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C O N T E N T S

The Problems of Contemporary Education

The Formation of Digital Communicative Competence by Means of the Twee Neural Network
E.A. Bakina 121

Cooperation between Parents and Teachers in the Early Identification of Mental Disorders and Problem Behaviour of Pupils at the Primary Level of Education
D. Borbélyová, D. Gonda, A. Tirpaková 134

How Psychological Well-Being Affects Patience, Motivation to Teach, and Emotional Exhaustion in Teachers
N. Çobanoğlu, S. Demir 150

The Implementation of TPACK in Bosnian Classrooms
A. Doljančić, S. Selimović 163

Educational Computer Programs as a Mechanism and Means of Mathematical Literacy Forming
S.N. Dvoryatkina, R.A. Melnikov, E.I. Smirnov 181

Parental Volunteering at Schools in the Light of a Qualitative Survey in Hungary
Z. Kocsis, H. Fényes, V. Markos, E. Fazekas 193

Professional Competence of Teachers in the Context of STEM Education
M. Valentová, P. Brečka, A. Hašková 206

Comparison of Digital Skills Upgrading of Students and Teachers in the Digital Transformation of East-Central Europe
J. Záhorec, A. Hašková 216

The History of Education

Education of Regional Identity Among Soviet Children, Youth and Youth through Radio Broadcasting (based on Materials from the Penza Region)
L.A. Koroleva, N.V. Miku 228

A Social Portrait of Students at Ukrainian Universities in the 19th century
A.E. Lebid, S.I. Degtyarev, V. Stupakova 238

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The Problems of Contemporary Education

The Formation of Digital Communicative Competence by Means of the Twee Neural Network

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Abstract

In the digital economy, the mastery of digital communicative competence is becoming a priority not only in the field of education, but also in business and society as a whole. Digital communicative competence provides access to information, educational services and communication at a new level. Modern digital technologies are used to build effective interaction in the digital environment: artificial intelligence, neural networks, podcasts, blogs, etc. The goal of this article is to study the Twee neural network as a means of the digital communicative competence formation. This article reviews the possibility of the formation of this competence in the field of a foreign language among first and second-year undergraduate students of a non-linguistic specialization of the Ural Federal University. During the research, we have studied the linguistic and didactic potential of Twee, identified its features, modeled the educational process according to the topic of the module of the educational program, highlighted the advantages of implementation of this digital tool, determined the significance of the survey. The results obtained indicate the fact that the Twee neural network with digital communication platforms creates effective interaction in the digital environment, in other words, Twee contributes to the formation of digital communicative competence.

Keywords: communication, digital competence, digital communicative competence, digital technologies, digital literacy, neural network, Ural Federal University, foreign language.

1. Introduction

Personal success is largely determined not only by professional skills, but also by communication skills (Nikulina, 2022). It is well known that communication has always been the

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essence of any interaction (Tretyakova, 2012), and professional skills are secondary to determine the outcome of a person's performance in a job. In the modern world, when the use of computers and access to the Internet have become an everyday reality, the mastery of digital competence (one of the competencies dictated by the digital economy) is becoming a priority in all areas of activity. And the improvement of digital competencies is a key factor in the progressive and innovative development of the Russian Federation. The expectations of the government and employers towards university graduates regarding the issue of digital competencies are due to the active implementation of digital technologies into various sectors of the economy. Moreover, the formation process of this competence is also an integral part of the modern education and pedagogical science, as a result of the digital transformation of the Russian economy (Savelyeva, 2024). As the government and employers' expectations towards the graduates grow, so does the need to develop communication skills in the digital environment. Also, in the digital economy, the labor market is constantly changing, the mastery or development of this competence helps everyone successfully adapt to changing requirements, promote productive interaction with other people, increase the digital literacy, competitiveness and overall productivity of a specialist. Therefore, having digital competence is more actual than ever before. Based on this, it would be reasonable to define this concept. Digital competence is the ability of a person to apply digital technologies in every area of life confidently, effectively and safely (Tokareva, 2021). This competence includes the ability to use digital tools, software, the ability to use information on the Internet, as well as the use of various messengers and effective communication skills in the digital environment. However, digital communicative competence is becoming particularly relevant in modern digital realities. It is, in turn, the ability to use digital technologies, such as artificial intelligence, neural networks, blogs, podcasts, forums, webinars and more, for effective interaction or communication in the digital setting. It also includes the ability to interact with digital communication platforms and understanding of communication ethics or the so-called netiquette (network + etiquette) in the digital sphere (Baimuratova, 2018). Thus, digital communicative competence is a priority in the context of digital realities.

In the educational process, innovative technologies are no longer an exception, but are essential, meeting the modern demands of the digital society. The influence of the digital transformation in the field of education is obvious, as its goal is to improve the entire educational system (Robert, 2020).

This article considers the possibility of the digital communicative competence formation among first and second-year undergraduate students of a non-linguistic specialization of the Ural Federal University using the Twee neural network in the field of a foreign language.

The development of neural networks is of significant importance in the era of digital technologies, and the future of foreign language learning is undoubtedly intertwined with the development of technologies and innovations in the sphere of communication and information.

Thus, the relevance of this research is explained by public demand and digital transformation concept (Robert, 2020), which is mainly defined by the integration of digital technologies in education, the development of digital infrastructure, personalized educational trajectory and creation of high-quality digital educational content. The novelty lies in the fact that application of Twee in the educational process provides a comprehensive approach to foreign language learning and its didactic and methodological potential can be used to create individual teaching methods developing digital competences.

2. Methodology

In the last decade, we have witnessed rapid digitalization, and education is no longer an exception. A number of new innovative resources and platforms have emerged that are fundamentally changing the way we teach. One of these resources is the Twee neural network, which uses the capabilities of artificial intelligence. In general, a neural network is a type of artificial intelligence that models and simulates the work of the human brain (Rastorgueva, 2023). The founders of this service, specialists in education and cognitive sciences, experts in the field of AI and natural language processing, as well as communication technologies, dreamed of creating an intelligent platform for multimodal language learning that would combine adaptability and personalization. Multimodal learning is based on the use of multiple forms of data such as text, images and graphics (Zhu, 2021). In general, the creators of this digital tool have demonstrated

their success in modeling the service capable of generating different tasks for language learning of high-quality level.

Twee appeared at the end of 2022. This tool is a great option for teachers but can also be useful for studying the language on one's own provided that one has a good level of English (Robert, 2024). The interface of the service ensures that any user can easily understand and use it without any difficulties, and the available features are clearly described. So, the service is accessible for users of various levels of digital literacy: those who have high level of experience with digital technologies and those who have less experience.

As M.N. Evstigneev noted, Twee can be considered an effective tool and in the forthcoming future it will be used more and more often in linguistic education (Evstigneev, 2023). Then, what is the didactic potential of Twee? This neural network is able to plan and organize the learning process. It allows you to generate material for teaching the main types of speech activities (listening, speaking, reading, writing), covering such aspects of language as vocabulary and grammar. Let's delve into the details of these activities.

1. For the purpose of learning to read:

– Text generation on the specified topic is performed according to certain parameters: language proficiency level A1-C2 according to Common European Framework of Reference (CEFR), length (number of words), genre of the text (the user can choose 7 genres: usual text, descriptive /argumentative article, fictional story, official/unofficial letter, review) (The Twee..., 2024). Additionally, you can specify the lexical units that the generated text should consist of.

– Generation of questions to the text (multiple choice questions, open questions, true/false statements;

– Generation of small texts for reading (announcements, invitations, instructions, etc.);

– Text-based dialogue generation;

– Headline generation to the text.

2. For the purpose of learning to speak:

– Generation of quotes of well-known personalities for discussion and information exchange;

– Generation of key questions on the chosen topic;

– Generation of a dialogue based on active vocabulary, topic or background of the situation as an example for further development of speaking skills;

– Generation of ideas based on the specified lexical units.

3. For the purpose of learning to write:

– Generation of topics for writing an essay;

– Generation of quotes of well-known personalities on the specified topic;

– Generation of "four opinions" for argumentation when writing an essay;

– Sentence generation using key vocabulary.

4. For the purpose of learning to listen (the basis is a YouTube video):

– Generation of discussion questions which cover the key points and ideas of the video;

– Generation of multiple-choice questions, true/false statements, open questions, gaps filling task.

3. Materials and methods

We used the neural network to generate communicative tasks and to practise them in the digital environment, improving communicative language and digital skills. The research was conducted at the Ural Federal University in 2024 (Yekaterinburg). First and second-year students of the training direction «Human Resources» participated in the study with A2 language proficiency level. The total number of them was 78 but not all students agreed to make their results public, so in our research we presented the first group results (12 students, assignment material was generated by the Twee neural network) and the second group results (also 12 students, who had blended learning format). The results taken from 78 students are consistent with those presented in this study. The 1st group consisted of 5 male and 7 female students aged 18. The second group consisted of 4 male and 8 female students aged 19. The data was obtained through questionnaires, interviews, work with target groups, observations and experiment.

The study was carried out in 3 stages:

1) Questionnaire, that allowed us to determine which digital tools were used earlier and what level of digital competence students currently had;

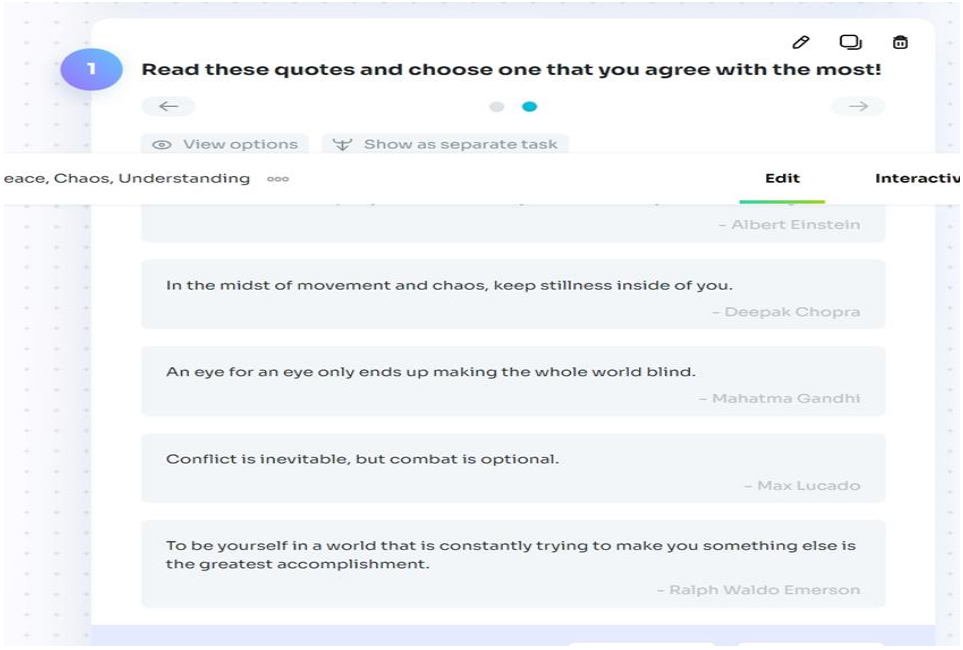
2) The experiment itself in the form of the course on developing communication skills based on the assignments generated by Twee and blended learning format (mainly tasks on Moodle platform). This stage contributed to the development and improvement of knowledge, skills and competences under study;

3) Presentation of the project using multimedia tools and artificial intelligence; questionnaire concerning the level of students' satisfaction about 2 different formats of study. This stage summarizes the work carried out, evaluates the results of academic performance and the level of formation of the studied competence.

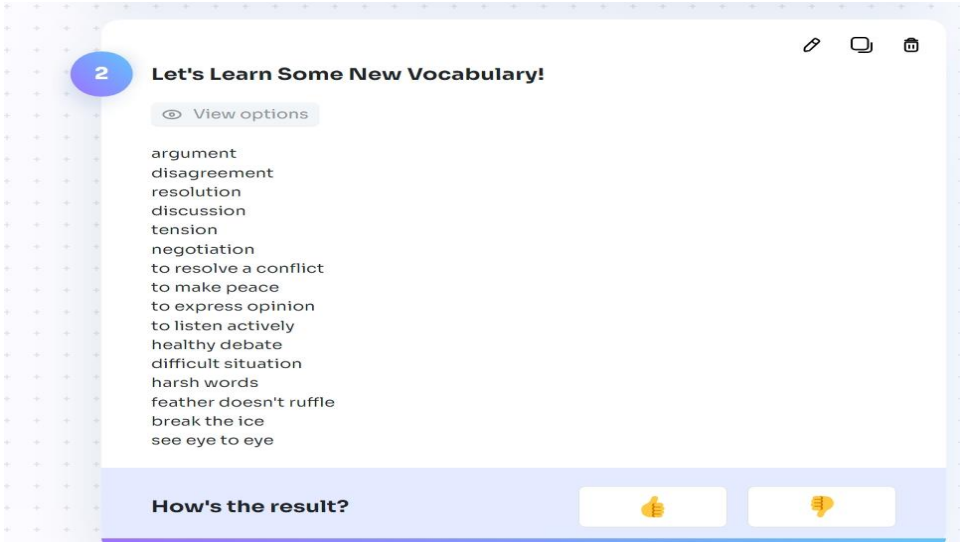
The evaluation was based on a point system: 0 implies that the marker under study was not identified or students had poor skills; 0,5 implies that the marker was identified/basic level of skills necessary to improve; 1 – well-developed skills and competences; 1+ implies high level of developed competences

Examples of assignments generated by Twee, when studying the topic of the module "Conflictology" for the A2 level students:

