective. Teacher support: 62 students found teachers very helpful, 17 extremely helpful. Technical issues: 71.4% sometimes experienced problems. Interaction: 64.8% said interaction depended on the course; 21.9% had less interaction. Learning outcomes: 97% reported achieving outcomes equivalent to in-person learning. Resources: 53.3% said availability depended on the course; 31.4% had more online resources. Convenience: 81% found access anytime/anywhere beneficial. Tools: 71.4% found online platforms easy to use. The study concluded that online teaching was generally effective, with students perceiving it as a valuable educational approach. However, improvements are needed in course design, instructor training, material provision, and technical infrastructure to ensure long-term success. E-learning is not simply a substitute for traditional teaching but requires innovation and adaptation.



Nr.	Author (s), year &country	Study Design	Study aim (s)	Sample	Data collection tools	Components relevant to data collection	Data analysis technique	Findings
			extent to which online tools supported learning outcomes, interaction, and convenience.					

Table 4. Characteristics of included studies



Optimizing EFL Listening Proficiency Through Technology-Mediated Instruction

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Abstract

Listening comprehension remains a persistent challenge for English as a Foreign Language (EFL) learners, often hindered by complex phonological features, unfamiliar vocabulary, varied speech rates, and diverse accents. This study investigates the effectiveness of technology-enhanced instructional approaches in improving listening skills among university-level EFL students. Two primary strategies were examined: (1) the use of authentic listening materials integrated with communicative tasks, and (2) the implementation of technology-assisted tools, including language learning applications, podcasts, and multimedia resources. Employing an experimental design with control and treatment groups, data were collected via pre- and post-tests, learner questionnaires, interviews, and classroom observations. Results indicate significant improvements in listening comprehension across both interventions. Authentic materials foster contextual and cultural awareness, while communicative activities promote engagement and active listening. Technology-supported tools enable flexible, self-paced practice and increased exposure to diverse spoken input. The study highlights the pedagogical value of integrating context-rich, learner-centered, and technology-mediated strategies in EFL listening instruction.

Keywords: EFL Listening Comprehension, Technology-Assisted Language Learning, Authentic Listening Materials, Communicative Language Teaching, Language Pedagogy.



1. Introduction

Listening comprehension is widely recognized as one of the most challenging skills for English as a Foreign Language (EFL) learners, as it requires the real-time decoding of sounds, vocabulary, and contextual meaning. Unlike reading or writing, listening involves immediate processing, leaving little time for reflection or correction. At the university level, these challenges are further intensified by factors such as varied accents, rapid speech, cultural references, and limited exposure to authentic oral input outside the classroom (Soomro et al., p. 233). Despite its crucial role in effective communication, listening remains difficult to master, and traditional rote exercises often fail to prepare learners for real-world interactions. According to Dien et al. (2023), “listening comprehension can be defined as understanding the meaning of what listeners hear, but the definition is a sophisticated, unconscious and mental process in which the listener must actively acquire meaningful knowledge spoken in their communication context by utilizing their language areas [...] and background knowledge.”

In response to these challenges, this study explores the effectiveness of two instructional approaches for improving EFL listening proficiency: (1) the integration of authentic listening materials—such as podcasts and real-life conversations—paired with communicative tasks, and (2) the use of technology-assisted tools that offer flexible, interactive practice opportunities. By examining their impact on learners’ comprehension, engagement, and contextual understanding, the research aims to provide practical insights for instructors and contribute to the development of more effective, context-based EFL pedagogy. Both groups were previously taught the same theoretical information, namely strategies for listening comprehension skills.

2. Literature Review

Listening is widely considered a dynamic and active process in foreign and second language acquisition. Vandergrift (2007) articulates it as requiring prediction, monitoring, and evaluation, rather than passive reception. Rost (2011) further underscores its foundational role, affirming that listening supports other language competences such as speaking and reading. Recent studies have extended these insights, particularly highlighting learner autonomy and strategy instruction.



Safa and Motaghi (2024) examined cognitive versus metacognitive scaffolding in improving EFL learners' listening comprehension, revealing that structured strategy support significantly enhances understanding. Zhang and Zou (2024) similarly advocate for metacognitive self-regulation in language learning, underscoring its effectiveness across skills, including listening. In the context of EFL classrooms, motivation and interaction remain pivotal. Ibna Seraj and Hadina emphasize the necessity of innovating traditional methods to foster sustained oral practice both in and out of the classroom. They call for research into how technological integration—despite its rapid adoption and learner challenges can effectively support listening and assessment.

A 2025 literature review reveals that digital tools like podcasts, AI-powered platforms, and multimedia significantly enhance listening skills through interactive, self-paced, and contextually rich experiences. However, challenges such as digital literacy and infrastructure persist. Complementary findings show that digital multimedia environments—including immersive VR and AR—can heighten learner engagement and retention. For example, VR-based simulations in Taiwan yielded notably higher listening comprehension and immersion compared to traditional video environments. Moodle and mobile-assisted listening tools have also shown effectiveness. In one study, Moodle-based activities for first-year students significantly improved listening proficiency by extending the classroom's reach through varied communicative exercises. Similarly, mobile learning platforms and podcast-based exercises have been shown to boost motivation and listening performance, particularly when integrated with learner-centered and interactive design. The use of authentic materials, such as podcasts, news broadcasts, interviews, and conversations from native speakers, has been widely advocated in the literature. Gilmore (2007) argues that authentic materials provide exposure to the natural rhythm, stress, and intonation of the language, thereby enhancing learners' ability to comprehend real-world spoken English. Similarly, Berardo (2006) states that authentic materials help bridge the gap between the classroom and the real world. Communicative language teaching (CLT) emphasizes interaction as both the means and the ultimate goal of learning a language. Brown (2001) suggests that through group discussions, role plays, and listening-focused tasks, learners become more



engaged and active in their learning process. These activities provide immediate feedback and opportunities for students to practice listening in meaningful contexts. The advent of technology has revolutionized language teaching, especially in the domain of listening. Mobile applications, language learning platforms, and multimedia content allow for interactive and flexible learning experiences. In addition, the Moodle platform enables students to stay on track by practicing listening assignments outside the class. Dien et al. (2023) remind us that “the Moodle management system allows students to be motivated and familiar with suitable technological features in teaching and learning English and enables teachers and students to convey not only their ideas but also learning tasks rapidly.”

3. The Study

Despite consistent exposure to English courses, many EFL learners continue to face persistent challenges in developing listening comprehension. These difficulties are particularly evident among students with limited prior exposure to authentic spoken English. Research indicates that the use of blended pedagogical approaches can enhance listening proficiency by addressing learners’ cognitive, linguistic, and motivational needs. Successful listening instruction often involves raising learners’ awareness of their own difficulties, fostering sound recognition and grammatical tracking, and providing opportunities to engage with real-world communicative input.

In light of these considerations, this study explored the effectiveness of two instructional approaches designed to enhance EFL learners’ listening comprehension: (1) the integration of authentic listening materials supported by communicative activities, and (2) the use of technology-assisted tools that enable individualized and flexible listening practice.

4. Methodology

The study employed a mixed-methods design to allow for both quantitative measurement of listening gains and qualitative exploration of learners’ experiences. This triangulation



strengthened the validity of findings by combining outcome-based evidence with participants' perceptions and behaviors. The study was conducted with 14 intermediate-level EFL learners enrolled in a Romanian university program. Romanian was the participants' mother tongue, but they had studied English formally since primary school.

Students were divided into two groups of seven. The first group (Authentic and Communicative Activities) was exposed to authentic listening materials, including podcasts, news segments, dialogues, and video interviews. Lessons followed a pre-, while-, and post-listening structure, complemented by interactive tasks such as role plays, group discussions, and peer feedback. The second group (Technology-Assisted Tools) engaged with digital platforms such as Moodle, Duolingo, BBC Learning English, and TED-Ed. Learners completed interactive exercises, pronunciation drills, and self-paced quizzes, and tracked progress through app-based analytics.

Data Collection

To thoroughly assess the impact of both approaches, several instruments were employed. Students completed pre- and post-assessments using standardized listening comprehension tests to measure their progress throughout the semester. To gain a broader understanding of both performance outcomes and learner engagement, the instructor gathered data on students' perceptions, attitudes, and reported challenges. Additionally, participant interviews were conducted to explore their experiences and reflections in greater depth, providing clearer insights into their attentiveness and participation during lessons.

Findings

Both instructional approaches yielded significant improvements in listening comprehension. Post-assessment scores indicated that the first group improved by 18% on average, while the second improved by 21%. Although the second group demonstrated a slightly higher gain, the difference was not substantial, suggesting that both strategies were comparably effective in enhancing learners' listening skills. On the one hand, the group experiencing authentic and communicative activities reported that exposure to real-world English through podcasts, dialogues, and news segments improved their ability to understand different accents and speech



rates. They emphasized that role plays, group discussions, and peer-based feedback reduced listening anxiety and fostered confidence. Learners also appreciated the social dimension of communicative tasks, which made learning more interactive and meaningful. On the other hand, the group using technology-assisted tools valued the flexibility of technology-based learning. Many highlighted the convenience of practicing on mobile devices during commutes or in free time. The built-in analytics, instant feedback, and adaptive exercises allowed learners to progress at their own pace, increasing motivation and perceived autonomy. However, a few participants noted occasional distractions when using mobile applications, pointing to the need for structured guidance in technology use.

While participation among students in the first group was highly interactive, with active discussion, question asking, and role-play engagement, learners in the second group demonstrated independence and consistency in self-paced practice. However, some instances of off-task behavior were recorded during app use. Overall, both groups displayed a high level of commitment to their respective instructional approaches.

5. Discussion

The results of this study confirm that both authentic communicative activities and technology-assisted tools play vital roles in improving EFL listening comprehension. Authentic materials provide learners with exposure to real-life speech, varied accents, and natural discourse patterns. This aligns with Gilmore (2007) and Berardo (2006), who emphasize that authentic input enhances contextual understanding and prepares learners for actual communicative encounters. At the same time, communicative activities grounded in the principles of Communicative Language Teaching (CLT) foster learner engagement, collaboration, and immediate practice opportunities (Brown, 2001). Findings from the first group demonstrate that such activities reduce anxiety, increase confidence, and promote active learning. Meanwhile, technology-assisted tools offer flexible, personalized learning experiences that cater to diverse learner needs. As Jones (2008) observed, digital tools can adapt to individual learning styles, and the present study confirms that learners appreciate features such as feedback, progress tracking,



and anytime accessibility. The second group's strong performance suggests that mobile and web-based platforms can effectively supplement classroom instruction, though they require careful monitoring to minimize distractions. Overall, the study demonstrates that neither approach should be viewed as exclusive. Instead, the findings suggest that a blended approach—integrating authentic communicative input with technology-supported practice—may provide the most effective pathway for enhancing EFL listening comprehension in higher education.

Pedagogical Implications

The findings of this study offer significant pedagogical implications for EFL instructors seeking to enhance listening instruction. The results demonstrate that authentic listening materials expose learners to natural speech and realistic communication contexts. They enhance comprehension and better equip learners for real-world communication. Moreover, the integration of communicative tasks forms a core component of listening pedagogy, as such interactive activities promote active engagement, reduce listening anxiety, and strengthen learners' confidence in oral comprehension. The study also emphasizes the value of technology-assisted tools, including mobile applications, Moodle, and online platforms, which extend learning beyond the classroom by providing flexible, self-paced opportunities for practice—provided that instructors guide learners in their effective and focused use. Ultimately, a blended approach that combines authentic input, communicative interaction, and technology-based learning offers the most comprehensive benefits, enabling institutions to design curricula that balance classroom-based and digital experiences, address diverse learner needs, and effectively develop listening proficiency for academic and professional communication.



6. Conclusion

Listening remains a vital yet often underemphasized component of foreign language acquisition. This study demonstrated that both the use of authentic listening materials with communicative activities and technology-assisted tools significantly enhance EFL learners' listening comprehension. Each approach offers unique advantages: authentic materials foster contextual understanding and confidence in navigating diverse accents, while technology provides flexible, personalized practice opportunities. Importantly, the findings highlight that a blended approach yields the most comprehensive benefits, creating a rich and supportive learning environment.

The study further indicates that learners' prior exposure to English, their motivation, and their cognitive capacities play crucial roles in their listening development. These insights underscore the value of adopting evidence-based, learner-centered practices that address both "the cognitive and affective dimensions of listening" (Vandergrift, 2007). As English continues to function as a global lingua franca, the ability to understand spoken English in diverse contexts is increasingly essential. By refining listening instruction through the integration of authentic, interactive, and technology-driven methods, educators can better equip EFL learners to become competent and confident communicators in academic, professional, and intercultural settings.

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Developing Research Skills of Students

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Abstract

The study aimed to understand FPSE students' perceptions of their own research skills, areas of interest, and difficulties encountered in educational research, as well as to identify opportunities for capitalizing on the results of the research conducted during university studies. Using a questionnaire with closed items, the investigation included 300 undergraduate (second year) and master's students (first and second years), who reported participating in educational research primarily within the Research Methodology course (75.6%), addressing topics such as curriculum, instruction and assessment theory, the education of children with SEN, and other areas, generally without further valorization of their work. The findings show that 75.6% of students capitalized on their research results exclusively within the Research Methodology course, while only 12.2% presented their results within methodological committees in schools or at conferences (4.9%). The main benefit perceived was preparation for the completion of bachelor's or dissertation theses (63.4%), followed by the consolidation of theoretical training (14.6%) and, to a lesser extent (9.8%), the identification of scientific solutions to professional problems. The major difficulties reported included balancing work responsibilities with research activities (61%) and challenges in identifying research participants (24%).

Keywords: research skills, innovative initiatives in education, academic visibility



1. Introduction

One way to transform the student into the main actor of his own academic development is the process of training research skills. This involves the transition from a receptive, teacher-centered learning to an active and reflective one. Research becomes not just a theoretically taught discipline, but a concrete experience of learning through action (Zuber-Skerritt, 1993).

In the context of current university education, the development of research skills is an important objective of students' professional and academic training. These skills reflect the student's ability to understand, analyze and investigate relevant educational problems, thus contributing to the scientific substantiation of educational practice and the development of reflective and critical thinking.

Carrying out a research approach by students can be considered a form of experiential learning, as they have the opportunity to observe and investigate the concrete educational reality, practicing a series of interrelated skills, such as: formulating a research problem or question, developing objectives and hypotheses, selecting appropriate investigation methods and techniques, collecting and interpreting data, using scientific sources, developing an academic paper and communicating results in a rigorous and ethical manner (Mertens, 2019; Robson & McCartan, 2016). The formative process is not limited to the theoretical transmission of methodological content, but involves the integration of students in concrete research experiences, such as applied projects, case studies, "learning by doing" activities or participation in student scientific sessions.

The training profile of the graduate in the field of Educational Sciences includes a range of skills, among which, research skills in education occupy an important place. According to the National Framework of Qualifications in Higher Education (CNCIS) and the ARACIS guides, graduates of bachelor's programs in this field must acquire the following relevant learning outcomes, embodied in the following skills/aptitudes:

- apply appropriate methods and techniques for systematic investigation and self-evaluation of their own professional practices;



- apply scientific methods specific to educational sciences in conducting empirical research on educational problems;
- adapt/apply innovations and capitalize on scientific discoveries in the field of activity - recent developments in educational sciences, legal regulations concerning the education system, new technologies etc. - for the optimization of educational activity;
- participate in collaborative professional development activities, educational research and communities of good practices (ARACIS, 2025).

In addition to the previously specified skills, master's programs also aim to develop skills in scientific communication of results, in formal contexts (conferences, publications, interdisciplinary projects), in this way the benefits are both personal, such as the opportunity to present one's work to diverse audiences, to interact with other researchers and to expand one's professional network (Mertens, 2020), and institutional, contributing to increasing the visibility of the institution.

Developing research skills in students is not a challenging process. Multiple studies indicate that most of them face significant difficulties in the process of conducting research, both cognitive and motivational:

- poor understanding of the stages of scientific research. The concepts of "hypothesis", "variable", "method", "validity" or "relevance of results" are often perceived as abstract and difficult to apply, especially by students in their first years of studies (Leech & Onwuegbuzie, 2009);
- problems in choosing the research methodology, in terms of choosing the right strategy and applying the methods of data collection and analysis (quantitative/qualitative).
- lack of institutional opportunities, limited resources (libraries, internet etc.) and therefore limited access to relevant scientific resources;
- disinterest or unfavorable beliefs towards research (perception that it is difficult, that it is not relevant) (Gómez-Delgado et al., 2017);
- lack of interest or intrinsic motivation for research activity, often perceived as a formal obligation, related to the development of the bachelor's thesis or dissertation. The attitude is



influenced by the institutional academic culture, in which student research is not visible, appreciated or supported through recognition mechanisms;

- lack of a coherent mentoring system (Otoluwa et al., 2021);
- lack of academic writing skills, scientific editing. Students often encounter problems in structuring articles, correct use of scientific language, organization of ideas and argumentative coherence (Wakerkwa et al., 2019).

The results of these studies indicate directions for improving the process of training students' research skills, therefore, a research approach was taken to this issue.

2. Purpose and Objectives of the Research

The purpose of this research was to analyze the perceptions of students of the Faculty of Psychology and Educational Sciences, Buzău and Focșani Branches, regarding the level of training of their research skills, the areas of scientific interest, the difficulties encountered in carrying out educational research, as well as to identify concrete opportunities for capitalizing on the results of student research in the academic and professional environment. Thus, the following specific objectives were formulated:

1. investigating the opinion of students and master's students regarding their own level of training of research skills;
2. identifying the main areas of scientific interest of students for research;
3. analyzing the difficulties encountered by students in the process of initiating and conducting educational research;
4. exploring opportunities to capitalize on student research results, in an academic and professional context;
5. identifying directions for optimizing the process of developing research skills through curricular and extracurricular activities.

3. Analyses

Taking into account the results of these studies and the professional experience acquired over the years, an investigation was carried out among the students of the two branches to find out the most appropriate ways to support them in this training activity, which they must carry out.

The investigation consisted of applying a structured questionnaire with closed, semi-closed, open questions and Likert scale grids, made in Google Forms. It was distributed online to a number of 200 students and master's students, being completed by 189 subjects.

A non-probabilistic sample (N=200) was formed from students and master's students who took research methodology courses from the study programs of Primary and Preschool Pedagogy (bachelor's degree) and Educational Management (master's degree).

The sample is distributed, from the perspective of years of study, as follows (**Figure 1**): 103 students from the 2nd and 3rd years, 55 master's students from the 1st and 2nd years, as well as 29 master's graduates from the last promotion, one bachelor's graduate.

In terms of employment, 97 respondents are teachers, 56 are not employed, 27 work in other fields, one is a school principal and 7 of the subjects are in another situation (see **Figure 2**).

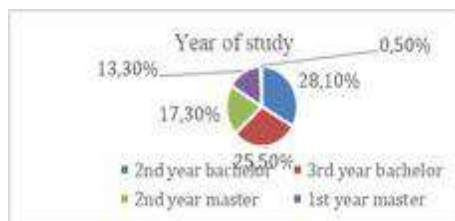


Figure 1. Distribution of research subjects by years of study

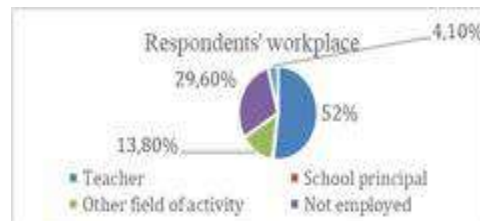


Figure 2. Respondents' workplace

4. Results

The data obtained using the questionnaire were analyzed, processed and interpreted in relation to the research objectives.

1. Investigating the opinion of students and master's students regarding their own level of training in the field of research skills



Questioned on the importance of research for the teaching profession, the student respondents consider in a large proportion (79.8%) that research activity is very important for a future teacher, suggesting a positive perception of the link between research and the quality of education.

Regarding the involvement of students in research activities during their bachelor's or master's studies, 72.7% of the respondents participated in conducting research during their years of study, 23.5% did not participate, and 3.7% chose the option DON'T KNOW/DO NOT ANSWER.

From **Figure 3** it can be seen that students consider the level of research skills training as good in a proportion of 41.7%, average level - 34.2% of the subjects and 13.9% of them consider that they have very well-formed research skills. Approximately 10% consider that the level of research skills is satisfactory/unsatisfactory. More than half of the respondents have a positive perception of the level of research skills development. At the same time, the results obtained "invite" to reflection regarding the ways of improving the process of training these skills.



Figure 3. Self-assessment of the level of research skills development

Regarding the ability of students to design and carry out effective educational research, the results obtained correlate with those from the previous question, which reinforces the idea that students may be able to effectively engage in activities to improve educational practices based on research approaches.



10. În ce măsură considerați că ați putea proiecta și realiza o cercetare educațională eficientă?
188 de răspunsuri

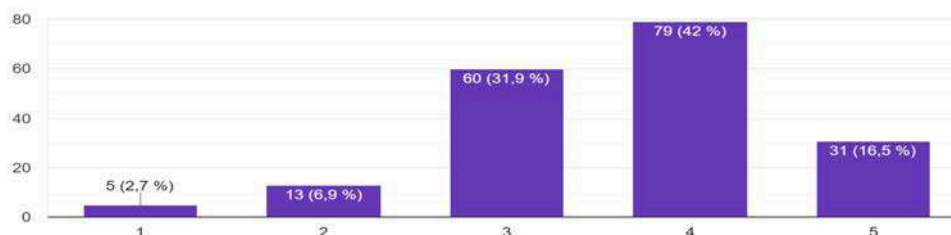


Figure 4. Self-assessment of research design and implementation skills

Therefore, the investigated students recognize the value of research skills training in professional development and generally perceive their training in this area as adequate. However, the data indicate the need for additional measures to strengthen these skills, by deeper integration of research activities into university curricula and by providing more coherent and differentiated methodological support.

2. Identification of the main areas of scientific interest of students for research

Innovation in education should also take into account the prospective interests of youth, therefore the answers obtained to question 3 suggest directions for planning a coherent research strategy. Analyzing the respondents' answers, a variety of research areas / topics addressed by them is noted (**Figure 5**), and regarding the desire to conduct research, the respondents' interests are directed towards Classroom Management and Educational Management (**Figure 6**).

The research experience of the respondents is varied, they participated in research in the following areas, represented in similar percentages: 14.8% educational management, 12.2% theory and methodology of instruction, 11.6% curriculum, 10.1% communication, conflict and psychological research.

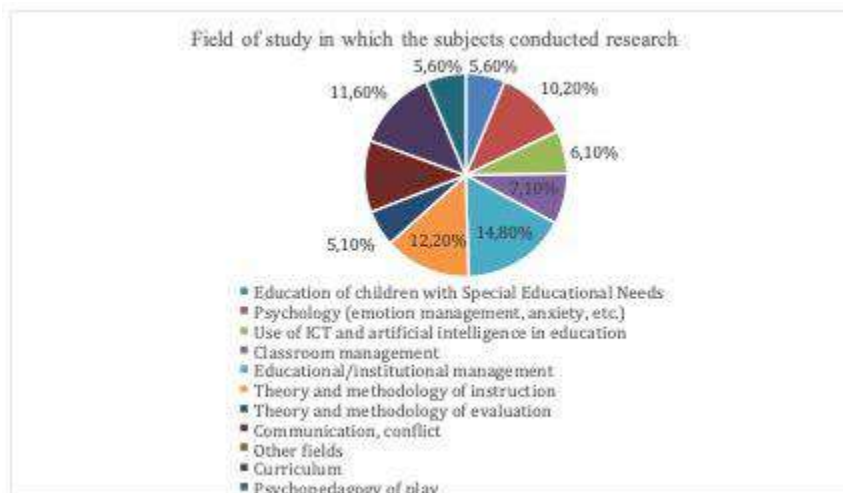


Figure 5. Research areas explored by students

The areas of scientific interest for research are better outlined by the answers to the following question:

- 30.7% psychology (emotion management, anxiety, student discipline),
- 19.6% education of children with SEN
- 19% classroom management, educational management
- around 9% mentioned areas such as instructional theory and game psychopedagogy, use of ICT and artificial intelligence, curriculum.

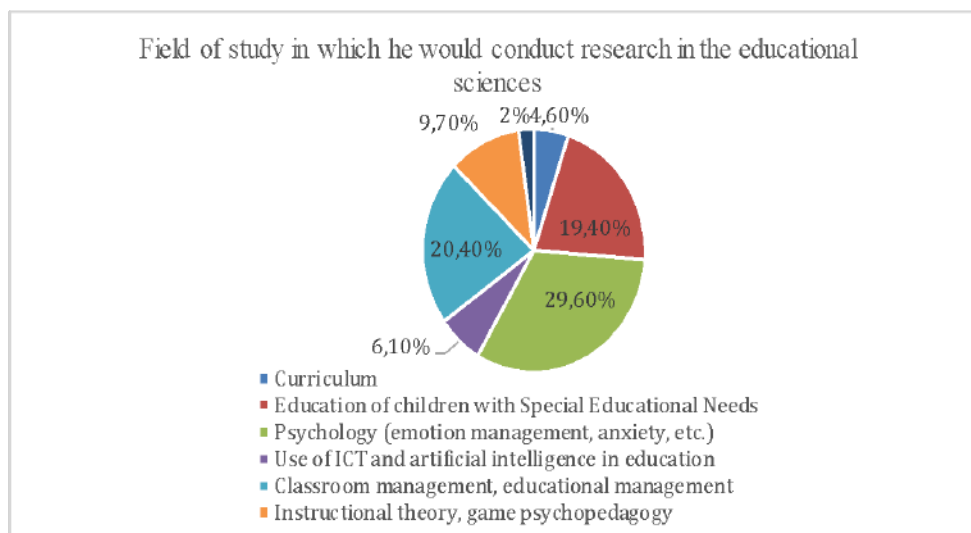


Figure 6. Field of study in which students would conduct research

3. Analysis of the difficulties encountered by students in the process of initiating and conducting educational research

37% of respondents experience difficulties in time management, dividing their time between work and academic activity. In second place are the difficulties related to the establishment of a relevant sample (large enough), facing the refusal of potential subjects to get involved in a research. Finding the right bibliography and the relatively low level of research competence represent 6.9% of difficulties in conducting research.

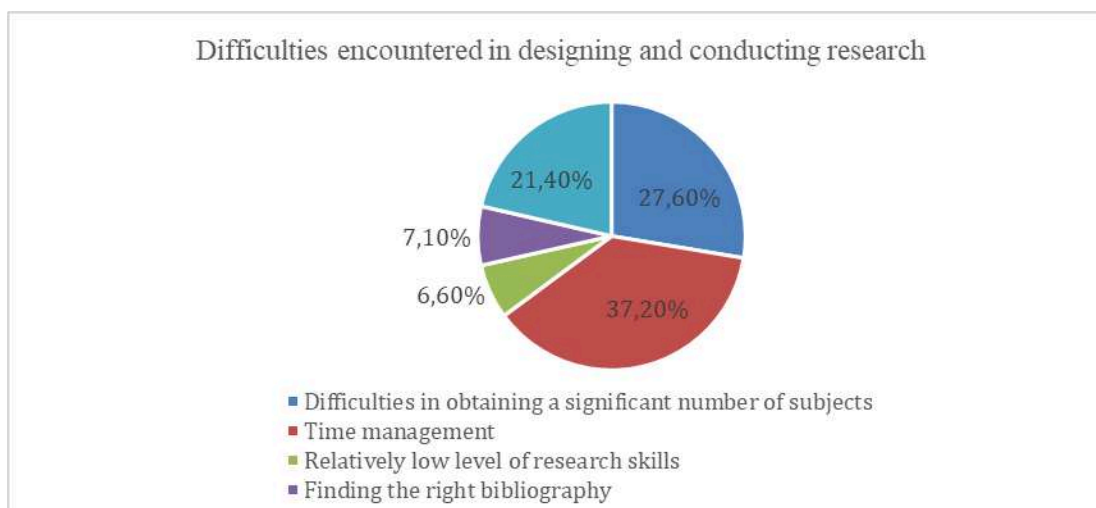


Figure 7. Ways to overcome obstacles/difficulties

The ways of overcoming obstacles were varied, highlighting several trends:

- a) better time organization (25 responses),
- b) thorough documentation, including in other languages (25 responses),
- c) motivating respondents through various methods (20 responses)
- d) study leave, less rest (10 responses)
- e) did not participate in a research (20 subjects),
- f) did not answer the question (8 subjects),
- g) other situations: help from the supervisor, consultation with colleagues ... etc.

The analysis of these responses shows the pressure of some respondents (who we assume are teachers) who have to divide their time between teaching tasks, academic work and research work. At the same time, their desire for responsible involvement in research work and perseverance in finding solutions to the problems they encounter is observed.

Seen from another perspective, the difficulties in designing and conducting research also arise from the existence of poorly defined research skills, such as (**Figure 8**): identifying a relevant research problem (36.7%), collecting and analyzing data (20.7), critical thinking and choosing appropriate methods.

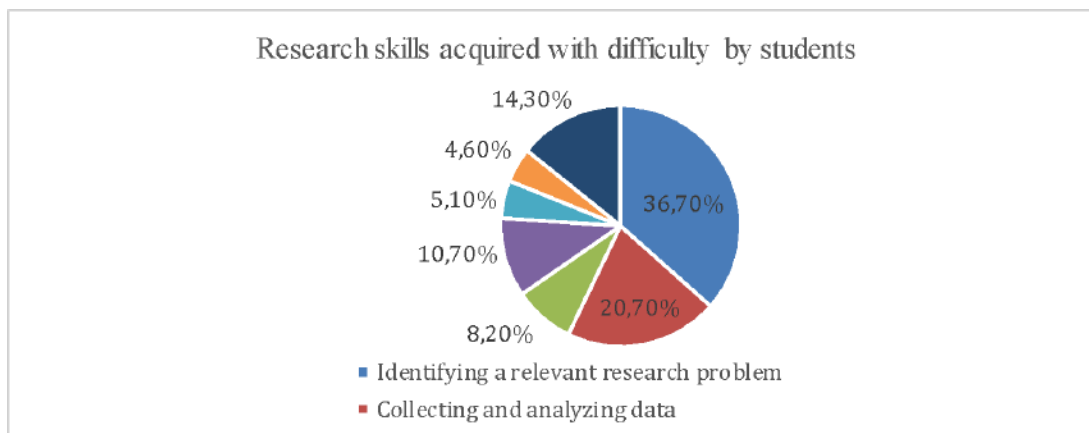


Figure 8. Research skills perceived as underdeveloped

This statistic indicates the opportunity to integrate ways to develop underdeveloped skills into academic work.

4. Exploring opportunities to capitalize on student research results, in an academic and professional context

45% of respondents capitalized on research results in their professional courses. Another way highlighted by the responses obtained was to present the results in methodological committees, pedagogical circles or other events organized in the schools where they work (20.1%) and only 7.9% of them participated in symposia and conferences. The presentation of research results in pedagogical circles may have as a possible explanation the desire to share with school colleagues examples of good practices discovered through research. It is noted again, the reluctance of respondents to present their research results in conferences and symposia, although these have a significant potential to recognize the involvement and effort made, as well as to motivate them to continue this endeavor.

Regarding the benefits of carrying out research projects and actual research, respondents appreciate in a proportion of 48.1% the preparation for completing bachelor's/dissertation papers, the consolidation of theoretical preparation through the documentation carried out (14.3%), the



improvement of the way to approach and solve various didactic/managerial problems (13.2%) and 5.8% the identification of scientific solutions for professional problems.

5. Formulating proposals for optimizing the process of training research skills through curricular and extracurricular activities

Knowing the main aspects that can be improved in education can start initiating studies, projects, research to find solutions. As expected, the instructional-educational process represented the main direction of improving education among respondents (37%), followed by class/group management (23.8%), 16.9% teaching staff training, 12.2% educational management and 9.5% extracurricular activities. This results in the focus on educational activity, the main activity of the 97 respondents who are both teachers and students/masters.

Specialized studies propose inquiry-based learning (Healey, Flint & Harrington, 2014), problem-based learning, case studies (Bocoş, 2013), applied projects, participation in student scientific sessions or research projects coordinated by teaching staff as ways to train research skills. Feedback received at all stages of the scientific approach and the provision of a support infrastructure are other ways to support student research (Mertens, 2020; Robson & McCartan, 2016).

In the case of students from FPSE, Buzău and Focşani Branches, through the answers to question 12, concrete ways of developing research skills were identified: mentoring with a professor (25%), team research projects (22.3%), practical workshops (21.8%), access to scientific resources and databases (16%), theoretical courses (5.9%). The low percentages (3.7%) obtained from participation in scientific conferences and extracurricular activities contradict the idea of encouraging students to get involved in such events in order to develop their research skills. The explanation of these results may reflect the students' belief that such events assume a high level of academic training, difficult for them to achieve, as well as a reduced capacity for communication and presentation of a research report.

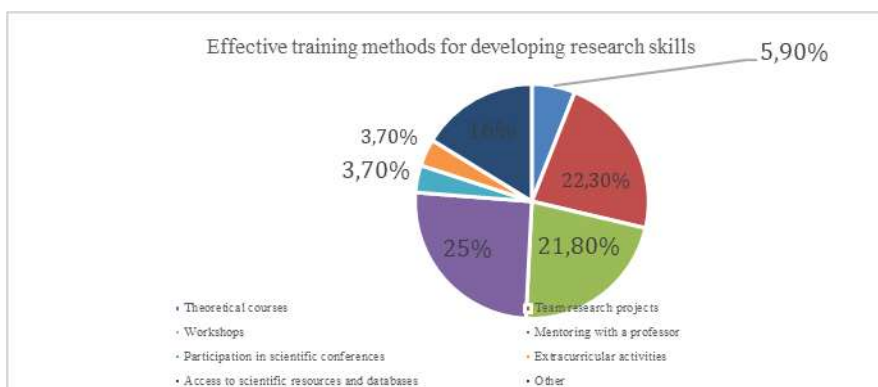


Figure 9. Effective ways to develop research skills

We observe several common ways of training/developing research skills, such as mentoring or coordination of research projects by teachers, practical workshops or applied projects, support infrastructure or access to scientific resources and databases.

5. Conclusions

Encouraging and supporting students to participate in conferences with their own research, involving them in research that demonstrates their importance in didactic innovation, increasing their confidence in their research skills and in disseminating good results obtained in the classroom, as well as developing a positive attitude towards extended professional roles (researcher, innovator) are some ways to support students in their research activity.

Student research represents a valuable potential not only for the personal and academic development of students, but also for the academic community and practitioners in the field of education. Capitalizing on the results obtained in student research involves identifying concrete ways in which these contributions can have a real and visible impact:

a) publishing scientific papers in student or specialized journals and magazines. This offers students the opportunity to experience the editorial process, receive feedback from the scientific community and consolidate their status as emerging researchers (Kumar & Stracke, 2025). Moreover, publication contributes to increasing the visibility of the university and strengthening the research-oriented academic culture.



b) presenting results at scientific conferences and symposia, where students have the opportunity to present their work to diverse audiences, interact with other researchers and expand their professional network (Mertens, 2020). Participation in such events is associated with increased motivation for research and the development of scientific communication skills.

c) integrating student research into interdisciplinary or collaborative projects with teaching staff or external partners (schools, non-governmental organizations, public institutions) can contribute to the practical applicability of the results and stimulate a positive social impact (Healey et al., 2014). This allows students to understand the relevance of their work and participate in solving concrete problems in the field of education.

d) the digital environment offers new opportunities for the dissemination and valorization of student research. Publishing on online platforms, academic blogs, podcasts or creating multimedia materials can facilitate access to a wide audience and contribute to the democratization of scientific knowledge.

A positive perception of students on the importance of research in teaching provides a solid foundation for implementing strategies aimed at developing students' research skills. If the university environment manages to provide them with real contexts and support for such activities, the development of these skills can become a natural, efficient and valuable process both for the professional training of students and for the higher education institution as a whole.

A direction for further research is to measure the impact of student research on the prestige of university institutions and their transformation (Kinzie & Larson, 2024).

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Directions and Emerging Trends in Teacher-Led Research on the Development of Communication Competences in Early Childhood and Primary Education

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Abstract

For teachers in pre-university education, the teaching career includes professional development stages marked by teaching degrees: second degree and first degree. The first degree certifies the practice of teaching at an advanced level, on a consistent basis, including teaching based on the exchange of good practices, reflection, and creativity, as well as showing interest in certain aspects of school practice which, through authentic and detailed understanding, can be improved. Thus, educational and psychological research provides the framework for the scientific investigation of educational phenomena.

This study highlights the topics of interest addressed by primary and preschool teachers in the methodological-scientific papers prepared for obtaining the first degree, with a focus on the formation and development of communication competences in children and pupils. In the early cycles of education (preschool and primary), the development of communication competences represents a major goal of the educational process, in accordance with the National Curriculum. Oral and written expression skills, active listening, dialogue, the use of nonverbal language, and the development of digital communication are key benchmarks for the harmonious development of the child.



The sample of our investigation consists of 149 papers written by preschool and primary school teachers during the period 2017-2025, in which we identified the main areas of interest, the most frequently used methodologies, strengths and thematic gaps, and proposed priority directions for future research.

The research objectives were:

1. to identify the main themes addressed in studies on communication carried out by primary and preschool teachers.
2. to analyze the research methods and instruments used in these works.
3. to determine the frequency and thematic trends depending on the level of education (primary vs. preschool).
4. to formulate recommendations for applying research results in educational practice.

The content analysis was carried out using a grid that included the following indicators: research theme, research objectives, methodology used, targeted level of education (primary/preschool), and results/recommendations formulated.

The formation of communication competences in preschool and primary school children represents the foundation of the educational process, serving as the basis for all other areas of learning. Research conducted by teachers in their first degree papers demonstrates an increasing interest in the linguistic, socio-emotional, and digital dimensions of communication. However, there remains a need for more rigorous studies and an expansion into new themes.

Keywords: educational research, research topics, communication competences, primary and preschool education

1. Introduction

The professional profile of the teaching staff in pre-university education is built by reference to national legislative benchmarks, corroborated with recommendations and regulations at the



European and international level, and is based on a series of references derived from the analysis of recent research and specialized literature.

For the teaching staff in pre-university education, the teaching career includes professional development stages marked by the teaching degrees: teaching degree II and teaching degree I. Teaching degree I certifies the consistent practice of the teaching profession at an advanced level, including teaching based on the exchange of good practices, reflection, and creativity, as well as showing interest in certain aspects of school practice that, through authentic and detailed knowledge, can be improved (Denzin & Lincoln, 2018).

2. Literature Review

In the *Profile and professional standards of teaching staff in pre-university education, by career stage and education level*, a document drafted by the Romanian Ministry of Education (M.E., 2024), it is indicated that the teacher for primary and pre-school education who reaches the stage of obtaining the Teaching Degree I carries out applied research and deepens the knowledge and understanding of the processes and developmental needs (physical, cognitive, emotional, and social) of children and young students, as well as the way children develop and learn, and the implications thereof for care and learning (Miller, 2011). By testing authentic, innovative learning approaches in school and extracurricular contexts through an investigative process, teachers ascertain the validity of hypotheses and facilitate the transfer of good teaching practices within the teaching collective or in professional communities (Lenoir, 2000; Darling-Hammond, Hyler & Gardner, 2017).

Thus, the psycho-pedagogical research that teachers organize and implement when writing the methodological-scientific paper for obtaining teaching degree I provides an adequate framework for the scientific investigation of educational phenomena. The themes of interest addressed by teachers for primary education and teachers for pre-school education in their methodological-scientific papers for obtaining teaching degree I focus on the formation and development of communication competencies in children and students (Florin & Véronique,



2003; Kalinina, Enova, & Tolkova, 2021). In early education cycles (pre-school and primary), the formation of communication competencies constitutes an important objective of the educational process, according to the National Curriculum. Oral and written expression skills, active listening, dialogue (Mercer & Littleton, 2007), the use of non-verbal language, and the development of digital communication are key benchmarks for the child's harmonious development (Hammond, 2005; Laurent, 2018; Torkos & Pasinszky Bernadett, 2021).

Our ascertaining investigation, which used qualitative and quantitative content analysis, was conducted on a sample consisting of 149 methodological-scientific papers by pre-school and primary education teachers, written between 2017-2025 at the University of Bucharest, Faculty of Psychology and Educational Sciences, Focșani Branch, most of them being accessed by us as coordinator or president of the committee for granting the first teaching degree. In these papers, we identified the areas of interest, the most frequently used methodologies, the strengths and thematic gaps, and proposed priority directions for future research. The distribution of titles based on the level of education indicates a slightly greater concentration on the basic stage of language development: out of the 149 papers, 76, representing 51% of the total, targeted the pre-school level, while 73 papers, or 49%, targeted the primary education level. The slight predominance of papers from pre-school education aligns with the critical importance of this period for the correct acquisition of oral language (pronunciation, vocabulary), which underlies subsequent success.

3. Methodology

Objectives

The research objectives were:

- identifying the main themes addressed in research on communication conducted by primary and pre-school teachers;
- analysing the research methods and instruments used in these papers;
- determining the frequency and thematic trends based on the level of education (primary vs. pre-school);



- formulating recommendations for leveraging research results in educational practice.

Analysis of Collected Data

The sample was subjected to a rigorous analysis process following three main identified axes of analysis: level of education, specific content elements of the communication, language, and literature domain, and the didactic strategies involved.

Thus, regarding the level of education, the classification of titles confirmed a balanced distribution, but with a slight inclination towards the early stage. Furthermore, each title was associated with the dominant content category (vocabulary, grammar, literature, etc.). From an instrumental perspective, the main didactic strategy was identified, either in general form or particularized at the level of didactic methods, forms of realization (didactic game, interactive methods, storytelling).

The themes were grouped based on the main aspect addressed, highlighting the research priorities of the teachers:

No.	Main Themes	Frequency (number of papers)	Percentage
1.	Didactic strategies/ methodology (active-participative/ modern)	38	26%
2.	Didactic game/ creative play/ role play	33	22%
3.	Children's literature/ fairy tale/ story/ storytelling/ folklore literature	21	14%
4.	Vocabulary (enrichment, activation, nuance)	16	11%
5.	Creativity and original expression	14	9%
6.	Building blocks of communication (grammar/ orthography/ punctuation)	11	7%
7.	Correction of speech disorders	8	5%
8.	Evaluation of communication competencies	4	3%
9.	Use of New Technologies (NTIC)	4	3%

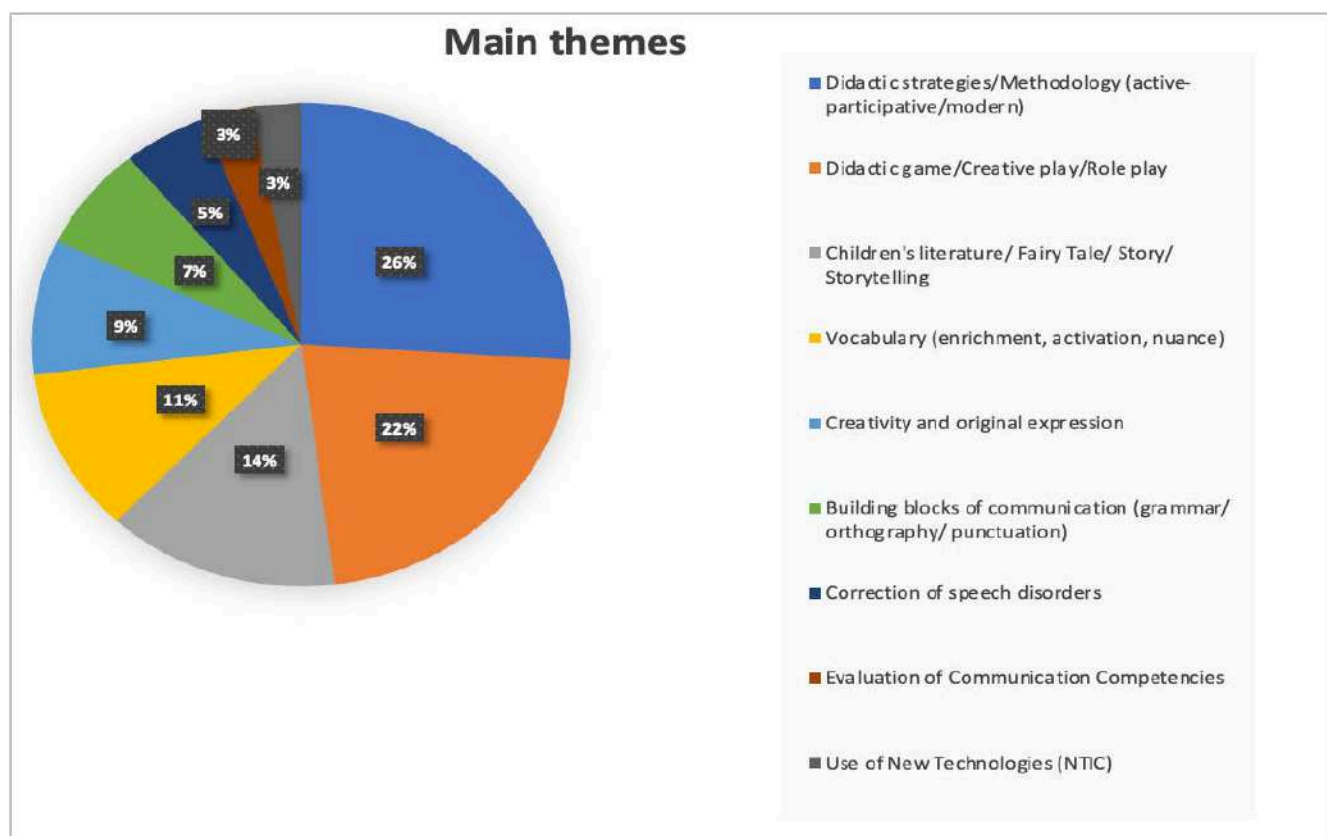


Figure 1. Main themes

Over 70% of the research focuses on teaching modalities and the didactic game. This confirms that teachers are primarily interested in the practical validation of methods that optimize their direct didactic intervention. Nevertheless, themes focused on content (vocabulary, fairy tale/story, storytelling, communication construction elements) also maintain a solid presence.