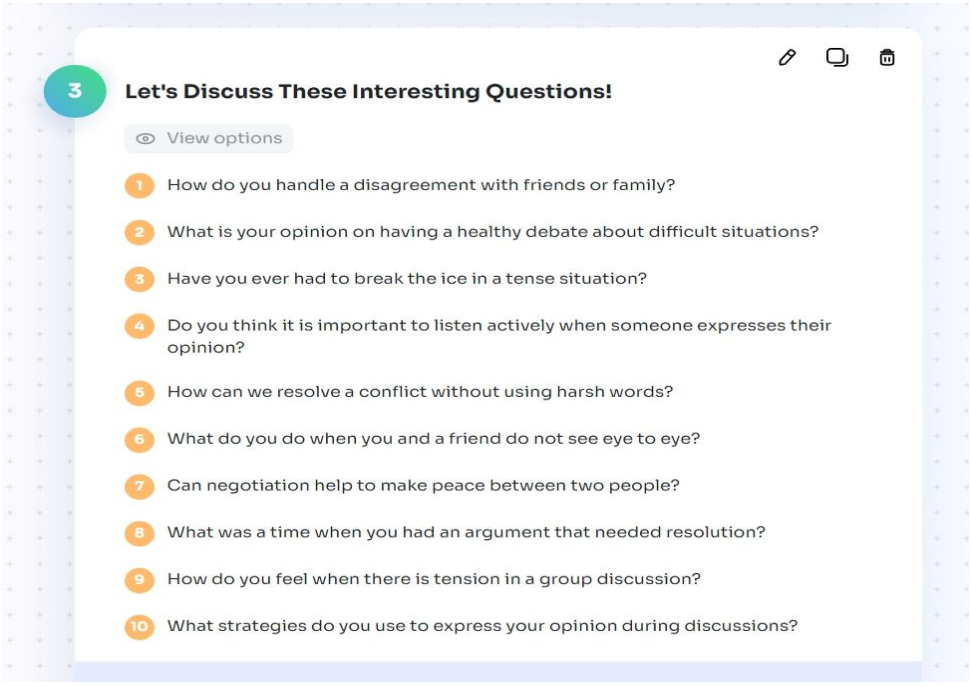
1) As a warming-up activity – generation of quotes of well-known personalities for discussion. The examples of these quotes are given below:



2) Vocabulary introduction to the topic "Conflictology": dispute, disagreement, tension, negotiations, conflict resolution, peace, harsh words;

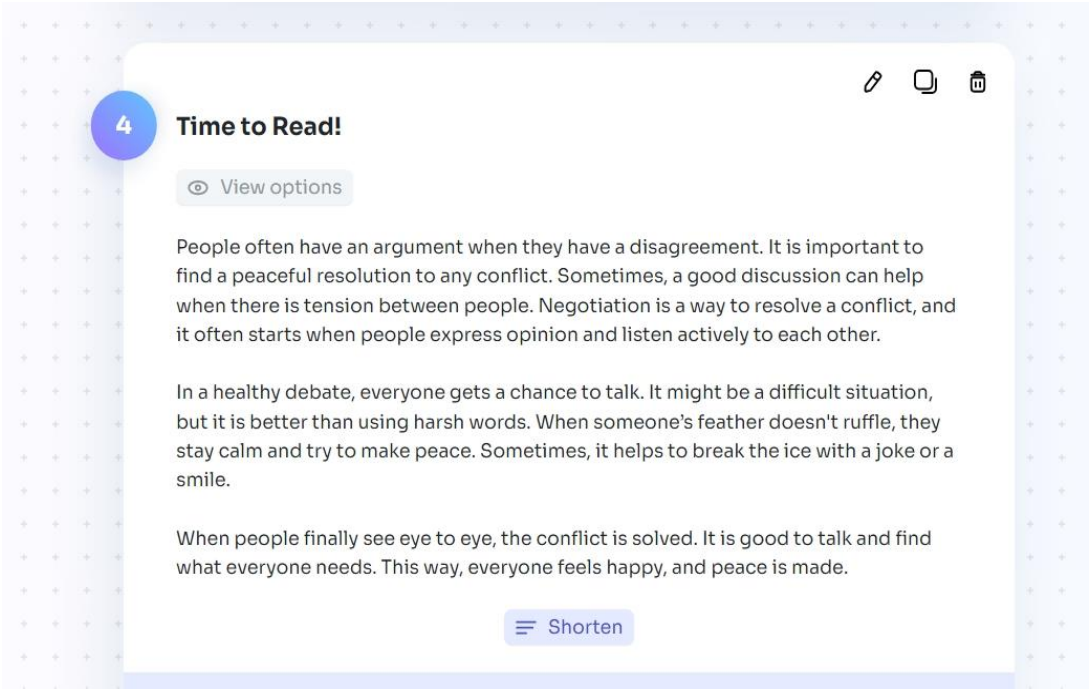


3) Discussion of the questions with active vocabulary presented above;

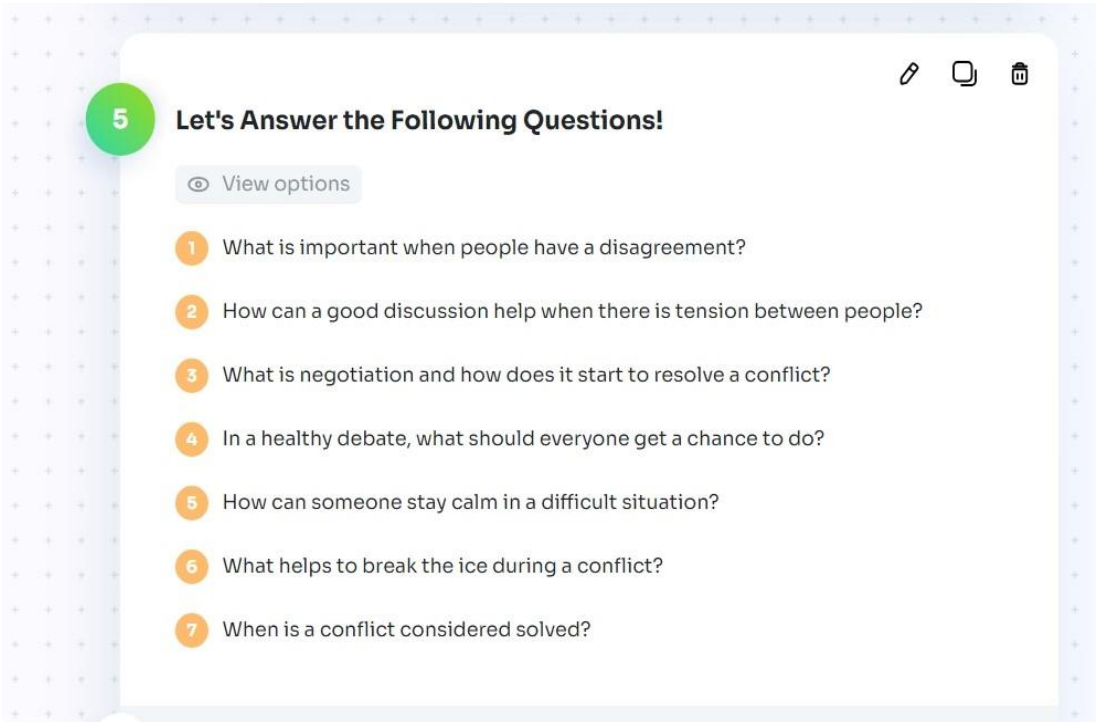


4) Text generation based on active vocabulary;

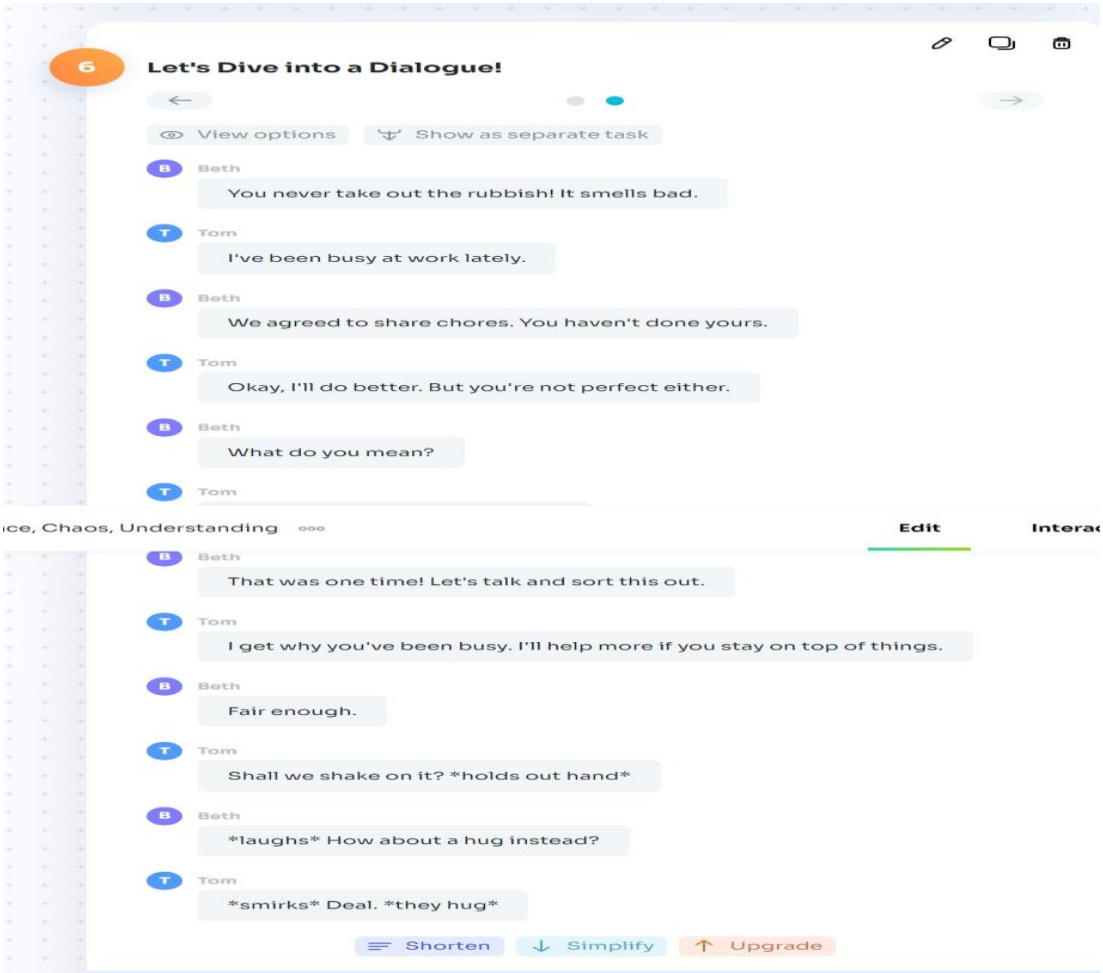
This option is of great interest to the teachers of higher educational establishments as it accelerates the process of searching, simplifying or upgrading different texts for «Human Resources».



5) Generation of questions to check the understanding of the content of the given text;



6) Dialogue generation for practicing active vocabulary related to the topic "Conflictology"; In this task there is an option of shortening the given dialogue, simplifying or upgrading the level when necessary.



4. Results

To determine the general level of students' digital competence a survey was conducted among first and second-year students of «Human Resources» to define the digital tools they used throughout the educational process up to the second course. The data is demonstrated in Figure 1 below:

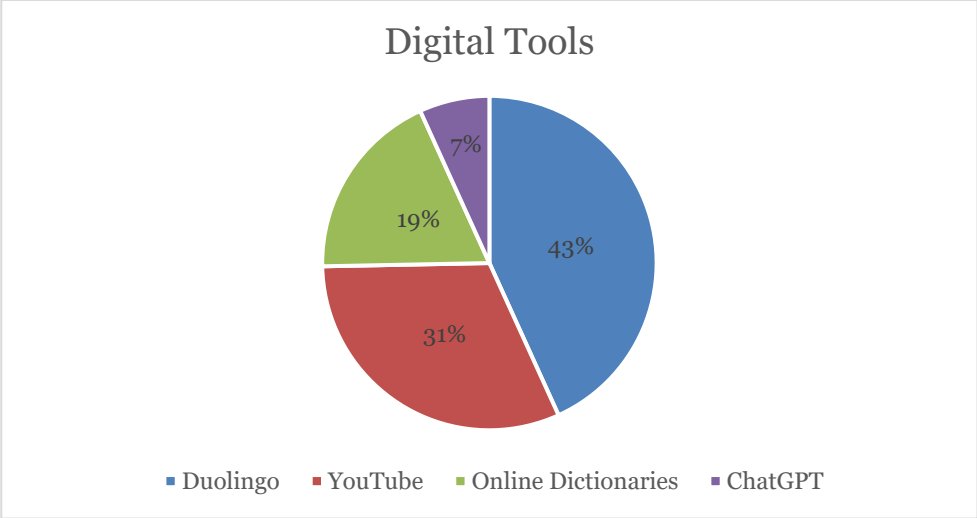


Fig. 1. Digital tools applied in education in general

The results of the development of key components of digital communicative are given below in the diagrams:

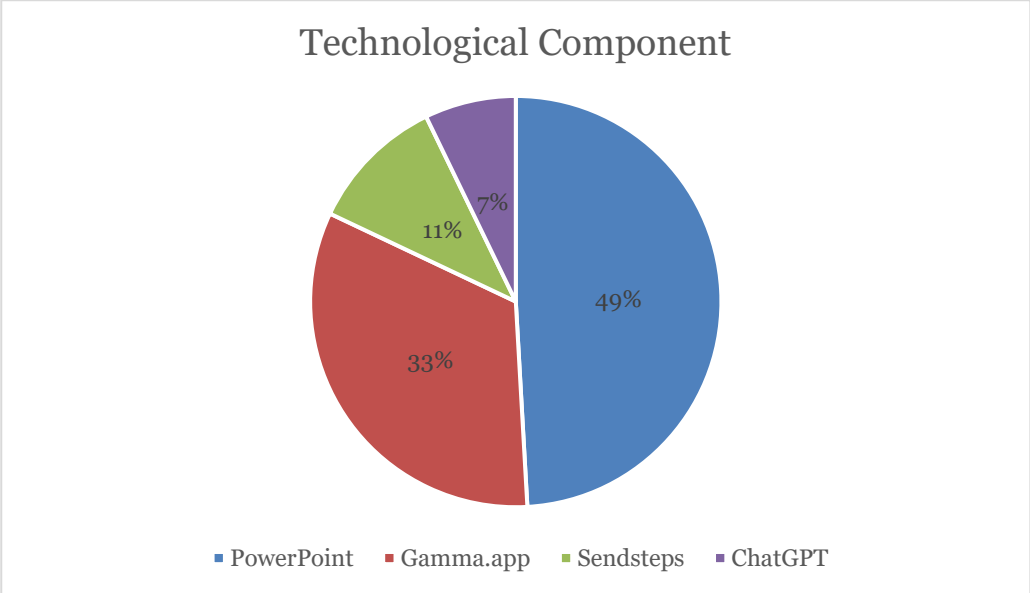


Fig. 2. Technological component of digital communicative competence

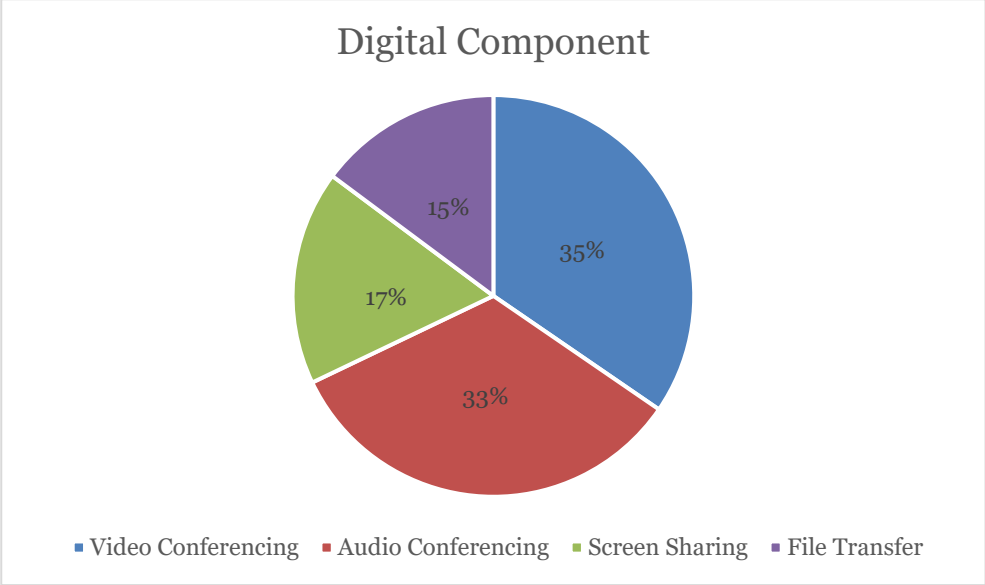


Fig. 3. Digital component of digital communicative competence

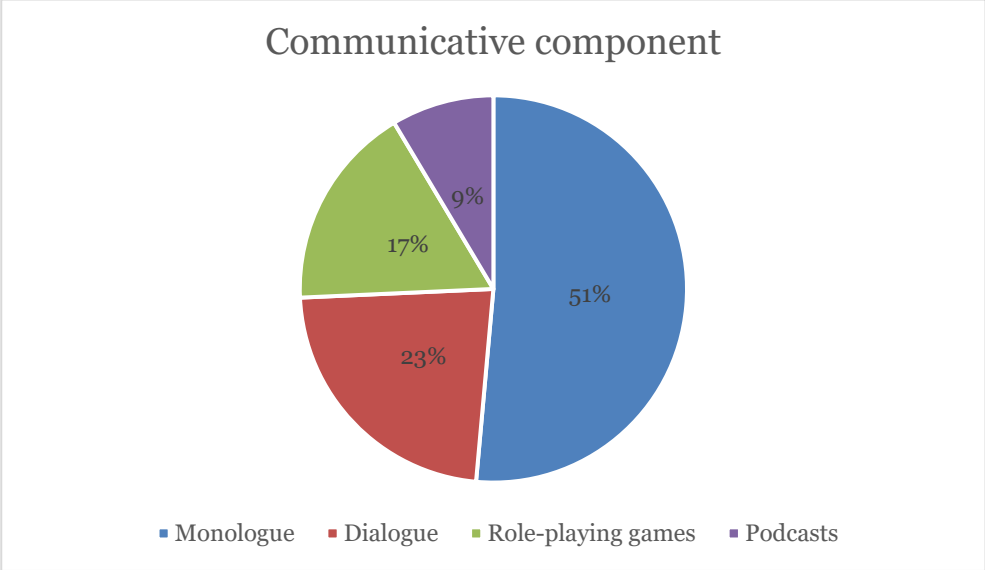


Fig. 4. Communicative component of digital communicative competence

Let's have a look at the general results of our research on the formation of digital communicative competence by means of Twee, they are presented in the table below.

Table 1. Digital communicative competence (Twee)

Number of students	**Technological component**		**Digital component**		**Communicative component**	
	start	final	start	final	start	final
1	0,5	1	0,5	0,5	0,5	1
2	0,5	1	0,5	1	0,5	1
3	0,5	1	0,5	1	0,5	1
4	0,5	1	1	1	0,5	1
5	1	1	1	1	1	1+
6	1	1	1	1	1	1+
7	1	1	0,5	0,5	0,5	1
8	1	1	1	1	0	0,5

Number of students	Technological component		Digital component		Communicative component	
9	0	0	1	1	0	0,5
10	0	0,5	1	1	0	0,5
11	0,5	0,5	1	1	0,5	0,5
12	0,5	0,5	0,5	0,5	1	1

The results of digital communicative competence development by means of Moodle platform (without Twee) are presented in the table below.

Table 2. Digital communicative competence (Moodle platform)

Number of students	Technological component	Digital component	Communicative component
1	0,5	0,5	0,5
2	0,5	1	0,5
3	0,5	1	0,5
4	1	1	0
5	0,5	1	0
6	1	1	1
7	0,5	0,5	1
8	0,5	1	0,5
9	0,5	1	0
10	0,5	0,5	0
11	0	1	0,5
12	0,5	0,5	0,5

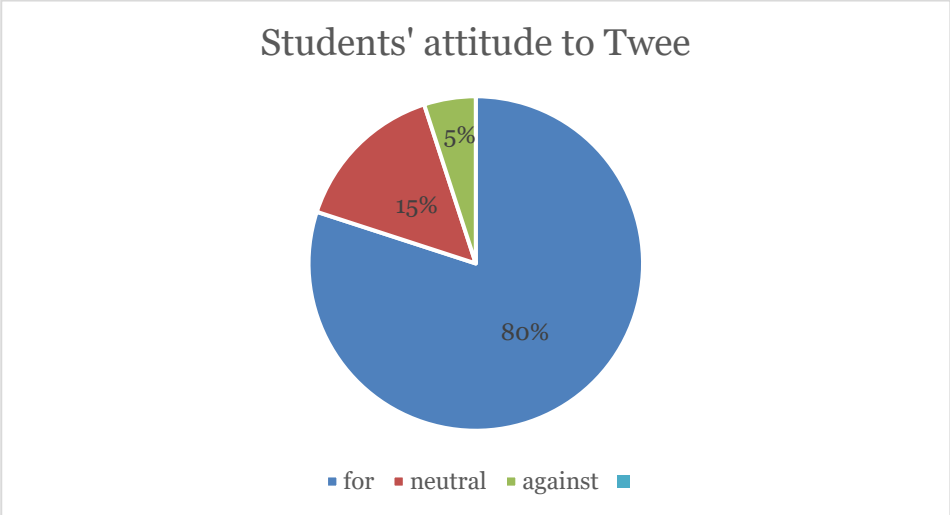


Fig. 5. Students' attitude to the practice of applying Twee

5. Discussion

The results in Figure 1 showed that all students, to some extent, used digital tools for their study. The survey also showed that Duolingo, YouTube, and working with online dictionaries are well-mastered by students. These results also highlighted that when it comes to working with artificial intelligence and neural networks students used Chat GPT to a lesser extent, but didn't use neural networks. Thus, they have limited knowledge or awareness of the application of neural networks in education, especially in developing communicative competence in digital language environment.

When discussing digital communicative competence, it is important to highlight the components making up this competence: technological, digital and communicative. Technological component implies the ability to safely use the networks, software to achieve specific goals. Digital

component includes the ability to use knowledge and skills to search, process, analyze and store information while using digital tools. And communicative component is about the ability to conduct online communication in various forms (in our case, using the English language): e-mail, blogs, dialogue, podcasts, chats, etc.

When working with the neural network Twee the development of these components were diagnosed in the following ways: 1) technological component was diagnosed by the application of PowerPoint, Gamma.app, Sendsteps and Chat GPT to create visually-appealing, dynamic and informative presentations; 2) digital component was diagnosed by the ability to effectively interact on platforms MTS Link, Zoom, using platforms' features and functions such as video/audio conferencing, screen sharing, file transfer; 3) communicative component – the diagnostic process was conducted through role-playing games, dialogues, monologue, presentation of the podcast based on the course materials already covered.

Based on Figure 2 results, it is fair to say that technological component is rather well-developed, as the students are able to use a variety of digital tools: PowerPoint, Gamma.app, Sendsteps, Chat GPT. However, it is worth noting that the low percentage of Chat GPT usage suggests there may be room for further development in terms of exploring new technologies and their potential application in education.

In Figure 3 it is clear that the students in the study are comfortable using video conferencing tool, as over 35 % of them apply this feature. They are also familiar with audio conferencing tool (33 %), sharing their screen (17 %) and sharing files (15 %). This suggests they have a basic level of comfort and competence with these instruments, and are able to use them in communication and collaboration.

As for communicative component in Figure 4, from the percentages provided, we can make the following conclusion: the students prefer monologues as a method of communication, as 51 % of them reported choosing this option. 23 % of students indicated a preference for dialogues, 17 % stated for role-playing games and the least popular option was creating podcasts. Judging by these results, the majority of students seem to favor more conventional forms of communication due to different factors: lack of knowledge or experience with these, especially taking into account their current level of English (A2), general preference for more familiar forms of communication. Further study may be needed to explore these reasons.

Table 1 shows average progress in the group. 70 % of students are attributed to the average level of digital communicative competence formation: rather good and conscious orientation in digital and communicative components, a bit selective orientation in technological component. Two students presented significant results, especially in communicative component. The level of their digital communicative competence is characterized as high. One student didn't show any progress in general, so his level is low. All in all, the necessary skills represented by these components were improved or developed to some extent.

We compared the given results with the results of the students of the same level but having blended learning format (online component on Moodle platform + traditional model). Blended learning format was adopted by the department of foreign languages and educational technologies for non-linguistic students of the Ural Federal University in 2022. Online component contains such modules as speaking, vocabulary, writing and grammar.

Table 2 shows the results of students working on Moodle platform, their results are worse. Communicative component is not developed at all. The indicators for technological component are lower too. What factors influenced the low level of the development of this competence? They are the following: communicative tasks generated by Twee are individually and adaptively worked out for every topic of the module than the tasks presented in Moodle; interactivity is higher while working with Twee. Communication in Moodle is limited, no emotional intelligence and necessary feedback, common technical problems. Generation Z students are more motivated due to the interest to Twee as a new innovative digital instrument.

Also, at the end of the term students were offered to list out negative features of their courses, that could affect the process of digital communicative competence development and their academic performance as a whole. The results are presented below (Table 3).

Judging by this data we can conclude that there are more negative features while working with Moodle platform than with the neural network. Students are more negatively inclined towards Moodle. So, the result is evident – low level of digital communicative competence formation and low level of academic performance.

Table 3. Students' attitude to Twee and Moodle platform

Twee	Moodle platform
– for introverts it is hard to communicate with others; – abundance of communication tasks (reaction of low-motivated students)	– lack of communication; – lack of feedback; – lack of individual approach; – no emotional intelligence; – monotonous and similar tasks; – mediocre and boring format; – self-organization problems; – lack of self-presentation; – lack of opportunity to improve digital skills; – technical problems (unsaved students' results; site «freezing», etc.)

Figure 5 shows the result of the survey of students who dealt with Twee. According to it, students are positively inclined towards this neural network as 80 % are for applying it in educational process, 15 % are neutral and 5 % are against. Therefore, we consider this service is perfectly suited for non-linguistic students and teachers working with them.

Thus, the research was conducted among first and second-year students of non-linguistic specialization to define the possibility for digital communicative competence formation by means of the Twee neural network in educational process. During the study structural components and their diagnostics were determined. The levels of formation of digital communicative competence were characterized as low, average and high. The results of comparative analysis of Twee with Moodle platform and students' attitude were taken into account. So, the research traces the efficiency of Twee in foreign language teaching, as it is able to easily create tasks for developing communication skills and contributes to the development of digital communicative competence, increasing the level of digital literacy, improving the ability to use digital technologies effectively and safely.

6. Conclusion

In general, when creating exercises using this service and practicing them with the students, we identified both its advantages and disadvantages. However, as it is known, pluses and minuses are present in any technology or service. According to Elsen-Rooney, educational technologies based on artificial intelligence should be prioritized and it is necessary to develop effective strategies to eliminate these challenges (Elsen-Rooney, 2024). Therefore, we have come to the conclusion that it has more positive aspects than negative ones, as this digital tool is pedagogically beneficial, it allows to expand and replenish teachers' methodological thinking, upgrading the necessary skills and competences of the students and teachers. That is why we will proceed the advantages of this neural network highlighting the following:

1) Individualized learning: Twee analyzes information about language skills and professional needs and adapts content to these needs;

2) Adaptive approach: adapts real-time content, offers exercises of varying difficulty depending on the progress and language level (Sysoyev, 2024);

3) Effective communication: it includes tasks aimed at improving professional language skills: conducting discussions and dialogue;

4) Provides interactive content: video and audio allow to immerse oneself in authentic language environment. Twee can also be connected to the digital communication platforms, for example, MTS Link, Zoom, which enhance the interactive and communicative component of the course;

5) The neural network uses a huge amount of data to update knowledge and skills;

6) It saves time;

7) Creation of the material for the four main types of speech activity.

The significance of the present study is, firstly, in the ensuring the opportunities for further research in the development of methodological recommendations to foreign language teaching with the implementation of digital tools and upgrading digital competence, especially digital communicative competence, secondly, in defining the new structural content of the phenomenon under study and enhancing the effectiveness of educational process in general.

The modern use of the Twee neural network in language learning today is the next step in the effective and individualized language learning process in the world where technology is constantly changing the ways how to teach and communicate. Besides, it is also productive in organizing the educational process in cooperation (Khmarenko, 2021). Twee, with its adaptability and personalization of the content (Sysoyev i dr., 2023; Sysoyev, 2023; Fahimirad, 2018), provides an opportunity to create a comfortable and efficient language environment in which students can easily improve their skills in the given professional setting. With such communication platforms as MTS Link and Zoom, it also promotes fast and effective communication, expanding the area of its application. The implementation of digital tools into the language learning process of students of non-linguistic specialization will contribute to the formation of digital competencies (Sysoyev, 2024a), in particular, digital communicative competence, as it was presented in the survey.