The research described in the teachers' papers concentrates on several major directions that contribute to the formation of a professional profile of teachers in terms of their majority concerns. Thus, it is found that the didactic game dominates the corpus, being the most researched theme by teachers, perceived as the most frequent method of stimulating language, both a formative and therapeutic tool (in correcting speech disorders and developing phonemic hearing in pre-schoolers and students). The fact that the didactic game is the most researched



didactic strategy on its own (22%) confirms its recognition as the didactic tool with the highest predictive value in language development at an early age.

Furthermore, children's literature – stories, fairy tales, poetic texts, narrative texts, folklore literature – is used as a resource for vocabulary, expressiveness, and moral education. Regarding didactic strategies, as well as instructional or evaluation methods used in the instructive-educational process, the emphasis is on the balance between traditional methods (storytelling, exercise, memorization) and modern methods (interactive, active-participative, digital technologies). The interest of the teaching staff is also manifested in the direction of integrated language education activities, in accordance with the variety of proposed didactic strategies.

Regarding the communication building blocks, vocabulary, in terms of enrichment and nuance, is considered the core of communication competencies, with many papers dedicated to it. However, a constant concern of the teaching staff is also for speech therapy, correcting pronunciation through adequate and effective didactic methods, and for the correctness of written and spoken language, part of the communication competencies assumed by the Curriculum.

Timidity, but visibly, a concern for technologies and non-formal methods in teaching Romanian language and communication emerges, with an emphasis on developing the learners' vocabulary. Based on the analysis of the 149 papers, we found that, regardless of the title's phrasing, they all address a complex theme, combining both the didactic/methodological aspect and the specific content of the Language and Communication field. These papers may opt for a more general phrasing, such as *approach*, *optimization*, or a specific one that names both the instrument (method) and the object (content) being studied:

- the didactic game with: language, vocabulary, oral expression, correction of pronunciation and speech disorders;
- the ensemble of didactic strategies with: oral and written communication, reading, elements of communication construction (vocabulary, orthography, and punctuation), correction of speech disorders;



- instructional methods with communication and language, children's literature (narrative text, poetic text, stories and storytelling), elements of communication construction (vocabulary, orthography, and punctuation);
- evaluation with communication or grammatical notions;
- creativity with different types of literary texts, such as poetry.

Thus, the authors of these papers demonstrate an advanced understanding of action research, establishing a causal or influential relationship between the methodological/didactic aspect and the content aspect. This indicates that a significant segment of teacher-researchers defines their research objectives with enough precision to test the impact of a specific strategy on a precise linguistic acquisition.

Regarding the research methods and instruments used in these papers, after a qualitative and quantitative analysis of the investigations conducted by teachers, considering the presence of at least two research methods in each paper, the following options were identified:

- Systematic observation (data recorded on observation sheets with different numbers of observational indicators, case by case) – 142 papers – 95%;
- Psycho-pedagogical experiment (with a single subject sample or with parallel samples, experimental and control) – 136 papers – 91%;
- Analysis of students' and pre-schoolers' activity products (worksheets, notebooks, compositions, drawings, journals, reading sheets, portfolios, etc.) – 112 papers – 75%;
- Questionnaire-based survey (questionnaires applied to different subject samples: teachers, parents, students) – 84 papers – 56%;
- Case study (monitoring the progress of a child or small group) – 48 papers – 32%.

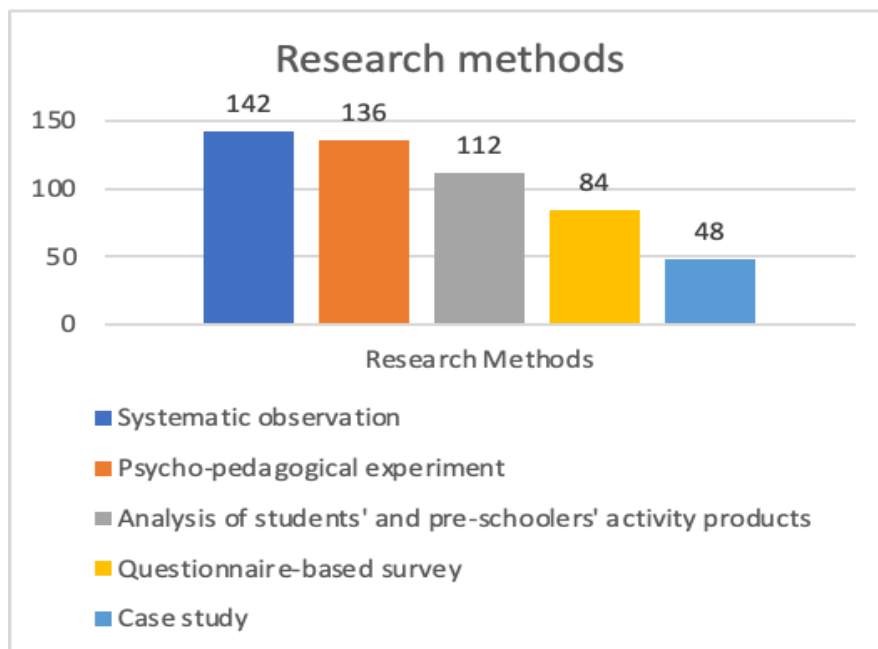


Figure 2. Research methods

4. Results and Discussions

The distribution of research methods confirms that the Teaching Degree I papers mostly fall within the paradigm of Action Research and applied research. The fact that each paper used at least two methods underscores the teachers' desire to ensure the validation of results through multiple sources, conferring an appreciable level of methodological rigor to their endeavors.

The dominance of methods oriented towards direct observation and intervention (observation, experiment) indicates a focus on the didactic process and the practical validation of innovative strategies. Systematic observation (95%), a fundamental data collection method, reflects the researcher-practitioner character of the authors. The use of observation sheets with specific indicators suggests an effort to transform an ordinary didactic activity (observation) into a standardized and rigorous research instrument. The psycho-pedagogical experiment (91%) is of paramount importance; its presence in most papers confirms that teachers are not just describing



a situation but are seeking to demonstrate the effectiveness of a specific didactic strategy (the independent variable) on the development of students' and pre-schoolers' communication (the dependent variable). The use of control samples (parallel samples) shows a correct understanding of the need to isolate the effect of the intervention.

Analysis of activity products (75%) is an indicator of the validity of the investigated didactic actions. Teachers use authentic instruments created by children – concrete results of the didactic process – to measure progress. This confirms an authentic evaluation and a measurement of competencies as a whole, not just knowledge.

The questionnaire-based survey (56%) shows a concern of teachers for the contextual perspective. Applying questionnaires to various samples (teachers, parents) allows, on one hand, the identification of colleagues' perceptions on different options and solutions in approaching components of oral or written communication in class, and, on the other hand, the understanding of the role of the family environment in communication.

The Case study, a method of in-depth analysis, although less frequent, is used in papers targeting themes such as the correction of speech disorders or communication difficulties of pre-schoolers and students. The case study allows for a longitudinal analysis of a subject, providing qualitative details that cannot be captured by quantitative methods, such as the experiment.

From the examination of research methods, the observation emerges that the research of primary and pre-school teachers in the field of language and communication is characterized by precision because it focuses on several main directions. First, from an interventional perspective, the dominance of the experiment (91%) demonstrates that the central objective of the teachers is to test and prove the efficiency of the proposed didactic strategies (didactic game, active-participative methods, storytelling, etc.). Second, the use of systematic observation and the analysis of activity products (over 75%) confirms that progress is systematically monitored by teachers and is based on concrete and authentic results of students' activity. Third, the inclusion of the questionnaire-based survey in research (56%) shows an awareness that educational results depend not only on the direct intervention of the experimental factor but also



on other factors, such as environmental factors (parents, colleagues), subjectivity, and the teachers' own vision.

The content analysis of the papers making up the research sample revealed that the concerns of pre-school teachers (76 papers) are directed towards the acquisition of basic oral language and the correctness of expression, as follows:

- developing vocabulary represents the most researched content element. The titles emphasize enrichment, activation, and nuance, reflecting the importance of the pre-school stage for lexical expansion.
- storytelling and the fairy tale are researched to validate the formative, educational, and therapeutic valences of the narrative (example, from story to storytelling). Content is viewed not only as a source of language but also as a tool for socio-emotional development and imagination stimulation.
- regarding speech correction, the papers focus on detection, prevention, and early intervention in speech disorders and the development of phonemic hearing. This activity is specific to the preschool age and highlights the teacher's role as an observer and an early interventionist.

The concerns of primary education teachers (73 papers) focus on the formalization of language and written communication competencies. Thus, the research targets the following aspects:

- Creativity, in primary grades, is most often an outcome pursued through the involvement of different strategies for stimulating oral and written expression during Romanian language and literature classes. This content is valued as a way to personalize learning and teaching.
- Communication construction elements (grammar, orthography, and punctuation) are not investigated in research focusing on what is taught (the content is given) but on how to teach efficiently (the methodology), to ensure understanding and the formation of lasting skills, whether it is about the noun and verb or orthography rules.



- The formation of writing or reading competencies is monitored in investigations that describe ways for a natural transition from oral language to functional literacy as a key content element.

To leverage the data collected from the examination of the research described in the Teaching Degree I papers of primary and pre-school teachers, the following actions are recommended:

- Creating a national bank of good practices based on the synthesis of the conclusions of the Teaching Degree I papers, by domain and education level. This would reduce research redundancy and facilitate access to field-validated solutions.
- Guiding teaching staff towards conducting quantitative analyses on larger samples, relevant to school practice, as many studies are based on small samples.
- Expanding research in the area of new technologies, both at the level of teaching and evaluation, with the creation, testing, and validation of efficient tools that ease the teacher's work and produce learning.

Encouraging teaching staff to explore how communication competencies (functional reading, creative writing) manifest and can be developed in the space of other curricular areas (for example, in Mathematics and Environmental Exploration), to ensure a holistic development of literacy within an interdisciplinary framework.

Therefore, the examined papers demonstrated the solidity of action research in early and primary education but also highlighted the necessity to expand the area of investigation towards adaptation to current technological challenges and the exploration of interdisciplinarity as a valuable resource for oral and written communication.

5. Conclusions

The present study demonstrates that the research interest of primary and pre-school teachers is characterized by a strong practical and interventional orientation, with a major concentration on the tools that maximize student or pre-schooler engagement: the didactic game and interactive methods. The formation of communication competencies in children in pre-school and primary education represents the basis of the educational process, being the foundation for all other



learning domains (Suebsing, Udomsan, & Bunphok, 2023). The research conducted by teaching staff in their teaching degree I papers demonstrates a heightened interest in the linguistic, socio-emotional, and digital dimensions of communication. However, there is a need for more rigorous research and expansion towards new themes.

The Grade I certification papers completed by primary and preschool teachers show a clear preoccupation with communication in its multiple dimensions: from language development in preschool, to didactic communication in school, to the relationship with parents, and increasingly, to digital communication. Practical interventions and active methods predominate; however, there is a need for studies with more robust methodologies and new topics related to linguistic diversity, emerging technologies, and longitudinal research. The thematic proposals in this study can guide teachers who wish to write a Grade I paper with theoretical and practical impact.

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Inclusive Learning: The Antipa Museum for Neurodiverse Children

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Abstract

This article examines the programs designed for neurodiverse audiences developed by the Grigore Antipa National Museum of Natural History in Bucharest. Framed within the theoretical context of Disability Studies and informed by relevant legal frameworks, the analysis situates the museum's activities in relation to inclusive practices implemented by contemporary European and U.S. museums. The study pursues two main objectives. First, it investigates the availability, structure, and specific features of educational programs targeting neurodiverse children and young people at the Antipa Museum. Second, it shows the degree of interest and engagement demonstrated by the target audience in response to these initiatives. By addressing these objectives, the article contributes to a broader understanding of how cultural institutions can design and implement inclusive educational strategies that respond effectively to the needs of diverse audiences, while also aligning with international accessibility standards and theoretical developments in the field of disability and museum studies.

Keywords: disability studies, neurodiversity, museum, inclusion

1. Introduction

Museums are increasingly recognized as partners in the field of education, offering non-formal learning experiences that complement and extend formal curricula. Through interactive exhibits,



workshops, and inclusive programs, they engage diverse audiences in active, experiential learning. By ensuring accessibility for persons with disabilities, museums promote equal participation and strengthen their role as inclusive educational spaces that foster lifelong learning for all. In a context where cultural institutions are making increasing efforts to facilitate access for people with disabilities and to offer them inclusive cultural experiences, the “Grigore Antipa” National Museum of Natural History (The Antipa Museum) in Bucharest has long stood out for its commitment to creating an accessible environment for all visitors. Since 2003, the museum has implemented a series of initiatives designed to engage visitors with visual and hearing impairments through interactive and multisensory experiences. Among the most significant projects are “Lumea văzută de noi” (April–December 2003), “Simte Arta” (2011–2012), “Muzeul Tutor” (2012), and “Vizite senzoriale – Sensory Visits” (2012–2013). Moreover, the institution is the first museum in Romania to offer educational programs specifically tailored to neurodiverse children and young people—a group that is often difficult to reach and remains largely underrepresented in museum spaces across the country—and to include these programs as part of its current educational offer.

The objectives of this study are twofold. First, it seeks to investigate the availability and specific features of educational programs designed for neurodiverse children and young people at the Antipa Museum. Second, it aims to assess the level of interest and engagement demonstrated by the target audience in relation to these programs. By addressing these objectives, the study contributes to a broader understanding of how cultural institutions can develop inclusive educational strategies that respond to the needs of diverse audiences.

2. Literature Review

Disability Studies represent an interdisciplinary field, drawing from the humanities and social sciences, which examines the concept of disability in social, cultural, and political contexts. This field developed primarily in Anglo-Saxon countries starting in the 1990s and is linked, on the one hand, to activism around the rights of persons with disabilities, and on the other hand, to moving away from viewing disability solely through a medical lens (the so-called medical



model). The traditional dichotomies of normal–abnormal and healthy–sick have progressively been replaced by approaches emphasizing social inclusion, the recognition and acceptance of diversity, and active participation. The cultural and artistic dimensions of disability have become increasingly prominent. In recent years, academic literature has explored the intersection between **museum studies** and **disability studies**. Museums are developing projects in collaboration with, or targeted toward, specific communities of people with disabilities. In doing so, they are positioning themselves as platforms that amplify social messages, advocating for inclusion, solidarity, and acceptance. A growing number of collective volumes have assembled empirical studies, theoretical interventions, and project-based analyses that foreground both the museum visiting experiences of audiences with diverse disabilities and the transformative role of art and culture in these experiences.

A foundational contribution to this field is the volume *Rethinking Disability Representation in Museums and Galleries*, edited by Jocelyn Dodd, Richard Sandell, Debbie Jolly, and Ceri Jones (Dodd et al., 2008). This work presents the outcomes of a large-scale initiative implemented across nine museums and galleries in the United Kingdom, encompassing exhibitions, educational programs, and bespoke interpretative materials designed for disabled audiences. Beyond its descriptive dimension, the volume offers concrete case studies that critically illustrate how institutional practices can facilitate more inclusive forms of engagement. Importantly, it positions such initiatives not merely as targeted accommodations but as catalysts for raising awareness among non-disabled visitors, thereby reshaping broader museum narratives and visitor dynamics. The role of museums in redefining societal perceptions of disability and in fostering collaborations with diverse disability communities is examined in the volume *Re-Presenting Disability: Activism and Agency in the Museum*, edited by Richard Sandell, Jocelyn Dodd, and Rosemarie Garland-Thomson (Sandell et al., 2010). The volume mobilizes case studies, artistic projects, activist collaborations, and critical debates to underscore the imperative for museums to assume an active, agentive role in reshaping dominant discourses on disability. Collectively, these interventions position museums not as neutral spaces of display, but as cultural actors capable of challenging and transforming social imaginaries surrounding disability.



In recent decades, sustained scholarly attention has focused on the **access of neurodiverse individuals to education and culture**, including museum engagement. Early contributions, such as Elise A. Freed-Brown's *"A Different Mind: Developing Museum Programs for Children with Autism"* (2010) and Chiara Di Lello's *"Guggenheim for All"* (2015), explored the challenges faced by autistic visitors and examined inclusive program models grounded in Universal Design for Learning, emphasizing flexibility and multimodal engagement. Since 2020, research on **neurodiversity and disability inclusion in museums** has expanded significantly, reflecting a broader institutional shift toward participatory and accessible practices. Notable works include Piper and James Hutson (2022) and Ross Edelstein (2022), which collectively theorize museums as adaptive spaces and identify key strategies: pre-visit preparation, sensory-friendly environments, structured and predictable programming, small group formats, multisensory materials, quiet zones, accessible communication, trained staff, and collaboration with disability communities. These studies further articulate broader accessibility principles, including co-decision-making, lifelong inclusion, integrated physical and cultural access, and institutionalized long-term commitments.

These developments align with broader thematic concerns in contemporary museology, ranging from the **new definition of the museum** adopted at the ICOM General Assembly (Prague, 2022), to the increased emphasis on audience engagement, the creation of meaningful and diversified visitor experiences, and the adaptation of institutions to evolving societal interests. The use of terms such as "accessible," "inclusive," "diversity," "sustainability," and "communities" reflects the incorporation of issues frequently debated in society and confirms the ongoing trend of museums becoming increasingly active and socially engaged institutions.

In Romania, research and initiatives in the field of disability studies are sporadic and still in their early stages. There are several articles discussing various projects carried out in museums, such as: Dan Patzelt on the "Simte Arta" ("Feel the Art") projects from 2011–2012 (Patzelt, 2011, Patzelt, 2012), Ioana Mucenic on "Muzeul Tutoror" ("Museum for All") project in 2012 (Mucenic, 2012), Despina Hașegan on accessibility projects at the Antipa Museum and the National Museum of Art of Romania in 2014 (Hașegan, 2014) and about artistic projects on



inclusion and diversity at The National Museum of Contemporary Art and at the Maps Museum (Hașegan, 2024) and Costel Crangan on projects at the Galați County History Museum in 2019 (Crangan, 2019) Other works address the implementation of measures to ensure access to cultural activities, such as Oana Maria Sava's "Access of People with Disabilities to Cultural Institutions in Romania"(Sava 2021). Moreover, increasing efforts are being made to ensure that museums comply with legal provisions regulating the rights of persons with disabilities and facilitating their access to culture. Relevant legislation includes Law no. 221 of November 11, 2010, (Legea nr. 221/ 11.11.2010) which ratifies the Convention on the Rights of Persons with Disabilities, adopted in New York by the UN General Assembly on December 13, 2006; the National Strategy on the Rights of Persons with Disabilities "O Românie echitabilă 2022–2027", adopted through Government Decision no. 490 / 2022 (HG nr. 490/ 2022), which is also based on the provisions of the UN Convention; and Law no. 448 of December 6, 2006 (Legea nr. 448 / 6.12.2006), on the protection and promotion of the rights of persons with disabilities, which regulates the main aspects regarding the rights and obligations of people with disabilities in Romania, including their access to culture.

3. Methodology

This article forms part of a broader research project examining access to museum heritage in Romania for individuals with disabilities. The analysis focuses on the programs developed by the Antipa Museum for neurodiverse audiences, situating these initiatives within the theoretical framework of disability studies and in dialogue with approaches implemented by major museums in Europe and the United States. Adopting an interdisciplinary cultural studies perspective, the research methodology integrates several components: a critical review of specialized literature in disability studies and legal studies; analysis of the museum's official reports and digital communications; and on-site participation in programs, which included informal discussions with both staff and visitors. The theoretical framework draws upon general disability theories as well as museum-specific initiatives addressing neurodiversity. The legal analysis highlights Romania's formal alignment with relevant international frameworks concerning disability rights



and accessibility. The overall analysis combines descriptive presentation of the museum's programs with empirical data derived from institutional reports, media coverage, communications from non-governmental organizations (such as *Supereroi printre noi*), and first-hand field observations.

Programs for neurodiverse children at the Antipa Museum: the “Quiet Hour” and the “Discover Workshops”

In 2021, the Antipa Museum organized its first activities specifically designed for neurodiverse audiences, in collaboration with the association “Supereroi printre noi” (“Superheroes Among Us”); this is a non-governmental organization dedicated to promoting the social inclusion of persons with disabilities by facilitating their participation in cultural life, as well as in a range of events and activities, with particular emphasis on supporting neurodiverse individuals. Previously, the museum had developed several projects dedicated to visitors with mobility, visual, and hearing impairments. Notable initiatives include “Lumea văzută de noi” (“The World Seen by Us”), April–December 2003, “Simte Arta” (“Feel the Art”) 2011–2012, “Muzeul Tutor” (“Museum for All”) 2012, and “Vizite senzoriale / Sensory Visits” 2012–2013. Through these initiatives, the museum ensured access for all categories of visitors to the building and created products and services tailored to specific needs, such as Braille labels and catalogues, a presentation film in Romanian Sign Language, and various tactile materials. However, neurodiverse audiences had not previously benefited from dedicated projects.