Taking into consideration the fact that our research problem hasn't been widely studied by other scholars, we can't compare it with any other results in this field. And we can predict that further research is possible in the development of individual teaching methods of foreign languages and digital competences too.

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Cooperation between Parents and Teachers in the Early Identification of Mental Disorders and Problem Behaviour of Pupils at the Primary Level of Education

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Abstract

The increase in the incidence of mental disorders and problem behaviour in students and their negative impact on their social life in the classroom and academic performance require increased attention to diagnosing various attributes of children's mental health. The first level of primary school is an ideal environment for implementing screening procedures to detect early symptoms. The aim of our contribution was to identify how to combine the views of teachers and parents on the child's behaviour in diagnosing mental health problems and behaviour disorders. Therefore, we compared and analysed the views of teachers and parents on the symptoms of mental and behavioural problems of students using the SDQ questionnaire. The results of our research confirmed the usefulness of using multiple informants in school screening and, in the context of the findings, we were able to identify ways to combine the teacher and parent perspectives in diagnosing externalizing and internalizing manifestations of sleep problems in primary school students.

Keywords: mental health, mental disorders, behavioural disorders, externalizing and internalizing behaviour problems, SDQ.

1. Introduction

The incidence of mental health problems and disorders in children and adolescents under 18 years of age has increased significantly in the 21st century (Boleková et al., 2022; Saurabh,

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Ranjan, 2020). According to a meta-analysis conducted by Polanczyk et al. (2015), the prevalence of mental health disorders in this age group is 13 %. According to other international studies, the prevalence of behavioural disorders from 5 to 16 years of age is between 10 % and 20 % (Horňáková, 2016; Ogundele, 2018; Vágnerová, 2014). In some countries, it has climbed even higher during the COVID-19 pandemic, reaching 47.83 % (Marques de Miranda et al., 2020). Therefore, it is important to assess the level of behavioural manifestations of children and adolescents using reliable tools and to identify potential mental problems and disorders early (Boleková et al., 2022; Feeney-Kettler et al., 2011; Kožárová et al., 2014; Kožárová-Ceľuchová, 2018; Lipnická, 2014).

Research findings have confirmed that late-diagnosed mental disorders lead to a deterioration in quality of life in several areas: deterioration in academic functioning (Busch et al., 2017), the quality of interpersonal relationships (Ogundele, 2018), the development of additional psychiatric morbidity and unhealthy lifestyles (Trebatická et al., 2017). Unidentified emotional and behavioural problems increase the likelihood of developing additional disorders (Campbell et al., 2006; Costello et al., 2003, Essex et al., 2009). On the contrary, early intervention can prevent the development of serious mental health problems (O'Connell et al., 2009). Therefore, there is currently a great interest among researchers in better understanding the phenomenology of mental disorders and problem behaviour in order to prevent their onset or to mitigate their adverse consequences (e.g. Arslan, 2018; Merikangas et al., 2009; Willner et al., 2016). However, this can only be achieved through high-quality and timely diagnostics, because timely and correct diagnostics and subsequent intervention are the basis for the effective implementation of the educational process, as well as for improving the overall quality of life of students (Borbélyová, 2021; Kessler et al., 2007; Miňová, 2024).

Diagnostic activities in the school environment are often limited to the issue of assessing the academic success of a student, despite the fact that in today's schools, teachers are exposed to many problematic situations of students every day, associated not only with educational but also with educational character. Therefore, in addition to diagnosing the success of school results, monitoring mental health, manifestations of behavioural disorders, internalizing and externalizing behavioural problems of students should also form an integral part of diagnostic practice. According to Hennelová (2022), nowadays the need to diagnose various attributes of supporting the development of children's mental health is significantly increasing.

In order to correctly diagnose the occurrence of mental problems and disorders, it is necessary to consider the different influence of the school and home environment on the mental health and behaviour of the child. When identifying the manifestations of mental health disorders and the causes of problematic behaviour in students, researchers prefer to obtain information from teachers, as they consider them to be privileged informants (Fonseca, Simões, 2004; Rescorla et al., 2012). The team emphasizes the influence of the school environment, which can lead to a distorted view of the causes of the student's mental problems and disorders and reduce the effectiveness of the intervention. The home environment, in which the child spends more time than in the school environment, has a significant impact on the child, i.e. on his mental health and behaviour, and therefore the involvement of parents in the diagnostic process can complete the view of the child and his problems. However, there are relatively few studies that examine the issue of mental health and child behaviour in parallel from both perspectives, i.e. comparing the views of parents and teachers (e.g. Firmin et al., 2005; Santos et al., 2020). Therefore, the aim of our research was to identify how to combine the views of teachers and parents on child behaviour in diagnosing mental health problems and behavioural disorders.

2. Literature review

Mental, behavioural, or neurodevelopmental disorders (which form a common category according to the ICD-11 classification) are syndromes characterized by clinically significant impairment in cognition, emotional regulation, or behaviour of an individual. These disorders reflect dysfunction in the psychological, biological, or developmental processes that underlie mental and behavioural functioning. These disorders are usually associated with distress or impairment in personal, family, social, educational, occupational, or other important areas of functioning of the individual. Mental, behavioural, and neurodevelopmental disorders are syndromes characterised by clinically significant disturbance in an individual's cognition, emotional regulation, or behaviour that reflects a dysfunction in the psychological, biological,

or developmental processes that underlie mental and behavioural functioning. These disturbances are usually associated with distress or impairment in personal, family, social, educational, occupational, or other important areas of functioning (ICD-11..., 2024).

Conduct disorders, affective disorders and socialization disorders have an impact on the social relationships of the student in the school environment, on his school performance and learning outcomes (DiLalla et al., 2004; Lane et al., 2008; Busch et al., 2017; Ogundele, 2018; Smith et al., 2014) and also on his academic success in the later period (Breslau et al., 2009). Research has revealed that the above disorders have an impact not only on the socialization of the student in the classroom at the beginning of his education but also determine his later success at further levels of education (Verhulst, 1994), as well as his application in life.

Mental health problems in children and adolescents include several types of emotional and behavioural disorders, including disruptive, depressive, anxiety, and pervasive developmental (autistic) disorders (Ogundele, 2018). These disorders manifest in two distinct behavioural dimensions: internalizing and externalizing behavioural problems (Ciccheti, Toth, 2014; Mazzucchelli, Sanders, 2018). These dimensions form distinct categories of behavioural symptoms and mental disorders depending on the extent to which they affect the individual's experience and those around them (Willner et al., 2016).

Externalizing behaviours, which manifest as inappropriate, outward-facing behaviours, negatively impact the individual's environment and often lead to problems in many areas of life for students, especially in the school environment. They can most often be observed in the form of behavioural problems and inattention with hyperactivity (Wang et al., 2017). Attention deficit hyperactivity disorder (ADHD), oppositional defiant disorder, and conduct disorder are the most commonly diagnosed mental disorders with externalizing behavioural symptoms (King et al., 2018). Research has confirmed a higher incidence of externalizing behaviours in boys than in girls (King et al., 2018; Matos et al., 2017). Some research has revealed a negative impact of externalizing behaviours on the cognitive, emotional, and social functioning of children and adolescents (e.g. Mazzucchelli, Sanders, 2018; Van Lier et al., 2012). Internalizing behaviours (directed inward) are characterized by social withdrawal, fear, or sadness (Achenbach, Rescorla, 2001). They are characterized by an internal experience of tension, uncertainty, and suffering and manifest in the form of self-focused behaviour, anxiety, and depression (Kožárová et al., 2014; Törő et al., 2023). Persistent internalizing behaviours negatively affect the individual on the cognitive, emotional, and social levels and are associated with, among other things, reduced school achievement, school inclusion, poorer physical health, and lower personal well-being (Arslan et al., 2020; Barker et al., 2019; Pate et al., 2017; Spiroiu, 2018). The longer persistence of internalizing manifestations is due to their inconspicuousness and the fact that they do not have a disruptive effect on the student's surroundings. According to Kožárová et al. (2014), these manifestations are only noticed by teachers or parents when their manifestations are intense and very frequent.

Research has also confirmed that there is a certain connection between internalizing and externalizing manifestations of problem behaviour. Children with externalizing manifestations of behaviour are predisposed to the later development of internalizing manifestations (Willner et al., 2016; Matos et al., 2017). The occurrence of externalizing symptoms after the initial onset of internalizing manifestations is also supported in the literature (Willner et al., 2016), although to a lesser extent. It has been found that internalizing manifestations in childhood are related to externalizing manifestations at the age of nine, but also that externalizing manifestations at the age of five are related to more intense manifestations of internalizing behaviours at the age of 9 (Wiggins et al., 2015). Internalizing and externalizing manifestations of problem behaviour in children can also be a predictor of mental disorders in late adolescence and adulthood, as most adults with a psychiatric diagnosis were first diagnosed in childhood and/or adolescence (Arslan, 2018; Copeland et al., 2009). Fifty percent of mental health problems are detected by the age of 14 (Mental health statistics, 2024). Epidemiological studies have also pointed out that most mental disorders have their onset in childhood and adolescence (Kessler et al., 2007; Merikangas et al., 2009). For example, in Slovakia, in the group of children under 14 years of age in 2021, the most common group of diagnoses detected for the first time in life were conduct disorders and emotional disorders with a usual onset in childhood (ICD-10 dg. F90.0 – F98.9). The above groups of diagnoses accounted for 49.4 % of all newly diagnosed mental disorders in this age category (Gécziová, 2023).

Worldwide, the most common mental disorders are anxiety disorders, followed by conduct disorders and affective disorders (Merikangas et al., 2009; Thalappillil, Jimmy, 2014; Interactive Data Query..., 2025; Data and Statistics..., 2025), depression and eating disorders (Lemešová, Sokolová, 2023). The level of depression and anxiety in 6–21-year-olds in Europe has ranged between 12 % and 48 % in recent years. This is according to a meta-analysis of fifty-one studies (Margques de Miranda et al., 2020). This is likely related to the significant increase in internalizing and externalizing behaviour problems in children and adolescents in the 2020s, due to the Covid-19 pandemic (Crescentini et al., 2020; Margues de Miranda et al., 2020). However, the age and gender prevalence estimate of various childhood behavioural disorders are variable and difficult to compare worldwide, as both poverty and low socioeconomic status are risk factors that appear to increase the prevalence of these disorders (Ogundele, 2018).

The increased incidence of the above manifestations is also present in students with disabilities, to a greater extent than in intact children. Numerous studies have pointed out a number of problems related to the emotional and social aspects of the education of students with disabilities (Butler, Silliman, 2008; Elias, 2004; Schiff, Joshi, 2016). It has also been found that students with learning disabilities exhibit problematic behaviour of both externalizing and internalizing nature to varying degrees and intensity (Zemančíková, 2022).

For the above reasons, there is currently a growing interest among educators in learning about the individual characteristics/specificities of a child (Borbélyová, 2021), including various mental health attributes that affect the learning process and the overall functioning of a child in the school environment (Smith et al., 2014). Researchers, as well as teachers, are aware that diagnostic activities in the school environment help to describe and define the causes, manifestations, and consequences of children's difficulties and that their results are important in terms of providing follow-up care and support measures (Vojtová et al., 2023). It is true that the diagnostic competencies of pedagogical staff are included among the key competencies of teachers (Spilková, Vašutová, 2008), however, there are certain competence boundaries/restrictions that are based on the teacher's competence profile and limit the application of diagnostic tools. This means that psychodiagnostics can only be performed by a psychologist and a teacher is only competent to perform pedagogical diagnostics. However, the identified increase in the incidence of mental disorders in children and their negative impact on their social life in the classroom and academic performance require that monitoring of the mental health of students in the school environment be part of the diagnostic process.

Therefore, there is currently a great interest in better understanding the phenomenology of mental disorders and problem behaviour to prevent their onset or to mitigate their adverse consequences (e.g. Arslan, 2018; Willner et al., 2016). In particular, early, and effective identification of problematic symptoms is very important, as it can contribute to the creation of a preventive strategy aimed at supporting at-risk individuals (Powell, 2006). However, this can only be achieved through high-quality and timely diagnostics, not only by psychologists, who do not have such wide opportunities to monitor the behaviour of a student in a collective as a teacher during classes or a parent in a home environment.

There are many studies focusing on student behaviour (e.g. Bellová, 2024; Emmerová, 2022; Oliver et al., 2011; Tišťanová, 2018), but this dimension is mostly examined from the perspective of teachers (Ottenheym-Vliegen et al., 2023; Pašková et al., 2018). When identifying manifestations of mental health disorders in students, researchers consider teachers to be privileged informants, primarily due to their experience with assessing student behaviour (Fonseca, Simões, 2004, Rescorla et al., 2012). The reason is also that information can be obtained from them relatively easily (Laidra et al., 2006) and they are considered experts in the field of upbringing and education (Kurincová, Turzák, 2021) and professionally trained observers of children's social interactions in a structured environment (Santos et al., 2020). Teachers also often perceive themselves as sufficiently competent to assess not only a child's educational progress, but also their development. There are fewer scientific studies that deal with student behaviour based on parental perceptions (Ciceková et al., 2021). This is even though information from parents is considered an important source of information about children's behaviour problems (Fonseca, Simões, 2004). One of the reasons for the lower involvement of parents in diagnosing mental health disorders in students is the tendency of parents to "over-report" symptoms... symptoms of behavioural disorders in their children (Strickland et al., 2012). Several research studies suggest that parents tend to judge their children's behaviour more negatively than teachers (Grigorenko et al., 2010; Huang, 2017) and

report higher levels of externalizing and internalizing problems in their children compared to teachers (Stone et al., 2013). Other studies have reached similar conclusions in the context of examining children's externalizing problems (Salbach-Andrae et al., 2009; Rosnati et al., 2010). On the other hand, according to some experts, parents have an increased tolerance of certain types of behaviour (Loeber, et al., 1990; Al-Awad, Sonuga-Barke, 2002), which can lead to ignoring the first signs of behavioural disorders. Perhaps for these reasons, parents' perception of the child is often considered unprofessional and biased (Kurincová, Turzák, 2021).