Terms such as “neurological diversity,” “neurological pluralism,” and “neurodiversity” emerged in the mid-1990s within online communities of individuals with autism spectrum disorders (ASD) in the United States. Judy Singer (Singer, 1999) introduced the term neurodiversity to conceptualize neurological variation as an inherent and natural aspect of the human condition, analogous to biological or cultural diversity. Later, Nick Walker (Walker, 2014) refined the terminology, defining “neurodiversity” as the range of neurological differences within a group, “neurodivergent” as individuals whose neurological functioning diverges from social norms, and “neurotypical” as those who conform to such norms. The term “neurodiversity” is not a medical



category and does not appear in Romanian legislation. Instead, expressions such as “intellectual disabilities,” “neurocognitive disabilities,” “special needs,” or “learning difficulties” are commonly used. This variety reflects the complexity of the subject and explains the growing adoption of the term “neurodiversity” in both academic and public discourse. Neurodevelopmental conditions can manifest in diverse ways, including but not limited to difficulties in understanding or communication, involuntary movements, restlessness, limited attention spans, as well as stereotyped movements or vocalizations. A variety of external factors—such as crowded environments, intense lighting or loud noises, dark spaces, as well as specific emotional states or social interactions—may intensify these manifestations. Consequently, certain everyday activities may pose significant challenges, including visiting museums, attending theatrical performances, or going to the cinema. This broad spectrum of manifestations and the factors influencing them highlight the institutional challenges faced by museums and cultural organizations in designing and implementing inclusive educational programs for neurodiverse audiences.

The “Quiet Hour” program was launched at the Antipa Museum in August 2021, within the context of the exotic butterfly exhibition. In support of the neurodiverse audience, the butterfly house was equipped with a glass-enclosed area, enabling visitors to observe the butterflies from outside while minimizing direct contact. Participation was free and required completion of an online registration form. Neurodiverse visitors, particularly children and young people, along with their accompanying caregivers or friends were invited to attend the museum on Mondays, when it is normally closed to the general public. This arrangement provided an opportunity to explore the butterfly house in a calm and unhurried manner, without the usual bustle and crowding associated with standard visiting hours. Similar initiatives are implemented in prominent Anglo-Saxon museums, including the Smithsonian Institution, Tate Liverpool, and Tate Modern. Programs such as “Quiet Hours,” “Relaxed Hours,” and “Morning at the Museum” offer neurodiverse visitors a tranquil environment, free from crowding and potential sensory disruptions, thereby facilitating thoughtful exploration alongside family or friends.



The “Quiet Hour” initiative proved successful; according to the museum’s 2021 activity report, a total of 82 neurodiverse visitors and their companions participated in three visits to the butterfly house. Since December 2021, the program has been adapted for the permanent exhibition and is organized in various spaces within the museum or in the butterfly house in the garden, free of charge, by registration. Also, the duration of the program was extended from one hour to two hours, prompting a corresponding change in its title to “Quiet Hours”. Now part of the museum’s regular offerings, the program has an increasing number of participants, as shown in the museum’s official annual reports, summarized in the tables below:

Year	2021	2022	2023	2024
Activities	3	5	6	6
Participants	82	223	365	144

Table 1. “Quiet Hour”/ “Quiet Hours” in the butterfly house

Year	2021	2022	2023	2024
Activities	1	18	23	24
Participants	6	846	774	726

Table 2. “Quiet Hour”/ “Quiet Hours” in the museum

The visits take place in a calm and relaxed atmosphere. Emphasis is placed on the visitors’ sense of well-being and comfort, as they enjoy discovering the museum in a quiet environment, free from disruptive factors, at their own pace, exploring the interactive areas in an unhurried manner.



The visits are supervised by museum staff, though with a reduced number of employees compared to regular opening days.

The first workshops designed for neurodiverse children – with special educational needs – and their peers were organized by the Antipa Museum in collaboration with the association “Supereroi printre noi” in August 2021. Participation was free of charge and based on prior registration. Entitled “**Discover Exotic Butterflies**”, the workshops were held outdoors, near the butterfly greenhouse, for groups of up to 10 participants. The overall structure of the program, as well as the various stages of each session, were clearly explained and reiterated throughout the activities to support comprehension and engagement. The workshops incorporated a wide range of activities aimed at facilitating learning about butterflies, including their life cycle, habitats, and feeding behaviors. Participants either visited the greenhouse or observed the butterflies from outside, conducted microscopic observations, explored tactile replicas and various related objects, and engaged in creative activities such as drawing and collage-making. Periods of movement, musical listening, and storytelling were interspersed with activities focused on learning, observation, and fine motor skills activities during the workshop. This structure allowed for the inclusion of breaks, supported the development of sustained attention across different types of tasks, and engaged multiple sensory modalities. Basic information regarding butterflies and their way of life was conveyed using clear and accessible language and was reinforced through successive activities. For example, participants first observed a particular species in the greenhouse, then examined the same species under the microscope, and finally identified it among a selection of materials prepared for hands-on exploration. The program aligns with general principles used by museums that organize activities for neurodiverse children or children with autism — such as the Metropolitan Museum of Art in New York, the Museum of Modern Art, and the Guggenheim Museum — and outlined by Elise A. Freed-Brown (2010), Chiara Di Lello (2015), and more recently by Piper and James Hutson (2022) and Ross Edelstein (2022). These include: small group formats, multisensory materials, structured and predictable programming, and accessible communication.



According to the Antipa Museum’s Annual Report, the first three workshops organized in 2021 brought together a significant number of participants and accompanying persons — 64 in total. In the subsequent years, both the number of workshops and the number of participants increased steadily, reaching 41 events with 445 participants in 2023, as shown in the table below, which summarizes data from the institution’s official annual reports. In 2024, a slight decrease can be observed, occurring in the context of an overall decline in the total number of visitors.

Year	2021	2022	2023	2024
Activities	3	16	41	25
Participants	64	245	445	380

Table 3. The “Discover” Workshops

The inclusion of the “Discover” workshops in the museum’s regular program was motivated by the increasing interest expressed by beneficiaries — neurodiverse individuals, persons with various other disabilities, and their companions, friends, or family members. Over time, the range of topics has expanded to cover various themes from the museum’s permanent exhibition, as reflected in titles such as: “Discover: Life in the Forest”, “Discover Life in the Mountains”, “Discover: Life on Ice”, “Discover: Stories from the Animal World” and others.



Figure 1. Materials prepared in the room for the “Discover” workshop, May 2025



The workshops are organized on a monthly basis, with participation requiring prior registration. They continue to take place on Mondays in order to provide these groups with a calm, low-stimulation environment, away from the crowds typically present during regular opening hours. Although the themes differ, the structure of the program remains consistent. Each session begins with a visit to the museum or to the butterfly greenhouse, during which participants complete a treasure-hunt-style worksheet. The second part takes place in the workshop room, where participants listen to a story or watch a short film, engage in guided discussions, and take part in practical, hands-on activities related to the theme. During the museum visit, children are directed to exhibition halls selected according to the theme of the workshop. Using the instructions provided in the worksheet and information available on the museum's touchscreens, they are tasked with identifying specific exhibits, observing them carefully, and recording various details (e.g., appearance, habitat). These notes are reviewed in the initial part of the workshop, and participants' knowledge is further consolidated through complementary materials and activities, such as storytelling, film screenings, or tactile exploration of objects including toys, replicas, and samples. Participants are allocated approximately two hours to complete all activities at their own pace, alternating between different types of tasks, moments of rest, and opportunities for social interaction. Throughout the session, the workshop coordinator provides clear explanations and instructions, using simple, accessible language adapted to the participants' needs.



Figure 2. Work table during a “Discover” workshop, May 2025



4. Results

The “Quiet Hour” program, initiated in 2021, has continued to evolve and is currently implemented under the name “Quiet Hours”. Similarly, the “Discover Workshops”, first organized in 2021, have become a regular component of the museum’s monthly programming. Between 2021 and 2024, the “Quiet Hour” initiative expanded substantially, increasing from a single activity involving 6 participants to 24 activities with a total of 726 participants. Over the same period, the “Discover Workshops” grew from 3 activities attended by 64 participants to 25 activities with 380 participants. Adopting an inclusive approach, these programs are designed to involve not only neurodiverse children and young people but also their friends and family members, thus fostering shared cultural experiences within the museum setting.

This success can be attributed to a series of well-considered measures implemented by the museum, as documented in its official annual reports for the period 2021–2024. Key measures include: **The creation of a safe and quiet environment**, accompanied by the extension of the allocated time slot on Mondays from one to two hours, and the rebranding of the initiative as “Quiet Hours.”

- **Collaboration with associations representing people with disabilities** (such as “Supereroi printre noi”) which provide feedback and contribute to the ongoing improvement of the programs.
- **Partnerships with a wide range of organizations**, including day care centers, social service providers, neuropsychiatric recovery and rehabilitation centers, maternal centers, as well as associations and foundations that support individuals from disadvantaged backgrounds, persons with intellectual disabilities or mental health challenges, and special schools for students with visual, auditory, or neurocognitive impairments.
- **Engagement with new audiences**, notably refugees and asylum seekers from Ukraine, Palestine, Iraq, and other countries, facilitated through partnerships with organizations that provide assistance to these communities. Their participation in “Quiet Hours” is motivated by the need for translation services and by a preference for a calm, less crowded environment, which enables them to explore the museum in a more comfortable and supportive setting than during regular visiting hours.



5. Conclusions

Situated within the broader framework of disability studies and international museum practice, the programs developed by the Antipa Museum for the neurodiverse children distinguish themselves through their conceptual coherence, methodological rigor, and alignment with established international standards and validated implementation models. These initiatives are grounded in fundamental principles, including the creation of safe and welcoming environments, the systematic consultation of persons with disabilities and the active involvement of representative associations in program design and delivery, as well as the promotion of inclusion and meaningful participation in community life alongside family members and peers.

While the achievements to date are significant, several avenues exist for further enhancement of the museum experience for these audiences. These include:

- The creation of additional relaxation areas along the visitor route, offering opportunities to withdraw from sensory or emotional overstimulation.
- The development and distribution of a sensory map to support visitors in identifying areas with potentially challenging environmental factors such as lights, sounds etc.
- The strategic engagement of collaborators and volunteers willing to contribute to program implementation, addressing the increasing demand for these programs, which has occurred despite limited human resources.

The steady expansion of both the range of activities and the number of participants, alongside the programs' integration into the museum's permanent educational offer, demonstrates both the growing interest of the target communities and the museum's institutional capacity to address genuine social and cultural needs. In this context, the Antipa Museum emerges as a benchmark within the Romanian museum landscape, exemplifying how cultural institutions can develop inclusive programs that are open to diverse audiences while upholding the universal right of all individuals to access and participate in cultural life.



Acknowledgements

All photographs included in this paper were taken by the author. Their use complies with ethical standards for research and publication, ensuring respect for the dignity and privacy of all individuals depicted. The identities of persons with disabilities have been appropriately protected.

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Arduino as an Educational Tool for Exploring Medical Signals

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Abstract

These days, gadgets of various kinds are an essential aspect of everyone's life. All these smart devices, whether they are watches, phones, rings, or wristbands, are built on basic sensors that allow us to continuously monitor our body temperature, heart rate, blood oxygen saturation, or sleep quality. There are numerous accessible, simple alternatives to these sensors, such as Arduino-compatible modules, which, configured properly, can build effective continuous monitoring systems. Students in the Faculty of Medical Engineering learn the fundamentals of medical electronics, which they can use in the class projects, bachelor's thesis, or at work. Since signal processing is the foundation of most applications and devices for monitoring vital parameters, this study proposes including a medical signal acquisition laboratory in the Arduino classes. In the theoretical section, students interactively discover medical signals, and then, in the practical section, they acquire, visualize, and measure them. To ensure the accuracy of the obtained signals, an advanced medical signal acquisition system, Biopac, is also used, and the outcomes are compared both visually and numerically.



Keywords: Medical signals, Laboratory classes, Arduino, Heart rate, Muscle contraction, Wearable sensors.

1. Introduction

The quality of education is constantly improving, particularly in the field of medical engineering, where hardware and software tools are used, and require the understanding of both the functionality of the equipment and the fundamentals of the recorded biosignals (Hernández-Delgado et al., 2017; Bañuelos-Mezquitan et al., 2025). The human body generates numerous biosignals that can be continuously measured and monitored (Ahamed et al., 2015). A proper acquisition, processing, and analysis of the recorded biosignals can provide relevant information about an individual's health and can be used for robot or prosthetic control, as well as a tool for automatic detections and physician diagnosis (Satiro et al., 2019; Ehrmann et al., 2022; Ahamed et al., 2015).

Nowadays, wearable devices have become an indispensable part of everyday life, allowing us to constantly track our vital signs, in addition to the professional devices found in hospitals and clinics. With the focus on education, new low-cost systems that perform the same functions as professional ones have been developed, providing students with an excellent alternative (Bañuelos-Mezquitan et al., 2025; Satiro et al., 2019; Delgado-Torres et al., 2024; Puente et al., 2017). With its many benefits, the concept of "Wearable Biosensor Technology", which is discussed by Hernández-Mustieles et al. (2024), has become increasingly integrated into educational environments.

The second-year students of the Faculty of Medical Engineering, National University of Science and Technology POLITEHNICA Bucharest, Bucharest, Romania, learn in the Arduino classes how to program various sensors used in the medical devices to read and write data. This study proposes incorporating a medical signal acquisition laboratory (**Figure 1**) that begins with a theoretical section, where students interactively discover medical signals (characterization of medical signals, wave morphologies, all the steps from recording the signals to an automatic detection or classification and exploring various devices and their applications). In the practical section, students use an Arduino UNO Board and specific sensors to record, visualize, and evaluate three medical signals: electrocardiogram (ECG), electromyogram (EMG), and photoplethysmogram (PPG). To ensure the accuracy of the Arduino-obtained signals, an

advanced medical signal acquisition system is also used, called Biopac, and the outcomes are compared both visually and numerically, as it will be further described.

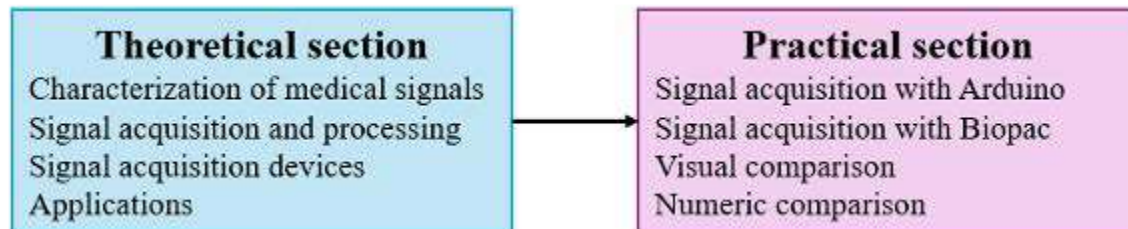


Figure 1. Block diagram of the proposed laboratory

This paper is structured into several sections that cover all the aspects of the laboratory. After a brief overview of the Arduino-based devices used in the educational process, the materials and methods necessary to develop this laboratory are described in terms of recorded signals, and acquisition and processing systems. Following the presentation and discussion of the results, several conclusions are made.

2. Literature Review

Numerous Arduino-based solutions are available to facilitate student laboratories, and a wide range of sensors are accessible to record various medical signals. In addition to its multiple software and hardware advantages, Arduino is compatible with other signal recording and processing software. Arduino boards are available in a variety of sizes and memory capacities, as well as sensors that can read various biosignals. Additionally, the Arduino IDE software is very user-friendly and intuitive.

Alsabah et al. (2023) focus on the design and implementation of a simple open-source medical sensor system for educational purposes, proposing an educational Arduino-controlled training board that includes many sensors and actuators (ECG, heart rate, motion processing unit, servomotor, DC motor, relay, and ultrasonic sensor), as well as a mini oscilloscope and LCD for data visualization. The proposed system was used by 87 students. A methodology for developing



a low-cost prototype for acquiring and visualizing biosignals (ECG, EMG, galvanic skin response (GSR), and body temperature) is presented by Delgado-Torres et al. (2024). In addition to the sensors, an Arduino Nano board and a Bluetooth module to transmit the information wirelessly were used. Hernández-Delgado et al. (2017) also describe the design of a low-cost device that registers and displays ECG signals for educational purposes, which is based on the Arduino UNO board.

The model described by Satiro et al. (2019) measures three types of biopotentials (ECG, EMG, and EOG – electrooculogram) with a non-invasive, low-cost device, using dedicated sensors and other components, as well as the Arduino Mega 2560 programmable platform. Ahamed et al. (2015) also presents a portable, battery-powered, wireless, low-cost prototype designed for ECG, EMG, and EOG. In this system, an Arduino Uno is used, and an application is created to visualize and store the signals in real time, which can be further analyzed in Matlab.

3. Materials and Methods

In this laboratory, students record, visualize, and measure medical signals with Arduino sensors, as well as with the Biopac system, as will be further described.

3.1. Signals

Three 10-second signals (ECG, EMG, and PPG) are recorded successively from the same subject in the same environment using both acquisition systems, which will be further explained. Prior to the experiment, the subject signed a written consent. The electrodes and sensors are non-invasive and are placed on the skin's surface, which is cleansed with sanitary alcohol before and after each session of recording; they are placed similarly in both systems, as shown in **Figure 2**.

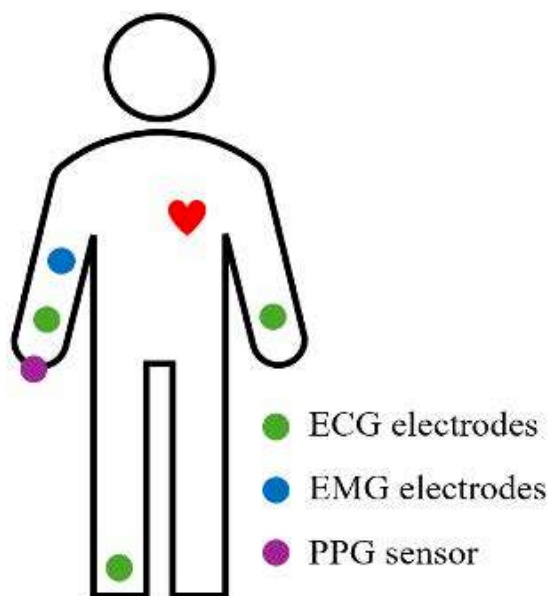


Figure 2. Electrodes and sensors placements

ECG signals. The electrocardiogram measures the electrical activity of the heart. To record ECG signals, three disposable gel electrodes are placed in Einthoven's triangle configuration: wrists and right ankle. This configuration is more practical for students to use in the laboratory and offers similar results as the chest configuration, according to the findings of Mihailovschi et al. (2023). During the recording, the subject stays still and relaxed.

EMG signals. The electromyogram measures the electrical activity of a muscle. The Arduino EMG sensor measures surface EMGs (sEMG) using a three-nondisposable-electrode-integrated plate placed on the forearm. The Biopac module also measures sEMGs using three disposable gel electrodes placed on the forearm, recording the same group of muscles. During the recording, the subject follows the sequence: 2-second relaxation, 2-second contraction (fist contracted), 2-second relaxation, 2-second contraction (fist contracted), 2-second relaxation.

PPG signals. The photoplethysmogram measures changes in blood volume in the microvascular bed of the skin (in this case, on the index finger). Both Arduino and Biopac PPG sensors use an

optical method, with an IR LED (infrared light) emitting light and a photodetector detecting the amount of light absorbed or reflected by the blood. During the recording, the subject stays relaxed, with his finger placed still on the sensors.

3.2. Acquisition and Processing Systems

The goal of the proposed laboratory is to record, visualize, and measure medical signals with Arduino sensors during the Arduino classes. To confirm the accuracy of these signals, an advanced medical signal acquisition system – Biopac, is used to compare the results visually and numerically.

3.2.1. Arduino

To record signals using Arduino, a few hardware and software resources are required. **Table 1** summarizes all of them, including their roles. Some of the modules, such as ECG and EMG, were tested in our previous studies (Zîrnă et al., 2024). For this application, the Arduino UNO board is chosen because it has enough pins and memory, being also the most commonly used model of the Arduino boards and the one utilized in these laboratories. The code is developed in the dedicated Arduino IDE software, and the signals are then recorded using Excel's Data Streamer Toolbox. Due to the board's baud rate and the loss from the recording software, the signals are sampled at 200 Hz for ECG and EMG and 50 Hz for PPG.

Resource	Component	Role
Hardware	AD8232	records ECG signals
	SEN0240	records EMG signals
	GY-MAX30102	records PPG signals
	Arduino UNO	the main board that enables analog reading of the signals
	USB cable	ensures the connection between the PC and the board (powers it and allows programming it in the dedicated software)
	Jumper wires	connects the modules to the board
Software	Arduino IDE	dedicated software for developing the code for reading the signals
	Data Streamer	Excel toolbox that allows real-time data reading and storing

Table 1. Hardware and software resources - Arduino

Each module is connected to the Arduino UNO board, as indicated in **Table 2**. For a better understanding, **Figure 3** illustrates the electrical circuit of the proposed method. Even though the signals are recorded separately, the scheme displays all three modules together: AD8232 (Analog Devices, 2012), SEN0240 (DFRobot & OYMotion, 2017), and GY-MAX30102 (breakout board based on the Maxim Integrated (2018) sensor chip).

Module	Module Pin	Arduino UNO Pin
ECG	GND	GND
	3.3V	3.3V
	OUTPUT	any analog pin (A0-A5)
EMG	-	GND
	+	5V
	V	any analog pin (A0-A5)
PPG	VIN	5V
	GND	GND
	SCL	A5
	SDA	A4
the other pins are not connected		

Table 2. Arduino sensors connections

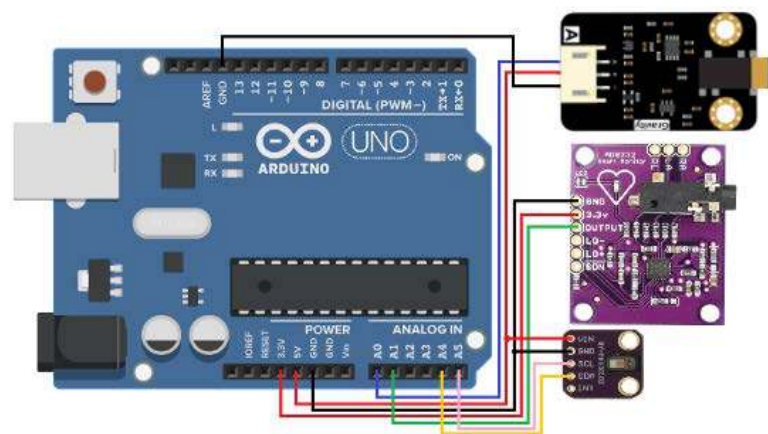


Figure 3. The electrical circuit of the proposed method

3.2.2. Biopac

The Biopac system is a professional medical signal recording equipment that includes a main unit (BIOPAC Systems Inc., 2025a) and various auxiliary modules depending on the type of recording desired: ECG, EMG, and PPG (BIOPAC Systems Inc., 2025b). Even though the signals are recorded separately, the scheme displays all three modules together (**Figure 4**). The signals are directly displayed and recorded using AcqKnowledge, the dedicated software. All three signals are recorded at 2000 Hz. **Table 3** presents all these resources and their roles.

Resource	Module	Role
Hardware	MP160	Main unit for receiving and transmitting data
	ECG2-R	records ECG signals
	DYNEM-R	records EMG signals
	PPGED-R	records PPG signals
Software	AcqKnowledge	dedicated software for visualizing, analyzing and recording signals

Table 3. Hardware and software resources - Biopac



Figure 4. Biopac system: main unit and the signal acquisition modules

3.2.3. Matlab

Even though each signal can be visualized when recorded in the software interface (Arduino IDE or Data Streamer for Arduino and AcqKnowledge for Biopac), for a simultaneous visualization and comparison, another signal processing software, Matlab, which students are familiar with, is used. Since Data Streamer stores signals in .csv format and AcqKnowledge supports a variety of

file formats (.csv, .mat, etc.), the recorded signals are easy to be uploaded and read in Matlab. Different computations and graphs are then conducted to allow for visual and numerical comparisons of data from both acquisition methods, as will be further described.

4. Results

The signals are initially visualized in the program where they are recorded. The Data Streamer records the values printed on the Serial Monitor in the Arduino IDE and displays the results in real time (**Figure 5.A**). The AcqKnowledge program supports real-time signal display and recording, as well as various signal processing and analysis features, such as automatic HR computation when two R-R intervals are selected (**Figure 5.B**).

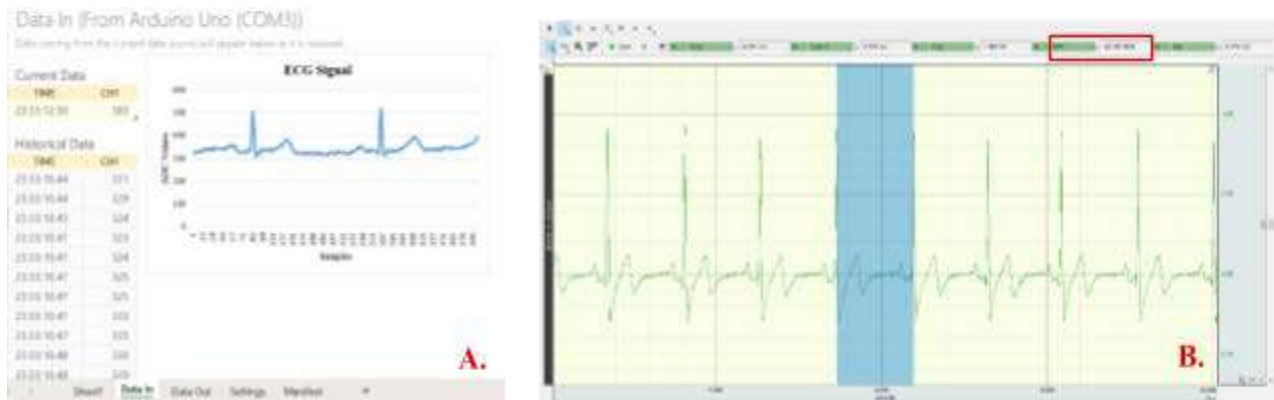


Figure 5. The acquisition interfaces during the recordings:

A. Data Streamer for Arduino; B. Acqknowledge for Biopac

After the signals are uploaded and read in Matlab, they are normalized and displayed in the same window for a general overview of the results, with no additional processing. The morphology of the waves is similar, as shown in **Figure 6**. The main difference comes from the human factor, as two biosignals cannot be identical. Furthermore, the sampling rate is significantly different, and the Arduino signals are noisier. However, the results of the applications that are further described are unaffected by these factors.

The following computations can also be done automatically in the Arduino IDE software (by coding) and in AcqKnowledge (by applying different functions), but all computations are performed offline in Matlab to allow for simultaneous signal analysis.

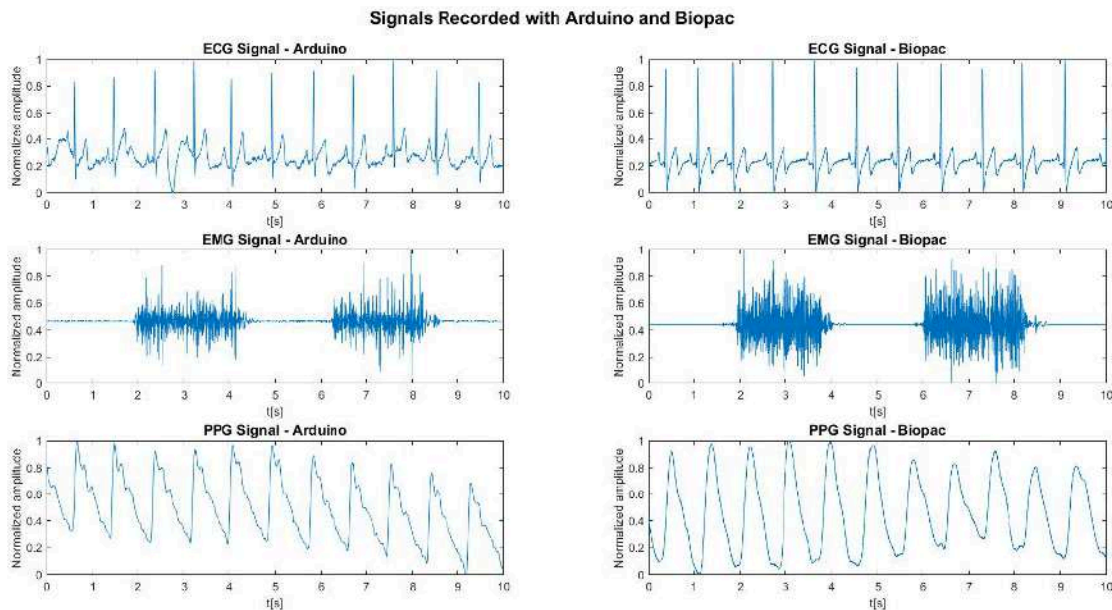


Figure 6. Signals recorded with both systems – Matlab graphs

A vital parameter that can be computed from an ECG or PPG signal is heart rate (HR), which ranges between 60 and 100 beats per minute (bpm) for a healthy individual. Values outside of this range may indicate various disorders, such as bradycardia (values below 60 bpm) or tachycardia (values above 100 bpm). Since ECG and PPG signals are correlated, they should indicate the same HR for an individual. However, the signals are not recorded simultaneously; thus, the values may slightly differ.

The algorithm used for computing HR from ECG signals (Zîrnă et al., 2025) is:

- Identify the R-peaks as local maximas within a time window
- Compute the R-R intervals' durations based on the R-peaks' locations
- Check that R-R intervals' durations are within the proper range (a regular R-R interval has between 0.6 – 1 seconds and the subject is healthy)

- Compute the average R-R interval's duration (noted as $\overline{R - R \text{ interval}}$ [s])
- Compute the HR: $HR = \frac{60}{\overline{R - R \text{ interval}}} \text{ bpm} \quad (1).$

The same steps are followed to compute HR from PPG signals but, instead of identifying the R-peaks, systolic peaks are identified (which are also the highest peaks of the signal).

Figure 7 presents the four recordings, the identified and marked peaks (red triangles) and the computed HR. As can be seen, the values are almost identical, the difference coming from the fact that they are not recorded simultaneously and different electrodes or sensors are used.

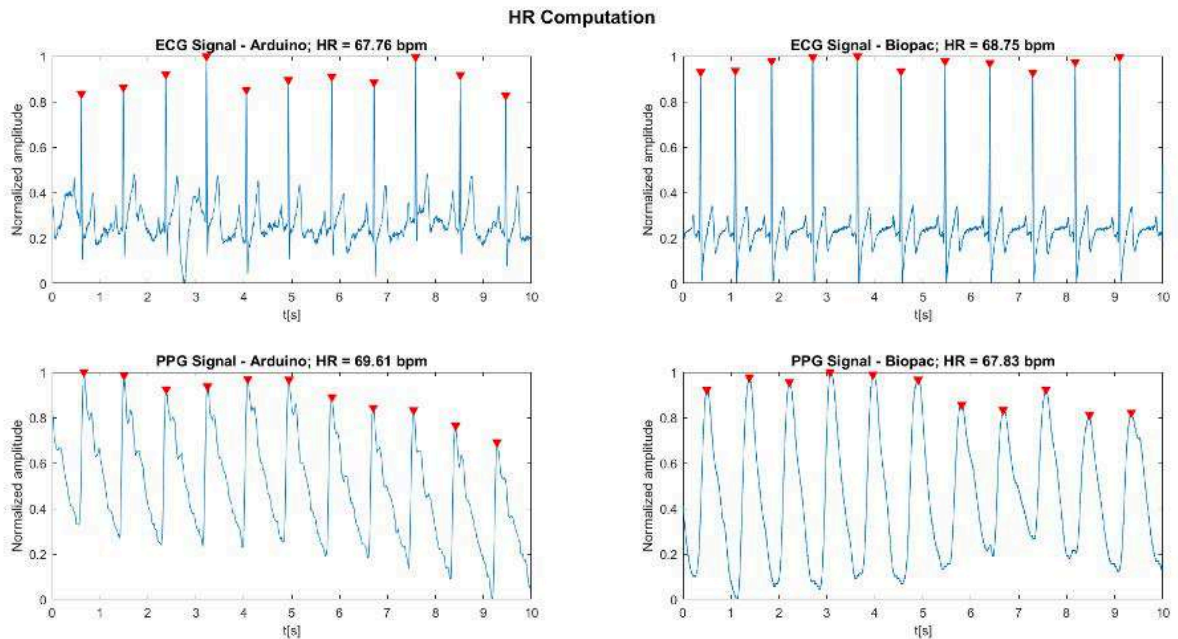


Figure 7. HR computation from ECG and PPG signals – Matlab graphs

Depending on the application, EMG signals are frequently rectified, as this converts the signals from bidirectional to unidirectional, allowing the signals to be directly correlated with the intensity of muscular force. As a result, important parameters such as global amplitude or root mean square (RMS) can be calculated. The two rectified overlapped signals are presented in

Figure 8, demonstrating that they have similar morphologies and that contractions can be easily identified and differentiated from relaxation states.

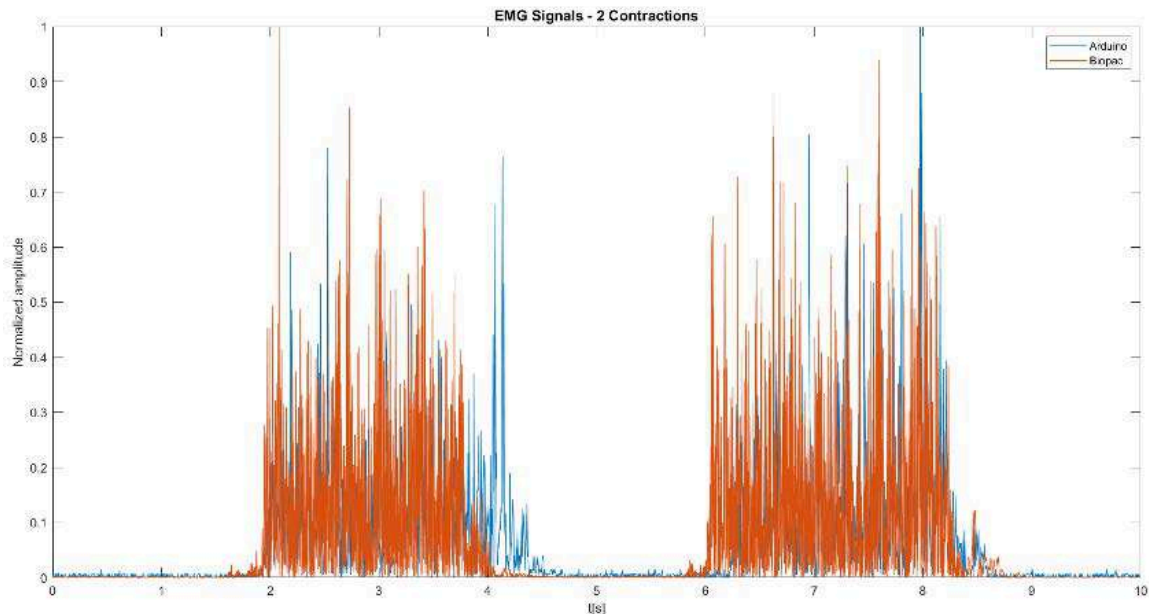


Figure 8. Rectified EMG signals: contraction vs. relaxation states – Matlab graphs

5. Conclusions

The suggested laboratory's purpose is to demonstrate another application of the Arduino in the medical field, specifically signal acquisition. To ensure that the results are valid and that these modules may be further integrated into wearable devices, the signals are compared to those recorded using a professional system known as Biopac, using the same electrode placement and acquisition protocol. As previously proved, the results are nearly comparable, suggesting that these modules are excellent for integration in wearable devices.

Students may further develop their bachelor's thesis projects by adding necessary processing steps and additional features such as alerts or displays. The use of non-invasive signal recording methods allows these projects to be easily integrated into a wide range of applications. Furthermore, Arduino is compatible with numerous processing software, such as Matlab or Python, which means that data may be easily transmitted to or received by these programs,



allowing for the development of various graphical interfaces, command and control applications, and advanced processing algorithms. Data can also be wirelessly transmitted, and printed circuit boards (PCBs) can be developed to produce customized wearable devices. However, a few more components are necessary for the development of a wearable device, including wireless data transfer and autonomy, as well as the device's lightweight and comfortable wearability, which should be taken into consideration.

This approach proves that, for basic applications like monitoring vital parameters or counting contractions, Arduino-recorded signals are as useful as those recorded with professional devices. As a result, these sensors can be integrated into wearable devices for daily monitoring, fitness gadgets, e-health, and other applications. A future goal is to create a full-semester or one-year laboratory of signal acquisition and processing in which students progress from basic sensor use and simple signal processing to the development of fully integrated wearable medical devices. This allows them to combine their hardware and software skills to develop a variety of gadgets.

Ethical Approval

This study was approved by the Ethics Committee of the National University of Science and Technology POLITEHNICA Bucharest (Approval No. 25/06.10.2025). The subject provided written informed consent prior to their participation in this study.

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An Exploratory Study on the Use of Augmented Reality (AR) in Medical Education

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Abstract

The use of digital technology in the teaching and learning process has grown significantly in recent years. Augmented reality (AR) is a technology/software that allows the digital creation of three-dimensional representations that can be integrated with real stimuli in the environment. It is an interactive, real-time experience that combines reality with elements from the virtual world, leading to an augmented reality enriched with virtually generated information, based on human visual, auditory, olfactory and/or somatosensory input. The result is an image of reality modified by a computer program, which aims to improve the real-world experience, but does not replace the real world. It is not a 360° virtual world, but makes reality more manageable, amplifies it, mapping three-dimensional virtual objects in a real environment. Such AR programs can be used on various devices such as: smartphones, tablets, computers, AR glasses, headsets, etc.

Even though augmented reality (AR) was initially used for entertainment and gaming, its application has expanded into industry, healthcare, marketing, military, travel, architecture and engineering, but also in the medical education of students in medical schools. So far, we have not found global or regional statistics on the degree of use of AR in medical education, but there are a number of universities that use AR platforms or others that implement pilot studies or isolated modules. We have not identified any large-scale implementations or fully integrated implementations into core curricula. The obstacles to adopting this technology in medical education are mainly related to the high costs of implementing AR technology, the lack of



adequate infrastructure in universities, the need to train teachers in the use of AR technology, access to technology (hardware).

The present paper is a theoretical-exploratory one in which we analyze a series of articles, identified through the associated search of 3 keywords, in different scientific databases, namely: "digital learning methods", "medical students" and "augmented reality". In this paper, we analyze to what extent AR can improve the learning experiences of medical students, through practical understanding and skills training, with examples of software already used in didactic training, such as: HoloHuman, OculAR SIM, Hololens, HoloPatient. Finally, we discuss the challenges of AR in learning and teaching, limitations in implementation, and propose future research directions.

In Romania, two universities stand out that implement AR technology in medical education, namely: the "Iuliu Hațieganu" University of Medicine and Pharmacy in Cluj-Napoca, which had a project to develop AR simulators for laparoscopic, robotically assisted, single incision surgery, using Hololens 2, and the University of Medicine, Pharmacy, Sciences and Technology in Târgu Mureș, which within the Center for Simulation and Practical Skills has a department dedicated to "Virtual and Augmented Reality". In Europe there is growing interest, through pilot projects and elective courses, involving AR, but it is not yet a widespread use in standard curricula at all medical schools. Worldwide, the adoption of AR technology in medical education is taking place especially in highly prestigious universities with good financial resources. Finally, as a case study, we focused on Romania. We conducted a search on the official websites of the eleven major universities in the country that provide education and training for future medical professionals, with the aim of identifying programs or any references related to the use of AR technology in their medical education curricula. The findings for Romania reveal that among the eleven universities providing medical training programs, only five have established simulated learning centers employing VR technologies for students, whereas one university has initiated two minor VR technology acquisition projects within the last two years. *Conclusion.* In the field of medical education, the adopting of augmented reality (AR) could provide both students and



teachers with significant advantages, including a stimulating learning environment, immersive practical experience, and opportunities for distance learning.

Keywords: augmented reality, medical education, digital technology, teaching methods, students, learning

1. Introduction

Augmented reality (AR) has been applied in medicine mainly in two areas: clinical programs (for patients, therapies, rehabilitation, surgery) and educational programs (for teaching and training in universities). This review focuses on the educational side, where AR enhances knowledge, learning, and skill development.

AR is an interactive technology that superimposes computer-generated three-dimensional objects and information onto real-world environments in real time. By integrating virtual elements with sensory inputs (visual, auditory, tactile, or olfactory), AR enriches reality by creating an enhanced perception of the physical world. Unlike fully immersive virtual reality, AR maintains the user's connection to the real environment while amplifying it through digital overlays. Its applications are accessible across multiple platforms, including smartphones, tablets, computers, head-mounted displays, and AR glasses.

2. Literature Review

Although AR was initially developed for entertainment and gaming, its applications have expanded into diverse fields such as industry, healthcare, marketing, the military, tourism, architecture, and engineering, as well as into the medical education of university students (Zhu et al., 2014).

Traditionally, medical education relied on textbooks, lectures, cadavers, anatomical models, and patient practice. In the early 1990s, computer-assisted anatomy tools and multimedia resources appeared. With advances in hardware, software, such as PowerPoint replaced blackboards, while the internet enabled large-scale projects like the Visible Human and Visible Embryo. Mid-1990s



technologies also introduced stereoscopy for 3D visualizations. Although head-mounted displays (HMD) existed since the 1968, "The Sword of Damocles" is considered the world's first augmented reality system, widespread use of VR/AR in medical education became possible only with modern devices such as Google Glass, Microsoft HoloLens, HoloHuman, HoloPatient, Oculus Rift, and Samsung Gear VR, OculAR SIM (Dhar et al., 2021). This narrative review by Dhar et al. (2021) explored the role of AR in medical education, focusing on its influence on students' experiences, knowledge acquisition, practical competence, and social skills. A comprehensive literature search was conducted in PubMed, Scopus, and Google Scholar, targeting English-language publications from 2010 to 2020. Unlike a systematic review, article selection relied on author discretion, allowing a broader inclusion of relevant themes and evidence.

Findings demonstrate that AR-based learning holds significant promise in enhancing medical education by creating immersive and interactive environments that replicate real clinical settings. AR enables learners to visualize complex anatomical structures dynamically and to practice procedural and surgical skills safely before performing them on patients. Studies showed that AR applications improved theoretical understanding, procedural accuracy, and psychomotor skills, while also minimizing adverse effects such as discomfort or disorientation often associated with virtual reality (VR).

Beyond technical training, AR also contributes to the development of social and interprofessional competencies. Simulation-based AR scenarios were found to strengthen teamwork, communication, and decision-making under pressure - skills critical to modern medical practice. Despite these benefits, the current body of evidence remains fragmented, with most studies focusing on feasibility and face validity rather than long-term educational outcomes.

This review indicates that major challenges to large-scale adoption include high implementation costs, limited hardware access, and the need for faculty training. The review highlights future directions such as the use of AR textbooks, wearable devices, and mobile learning platforms to enhance accessibility and engagement. Emerging collaborations between academia and industry -



such as those led by the University of Southern California's Medical Virtuality Lab - are paving the way for the integration of AR in medical curricula.

Another recent research by Tang et al. (2020) evaluated the existing augmented reality applications (ARAs) used in the training of medical students and proposed an analytical model for assessing their effectiveness and readiness for curricular integration. The study methodology included an extensive literature search in PubMed, Embase, Web of Science, Cochrane Library, and Google Scholar databases, conducted in accordance with PRISMA guidelines, covering publications from 2000 to 2018. Out of 100,807 initially identified articles, 36 met the inclusion criteria and were classified into three main categories: surgery, anatomy, and other areas of application. The analysis revealed a generally low methodological quality among the studies and a lack of comprehensive validity assessments for AR applications. The findings suggest that, although AR technology is developing rapidly, the level of research available at that time did not yet support large-scale implementation in medical education. The proposed analytical model may serve as a valuable foundation for standardizing evaluation methods and defining the role of augmented reality in medical education.

A meta-analysis by Baashar et al. (2022) evaluated the effectiveness of augmented reality (AR) applications in medical education and training. Following PRISMA (Preferred Reporting Items for Systematic Reviews and Meta-Analyses) guidelines, the authors analyzed 13 experimental studies published between 2013 and 2021, encompassing a total of 654 participants from ten countries. The included studies assessed AR interventions across various medical disciplines, comparing them with traditional teaching and learning methods.