However, to gain a comprehensive picture of a child's behaviour, it is important to know how they behave in different environments, especially in those that will most influence their development in childhood – the home and school environment (Bertrand et al., 2007). A child's behaviour is often specific to a given situation or context. Therefore, behaviour or expressed emotions may differ in different environments (Santos et al., 2020). At the same time, some challenging situations can only be effectively addressed in cooperation with parents, and some behavioural symptoms are better observed in the home environment. Several experts also strongly recommend assessing children's problems using multiple informants (Achenbach, 2006; De Los Reyes, Kazdin, 2005; Grigorenko et al., 2010). The suitability of a parent as an additional informant is also supported by the fact that the development of some behavioural disorders (e.g., the development of aggression) is related to the type of family environment (Brown, 2009).

Culp et al. (2001) emphasized that multiple assessor perspectives are essential to ensure accurate diagnosis and to support individuals at risk in making the correct diagnosis. Multiple informant assessments can not only provide a deeper understanding of the nature, extent, and severity of the problem, but can also help reduce the risk of misdiagnosis (Kagan et al., 2002). This is even though inconsistencies between informant assessments often occur (Achenbach, 2006; De Los Reyes, 2011). In nonclinical studies, there is a tendency for inter-rater agreement to be low to moderate and for there to be relatively high inconsistencies between informants (Cheng et al., 2017; Santos et al., 2020). Regarding children's behavioural problems or their social skills, several clinical studies demonstrate these discrepancies, revealing no agreement or low to moderate levels of convergence between parent and teacher ratings (Althoff et al., 2010; Huang, 2017; Rescorla et al., 2014; Sointu et al., 2012). Disagreements may reflect differences between raters due to pre-established expectations regarding the child's behaviour, or their opinions may be influenced by factors such as culture, relationship with the child, stereotypes, low tolerance for certain behaviours, and a tendency to underestimate problems (Efstratopoulou et al., 2012). The difference between informants may also be related to the psychopathology of parents: depression and stress in mothers are associated with distorted perceptions of their children's problems, which are often not confirmed by teachers (De Los Reyes, Kazdin, 2005). Despite the possible differences between teacher and parent raters, both views of a child's behaviour can be an important source of information in diagnosing a student. Comparing the assessment of a child's behaviour with the teacher's assessment can provide a better basis for creating support measures, or, if necessary, for finding the optimal fulfilment of the student's special educational needs. Therefore, the aim of our research was to identify the possibilities of combining teacher and parent perspectives on a child's behaviour in diagnosing mental health problems and behavioural disorders.

3. Research methodology and methods

Despite the fact that parental and teacher assessments of children's behaviour using questionnaires are among the most common methods of assessment during childhood (Crane et al., 2011), there are few studies in Slovakia that examine the issue of mental health and child behaviour in parallel from both perspectives, comparing the opinions of parents and teachers. Several foreign studies are devoted to a deeper examination of the issue from this perspective, e.g. Firmin et al. (2005), Cheng et al. (2017), Koumitzi et al., (2024), Santos et al. (2020) and so on. The aim of our research was to analyse and compare the views of teachers and parents on mental health problems and problematic behaviour of pupils in Slovakia. The research group consisted of six teachers, 104 parents (mothers) and their children. Both parents and teachers participated in the research voluntarily and were assured of the anonymity of the research. Since we focused on assessing some internalising and externalising behaviour problems in children, we used the standardised SDQ questionnaire by Goodman et al. (1998) as a research tool. This is a behavioural questionnaire aimed at screening the behaviour of children and young people aged 4 to 17. The SDQ questionnaire is divided into five dimensions: emotional symptoms Emotional Symptoms

score (D1), peer problems Peer Problems score (D4) (together indicating internalizing problems), conduct problems Conduct Problems score (D2), hyperactivity Hyperactivity score (D3) (together indicating externalizing problems) and prosocial behaviour Prosocial score (D5). The task of parents and teachers was to evaluate the behaviour of a total of 104 students who completed primary education in the 2023/24 school year (grades 1-4) using the SDQ questionnaire. For each item of the questionnaire, they selected one of three possible answers: 0 – not true , 1 – rather agree/sometimes/partially Somewhat true, 2 – certainly true. Parents assessed only their children and teachers only the children they taught. The data obtained using the questionnaire method were subsequently analysed using selected statistical methods.

4. Results

The primary goal of the research using the standardized SDQ questionnaire was to determine whether parents perceive their children in the same way as their teachers. Given that the questionnaire is divided into five dimensions, we used the semantic differential method (Charles E. Osgood to analyse the data obtained using the questionnaire method.

Using the semantic differential method, we can define the distance between the observed concepts A and B. The distance between the concepts *A, B* can be assessed using D_{AB}, which is defined by the formula $D_{AB} = \sqrt{\sum_{i=1}^{k} d_i^2}$,, where $d_i$is the difference of the average values in the ith scale (question) (Reiterová, 2003). D_{AB} statistic is a simple measure expressing the linear distance between the concepts *A, B*. The lower the value of D_{AB}statistic, the smaller the distance between the concepts *A, B*. Conversely, a higher value of D_{AB}statistic means a greater distance between the concepts *A, B*. In addition to D_{AB}statistic, semantic differential data can also be analyzed using the so-called Q-correlation ([ ]), which is a certain modification of the product correlation and expresses the degree of similarity of two profiles. From the degree of similarity of the profiles, one can infer the similarity in the understanding of concepts. We express the Q-correlation using the correlation coefficient Q_{AB}, which is defined by the formula

$$Q_{AB} = 1 - \frac{\sum_{i=1}^{k} d_i^2 - k(\bar{x}_A - \bar{x}_B)^2 - (\sigma_A - \sigma_B)^2}{2k \cdot \sigma_A \cdot \sigma_B}.$$

The correlation coefficient Q_{AB} takes values from the interval ⟨-1,1⟩. Its values are interpreted in the same way as the values of the Pearson correlation coefficient. The value 1 indicates perfect agreement in the understanding of the concepts *A, B*, the value -1 means completely opposite understanding of the concepts. A zero value of the coefficient Q_{AB}means zero agreement in the understanding of the concepts *A, B*. A higher absolute value means a closer dependence in the understanding of the concepts *A, B*.

In the following, we will calculate the values of the correlation coefficient Q_{AB} for the considered pairs of concepts *A, B*.

First, we analysed each observed dimension separately using the semantic differential method. In all dimensions, we calculated the average score for each item that belongs to it. Then, we determined the distance of children's perception in a given dimension between parents and teachers using D_{AB} statistic. A large value of D_{AB} statistic does not necessarily automatically mean conflicting perceptions of children by parents and teachers. Therefore, we used the so-called Q-correlation to determine the degree of similarity of children's perceptions by parents and teachers. For individual dimensions, we calculated the values of the correlation coefficients Q_{AB}, which are listed in Table 1.

Table 1. Q-correlation parents and teachers

Dimension	Q_{AB}
Emotional symptoms	0,922301
Behavioural problems	0,873305
Hyperactivity	0,981207
Peer problems	0,998246
Prosocial behaviour	0,976345

Table 1 shows that there is a high level of positive correlation between the perceptions of children by parents and teachers. This means that if parents identified symptoms of internalizing or externalizing behaviour problems in their child's behaviour, their child's teacher also identified these symptoms. Despite the high correlation in the responses of parents and teachers, statistically significant differences were found between the parent's and teacher's views of the child's behaviour in three of the five dimensions. The largest difference was recorded in dimension D1 – Emotional symptoms (Figure 1), where D_{AB} statistic had a value of 1.046.

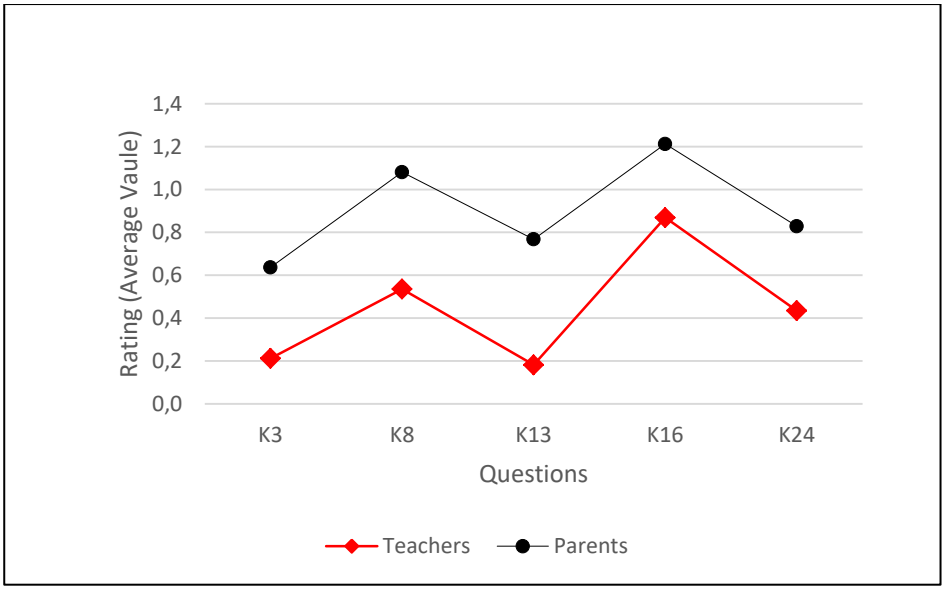

Fig. 1. Average response values in dimension D1

Figure 1 shows that in dimension D1 (Emotional symptoms) potential behavioural disorders of children were rated in all items with higher average scores by parents than by teachers. The largest difference between the evaluations of parents and teachers was recorded for item K13 (Is often unhappy, depressed, or sad). An interesting finding is that this item had the lowest average score for teachers, but not for parents.

We found a similarly large distance between the responses of parents and teachers in dimension D5 – Prosocial behaviour (Figure 2). In this case, D_{AB} statistic had a value of 0.950.

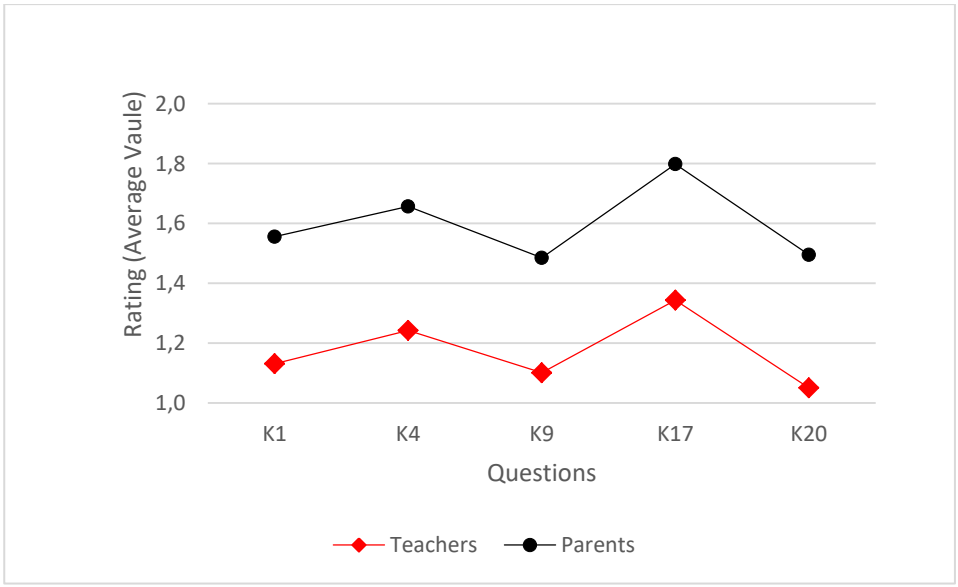

Fig. 2. Average response values in dimension D5

Figure 2 shows that in dimension D5 (Prosocial behaviour) parents' ratings have higher average scores than teachers' in all items. In all items we recorded approximately the same difference in the responses of parents and teachers. An interesting finding is that the lowest average score for teachers was item K9 (If someone hurts him, he is sad or feels bad, but is always willing to help), which corresponds to item K13 (He is often unhappy, depressed or sad) from dimension D1, which also had the lowest average score for teachers.

A slightly smaller distance between the responses of parents and teachers was in dimension D2 – Behavioural problems (Figure 3), with the value $D_{AB} = 0.654$.

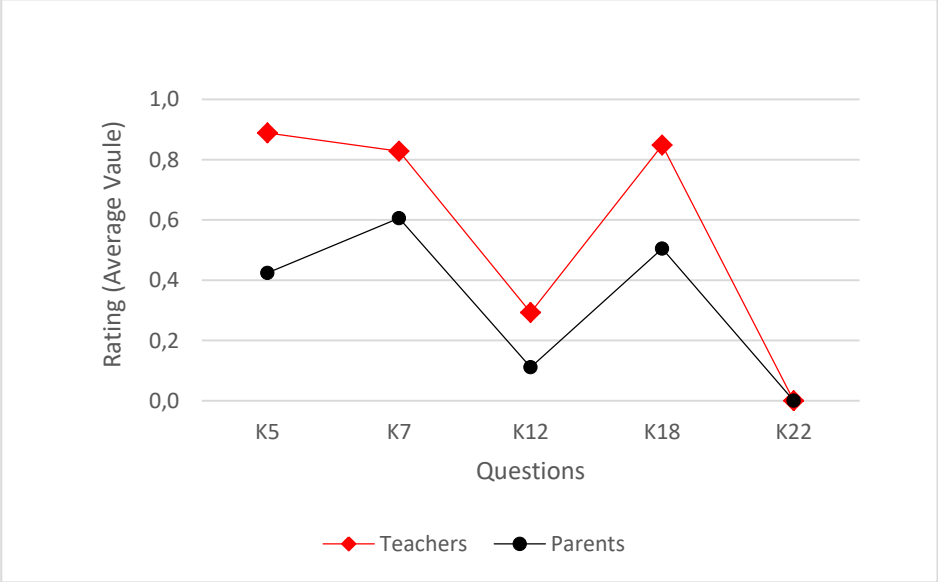

Fig. 3. Average response values in dimension D2

From Figure 3 we can see that teachers achieved higher average scores in dimension D2 (Behavioural problems), in all items, except item K22. This finding, also considering the nature of the questions, indicates that potential behavioural disorders are more evident in the school environment. It is interesting that the largest distance was recorded for item K5 (Often has fits of anger or explosive mood), which is a manifestation of negative emotions. This item had the highest score for teachers, and the third highest score for parents.