The review focused on five primary outcome measures: knowledge acquisition, skills development, confidence, performance time, and learner satisfaction. Statistical analysis revealed that AR training significantly improved participants' confidence ($P=.02$), performance time ($P<.001$), and satisfaction ($P=.006$) compared with conventional methods. However, no statistically significant differences were observed in knowledge or skill acquisition between AR-based and traditional training approaches.



Despite its promising outcomes, the study noted substantial heterogeneity among trials and highlighted methodological weaknesses such as small sample sizes, inconsistent study designs, and limited reporting of randomization and blinding procedures. Nevertheless, the findings suggest that AR can be a valuable supplementary tool in medical education, particularly for enhancing learner engagement, confidence, and procedural efficiency.

According to Bashar et al. (2021) AR shows strong potential to enrich medical training and reduce performance time, further high-quality, large-scale, randomized studies are required to confirm its long-term educational benefits and integration into medical curricula.

Harrington (2024) conducted a study about the transformation of preclinical medical education during and after the COVID-19 pandemic prompted the integration of e-learning tools into traditionally lecture-based curricula. In response to this educational shift, the MedMicroMaps system was developed as an interactive, visual, and spatially organized digital learning resource for teaching microbiology and infectious diseases. Designed around mind mapping and the Method of Loci pedagogical principles, MedMicroMaps utilizes color-coding, directional organization, and hyperlinking to structure information by disease onset, anatomical location, and microbial classification.

Each module within MedMicroMaps is organized by organ system and guides learners through differential diagnoses, epidemiological factors, and diagnostic algorithms using decision tree logic. The resource aims to enhance student engagement and retention through self-directed, visually oriented learning pathways.

A pilot study conducted at St. George's University, Grenada, included 865 medical students in hybrid courses during 2022. Website analytics revealed over 16,000 views within 14 months, with peak engagement occurring before examinations. Survey feedback ($n = 79$, 9.1% response rate) indicated high satisfaction levels, particularly for the Microbe Biology MedMicroMaps module (75% "Extremely Satisfied"). Students most frequently used the tool for exam preparation and integration with practice questions.

The findings support MedMicroMaps as an effective supplemental e-learning resource for microbiology education. Future developments include cross-platform expansion into immersive



learning environments such as virtual and augmented reality (XR), with applications across multiple biomedical disciplines. A longitudinal study is planned to evaluate its impact on both short-term and long-term knowledge retention.

3. Objectives and Method

The present paper is a theoretical-exploratory study aimed at analyzing the role of Augmented Reality (AR) in enhancing the learning experience of medical students. For the purpose of this theoretical analysis, the PubMed database was used to perform a combined search based on specific keywords appearing in the titles of articles: “digital learning methods”, “medical students”, and “augmented reality”, covering the period 2014–2025. The search identified 23 results corresponding to previous research studies. Out of these, five articles were selected as relevant and closely aligned with the proposed topic, serving as the foundation for the documentation and analysis conducted in this paper. The objective is to determine the extent to which AR technologies can improve medical students’ educational outcomes, focusing on both cognitive understanding and practical skill development.

In the last 11 years, the increasing integration of digital technologies in higher education has led to significant pedagogical transformations, especially in medical training. Augmented Reality, which overlays digital information and 3D visualizations onto the real-world environment, offers a unique opportunity to bridge the gap between theoretical knowledge and clinical practice. Unlike traditional e-learning tools, AR provides an immersive and interactive experience that enables students to visualize anatomical structures, physiological processes, and clinical scenarios with unprecedented realism.

This paper provides an overview of AR technologies successfully applied in medical student education, highlighting platforms such as HoloHuman, OculAR SIM, Microsoft HoloLens, and HoloPatient.

HoloHuman allows students to examine detailed, full-scale 3D anatomical models that can be manipulated in real time, improving spatial understanding of the human body.



OculAR SIM focuses on ophthalmology, offering interactive simulations that help learners understand complex eye disorders and surgical procedures.

HoloLens, a mixed-reality headset developed by Microsoft, enables users to interact with holographic patients and virtual organs while maintaining awareness of their physical surroundings, thus combining hands-on learning with digital enhancement.

HoloPatient provides realistic patient scenarios in which learners can observe symptoms, make diagnostic decisions, and practice communication and empathy - key competencies in clinical education.

Integrating AR supports experiential learning, active engagement, and multimodal cognition, aligning with constructivist and experiential learning theories. Furthermore, AR facilitates collaborative learning environments, allowing multiple students to interact simultaneously with the same virtual object or patient case.

However, despite its potential, the implementation of AR in medical education faces several challenges. High costs associated with hardware and software development, limited technical expertise among educators, and unequal access to technology across institutions remain significant barriers. Additionally, there are ongoing concerns regarding cognitive overload, data security, and the validation of AR-based assessment methods.

4. Results and Discussions

No comprehensive data were found concerning the total number of universities worldwide that offer medical education programs employing AR technologies. The studies identified in our search on PubMed, that we mentioned provide information only about certain pilot projects. Carle Illinois College of Medicine (USA) is the first medical school to integrate the AR-MediView XR90 platform (Carle Illinois College of Medicine, 2025). The University of Cambridge and Cambridge University Hospitals have collaborations for holographic simulations through GigXR, University of Michigan Health collaborates with GigXR for mixed/augmented reality curriculum (ISPR, 2022). The University of Bradford (UK) has implemented AR headsets for medical students (Study in UK, n.d.).



Finally, as a case study, we focused on Romania. We conducted a search on the official websites of the eleven major universities in the country that provide education and training for future medical professionals, with the aim of identifying programs or any references related to the use of AR technology in their medical education curricula. The results obtained are summarized in

Table 1.

No.	University Name	Use in Medical Education	AR/VR simulation mentioned	Details
1	Carol Davila University of Medicine and Pharmacy, București	eHealth Centre	VR simulation mentioned, no explicit AR use	https://umfcd.ro/general/comunicat-de-presa-umf-carol-davila-din-bucuresti-initiaza-activitatile-centrului-de-inovatie-si-e-health-cieh/
2	Iuliu Hațieganu University of Medicine and Pharmacy, Cluj-Napoca	Centre for Practical Skills and Simulation in Medicine	VR simulation mentioned, no explicit AR use	https://umfcluj.ro/en/medicine/education/students/centre-practical-skills-simulation-medicine/
3	Grigore T. Popa University of Medicine and Pharmacy, Iași	VR Simulation Center	VR simulation mentioned, no explicit AR use	https://www.umfiasi.ro/academic/Pagini/Centrul-de-Simulare.aspx
4	Victor Babeș University of Medicine and Pharmacy, Timișoara	Partial, MedSimVR FDI 2024, VRPlus FDI 2025	VR simulation mentioned, no explicit AR use	https://www.umft.ro/ro/medsimvr-fdi-2024/ https://www.umft.ro/ro/vrplus-fdi-2025/
5	University of Medicine and Pharmacy of Craiova	Center for Applied Simulation in Medicine	VR simulation mentioned, no explicit AR use	https://www.umfcv.ro/ro/cercetare/centre-de-cercetare/centrul-de-simulare-aplicata-in-medicina
6	George Emil Palade University of Medicine, Pharmacy, Science and Technology, Târgu Mureș	Simulation and Practical Skills Center	VR and AR simulation mentioned	https://umfst.ro/centrul-de-simulare-si-abilitati-practice/departamente/realitate-virtuala-si-augmentata/
7	Ovidius University, Constanța	Not specified	Not specified	Not specified
8	Dunărea de Jos University, Galați	Not specified	Not specified	Not specified
9	Vasile Goldiș Western University, Arad	Not specified	Not specified	Not specified
10	Titu Maiorescu University, București	Not specified	Not specified	Not specified
11	Lucian Blaga University, Sibiu	Not specified	Not specified	Not specified

Table 1. Information based on official university websites. (accessed October 2025)



As indicated in the table above, the University of Medicine, Pharmacy, Science, and Technology of Târgu Mureș is the only institution in Romania that explicitly states on its official website the implementation of AR technology in medical student education, within its Simulation and Practical Skills Center, has a dedicated department for 'Virtual and Augmented Reality.' This Center explicitly mentions that its equipment includes 20 pairs of Microsoft HoloLens 2 glasses, applications such as HoloPatient (150 licenses) and HoloHuman (150 licenses), and specific hospital ward furniture for simulations (University of Medicine, Pharmacy, Science, and Technology of Târgu Mureș, n.d.)

In the study 'Digital Health Training, Attitudes and Intentions to Use It among Romanian Medical Students: A Study Performed during COVID-19 Pandemic', Lotrean et al. (2023) analyzed the responses of 306 students from the 5th and 6th years of the Faculty of Medicine at the 'Iuliu Hațieganu' University of Medicine and Pharmacy, Cluj-Napoca. The results indicate that 'less than half' of the students reported having received training or practical examples during their medical education regarding the use of digital tools in various medical fields. The majority of students would like more training. AR is not explicitly mentioned as a separate technology in the study.

The findings for Romania reveal that among the eleven universities providing medical training programs, only five have established simulated learning centers employing VR technologies for students, whereas one university has initiated two minor VR technology acquisition projects within the last two years.

5. Conclusion

AR holds significant transformative potential in medical education, offering immersive, interactive, and flexible learning environments that can bridge the gap between theoretical instruction and practical experience. By enabling realistic simulation, enhanced visualization, and distance learning opportunities, AR serves as a powerful pedagogical tool for both students and educators. However, despite its promise, current research remains fragmented and lacks standardized evaluation frameworks. Future empirical studies should rigorously examine the



long-term effects of AR-based instruction on knowledge retention, psychomotor skill acquisition, and clinical reasoning, while also addressing issues of scalability, accessibility, and pedagogical integration. Moreover, the convergence of AR with emerging technologies such as artificial intelligence and virtual reality could further advance personalized and adaptive medical education. This study contributes to the growing body of literature on digital transformation in healthcare education and underscores the role of AR as a catalyst for immersive, student-centered, and competency-driven learning.

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Combat Mindset (CoMind): from an innovative project to a mandatory discipline

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Abstract

The article presents the evolution of the Combat Mindset Training for Romanian Military Students (CoMind) approach within “Henri Coanda” Air Force Academy in Brasov. Mental preparation for the battlefield is a tactical necessity for any category of armed forces and, for its inclusion in a curriculum that requires approval from the Ministry of National Defense, it needed a rigorous scientific substantiation. CoMind was the central theme of an inter-institutional cooperation project funded by EEA and Norwegian grants, as an optional training module conceived in an interdisciplinary manner (through the contribution of neuroscience, cognitive psychology, social psychology and martial arts). Taking over the model of good practices from the Norwegian cultural environment, adapting it to the conditions of the cultural environment and military organizational culture in Romania and implementing it, especially regarding mental preparation for battlefield or Combat Mindset (CoMind) as a subject or module, first optional, then mandatory, in the curriculum of “Henri Coanda” Air Force Academy, meant a long process, which, fortunately, can serve as a model of good practices regarding the implementation of research results in the higher educational process (BA degree)

Currently, CoMind is both a mandatory discipline and a research paradigm, embodied in scientific articles and communications and as the topic of bachelor's/dissertation theses.

Keywords: combat mindset (CoMind); mindset training; military students; military higher education; curriculum



1. Introduction

1.1. National context

The Romanian Armed Forces has always had the trust of the Romanian population, and in last decades, is the first choice, compared to other authorities, according to national opinion surveys. For example, in July 2025, Romanian people entrusted the army with 63% for high or very high trust (INSCOP, 2025). This percentage alone is a remarkable one, compared with the percentages registered by other Romanian authorities and institutions, but also compared to numbers registered in similar surveys by EU or NATO. We consider that this high percentage was entrusted to the army institutions due to its constant concern for professionalizing the institution and multiple international missions.

If from an institutional point of view the risks regarding the Romania Armed Forces concerns budgets, equipment, capabilities -- here the aspects are quite old and are highlighted up to the level of the (former) Chief of the General Staff (Dănilă, 2021:18) or up to the political level --, the updating of doctrines and field manuals, the assimilation of the new technologies into the defense system, the configuration of operational requirements regarding the use of these technologies, hybrid risks, cognitive risks and risks related to political-military interference, in terms of military personnel is simpler to explain. In the past 30 years the main specific risk of military activity within the international missions is that of having posttraumatic stress syndrome (PTSD) and comorbid conditions (Andronic, 2021; Andronic et al., 2025). These kinds of psychological problems are defined in the Romanian Law (i.e. Law 168/2020, art 2., pct. i) as

“disorders developed by the participant personnel during military action, missions and operations, that trigger a significant disruption of thought, emotional management and behavior, that reflects an associated disfunction like emotional distress or significant disability within the professional, social and family roles, that are ascertained by the medical and military expertise commissions, by the occupational doctor and by the medical expert of work capacity, when suggested by the clinical psychologist and/or by the psychiatrist”.



PTSD affects between 5% and 18% of military personnel involved in international missions and NATO state members. When computing the actual number of what this percent reflects, PTSD could be registered for around 2750 and 9900 out of 55,000 military officers involved in international missions (Andronic et al., 2025). Still, in 2018, only 19 military officers were registered officially with the PTSD diagnosis, according to the minister of defense at that time (Sasu, 2018). Therefore, improving the way future officers can manage their own psychological state is a pressing matter for military students. Thus, our main goal within this project is to adapt an instrument relevant for psychological testing of self-control (psychological feature that prevents PTSD) and develop a training module for mindset control to better understand the psychological state associated with debilitating diagnosis (i.e. PTSD).

Starting with 1993, over 55,000 military soldiers participated in international missions, according to Army Press Trust, and were exposed to extreme and challenging events (Anghel, 2020). Romanian soldiers have now the opportunity to have multiple career opportunities, in both the national and international context where the militaries are deployed. Moreover, they can also work in other professional contexts, like private ones, before and after they finish their military service career (i.e. after the age of 50). Therefore, a military officer's career is considered by most as desirable and recommends militaries for other career opportunities because: a) there is a high trust Romanians have for the army, in general; b) there is a rigorous selection of militaries, including a psychological one, a medical and a physic one; c) competition is high and d) military students are given a motivating salary and they already know their uprising career evolution. Still, their career trajectory includes hardship and challenges. In fact, although most people see the military career as a sure and a lifetime job, the military service usually includes psychological risk in the form of different types of disorders (i.e. posttraumatic stress syndrome).

Nevertheless, a military career is extremely desirable for young people and there is higher competition in the military universities, compared to the usual national universities, especially for those from disadvantaged or vulnerable groups. In fact, students from



vulnerable environments represent 45 % of the military students enrolled in the Air Force Academy.

2. Literature Review

To address the issues regarding institutional risk factors and, especially, individual risk factors regarding military personnel involved in military confrontations - including aspects related to PTSD - it is necessary to consider adequate preparation for the battlefield, which should be carried out starting from the period of training in military institutions of higher education. The specialized literature on mental preparation for the battlefield or combat mindset is not very rich. Relevant in the field of mental preparation are also works or articles that belong to the field of individual security, implemented by police or law enforcement institutions, especially in the United States and Norway (Hynes, 2015; Boe et al., 2020).

Regarding the operationalization of the concept of combat mindset in the military environment and military institutions, the terminology has been used mainly in several scientific articles, without being the subject of a distinct doctrinal direction or in terms of field manuals, also in the United States and in several European countries. The concept has been used in various categories of armed forces, especially in the Marines (Singleton II, 2012; Levine & McCoy, 2020), so that later research would involve extend it to other military branches and specializations (Stump et al. 2017; Mair et al., 2025). The implementation of Combat Mindset training in Romania is a pioneering activity both at the national level and at the level of Air Force in general.

3. CoMind Project. Methodology of Implementations and Results

The project Combat Mindset Training for Military Students (CoMind) was funded through EEA Grants, due to the existing partnership between the “Henri Coandă” Air Force Academy; University of South-Eastern Norway (USN) and the Romanian Society of Military Psychology Association, and it was implemented during the period 2022-2023. The CoMind



project had three major outcomes:

2.1 Developing a training module regarding combat mindset for military students

This project was focused on the social inclusion of vulnerable groups, but also on democracy and citizenship topics because it will include a teaching module in a field with a strong inter-disciplinary component (i.e. combat mindset training). The second main goal of the project was to develop a training module for combat mindset (1 semester long training) and train 40 students enrolled in the bachelor and master studies of the PP (20 students / group training, 2 groups in implementation period).

As an intellectual product, the team had to elaborate a trainer's manual for combat mindsetting. To create the possibility that this training model to be adopted by other military universities, there was necessary to be organized a multiplier event where 50 participants teachers from the military universities will participate, and also other specialist from other military institutions (i.e. human resources department, medical department, etc.) (Boe et.al, 2002). Beyond the classic training of this program module, like the "on site" method, military students were provided with the opportunity to access online the training, through open education system and using and e-learning platform provided by Romanian Society of Military Psychology Association (platform integrated in www.militarypsychology.ro site and already includes various training materials). Support materials for the training module and also video resources and bibliographic resources were provided online. Based on the experience of this training module and collection of psychological and/ or medical data from the participants, a scientific publication were drafted and sent for publication, through the contribution of experts from "Henri Coandă" Air Force Academy, University of South-Eastern Norway and Romanian Society of Military Psychology Association.

The curriculum of this module for continuous training were target and update what has already been acquired as knowledge, like for example basic military training, but also new thorough and specific military training of the primary target group (military students). In the case of multiplier events, the project also includes staff learning mobility between the donor



and beneficiary countries, including the professional development of teachers. Specifically, these opportunities were accessible for on-site activities and on an e-learning platform, integrated on the website of the Romanian Society of Military Psychology Association. The staff from the military universities were coordinated by the National Defense Ministry and psychologists certified for practice in the National Safety and Defense Applied Psychology. Therefore, the practitioners can facilitate the collection of data using Multidimensional Self-Control Scale (MSCS) on a relevant group and refer to the training module in their professions.

2.2 Adapting in the Romanian language (from Norwegian) the psychological test “The Multidimensional Self-Control Scale” (MSCS)

The adaptation of the MSCS tool into Romanian was completed by the collection of in the military context (Nilsen et. al, 2002). The self-control scale and the combat mindset training are an absolute novelty within the Romanian university context and also in the military context. To our knowledge, there are no other available educational resources regarding the training of combat mindset and neither a psychological test as MSCS (according to the methods and techniques certified by the Romanian College of Psychologists). The assessment has been previously empirically tested (Nilsen et al., 2020) as: Multidimensional Self-Control Scale (MSCS) and the Brief Multidimensional Self-Control Scale (BMSCS). The 29-item MSCS consists of 6 first-order factors (Procrastination, Attentional Control, Impulse Control, Emotional Control, Goal Orientation, and Self Control Strategies), 2 second-order factors (Inhibition and Initiation), and a third-order self-control factor. Overall, results indicate that the new scales are useful measures that integrate recent theoretical and empirical findings of trait self-control.

Translation and adapting in the Romanian language were done by the experts of Romanian Society of Military Psychology Association, military psychologists practitioners, and in collaboration with the experts from University of South-Eastern Norway. The new psychological assessment was tested within the military students population, as well with the



help of other military experts and respecting the legal conditions specific to the country. The intellectual product is available as open educational resource to every practitioner certified to use these kinds of psychological assessments in the military domain. To ensure proper collection of data and dissemination, the Romanian Society of Military Psychology Association organized a multiplier event with 50 participants. Adapting and testing the psychometric properties of the MSCS was drafted in a research manuscript. The tool is available in Romanian online on the website of the Romanian Society of Military Psychology Association (SPM, 2024) and can be used by psychologists authorized to practice in the military field.

3. Conclusions. Curricular and Experimental Developments

Currently, “Henri Coandă” Air Force Academy is in the process of transitioning from the three-year duration of bachelor's studies to four years. In this context, the course Psychological Preparation for Combat – CoMind has been introduced as a mandatory subject in the curriculum and approved by the authorized structured of the Ministry of National Defense, in accordance with the legislation applicable to Romanian military higher education. Additionally, the interdisciplinary approach that underpinned the previously described project serves as the basis for the curricular redesign of the Psychological Operations course. The CoMind Laboratory is a research entity within the Faculty of Air Security Systems and is used both for experimental research and for the practical component of bachelor's and master's theses. To date, a number of 6 bachelor's theses and 4 master's theses have been developed using this approach. In addition, the “Henri Coandă” Air Force Academy organized and hosted an edition of *Redefining Community in Intercultural Context (RCIC)* dedicated to the issue of Combat Mindset, which resulted in a series of articles that highlight potential developments both in terms of research and in terms of curricular development and implementation of CoMind good practices in military higher education (Lesenciuc et al., 2023; Lesenciuc & Sauciuc, 2023)



At the same time, part of the CoMind grant team initiated another project financed from sectoral funds of the Romanian Ministry of Defense, regarding the extension of the CoMind platform with compatible and interoperable technologies for measuring cerebral and ocular parameters (EEG headsets, eye tracking technologies) for an accurate mental preparation for the battlefield. The project, entitled Measuring the parameters of mental readiness for the battlefield (MP-CoMind) emerged as a result of the need identified in the operational environment to reduce the time of reaction on the battlefield, to optimally respond to stressors and psychological demands generated by the uncertainty. The sustainability of this project results from the need to design and integrate equipment for measuring the parameters of mental preparation for the battlefield into the CoMind laboratory as a whole, in order to evaluate the progress of students in terms stressors, physical fatigue and mental demand, being useful to students from “Henri Coandă” Air Force Academy and other military categories in training modules outside the rhythm of current university activities.

Following the implementation of the initial project, but also following the implementation of the new one, a series of relevant papers have resulted (Boe et al., 2022; Andronic et al., 2025). They highlight, on the one hand, the utility and applicability of the CoMind laboratory as a research laboratory or as a platform for future studies on mental preparation for the battlefield, and on the other hand, as a platform for education, for assisting training of “Henri Coandă” Air Force Academy’s military students.

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Kioi Seidō – The Architecture of Education: A Building that Teaches Without Teaching

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Abstract

Education has never belonged solely to classrooms. Architecture, as one of society's most pervasive yet overlooked teachers, silently shapes behavior, values, and perception through space, light, and material. This paper examines Hiroshi Naitō's *Kioi Seidō* (2022, Tokyo) as an architectural pedagogy -- a building designed "without purpose" that resists the dominance of utility, productivity, and profit. Through its spatial sequence—from dark, compressed entry to luminous atrium—*Kioi Seidō* dramatizes education as transformation: a journey from disorientation to insight.

Drawing connections to Dewey, Freire, and Montessori, the project exemplifies how architecture can embody problem-posing pedagogy, cultivate reflection, and position environments as active teachers. It also resonates with Japan's cultural lineage of Shinto shrines, Zen gardens, and tea houses, which educate through atmosphere and ritual rather than instruction. At the same time, its refusal of fixed function raises ethical debates about privilege, responsibility, and sustainability in a city of scarcity.

By situating *Kioi Seidō* alongside global precedents such as Ronchamp, the Salk Institute, and the Vittra Telefonplan School, this paper argues that the building is neither sanctuary, nor school, nor monument, but a deliberate anomaly - an architecture of ambiguity. In doing so, it reminds us that built environments are never neutral: they teach discipline, consumption, control, or, in this rare case, openness, humility, and interpretive freedom. *Kioi Seidō* demonstrates that



architecture itself can be a form of pedagogy, expanding education beyond curricula into the spaces of everyday life.

1. Introduction

Right in the middle of Tokyo's dense and tightly organized urban landscape—where space is scarce, real estate is expensive, and nearly every square meter is optimized for efficiency—stands an architectural anomaly: Kioi Seidō (completed in 2022, designed by Hiroshi Naitō). Commissioned by the RINRI Institute of Ethics with the unusual request to create a building *without a predefined function*, Kioi Seidō challenges deeply held assumptions about architectural purpose, economic value, and the cultural expectations placed on built environments. In a city defined by speed, productivity, and spatial compression (Sorensen, 2018), the notion of constructing a “form without function” appears almost contradictory. Yet this deliberate absence of program becomes the very source of the building's intellectual and educational power.

Architecture is traditionally understood as purposeful: it shelters, supports work, facilitates commerce, or expresses civic identity (Ching, 2020). To ask an architect to design without a clear function is to disrupt the discipline's foundational logic. However, Naitō's project demonstrates that architecture can transcend utility and work instead as a spatial, ethical, and phenomenological inquiry. The building's refusal of predetermined use invites occupants to confront their own expectations of purpose and meaning within the built environment. It provokes questions rather than offering instructions—a trait that aligns it with philosophical and educational traditions that value ambiguity as a catalyst for reflection (Eisenkot & Auster, 2022). The initial experience of Kioi Seidō makes this pedagogical quality immediately perceptible. Visitors enter through a dark, compressed ground-floor space whose rough concrete walls still bear the cedar-grain impressions of their formwork. The atmosphere is cave-like, heavy, and introspective. As one ascends the building, however, light enters more generously through nine apertures above, ceilings rise, and the space gradually expands. By the time visitors reach the top, the atrium has transformed into a bright, airy void—a transition that enacts an architectural



narrative of movement from darkness to light, enclosure to openness, and introspection to calm transcendence. This upward journey becomes a lesson in spatial perception and sensory awareness, a kind of experiential pedagogy reminiscent of phenomenological architectural theory (Pallasmaa, 2012; Zumthor, 2006).

Already, this movement through Kioi Seidō reveals how the building functions as a silent teacher. Unlike conventional buildings—where spatial cues guide behavior, purpose dictates circulation, and signs instruct occupants—Kioi Seidō refuses to signal how it should be used. There are no desks, no designated zones for productivity, and no functional anchors. Instead, visitors must interpret the space for themselves. In doing so, the building cultivates habits of perception, patience, and reflection. This aligns with broader theories of environmental learning suggesting that space shapes cognition and behavior as much as formal instruction does (Lippman, 2010).

The RINRI Institute's intention amplifies this educational dimension. As an organization devoted to moral reflection and ethical cultivation, commissioning a building without function was not an act of architectural whimsy but a deliberate ethical experiment. They sought a structure that could provoke introspection rather than activity, contemplation rather than productivity. In this sense, the building embodies a pedagogy of ethics: one learns not through direct instruction but by dwelling in uncertainty, interpreting space, and confronting assumptions about value. The building becomes a philosophical classroom, though one without lectures or syllabi.

This architectural experiment also resonates with Japanese traditions where learning is embedded in spatial experience. Jōmon dwellings emphasized harmony with ritual life more than efficient use; Shinto shrines built by miyadaiku carpenters transmitted knowledge through embodied apprenticeship rather than written plans. These traditions demonstrate that space itself can teach, shaping cultural values and ethical sensibilities through atmosphere and material, not merely function (Brown, 2021; Schnell, 1999). By echoing these lineages, Kioi Seidō situates itself within a long history of Japanese architecture that prioritizes experiential learning over utilitarian efficiency.



The contrast with contemporary educational architecture further highlights Kioi Seidō's significance. Modern classrooms, universities, and learning environments often prioritize visibility, control, and spatial efficiency—qualities aligned with institutional productivity but less supportive of contemplative learning (Nair & Fielding, 2014). By resisting these norms, Kioi Seidō demonstrates a different educational paradigm, one based on openness, ambiguity, and inquiry rather than outcome-driven instruction.

This study examines Kioi Seidō as a case that sits at the intersection of architecture, culture, ethics, and education. Its central thesis is that although the building lacks an explicit functional program, it nonetheless performs a profound educational role. Through its deliberate ambiguity, material expression, and phenomenological progression, Kioi Seidō teaches its occupants to see, think, and question differently. The building offers lessons not through content but through experience, and thus reframes the relationship between architecture and learning.

In an era dominated by metrics, efficiency, and economic optimization, Kioi Seidō stands as a compelling reminder that not all value is measurable. Its refusal of functional clarity becomes an opportunity to reconsider how architecture participates in cultural education. Just as learning extends beyond the classroom, architecture can teach beyond its program. Kioi Seidō thus becomes not merely a building but an educator—one that teaches through ambiguity, material presence, and experiential transformation (Pallasmaa, 2012; Tanizaki, 1977).

2. Literature Review

The conceptual foundations of Kioi Seidō draw from several overlapping domains of scholarship: architectural theory, phenomenology of space, Japanese cultural and material traditions, environmental psychology, progressive educational philosophy, and comparative studies of contemplative architecture. This literature review situates the building within these broader discourses, demonstrating that its ambiguity, materiality, and experiential form reflect long-standing traditions of learning through space, while also challenging modern assumptions about utility, efficiency, and architectural program.



2.1 Architectural Theory and the Question of Function

Modern architectural discourse has been shaped by the notion that “form follows function,” a principle popularized by Louis Sullivan in the late 19th century and later cemented by modernist architects such as Le Corbusier and Walter Gropius (Curtis, 2011). Buildings were expected to express their function clearly, minimize ornament, and operate as rational machines for living or working. Yet scholars of postmodern and experimental architecture have noted that deviation from function can itself become a critical statement (Venturi et al., 1977). Kioi Seidō intervenes in this lineage by deliberately rejecting functional clarity; instead, it aligns with architectural experiments that foreground ambiguity as a tool of critique (Leatherbarrow, 2009).

Naitō’s decision to prioritize form, atmosphere, and material presence over programmatic determinacy resonates with phenomenological architects such as Peter Zumthor (2006) and Juhani Pallasmaa (2012), who argue that architecture teaches through sensory engagement rather than through functional prescription. The literature suggests that buildings can produce meaning not through what they instruct occupants to do, but through how they shape perception, movement, and reflection. This theoretical foundation supports interpreting Kioi Seidō as a building that “teaches without teaching.”

2.2 Phenomenology, Atmosphere, and Sensory Learning

Phenomenology in architecture emphasizes embodied experience—light, shadow, sound, material texture, and movement through space—as a source of meaning (Pallasmaa, 2012; Pérez-Gómez, 2016). Kioi Seidō’s progression from darkness to light, its rough cedar-imprinted concrete, and its cavernous top-lit atrium align closely with this phenomenological scholarship. Zumthor (2006) argues that sensory atmospheres create emotional resonance and invite contemplation; similarly, Böhme (2014) conceptualizes “atmosphere” as a spatial condition that generates states of mind.

Such frameworks support the claim that Kioi Seidō functions pedagogically. Phenomenologists contend that sensory experience fosters reflection and awareness, cultivating forms of knowledge that precede or exceed verbal instruction. Environmental psychology also reinforces this notion:



spatial qualities—light levels, material warmth, openness—directly influence cognition, mood, and attentional patterns (Evans & McCoy, 1998). Spaces that slow perception, reduce functional cues, and heighten sensory awareness are shown to promote deeper reflection and cognitive openness. The literature therefore recognizes architecture as an active medium of cognitive and emotional learning.

2.3 Japanese Architectural Traditions as Embodied Pedagogy

Kioi Seidō also emerges from Japanese architectural and cultural histories where buildings transmit knowledge through ritual, atmosphere, and materiality rather than through explicit program. Scholarship on the Jōmon period (Imamura, 1996) reveals that prehistoric dwellings were not merely shelters but encoded spiritual and communal values through layout, circular settlement patterns, and their integration with nature. These structures cultivated a relational worldview, teaching occupants through spatial organization and ritual practice.

Shinto shrine architecture furthers this relationship between space and moral education. Historians of Japanese architecture emphasize that shrines were traditionally constructed by miyadaiku master carpenters, relying not on drawings but on oral knowledge, embodied apprenticeship, and ritualized building practices (Young & Young, 2007). This aligns with Deweyan educational philosophy, which views learning as experiential, embodied, and emergent (Dewey, 1938). Shrine architecture, with its purification rituals and disciplined craftsmanship, teaches humility, respect for materials, and reverence for natural cycles.

Scholars such as Brown (2021) and Schnell (1999) argue that shrine spaces cultivate moral sensibilities through atmosphere, not instruction. The quiet thresholds, dim interiors, and symbolic material choices foster a reflective mental state, shaping visitors' ethical awareness. Kioi Seidō's own emphasis on ritual-like ascent, sensory contrast, and open-ended interpretation mirrors this lineage of architecture as moral pedagogy.

2.4 Progressive Education and Ambiguity as Learning

The literature on educational theory provides a second key foundation for interpreting Kioi Seidō. Constructivist theorists, including Piaget (1970) and Vygotsky (1978), maintain that



learning occurs when individuals actively construct meaning rather than passively receive information. Montessori (1967) emphasizes the importance of open-ended materials that invite exploration rather than dictate outcomes. These principles correspond directly to Kioi Seidō's refusal of functional cues: the building invites interpretation, curiosity, and exploratory behavior. Paulo Freire's (2000) critique of "banking education" - where knowledge is deposited into passive learners—also resonates with Kioi Seidō's pedagogical form. Freire advocates spaces that promote questioning, dialogue, and consciousness-raising. Architecturally, a building without fixed purpose becomes a site where visitors must actively decode spatial meaning, embodying Freire's concept of critical pedagogy.

Educational psychologists further argue that environments rich in ambiguity foster creativity, critical thinking, and flexible cognition (Beghetto & Kaufman, 2014). Literature on problem-based learning reveals that uncertain or open-ended environments develop cognitive resilience and tolerance for ambiguity (Tawfik et al., 2021). Kioi Seidō's architecture aligns with these findings by intentionally withholding functional direction, thereby cultivating interpretive skills and reflective habits.

2.5 Architecture as Cultural Memory and Social Education

Beyond individual experience, architecture participates in shaping collective memory and societal values. Scholars such as Huyssen (2003) and Assmann (2011) argue that built environments encode cultural narratives, functioning as pedagogical sites that teach societies how to remember, mourn, or imagine. Memorial architecture—such as Maya Lin's Vietnam Veterans Memorial or the Berlin Holocaust Memorial studied by Young (1993)—demonstrates how spatial form influences collective emotional and moral engagement.

Sociologists describe public spaces as arenas of civic learning, where individuals encounter difference, negotiate shared resources, and internalize social norms (Low, 2017). Architecture thus becomes a teacher of citizenship. Kioi Seidō's open, non-commercial space exemplifies this role by resisting the profit-driven urbanism of Tokyo and providing a contemplative public environment that teaches reflection over consumption.



2.6 Comparative Cases: Global Architectural Pedagogies

Comparative architectural scholarship provides additional insight into how buildings teach through atmosphere, material, and light. Studies of Louis Kahn's Salk Institute highlight how monumental concrete voids, framed by sea and sky, produce meditative settings that inspire scientific and philosophical inquiry (Tyng, 2013). Similarly, Le Corbusier's Chapel of Notre Dame du Haut is often analyzed for its ability to evoke spiritual reflection through asymmetry, curving surfaces, and shifting light (Curtis, 2006). These works parallel Kioi Seidō's pedagogical use of ambiguity and sensory experience.

In the context of public knowledge institutions, the Seattle Public Library by OMA demonstrates how transparency, spatial irregularity, and circulation complexity support exploratory learning (Burdett et al., 2011). Contemporary educational architecture, such as Rosan Bosch's Vittra Telefonplan School, shows how flexible, open-ended spaces can foster creativity, collaboration, and learner autonomy (Bosch, 2015). These comparative cases reinforce the broader trend toward architecture that functions as an educational agent.

2.7 Environmental Psychology and Spatial Cognition

Environmental psychology provides empirical grounding for understanding how architecture shapes learning. Studies consistently show that lighting conditions, spatial openness, material warmth, and sensory contrasts significantly influence cognitive performance, attention, and emotional states (Evans, 2003). Spaces that reduce noise, provide visual calm, or introduce natural materials enhance reflective thinking and well-being (Kaplan, 1995). Kioi Seidō's spatial sequencing - from dark enclosure to luminous openness—maps directly onto findings that gradual sensory transitions support cognitive resetting and attentional renewal.

Moreover, research on spatial ambiguity indicates that environments lacking explicit functional cues increase exploratory movement and interpretive engagement (Stamps, 2010). This aligns with Naitō's deliberate refusal to assign purpose, creating a spatial environment that stimulates cognitive openness and self-directed meaning-making.



2.8 Summary

The literature across architectural theory, phenomenology, Japanese cultural history, educational philosophy, environmental psychology, and comparative architectural studies converges on a shared insight: space is a powerful teacher. Architecture can cultivate reflection, moral sensibility, sensory awareness, and cognitive openness not through explicit instruction but through embodied experience. Kioi Seidō participates deeply in this lineage, situating itself as a modern site of spatial pedagogy. Its ambiguity, sensory contrast, and cultural resonance are supported not only by historical precedent but also by contemporary research in learning and cognition.

3. Methodology

This study adopts a qualitative, interpretive, and multi-scalar methodological framework suited to analyzing Kioi Seidō as both an architectural artifact and an educational environment. Because the building is intentionally non-functional and relies on experiential interpretation, a conventional performance-based or quantitative approach would be inadequate. Instead, the methodology integrates phenomenological analysis, cultural-historical contextualization, comparative case study methods, environmental psychology, and educational theory.

3.1 Interpretive Architectural Analysis

The first methodological component is an interpretive examination of the building's architectural elements. This includes close analysis of:

- material expression, particularly the cedar-imprinted concrete;
- spatial sequencing and vertical transitions;
- the manipulation of light and darkness;
- the absence of conventional programmatic cues;
- atmospheric conditions such as silence, enclosure, and openness.

These elements are studied as communicative devices through which the building produces meaning. This approach draws from established methods in architectural phenomenology and



critical spatial studies, which treat architectural form and atmosphere as interpretive data rather than strictly functional determinants.

3.2 Phenomenological Reading of Spatial Experience

A phenomenological methodology is employed to analyze how Kioi Seidō influences perception, emotion, and embodied understanding. This involves reconstructing the sensory experience of moving through the building—from the dark, compressed ground floor to the luminous atrium above—and interpreting how such sequences cultivate reflection. Phenomenology enables the study to treat movement, sensory contrast, and atmosphere as central to understanding the building's pedagogical capacity.

3.3 Cultural-Historical Contextualization

To situate Kioi Seidō within a broader Japanese architectural lineage, the study applies cultural-historical analysis to compare the building with:

- Jōmon-period dwellings and prehistoric spatial practices
- Shinto shrine construction and *miyadaiku* apprenticeship traditions
- architectural forms associated with ritual, purification, and moral cultivation
- contemporary patterns of urban development in Tokyo

This contextual method highlights how cultural traditions of spatial pedagogy—learning through atmosphere, material, and ritual—inform the building's design and its non-utilitarian orientation.

3.4 Comparative Architectural Case Study Method

Comparative analysis is used to position Kioi Seidō within an international discourse on contemplative and pedagogical architecture. Relevant precedents include:

- Louis Kahn's Salk Institute
- Le Corbusier's Chapel of Notre Dame du Haut
- Rem Koolhaas's Seattle Public Library
- Rosan Bosch's Vittra Telefonplan School

Examining these cases allows the study to identify shared strategies—such as spatial ambiguity, sensory modulation, and open-ended circulation—that support reflective or inquiry-based



engagement. Comparative analysis clarifies how Kioi Seidō participates in broader architectural efforts to cultivate learning through space.

3.5 Educational-Theoretical Framework

The study integrates theoretical perspectives from educational philosophy and psychology, especially:

- constructivism (Piaget; Vygotsky)
- Montessori's principles of open-ended learning environments
- Deweyan experiential learning
- Freirean critical pedagogy
- the concept of the "hidden curriculum"

These frameworks provide a conceptual basis for understanding how architectural ambiguity, sensory immersion, and spatial openness operate as pedagogical tools. The theories help explain how a building with no prescribed function can nonetheless shape interpretive behavior, critical awareness, and reflective learning.

3.6 Ethical and Societal Evaluation

Given that Kioi Seidō was commissioned by an ethics-focused institution, the methodology includes an interpretive ethical analysis. This component examines:

- debates around architectural utility and public value
- tensions between idealism and pragmatism in dense urban environments
- issues of accessibility, inclusivity, and elitism
- questions of cultural memory and societal education

Rather than treating such critiques as external objections, the analysis incorporates them as part of the building's pedagogical effect. Ethical tensions are understood as instructive, revealing how architecture can provoke societal reflection.

3.7 Synthesis of Methods

Together, these methods create an interdisciplinary framework that interprets Kioi Seidō as a pedagogical environment shaped by cultural history, phenomenological experience, architectural



form, and educational theory. This integrated methodology supports a comprehensive understanding of how the building teaches through ambiguity, atmosphere, and sensory progression.

4. Results

The analysis of Kioi Seidō through architectural, cultural, phenomenological, and educational frameworks reveals the building's multifaceted role as a pedagogical environment. Rather than functioning as a conventional structure with a defined program, Kioi Seidō operates as an experiential teacher that cultivates reflection, sensory awareness, ethical questioning, and interpretive agency. The results of this qualitative inquiry are organized into thematic categories that illuminate how the building teaches through ambiguity, material expression, spatial progression, cultural lineage, ethical tension, and global architectural parallels.

4.1 Ambiguity as Pedagogy

One of the most significant findings is that Kioi Seidō's intentional ambiguity functions as a pedagogical mechanism. The building refuses conventional functional cues—there are no directional signs, no designated seating, and no clear spatial purpose. Visitors must interpret the environment for themselves, making decisions about movement, posture, and meaning without guidance.

This ambiguity parallels principles of inquiry-based and constructivist learning, in which learners construct knowledge through exploration rather than passive reception. In this context, the absence of program becomes the content: the building teaches critical thinking, perceptual attentiveness, and comfort with uncertainty. This result aligns with educational theories that identify ambiguity as a catalyst for creativity and reflective cognition.

The contrast between Kioi Seidō and its hyper-functional urban surroundings intensifies this pedagogical effect. In central Tokyo—an environment optimized for speed, efficiency, and commercial productivity—the building's refusal of utility disrupts normative expectations. It



asks visitors to reconsider the values embedded in urban form and to imagine alternative relationships between space, meaning, and purpose.

4.2 Spatial Sequencing and Sensory Transformation

A second major finding concerns the building's spatial progression from darkness to light, enclosure to openness. The ground level's compressed, cave-like atmosphere—with thick concrete walls marked by cedar formwork—creates a primordial, introspective state. As visitors ascend, light gradually increases through nine apertures, culminating in a bright, expansive top floor.

This sensory transformation aligns with phenomenological theories that emphasize how architecture shapes perception and emotional experience. The vertical sequence serves as an embodied narrative: darkness to illumination, heaviness to lightness, ambiguity to clarity. This progression is pedagogical in its own right, teaching through movement and sensory contrast rather than didactic content.

The ascending spatial experience mirrors historical ritual structures in Japan, where movement through architectural thresholds symbolized purification, preparation, or transformation. In this sense, Kioi Seidō's spatial sequence becomes a contemporary ritual of reflection.

4.3 Material Expression and Ethical Atmosphere

Analysis of material expression shows that Kioi Seidō's rough, cedar-imprinted concrete plays a significant educational role. Unlike smooth, polished finishes associated with corporate modernism, the textured concrete connects the building to natural material traditions and emphasizes imperfection, tactility, and the traces of construction.

This material honesty reinforces ethical and cultural values associated with Japanese architecture: humility, simplicity, memory, and an appreciation of natural processes. The concrete's imprint of cedar planks evokes ancient wooden construction methods, subtly linking the building to the Jōmon period's earthen structures and the austere spirituality of Shinto shrines. This resonance teaches occupants to recognize material as a bearer of cultural meaning.



The material atmosphere also contributes to what can be described as ethical quietness. Rather than stimulating activity, the building slows perception and creates conditions for contemplation, which aligns with both phenomenological understandings of atmosphere and Japanese aesthetic traditions of subtlety and stillness.

4.4 Cultural Lineage as an Educational Framework

Situating Kioi Seidō within Japanese cultural history reveals how the building participates in a longstanding tradition of spatial pedagogy.

Jōmon Resonances

The rough textures and ambiguity of the interior recall the Jōmon era's dwellings, which were constructed for ritual and communal gathering as much as shelter. These prehistoric structures taught social and cosmological orientations through embodied experience.

Shinto Shrine Practices

The connection to Shinto shrine architecture is equally significant. Shrines were historically built through oral transmission and apprenticeship, embedding learning in the act of construction itself. Visitors learned through purification rituals, silence, and atmospheric cues rather than explicit instruction. Kioi Seidō echoes these pedagogical forms through its ritual-like ascent and open-ended spaces.

Miyadaiku Tradition

The *miyadaiku* carpenters' approach—learning through repetition, embodied skill, and reverence for materials—offers a template for interpreting the building's educational significance. Kioi Seidō similarly teaches through encounter, sensory engagement, and respect for the qualities of material.

Collectively, these cultural findings demonstrate that Kioi Seidō is not an isolated experiment but part of a Japanese lineage in which architecture itself is an educator.