In the remaining two dimensions D3 – Hyperactivity (Figure 4) and D4 – Problems with peers (Figure 5), no significant differences were found in the responses of parents and teachers.

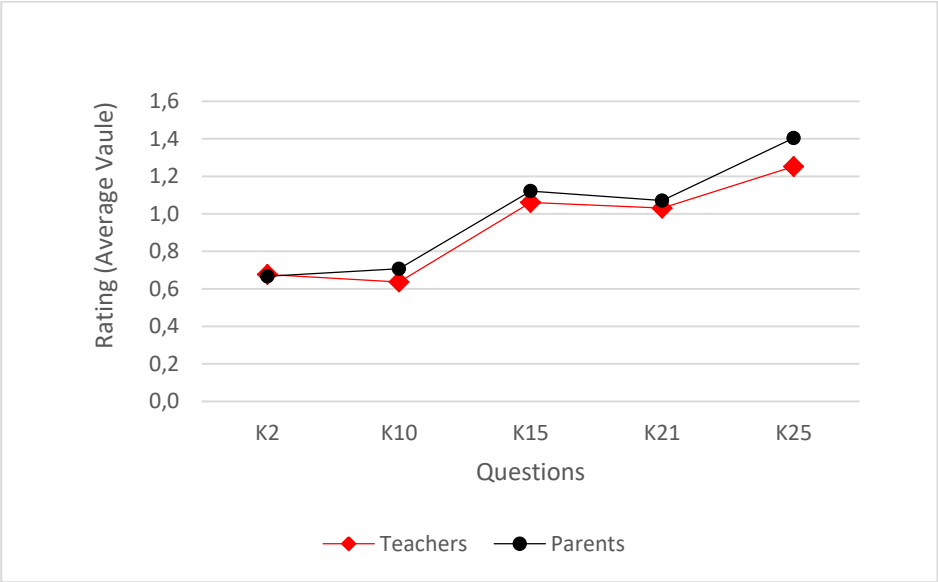

Fig. 4. Average response values in dimension D3

Although no significant differences were found in the ratings of parents and teachers in dimension D3 (Hyperactivity), a significant difference was noted in the responses of teachers and parents for item K25 (Perseveres to the end when completing a task).

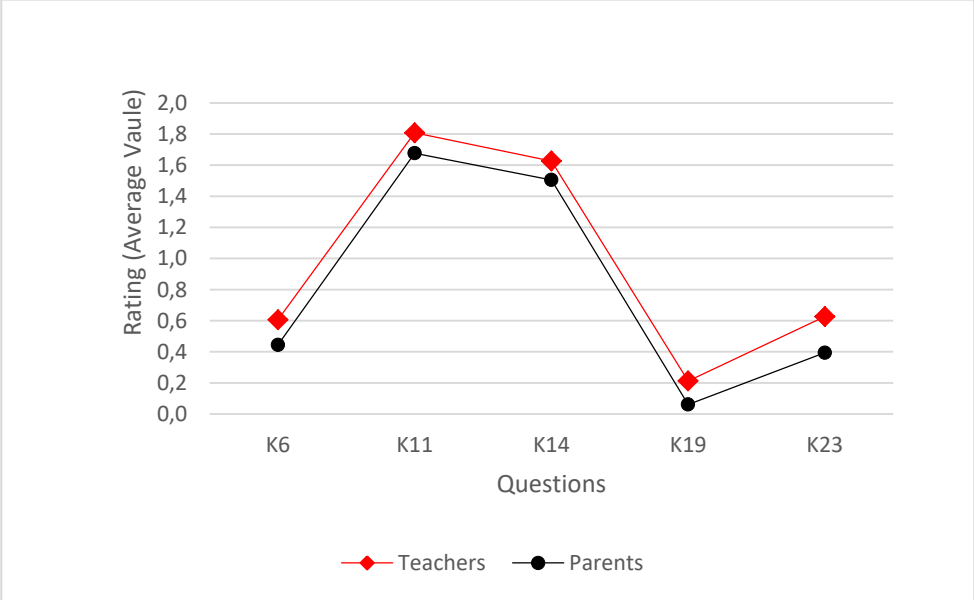

Fig. 5. Average response values in dimension D4

5. Discussion

The primary goal of our study was to identify the possibilities of combining the views of the teacher and the parent on the child's behaviour in diagnosing some mental health problems and behavioural disorders in children. By evaluating the data obtained using the standardized DMQ questionnaire, we found a high level of positive correlation between the parent's view of the manifestations of mental health disorders and problematic behaviour of their child and the view of their teacher. This finding leads us to the conclusion that internalizing and externalizing manifestations of problematic behaviour in students are manifested approximately equally in the home and school environment. This finding corresponds to other research results conducted in this area (Huang, 2017; Laidra et al., 2006; Park et al., 2010; Rescorla et al., 2014; Rosnati et al., 2010; Salbach-Andrae et al., 2009; Sointu et al., 2012). However, there are also research results in which the authors revealed no agreement (Kasik, Gál, 2016) or a low to moderate level of convergence between parent and teacher assessments (Althoff et al., 2010; Huang, 2017; Rescorla et al., 2014; Sointu et al., 2012). This finding can be supplemented by another finding resulting from our research. The high level of positive correlation between the assessment of a child by his parents and his teachers indicates that possible mental disorders or symptoms of problematic behaviour in a child can be observed in parallel and equally relevantly by the child's parents and his teachers. Our research leads us to the conclusion that a parent can be a relevant informant in the assessment of children's problems. Therefore, for the timely and effective identification of problematic symptoms in children, we recommend mutual communication between the child's parents and their teacher. This fulfils the recommendation of experts to use multiple informants in the diagnosis of mental health and behavioural manifestations in children (Grigorenko et al., 2010; Valk et al., 2001).

A more detailed analysis of the individual dimensions revealed that parents perceive some manifestations of mental disorders or elements of problem behaviour more sensitively than teachers and others less sensitively than teachers. Given the statistically significant higher values of parents' responses in dimension D1 and the same values of responses in dimension D4, we conclude that parents can detect the onset of internalizing manifestations of mental disorders or problem behaviour earlier than their children's teachers. The onset of externalizing manifestations, which are formed by dimensions D2 and D3, are detected earlier by children's teachers than by their parents, because in dimension D2, teachers achieved higher average response values than parents. In dimension D3, the average values were the same for both parents

and teachers. These conclusions support the need for cooperation between parents and teachers in diagnosing mental health and problem behaviour in children.

The benefit of this cooperation increases especially in the early diagnosis of emerging problems of the child. Our research shows that the teacher is more likely to notice externalizing manifestations of the student's behaviour and, by consulting with the parent, can gain a more comprehensive view. Internalizing manifestations are probably identified earlier by the parent, and through mutual communication with the teacher, they can diagnose the developing disorder in time and create a preventive strategy to support at-risk individuals. In the context of the above findings, we consider it important to implement school screenings in elementary schools and involve parents in them.

The first grade of primary school is an ideal environment for implementing screening procedures to detect early signs of mental health problems. The results of our research support the claims of experts about the usefulness of using multiple informants in school screening (e.g. Grigorenko et al., 2010; Brown, 2009; Kagan et al., 2002). In this regard, we would recommend that further research focus on comparing the views of mothers and fathers, to identify the extent to which the mother and father of the child can be considered different informants in school screening. At the same time, it would be interesting and important to find out to what extent the views of fathers coincide with the views of mothers and teachers, since our research data showed statistically significant differences in three dimensions, which would objectify the data from the third informant (father).

We are aware that anonymity could contribute to a more objective assessment by parents, but we believe that school-based diagnosis, as well as prevention and subsequent intervention, should be targeted. Therefore, we emphasize that the challenge for the future is also to prepare parents to participate in diagnosis, to guide them and inform them so that they do not fear stigmatization of their child. We also recommend their involvement so that they understand that early identification of problems could lead to a reduction in the number of children suffering from psychological problems.

6. Conclusion

The aim of the research was to analyse and compare the views of teachers and parents on mental health problems and problematic behaviour of pupils.

The results of our research point to the fact that in school screening it is important to systematically use multiple informants and acknowledge their different views, because each of them provides unique, diverse, and valuable information about the child's behaviour. We also see the contribution of our contribution in the fact that in the context of the findings we managed to identify ways to combine the views of the teacher and the parent in diagnosing externalising and internalising manifestations of problematic sleeping. We brought a view that is very important from the point of view of pedagogical practice. In an effort to prevent socio-pathological phenomena and subsequent criminality in children and young people, it is necessary to regularly map their mental health and related behaviour, including signs of risky behaviour, also in schools, from the perspective of multiple assessors. Diagnostic activities in schools could be created by cooperation between the teacher and the parents of the child.

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How Psychological Well-Being Affects Patience, Motivation to Teach, and Emotional Exhaustion in Teachers

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Abstract

This research aims to determine the impact and importance of teachers' psychological well-being, patience, motivation to teach, and emotional exhaustion. Correlational research design was used in this research. The population of this study consists of teachers working in Mardin. From this decided study population, 34 schools were randomly selected based on the rule of impartiality. The sample of the research consists of 270 teachers in these schools. The “Flourishing Scale”, “Teacher Patience Scale”, “Motivation to Teach Scale”, and “Emotional Exhaustion Scale” were used to collect the data. Descriptive statistics, validity and reliability analyses, correlation, and structural equation modeling analyses were applied to the data of the study. When the structural model is examined, teachers' psychological well-being statistically significantly and positively affects their patience and motivation to teach, while it negatively affects their emotional exhaustion. Psychological well-being positively affects motivation to teach through the partial mediation effect of teacher patience. Additionally, psychological well-being negatively affects emotional exhaustion partially through motivation to teach. Finally, in the model, it was seen that teachers' psychological well-being perceptions negatively affect emotional exhaustion, partially through the patience and motivation variables. It is considered important to increase the psychological well-being of teachers to improve their positive attitudes.

Keywords: emotional exhaustion, motivation to teach, psychological well-being, teacher patience.

1. Introduction

The teaching profession is a field of work in which one must always be strong psychologically, as well as academically and pedagogically competent. It was stated that enthusiasm and excitement for the teaching profession are related to psychological well-being (Lucas-Mangas et al., 2022).

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Many studies have been conducted on factors that affect teachers' psychological states positively or negatively (Darling-Hammond et al., 2012; Klassen, Tze, 2014). In addition to many variables affecting the psychology of teachers, there are also many variables affected by the psychological states of teachers (Schaufeli et al., 2009). It was found that making teachers feel good psychologically would reduce their negative emotions and increase their positive emotions (Keyes et al., 2002). Psychological well-being consists of autonomy, environmental mastery, individual development, positive relationships with others, life goals, and self-acceptance, which is based on the psychological well-being model developed by Ryff (1989). The positive effects of psychological well-being on the work that individuals do continues to be the subject of further research recently (Cansoy et al., 2020; Greenier et al., 2021; Kurt, Demirbolat, 2019). In this study, unlike other studies, psychological well-being is considered together with several variables. The relationship between psychological well-being and both positive emotions and negative emotions were examined in terms of the teaching profession. The effect of psychological well-being on reducing emotional exhaustion directly and indirectly on patience and motivation to teach was examined.

There are a few studies examining the relationship between psychological well-being and emotional exhaustion (Jeon et al., 2018; Lucas-Mangas et al., 2022). These studies examined direct relationships between psychological well-being and emotional exhaustion. The difference between this study from others is that it also examines the indirect effect of psychological well-being on emotional exhaustion through motivation to teach and patience variables. It is thought that psychological well-being may have an increasing effect on teachers' patience. Patience is seen as one of the most basic emotions of the teaching profession. Since teaching is a very long and arduous job, patience is what teachers need most on this long and arduous journey. It is thought that psychological well-being may increase teachers' patience, and patience may have a reducing effect on teachers' emotional exhaustion. Therefore, it is thought that psychological well-being may have a reducing effect on teachers' emotional exhaustion through patience. Another aspect of the research is that psychological well-being may positively affect teachers' motivation to teach, and motivation to teach may have a reducing effect on teachers' emotional exhaustion. Since patience and motivation to teach are mediating variables, this study tries to reveal a different aspect from other studies examining the relationship between psychological well-being and emotional exhaustion.

When the conceptual developments and definitions of the variables in the research were examined, it was seen that they were evaluated from different aspects by many researchers. Psychological well-being is a concept that includes elements such as an individual's general life satisfaction, positive emotions, a sense of meaning, and positive relationships (Keyes, 2002). Considering this definition, psychological well-being is generally associated with a person feeling mentally, emotionally, and socially healthy. Keyes, (2002) explained the dimensions of mental health and well-being by defining psychological well-being concepts such as "flourishing" and "languishing". Diener and Seligman (2002) contributed to the field of positive psychology and focused on happiness, life satisfaction, and positive emotions. Ryff and Singer (2008) considered psychological well-being as a multidimensional structure and associated it with a person's self-realization and maturation.

Emotional exhaustion is a condition that occurs as a result of a weakened ability to cope with long-term stress, excessive workload, and constant emotional demands (Maslach, Leiter, 1997). In this case, the individual may feel that his emotional energy is decreasing and his interest in work or life is lost. Maslach and Jackson (1981) and Maslach and Leiter (1997) explained emotional exhaustion as work stress and emotional demands consuming employees' energy. Demerouti, Bakker, and Bulters (2014) discussed the balance between job resources and demands and referred to the stress and loss of energy caused by employees' failure to meet demands as emotional exhaustion.

Patience is the capacity to show resilience and calmness required to cope with stressful or challenging situations. Being patient is associated with the ability to control negative emotions. This attitude is often linked to psychological resilience (Kashdan, Rottenberg, 2010). Feldman and Snyder (2005) clarified the relationship between patience and psychological resilience and personal development by focusing on the development of patience and its positive results. Rasmussen and Wrosch (2006) examined the role of patience in coping with stress. They suggested that individuals need to have the ability to cope with stress to postpone their personal goals. Tsukayama and Duckworth (2010) explained patience as the ability to focus on long-term goals, resist, and emotional control against short-term negativities.