4.5 Ethical Implications and Pedagogy of Value



The building embodies an ethical stance that challenges dominant economic logics. In a city where land value is exceptionally high and architectural purpose is often tied to commercial productivity, Kioi Seidō's lack of programmatic utility is a radical gesture.

Rejection of Profit-Based Value

By refusing to generate economic return, the building critiques the assumption that architectural worth must be measurable. This ethical reframing aligns with broader Japanese philosophical traditions that value contemplation, ritual, and intangible cultural heritage.

Architecture as Moral Inquiry

The commissioning body—the RINRI Institute of Ethics—intended the building to provoke reflection on moral life. The architecture itself becomes a medium for ethical inquiry, teaching that ambiguity, slowness, and contemplation are not wasteful but necessary for ethical and intellectual development.

Hidden Curriculum

The building functions as a “hidden curriculum,” teaching without explicit instruction by shaping behavior, silence, and interpretive habits.

4.6 Comparative Global Parallels

Comparative analysis positions Kioi Seidō within a global network of architecture that teaches through space.

Salk Institute (Louis Kahn)

The monumental concrete spaces and ocean-facing plaza teach a meditative attitude toward work and discovery. Like Kioi Seidō, it uses light and void as pedagogical devices.

Notre Dame du Haut (Le Corbusier)

This chapel demonstrates how asymmetry, indirect light, and sculptural form elicit reflection. Its ambiguity parallels Kioi Seidō's experiential strategy.

Seattle Public Library (OMA)

Transparent facades and unconventional circulation paths turn library use into an exploratory act, demonstrating that public buildings can encourage interpretive learning.



Vittra Telefonplan School (Rosan Bosch)

Flexible, non-hierarchical learning spaces foster creativity and autonomy, aligning with Kioi Seidō's refusal of fixed purpose.

These comparisons show that Kioi Seidō participates in a broader architectural movement in which buildings shape learning not through classrooms or curricula but through spatial openness and sensory engagement.

4.7 Societal Learning and Collective Memory

The analysis reveals that Kioi Seidō teaches not only individuals but also society. Drawing from sociological theories of public space, the building serves as:

- a counterbalance to commercialized urbanism
- a contemplative public resource
- an embodiment of alternative urban values
- a teacher of collective reflection

By resisting privatization and monetization, it reopens the public imagination, teaching that cities can make room for thought, ethical inquiry, and shared cultural memory.

4.8 Critical Tensions as Educational Devices

The study identifies several critiques—elitism, accessibility, practicality, sustainability—that are often raised in response to non-functional architecture. Importantly, these tensions are themselves pedagogical.

Elitism

Critics argue that dedicating prime real estate to contemplation may privilege certain populations, raising questions about who has access to reflective space.

Accessibility and Interpretation

The ambiguous spatial design may confuse or exclude visitors who expect clearer cues.

Pragmatism vs. Idealism

In a city where affordability and density are critical issues, a non-utilitarian building challenges assumptions about responsible land use.



Sustainability

The long-term adaptability of a functionless building is uncertain.

Yet each critique becomes a prompt for reflection, reinforcing the building's role as an educator.

By making cultural tensions visible, Kioi Seidō teaches society to interrogate its values.

4.9 Architecture as Teacher: Synthesis

Across these findings, a clear pattern emerges:

Kioi Seidō teaches through every aspect of its spatial, material, and cultural design.

- Architecturally, it teaches attentiveness, patience, and interpretation.
- Culturally, it teaches continuity with historical traditions of embodied learning.
- Ethically, it challenges the dominance of utility and productivity.
- Socially, it models alternative values for urban public space.
- Educationally, it aligns with constructivist, experiential, and critical pedagogies.

In sum, the building functions as a teacher—one that instructs not through words but through light, ambiguity, texture, and atmosphere.

5. Conclusions

The analysis of Kioi Seidō demonstrates that the building functions as a distinct architectural and educational phenomenon - a space that teaches not through prescribed function but through experiential ambiguity, sensory progression, material presence, and cultural resonance. Situated within Tokyo's hyper-efficient urban fabric, Kioi Seidō offers a counter-narrative to dominant paradigms of architectural utility and economic productivity. Its very existence challenges the assumption that buildings must articulate clear programs, maximize rentable space, or serve quantifiable goals. Instead, it asserts the value of contemplation, ambiguity, and open-ended experience as legitimate architectural and societal contributions.

At the architectural level, Kioi Seidō reveals how form, materiality, and light can shape interpretive and emotional engagement. The progression from darkness to light, the textured



cedar-imprinted concrete, and the absence of functional cues create an atmosphere that slows perception and cultivates attentiveness. This sensory and spatial pedagogy aligns with phenomenological theories that locate architectural meaning in embodied experience rather than in symbolic representation or utilitarian performance. The building demonstrates that spatial ambiguity can serve as a catalyst for reflection, much like a poem or philosophical text that invites multiple readings.

Culturally, Kioi Seidō participates in a long Japanese tradition in which architecture operates as a teacher. The building's atmosphere echoes Jōmon dwellings, Shinto shrine practices, and *miyadaiku* craftsmanship—forms of spatial pedagogy in which individuals learn through ritual movement, material engagement, and sensory awareness. By drawing from these historical lineages, Kioi Seidō situates itself within a broader cultural framework where architecture transmits ethical, communal, and spiritual values.

Educationally, the building embodies principles associated with constructivism, experiential learning, and critical pedagogy. By refusing to dictate how visitors should behave or interpret the space, Kioi Seidō cultivates self-directed meaning-making. Its ambiguity encourages questioning, creativity, and cognitive flexibility—traits that many educational theorists identify as essential for deep learning. In this sense, the building becomes a learning environment without classrooms, syllabi, or instructors. It teaches through what it withholds as much as through what it provides.

Ethically and socially, Kioi Seidō invites reflection on the purpose of architecture in public life. In rejecting market-driven value systems, it highlights the importance of spaces that serve cultural, moral, and intellectual functions. Its openness and contemplative atmosphere offer an alternative to commercial and instrumental urban paradigms, suggesting that cities can and should include spaces devoted not to consumption but to reflection. Even the critiques directed at the building—regarding elitism, accessibility, practicality, and sustainability—become part of its pedagogical impact by prompting debate about who deserves contemplative space, what public value means, and how architecture should respond to societal needs.



Globally, Kioi Seidō contributes to a growing architectural discourse that includes buildings such as the Salk Institute, the Chapel of Notre Dame du Haut, the Seattle Public Library, and experimental learning environments. These structures, like Kioi Seidō, demonstrate that architecture can transcend function and operate as a medium for reflection, inquiry, and transformation. Within this constellation, Kioi Seidō stands out by combining cultural specificity with universal themes of ambiguity, ritual, and sensory learning.

Ultimately, the building exemplifies the idea that architecture can serve as a teacher. It offers lessons in perception, humility, patience, cultural continuity, and ethical awareness. It teaches that not all forms of value are measurable and that spaces lacking explicit function can nonetheless cultivate profound intellectual and emotional experiences. In a world increasingly dominated by efficiency, metrics, and profit-driven design, Kioi Seidō stands as a reminder that ambiguity is not emptiness but richness, that reflection is not waste but necessity, and that the built environment can support forms of learning that exceed the limits of formal education.

Kioi Seidō demonstrates that architecture and education need not be separate domains. Rather, they can intersect in ways that shape how people think, feel, and imagine. By integrating ambiguity, atmosphere, cultural memory, and ethical inquiry, the building points toward a future in which architecture embraces its pedagogical potential—teaching not through instruction but through experience, inviting individuals and societies to rethink their assumptions about value, purpose, and the meaning of space.

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A New Approach to Interactive Education: Game Engine-Based Frameworks for Teachers to Develop Interactive Lessons

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Abstract

Recent studies in the field of education show a significant increase in students' level of concentration during classes when the learning experience is highly immersive. During lessons, students are engaged with immersive instructional materials, whether through exercises or video presentations. On average, this results in better information retention and a deeper understanding of the subject matter. Existing applications, whether in VR or in 2D/3D for computers and mobile devices, already offer rich curricula that approach abstract topics through practical student experiences.

This article introduces a new approach to creating teacher-centered interactive educational applications. In conventional applications, teachers must find the software that best fits their course, and in some cases, they must even adapt their existing teaching materials to align with



the chosen application. To address these challenges, this paper proposes a framework based on a game engine (Unity or Unreal Engine) that enables teachers to design interactive lessons through intuitive interfaces. These panels contain blocks representing sample lessons or educational scenarios, which teachers can modify via drag-and-drop to match their own instructional content. Furthermore, the article outlines a system for collecting student performance data during lessons. At the end of each session, students may also provide feedback, enabling teachers to refine and improve their lessons based on results and reviews.

The proposed framework aims to increase teacher autonomy, lesson customization, and student engagement in immersive learning environments.

Keywords: interactive education, game engine, ICT

1.Introduction

1.1 The Current State of the Romanian Educational System

In the OECD report for 2025, published on September 9, 2025 (Organisation for Economic Co-operation and Development [OECD], 2025), the amounts of money the Romanian state invests per pupil and per university student are presented as: USD 6,069 and USD 10,329, respectively. Compared with other countries, these figures are well below the average. For university students, the average investment per student is USD 15,102. The gap for pupils is also significant, with Romania ranking among the last EU countries on this metric.

Due to an underfunded education system, phenomena such as school dropout and socio-economic segregation arise, and in families facing extreme hardship, children may not be enrolled in any level of education at all. A high share is reported among children (ages 6-14) and young people (15-19) who are not enrolled in any form of education - 16% and 32%, respectively. These percentages are very high compared with the European average of: 2% and 16%.

Beyond the problems arising from insufficient funding, social constructs end up dividing educational institutions into “schools with a good reputation” and “schools with a poor



reputation”. In many cases, an elitist and segregationist approach is present, which translates into deepening the educational inequalities among students. Thus, creating an environment that runs counter to the foundations of education - one that fails to ensure equal chances and opportunities for all young people, regardless of family economic situation, ethnicity, or other socio-economic criteria (Țoc, 2024). A high-performing educational system is measured by its capacity to impart core competencies to every student - an inclusive system that does not permit the gradual exclusion of students facing socio-economic hardship.

1.2 Motivation and research objectives

The main objective of this article is to propose a game-engine-based framework that enables teachers to create interactive educational applications. The framework’s usage model relies on pre-existing, general examples for each subject. These examples are presented as an intuitive menu where the user can deploy visual blocks by dragging them into the scene in an intuitive manner. The user is free to modify parameters or specific features to suit their needs.

The main strength of this framework is the freedom presented to the teacher. With existing applications, the teacher has to find the preexisting option that most closely matches their subject; in some cases, the teacher even has to rely on modifying the course curriculum to integrate such applications.

Another important aspect is student feedback. At the end of each lab or lesson, students can give a rating and, if they wish, indicate what changes should be made or what they liked the most.

2. State of the Art

2.1 Immersive learning and Virtual Reality use in education - STEM learning

The rapid advancement of technology has changed the way information is being shared and perceived. One of the most impacted fields by these innovations is education. Among emerging technologies, Virtual Reality (VR) has shown particular promise in developing Science, Technology, Engineering, and Mathematics (STEM) learning even more. One of the challenges of traditional teaching methods is making students understand abstract concepts. VR addresses



these problems by providing an immersive, interactive, and safe environment where children can visualize and experiment with scientific phenomena that would otherwise be difficult, or impossible to experience in real life. VR also increases the motivation of students, the engagement with the subject matter, and the retention of information, positioning it as a novel way of modernizing learning and education.

VR technology can help teachers overcome the limitations of traditional teaching methods by creating a hands-on experience in a simulated and controlled environment. The benefits of VR being used in STEM learning are: creating an immersive learning experience - VR creates realistic and engaging simulations of scenarios, allowing students to learn actively rather than just observe; enhanced motivation for students - it catches the students' attention by offering a hands-on experience; better retention of information; and access to a personalized and self-directed learning environment.

2.2 Using game engines (Unity, Unreal) in education

In the article (Paul et al., 2012), a game engine is described as a platform that handles common game tasks - such as rendering, physics, and input. It is a collection of reusable components that can be manipulated to bring a video game to life, allowing developers to focus on the specific details that make the game unique.

Thanks to the technological advances of the last decade, game engines such as Unity and Unreal Engine have moved beyond entertainment, becoming robust tools in key fields due to their capabilities for simulations and training. Classic game engines - Unity, Unreal Engine, and Godot - offer extensive support for industries including engineering (automotive, industrial, aerospace), the military/defense sector, medicine, and education (Duțescu et al., 2025). Beyond company support, the community is another important factor. There are numerous open-source community projects that aid learning, creating a conducive environment for education - further reinforced by the fact that the engines mentioned above are free and offer student packages, courses, or discounts.



The table below presents several comparisons between the two most popular game engines on the market today: Unity and Unreal Engine. The comparisons were taken from the article (Salama & Elsayed, 2021). The conclusion was that no single engine is a clear winner across all categories, and the choice should be made according to one's specific needs.

Game Engine	Pros	Cons
Unity	- Supports 25 different platforms - Optimised graphical performance for every platform - Uses C# and JavaScript - Huge Asset Store - Drag and drop option - Involved community	- Hard to learn - Graphical optimisation can be time-consuming
Unreal Engine	- Very good graphical capabilities - Good templates - Blueprint system (drag and drop programming)	- Uses C++ - Not optimized for low-resource / low-spec devices.

Table 1. Unity vs. Unreal Engine

Unity stands out on its own, given the characteristics of the framework proposed in this article. It comes with lower hardware requirements and costs, being a platform that is friendly to mobile phones, tablets, and similar devices.

Using a game engine in education supports the following claim: a person perceives 80% of information through sight (Sobota & Pietriková, 2023). This high percentage indicates the need for a high-performance visual system running on appropriate hardware resources. Even though there are challenges - such as the high cost of hardware and teacher training - it offers a different approach to education, serving as a tool that benefits both teachers and students. It gives teachers curricular freedom, while students can learn abstract concepts in interactive environments without fearing the consequences of mistakes.



3. The Proposed Architecture

To constitute an effective and comprehensive learning environment, the proposed framework must integrate a set of essential functional features. It must ensure multiplayer compatibility to enable real-time collaborative work sessions and provide functionalities for configuring virtual workspaces, such as choosing a virtual classroom or setting the number of available seats. A central component is the educational "prefab" system—predefined, reusable packages for specific subjects, such as physics experiments or interactive maps—supplemented by the integration of subject-specific teaching materials. Furthermore, the platform must include a grading system with LMS integration to ensure interoperability with platforms like Moodle. Finally, the framework must comprehensively manage session data, incorporating audio-video recording, a data-saving system for storing participant lists and generated materials, and data collection on student progress, difficulties, and engagement.

3.1 Workflow example

From the educator's perspective, the life cycle of a single educational session within the framework is divided into four sequential stages. This design provides a clear and manageable process, beginning with the complete configuration of the session, followed by the pre-lesson initialization of materials, proceeding to the live student activity, and concluding with a formal session termination and data archival. The specific actions within each stage are detailed below.

Creating a session: The teacher can create a session using a dedicated menu that allows configuring the workspace (choosing the room, furniture, interactive whiteboard background color etc.), selecting participants or a participant list, and the subject. Session settings can be saved and reused, with a “Load settings” option.

Session initialization: Before allowing participants to join the virtual classroom, the teacher will have access to a subject-specific menu to bring into the virtual space the materials and objects needed for the activity - such as graph generators, geometric shapes, maps, electrical circuits, and more.



In-session work: Once the teacher allows participants to connect, they can begin the activity without any additional actions. This makes it easy to understand and use.

Ending a session: This involves closing participant connections (they will be automatically disconnected from the session) and automatically storing in the database both the materials generated during the session and the statistical data of the ended session (video recording, connection duration, number of specific actions, list of participants etc.).

3.2 Steps for Creating an Interactive Lesson Using the Framework

Developing and integrating a new interactive lesson is a straightforward process managed in five distinct phases. This subsection outlines the steps required for a teacher to select a subject, create or customize an experiment, test its functionality, and formally integrate the new application into their lesson planning.

1. Selecting the subject

The teacher begins by choosing the desired subject from the suite offered by the framework. The framework includes a wide range of disciplines - from mathematics, physics, and chemistry to Romanian language, history, and music. Selecting the subject allows for the organization and grouping of experiments or training activities relevant to that field.

2. Choosing or creating an experiment

Once the desired subject has been confirmed, the teacher selects one of the existing experiments available in the platform's library. Alternatively, they may choose to create entirely new content using a default template, which provides a customizable base structure for lesson development.

3. Customizing the content

In the third step, the teacher makes the necessary adjustments to adapt the lesson to the current educational curriculum or to the specific needs of their students. This customization ensures that the lesson is both pedagogically appropriate and engaging.

4. Testing the lesson

An essential stage in the development of any educational project is testing. During this phase, the teacher checks that all components function correctly and that the application is compatible with

different devices and platforms. Any detected errors can also be corrected at this stage.

5. Integrating the lesson into the curriculum

The final step involves updating the existing educational curriculum to integrate the newly created interactive application. The teacher can adjust lesson planning so that the application fits harmoniously within the school's structure and learning objectives.

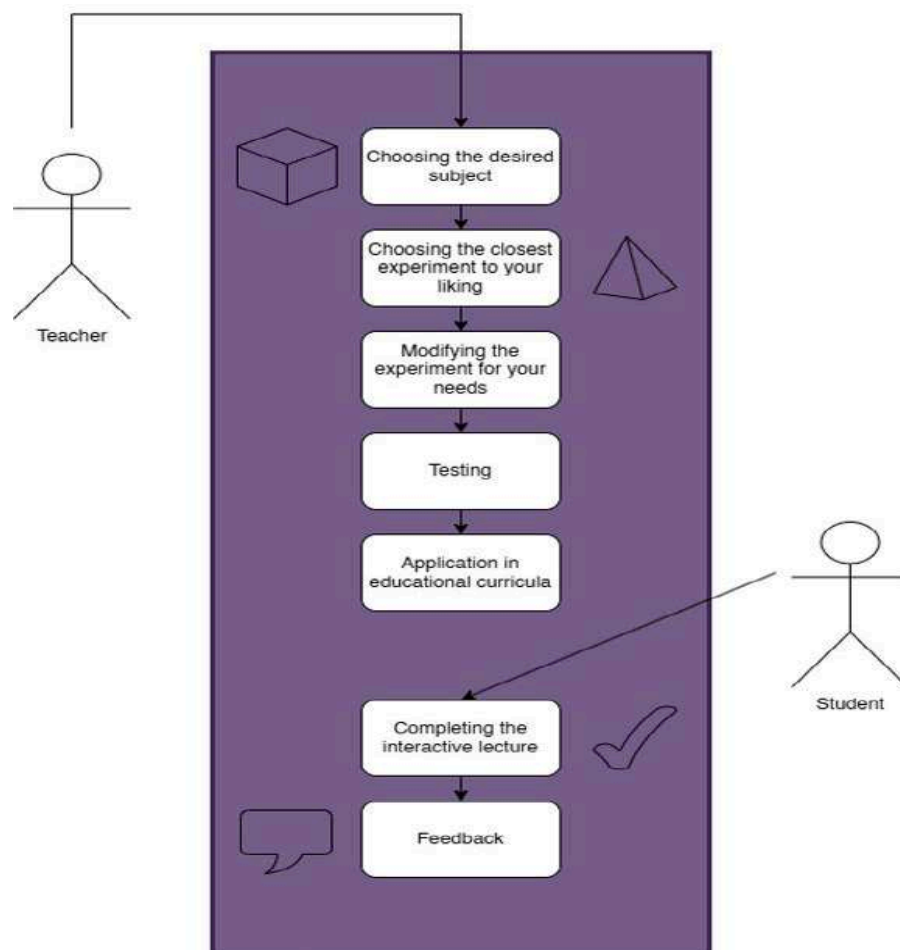


Figure 1. Proposed Architecture



4. Use Cases

This section presents a series of use cases across different courses to demonstrate the practical applicability of the proposed framework. It illustrates how teachers can use the game engine-based framework to create interactive lessons. Through these examples, the flexibility, accessibility, and pedagogical potential of the proposed framework are highlighted.

Biology Lessons: In biology classes, students can explore an interactive 3D model of the human circulatory system, navigating through arteries and veins as if traveling inside the body. Teachers can trigger explanatory animations to visualize key biological processes, such as oxygen exchange or blood flow through the heart chambers. This immersive approach transforms abstract concepts into tangible experiences, fostering deeper understanding and engagement.

Physics Lessons: For physics, the framework enables real-time simulations of fundamental laws of motion, gravity, and energy transfer. Students can modify parameters such as mass, force, or velocity, and immediately observe the resulting effects in a virtual environment. This interactive experimentation allows learners to test hypotheses safely, without the constraints or risks associated with real-world experiments, while reinforcing theoretical knowledge through direct application.

Mathematics Lessons: In mathematics, teachers can design visual and interactive representations of equations and geometric functions in a simulated 3D environment. Students can manipulate graphs dynamically - rotating surfaces, changing variables, and observing the effects of transformations in real time. This visual learning approach helps bridge the gap between abstract mathematical concepts and their spatial or functional interpretations.

Chemistry Lessons: In chemistry courses, students can perform virtual experiments in a 3D laboratory, mixing compounds, observing molecular reactions, and analyzing outcomes without exposure to hazardous materials. The system can simulate chemical reactions and display molecular structures at different stages, helping students visualize microscopic processes that are otherwise impossible to observe directly. This not only ensures safety but also enhances conceptual understanding through guided interactivity.



5. Conclusions

This paper has proposed a framework for creating interactive educational applications using powerful game engines like Unity and Unreal Engine. Unlike traditional educational tools, which often constrain teachers to pre-existing templates or content, the proposed system prioritizes educator autonomy and lesson customization, allowing teachers to build immersive, subject-specific experiences that align directly with their curriculum needs. By leveraging the graphical and modular capabilities of game engines, the framework enables the development of highly engaging and visually rich lessons. Its user-friendly drag-and-drop interface supports teachers with little or no programming experience, while its integrated data tracking and feedback mechanisms allow for real-time monitoring of student performance and continuous refinement of instructional strategies.

The application of immersive technologies in education, particularly in STEM subjects, has shown considerable promise in improving student engagement, motivation, and retention. This framework builds on those findings by enabling teachers to use such technologies more easily and effectively, directly integrating them into classroom practice and in the curriculum.

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