Motivation to teach is related to the factors that affect teachers' commitment to their work and the responsibility they feel toward students. A motivated teacher tries to create a more effective learning environment for his students and makes more effort in this direction (Ryan, Deci, 2000). Skinner and Belmont (1993) clarified the impact of teachers on students by discussing motivation to teach in relation to students' learning success. Tschannen-Moran and Woolfolk Hoy (2007) underlined that motivation to teach is linked to self-efficacy in the teaching process, effective classroom management, and student relations. Hargreaves (2000), on the other hand, explained the motivation to teach with teachers' professional development, cooperation, and the responsibility they feel toward students.

No study combined all the concepts examined in this research. However, there are variables whose relationships with each other were examined in pairs. Among these variables, studies presented that psychological well-being is inversely related to emotional exhaustion (Demerouti et al., 2001). There are also studies investigating the connection between patience and emotional exhaustion (Coutu et al., 2017). Studies examining the relationship between motivation to teach and emotional exhaustion are also present in the literature (Bakker et al., 2005).

There are studies examining the relationship between emotional exhaustion and psychological well-being. Among these studies, Maslach and Leiter's (1997) study examined how organizations trigger stress toward individuals and how this situation leads to emotional exhaustion. This study highlights the impact of job stress and organizational factors on individuals' emotional exhaustion.

Bakker and Costa (2014) conducted a theoretical analysis. This analysis examined the effects of chronic workplace exhaustion on daily functioning and the long-term effects of emotional exhaustion on daily life. This study explained how exhaustion affects practical life and how it affects the individual's daily life. In their research, Keyes and Simoes (2012) examined how psychological well-being can be associated with general life satisfaction and mental health and the effects of this on the general health status of individuals. Demerouti, Bakker, and Bulters' (2014) study addressed the feedback loop between work pressure, work-life balance disorder, and exhaustion. This study presented how work pressure and work-life imbalance influence each other, resulting in a cycle of exhaustion. Schaufeli and Taris's (2005) study examined how the concept of exhaustion can be conceptually handled and what common points there are in its measurement. This study aimed to better explain the general meaning of the concept of exhaustion by discussing different approaches and measurement methods. As can be seen in the above studies, the negative effects of exhaustion on the lives and psychological well-being of individuals and employees were examined in general. The present study examined how the psychological well-being of individuals and employees may affect emotional exhaustion.

There are also a few studies in the literature examining the relationship between patience and emotional exhaustion. The study conducted by Rasmussen and Wrosch (2006) examined the effects of a long-term perspective on the adaptation process to aging. This study examines the effects of a long-term perspective (which can also be thought of as patience) on elderly care. It focused on how this perspective impacts caregivers' emotional exhaustion levels. Long-term thinking can help people better cope with challenging situations and decrease the risk of emotional exhaustion. In another study, the connection between patience and emotional exhaustion was discussed, based on time-based discounting and compassion (Tsukayama, Duckworth, 2010). Patience involves dealing with such challenges, often regarding the priority of long-term rewards and satisfaction. This study examined the relationship between the ability to show patience in different areas and emotional exhaustion. Both studies help us understand this relationship by using different approaches when examining the effects of patience (the balance between long-term thinking, time-related considerations, and immediate gratifications) on emotional exhaustion. Additionally, it appears that both studies were not conducted specifically for educational organizations. From this perspective, it is thought that the present study would be both new and interesting to study these subjects on teachers.

Some studies encountered as a result of the literature review examined the relationship between motivation to teach and emotional exhaustion from different perspectives. In their study, Bakioğlu and Kandemir (2018) discussed the relationship between teachers' motivation to teach and emotional exhaustion with a qualitative research method. This study examined the relationship between motivation to teach and emotional exhaustion through in-depth interviews and analyses with teachers. In another study, the relationship between motivation to teach and

emotional exhaustion was examined by focusing on social studies teachers (Kurtuluş, 2016). This study, conducted specifically for social studies teachers, aimed to understand the effects of motivation to teach and emotional exhaustion on this specific group of teachers. In the study conducted by Saka and Gürbüz (2014), the relationship between primary school teachers' motivation to teach and emotional exhaustion levels was discussed. These studies aimed to understand this relationship in depth by examining the relationship between motivation to teach and emotional exhaustion across different teacher groups or specific teaching areas. In these studies, motivation to teach was considered as the main variable. In the present study, motivation to teach was considered as a mediating variable of psychological well-being. In this respect, the current study addressed a different and unexamined point in the field.

2. Methods

2.1. Research Design

In the present study, the relationships between psychological well-being, patience, motivation to teach, and emotional exhaustion were examined. Therefore, this research was shaped by the requirements of the correlational research design in which the relationships between variables were determined through scales (Büyüköztürk et al., 2012). Additionally, this model can provide insight into the cause-effect relationship between variables (Fraenkel et al., 2012). In this study, it was aimed to determine the relationship between teachers' psychological well-being perceptions and their perceptions of patience, motivation to teach, and emotional exhaustion. Based on the main purpose of this research, the following hypotheses in Figure 1 were tested:

H1: Teachers' perception of psychological well-being negatively affects their perception of emotional exhaustion.

H2: Psychological well-being has a negative effect on emotional exhaustion through the partial mediation effect of patience and motivation to teach variables.

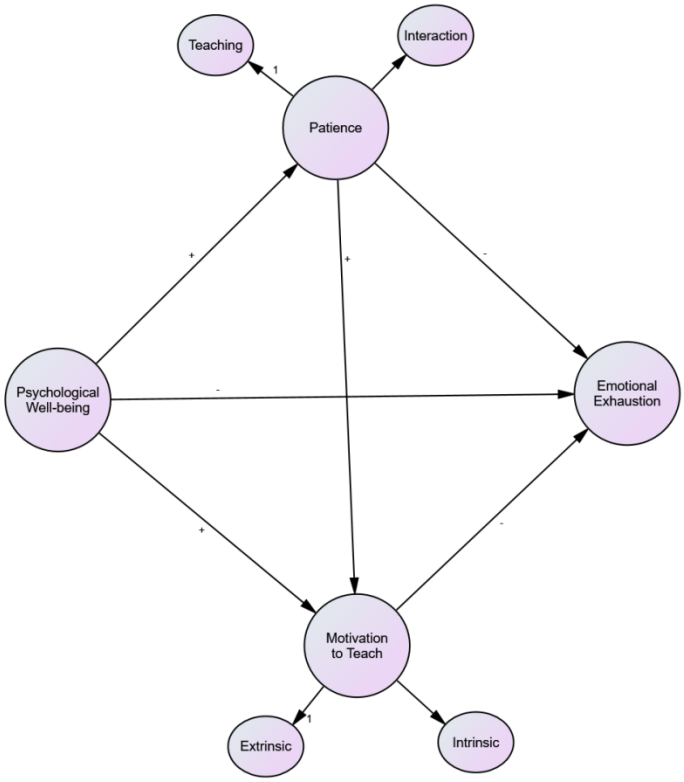

Fig. 1. Hypothesis model

2.2. Population and Sample

The population of this study consists of teachers working in Mardin From this decided study population, 34 schools were randomly selected based on the rule of impartiality. While selecting these schools, care was taken to reach the minimum required number of participants. A form containing personal information and scales was delivered to the teachers in these selected schools. The sample of the research consists of 270 teachers in these schools. Therefore, in this study, the disproportionate cluster sampling method, which is expressed in the form of unbiasedly determined groups forming the sample, was adopted. This sample number reached in the research was considered sufficient at the 95 % level (Field, 2009).

While 40 % of the participants were female (n = 108), 60 % of them were male (n = 162). 63 % of these participants were married (n = 170), and 37 % of them were single teachers (n = 100). 36.3 % of the participants were between the ages of 21 and 30 (n = 98), 45.6 % of them were between the ages of 31 and 40 (n = 123), and 18.1 % of them were between the ages of 41 and over (n = 49). 58.5 % of the participants were in the professional seniority range of 1-9 years (n = 158), 26.7 % of them were in the 10-18 years (n = 72), and 40 % of them were 19 years and higher (n = 40). 27 % of the teachers were working at primary schools (n = 73), 34.8% of them were working at secondary schools (n = 94), and 38.1 % of them were working at high schools (n = 103).

2.3. Data Collection Tools

Ethics committee approval for this study was received from Şırnak University's Ethics Committee with the decision numbered 67957 on 16.06.2023 (Document Date and Number: 16.06.2023-E.70100). The data of this research were collected through five-point Likert-scored scales. Detailed information about the scales is presented below.

Flourishing Scale: In this study, the "Flourishing Scale" developed by Diener et al. (2010) was used to clarify the psychological well-being levels of teachers. The scale was adapted into Turkish by Telef (2013). Psychological well-being was measured with 8 items on the scale. The scale has a one-dimensional structure. Scoring of scale items varies between "I totally disagree: 1" and "I totally agree: 5". Confirmatory factor analysis (CFA) applied to this research data showed that the one-dimensional factor structure of the scale was at good (X^2 = 29.38, df = 13, X^2/ df = 2.26, P = .00, GFI = .97, IFI = .97, TLI = . 96, CFI = .97) and acceptable (RMSEA = .06) levels. In the reliability analysis applied in the context of this study, Cronbach's Alpha Reliability Coefficient was determined to be .86.

Teacher Patience Scale: The "Teacher Patience Scale", used to determine teachers' patience levels according to their perceptions, was developed by Meriç and Erdem (2022). The scale consists of two subscales: teaching and interaction. The scale is rated between “Never: 1” and “Always: 5”. CFA results applied to the data set obtained within the scope of this research show that the two-dimensional factor structure produces good-level goodness of fit values (X^2 = 81.03, df = 42, X^2/ df = 1.92, P = .00, GFI = .987, IFI = .97, TLI = . 96, CFI = .97, RMSEA = .05). Cronbach's Alpha Reliability values of the scale within the scope of this research were calculated as .86 for the teaching subscale, .84 for the interaction subscale, and .89 for the entire scale.

Motivation to Teach Scale: The "Motivation to Teach Scale", which was used to determine teachers' perceptions of their motivation to teach, was developed by Kauffman, Yılmaz-Soylu, and Duke (2011). The adaptation of the scale to Turkish culture was carried out by Ayık, Akdemir, and Seçer (2015). The scale consists of two dimensions: intrinsic motivation and extrinsic motivation. The rating of the scale varies between "I completely disagree: 1" and "I completely agree: 5". The CFA results conducted within the scope of this research clarified that the two-dimensional factor structure of the scale produced good-level goodness of fit values (X^2 = 20.05, df = 12, X^2/ df = 1.67, P = .06, GFI = .97, IFI = .98, TLI = .98, CFI = .98, RMSEA = .05). The Cronbach's Alpha Reliability coefficients of the scale within the scope of this research were calculated as .77 for the subscale of extrinsic motivation, .79 for the subscale of intrinsic motivation, and .87 for the entire scale.

Emotional Exhaustion Scale: In this study, data was collected using the "Emotional Exhaustion Scale", a subscale of the Maslach Burnout Inventory (Educator's Survey), to determine teachers' emotional exhaustion levels. Scoring of the scale items varies between "Never: 1" and "Always: 5". The goodness of fit values obtained in the CFA results indicate that the factor structure of the scale is at good (X^2 = 4.34, df = 2, X^2/ df = 2.17, P = .11, GFI=.99, IFI = .99, TLI = .97, CFI = . 99) and acceptable levels (RMSEA = .06) with the data. The Cronbach's Alpha Reliability coefficient of the scale was found to be .78.

2.4. Analysis

The quantitative data obtained within the scope of the research were checked for normality assumption. For this purpose, the skewness and kurtosis coefficients of the data were calculated. In the flourishing scale, the skewness coefficient was calculated as -.42, and the kurtosis coefficient was calculated as .04; in the teacher patience scale, the coefficient of skewness was calculated as -.03, and the coefficient of kurtosis was calculated as -.72; in the motivation to teach scale, the skewness coefficient was calculated as -.43, the kurtosis coefficient was calculated as -.24; in the emotional exhaustion scale, the skewness coefficient was calculated as .34 and the kurtosis coefficient was calculated as -.15. The fact that the skewness and kurtosis coefficients were between ±1.96 showed that the data set exhibited normal distribution for all variables (Field, 2009). Multicollinearity problems may occur between independent variables. For this reason, tolerance, condition index (CI), and variance inflation factor (VIF) values were examined (Büyüköztürk, 2012). It was determined that the tolerance value was greater than .20 (Tolerance = .67), the CI value was less than 30 (CI = 27.17), and the VIF value was less than 10 (VIF = 1.48). Therefore, it was clarified that there were no multicollinearity problems between the variables. Analysis of the research data was carried out via SPSS.

CFA (with AMOS) was applied to each scale and the compatibility of the data and the scales was examined. CFA tests whether the created models are confirmed on the sample (Bayram, 2013). Reliability analyses (SPSS) were performed on the scales and Cronbach's Alpha coefficients were calculated. Covariances were drawn between unobservable variables and a measurement model was created. The covariances in the measurement model that produced the best-fit values were deleted. Based on the theoretical framework, the structural model to be tested was proposed by adding one-way paths between the variables. Although there are many values regarding model fit, x2, x2/sd, GFI, IFI, TLI, CFI, and RMSEA values have been generally reported in studies (Kline, 2011; Meydan, Şeşen, 2015).

3. Results

3.1. Descriptive Statistics and Correlation Matrix

Mean, standard deviation, standard error, and correlation values, which enable the determination of the participants' participation levels regarding the items in the scales, are presented in Table 1.

Table 1. Descriptive Statistics and Correlation Values

Variables	$\bar{X}$	Std. Deviation	Std. Error	1	2	3	4
1. FS	3.84	.66	.04	1			
2. TPS	4.23	.45	.02	.42**	1		
3. MTS	3.35	.86	.05	.52**	43.**	1	
4. EES	2.41	.73	.04	-.44**	-.35**	-.42**	1

*p < .05, **p < .01

FS: Flourishing Scale, TPS: Teacher Patience Scale, MTS: Motivation to Teach Scale, EES: Emotional Exhaustion Scale

Teachers' perceptions are "I generally agree: 4" regarding their psychological well-being, "Always: 5" regarding their patience, "I agree: 3" regarding their motivation to teach, and "rarely: 2" regarding their emotional exhaustion (Table 1). When the correlation coefficients were examined, there was a moderately positive and statistically significant relationship between teachers' perception of psychological well-being and their perception of patience ($r = .42$, $p < .01$) and motivation to teach ($r = .52$, $p < .01$). There were moderately negative and statistically significant relationships between the variables of emotional exhaustion and psychological well-being ($r = -.44$, $p < .01$); teacher patience ($r = -.35$, $p < .01$) and motivation to teach ($r = -.42$, $p < .01$). The relationship between the variables of teacher patience and motivation to teach was moderately positive and significant ($r = .43$, $p < .01$).

3.2. Measurement Model

The measurement model that produces the best-fit values with the data of this research is presented in Figure 1. Thus, it was checked whether the model produced was confirmed on the sample studied.

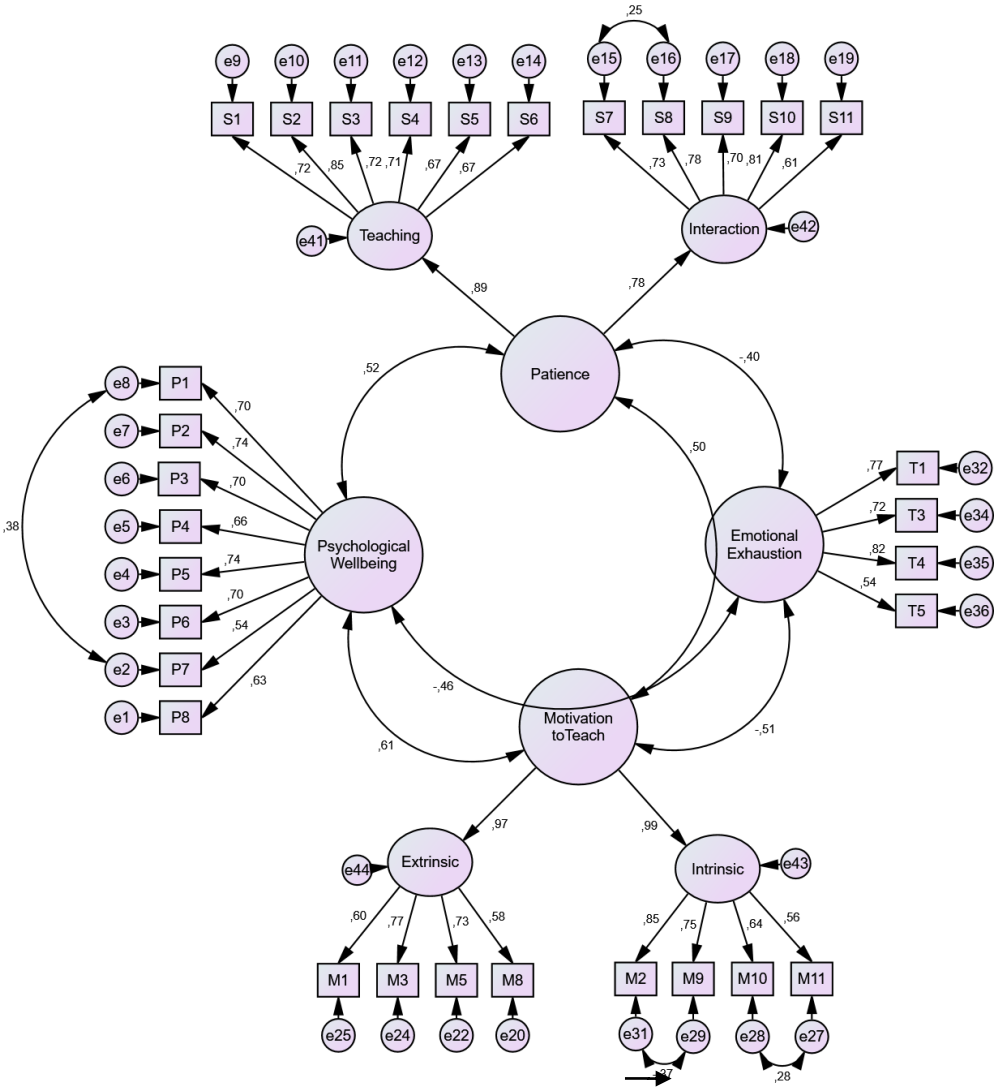

Fig. 2. Measurement model (with standardized coefficients)

When Figure 2 was examined, covariances were added between e2 and e8, e29 and e31, and e27 and e28, respectively, because measurement errors were related. It was found that the model produced good-level (X^2 = 841.29, sd = 451, X^2/ sd = 1.86, P = .00, RMSEA = .05) and acceptable (GFI=.85, IFI = .90, TLI = .90, CFI = .90) fit values with the research data. In the model in which measurement errors were also included, all variables were found to be moderately and statistically significantly related.

3.3. Recommended Structural Equation Model

From the structural model to be tested, the patience emotional exhaustion path was removed due to its insignificant path coefficient (B = -.32, β = -.13, t = -1.54, p = .12). Figure 2 presents the structural model that includes standardized values that were created with statistically significant path coefficients and confirmed by the research data, in other words, where the best-fit values were produced.

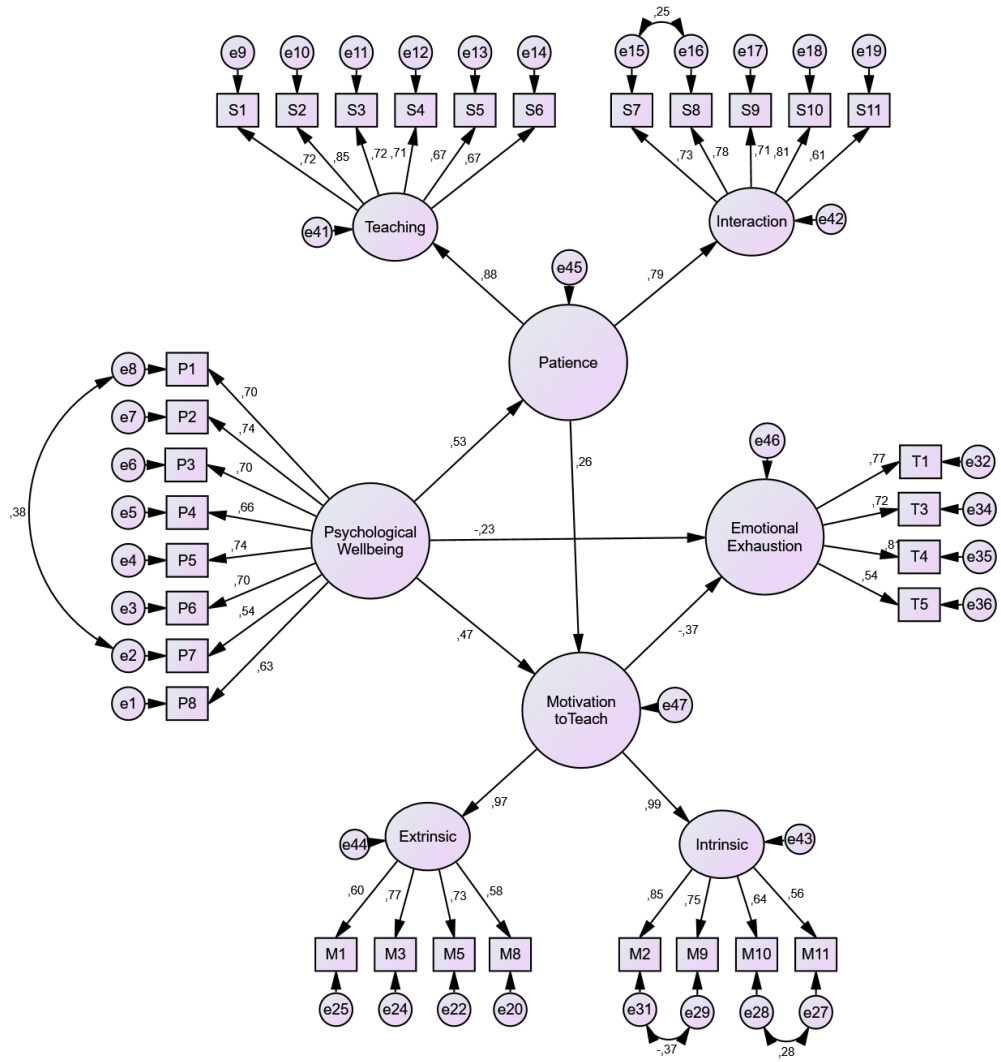

Fig. 3. Structural equation model

When the structural equation model (Figure 1) in which the best-fit values were produced was examined, it was seen that teachers' psychological well-being positively and statistically significantly affected their patience (β = .40, p < .01) and motivation to teach (β = .69, p < .01). However, it affected their emotional exhaustion negatively and statistically significantly (β = -.42, p < .01). Psychological well-being positively affected motivation to teach through the partial mediation effect of teacher patience (β = .14, p < .01). Additionally, psychological well-being negatively affected emotional exhaustion partially through motivation to teach (β = -.17, p < .01). Finally, in the model, it was seen that teachers' psychological well-being perceptions negatively affected emotional exhaustion, partially through the patience and motivation to teach variables.

4. Discussion

This research was conducted to understand the direct and indirect relationship between teachers' psychological well-being and their emotional exhaustion. The study also examined how teachers' psychological well-being affects their emotional exhaustion through patience and motivation to teach. In the research, firstly, teachers' psychological well-being, patience, motivation to teach, and emotional exhaustion levels were examined. In this analysis, it was seen that the psychological well-being of the teachers was "I generally agree", their patience was "Always", their motivation to teach was "I agree" and their emotional exhaustion was "Rarely". In many studies, teachers' psychological well-being was found to be at a high level (Ertürk et al., 2016; Köylü, 2018; Kurt, 2018), and their patience level was found to be at high level (Koç, 2010; Meriç, Erdem, 2023). Similar to the results in this research, teachers' motivation to teach was

found to be at a medium level in the studies conducted by Argon and Cicioğlu (2017) and Ayık and Ataş (2014). The emotional exhaustion of teachers was also seen to be at low levels in studies found in the literature (Duman et al., 2020). A study conducted during the COVID-19 period found that teachers' emotional exhaustion was at a moderate level (Kaleli, 2021). It may seem natural that there would be an increase in the negative thoughts and attitudes of teachers who were away from their schools and forced to stay at home, as was the case with all individuals during this period.

The relationships between the four variables discussed in this research were examined. The direction and levels of the relationships between these variables were examined. According to the results, it was seen that all four variables were related to each other, and these relationships were at a moderate level. Psychological well-being, patience, and motivation to teach were in a positive relationship with each other. However, emotional exhaustion had moderately negative relationships with all three variables. A study conducted with academics presented that there was a moderately negative relationship between psychological well-being and emotional exhaustion (Sakal, Yıldız, 2017). Different studies in the literature also demonstrated that there was a negative connection between psychological well-being and emotional exhaustion (Beaumont et al., 2016; Duran, Barlas, 2015; Kanten, Yeşiltaş, 2015). In the present study, it was determined that there was a moderately positive relationship between psychological well-being and patience. Similar results were obtained in a study conducted by Doğan (2017) with random individuals without limiting them to a certain profession. Similarly, many studies in the literature stated that there was a positive relationship between these two variables (Gençdoğan et al., 2012; Schnitker, 2010). One of the results of the present research is that psychological well-being is positively and moderately correlated with motivation to teach. In a study conducted by Kaya and Çenesiz (2020) with teacher candidates, it was observed that there was a positive relationship between psychological well-being and motivation to teach. It is theoretically expected that individuals who feel good about themselves are motivated to teach. What was wanted to be examined here was whether motivation to teach had a mediating variable feature. This situation also emerged in the present study. It was also seen in previously reported scientific studies that the patience and motivation to teach obtained in this research negatively predicted emotional exhaustion (Meriç, Erdem, 2023; Pishghadam et al., 2023; Ratisyanti et al., 2021). The result, which is one of the hypotheses in this research and confirmed by the findings, is that teachers' perception of psychological well-being negatively affects their perception of emotional exhaustion. This result also coincides with the findings in the literature. One of the results revealed in this research is that psychological well-being is indirectly and negatively related to teachers' emotional exhaustion through patience and motivation to teach. However, no other research explaining this indirect relationship has been found in the literature.

Another result obtained in this research is that teachers' psychological well-being negatively predicts emotional exhaustion. This result shows that the second hypothesis of the study (H2: Psychological well-being has a negative effect on emotional exhaustion through the partial mediation effect of patience and motivation to teach variables) was confirmed. In a study conducted with teachers working in special education classes, it was stated that the psychological well-being of teachers negatively predicted their emotional exhaustion (Soner, Yılmaz, 2020). However, unlike this study, a low-level negative relationship was found. It was thought that the reason for the difference from this study might be due to the fact that the research was conducted with teachers who worked with students with special needs. Since working with individuals with special needs is more difficult than working with individuals with normal development, it was considered that it might have affected teachers' emotional exhaustion less. In another study conducted with academicians, it was stated that psychological well-being negatively predicted emotional exhaustion, as in this study (Sakal, Yıldız, 2017). In a study conducted on hotel employees, it was observed that psychological well-being negatively predicted emotional exhaustion (Beaumont et al., 20165 Kanten, Yeşiltaş, 2015). The results of this research and the other research results given above indicated that psychological well-being may have a reducing effect on teachers' emotional exhaustion. This research puts forward an idea about the precautions that can be taken against emotional exhaustion that may occur as a result of long and intense work for teachers who must always have positive energy and present this energy to their students. Since no research was found in the literature review examining patience and motivation to teach in predicting teachers' emotional exhaustion and psychological well-being, a discussion regarding mediating variables could not be made.

5. Conclusion

However, this study showed that teachers' psychological well-being positively predicted their patience and motivation to teach. It was revealed that teachers' positively predicted patience and motivation to teach also had a reducing effect on teachers' emotional exhaustion.

6. Limitations

The data of this study were collected from teachers in Mardin. The data of the research were collected using the quantitative methods. Due to the nature of the research, data were collected in a limited time and from limited people. The research is limited in terms of these aspects.

7. Recommendations

In this study, the relationship between teachers' psychological well-being and emotional exhaustion was examined. This relationship was tried to be measured both directly and indirectly through patience and motivation to teach. As a result, it was observed that teachers' psychological well-being negatively affected teachers' emotional exhaustion both directly and indirectly. Based on this result, the following suggestions can be made:

To reduce the negative effects that teachers' emotional exhaustion may have on teaching, it is necessary to first improve them psychologically. It is considered important for administrators and education policymakers to look for ways to make teachers feel good. In addition, considering that patience and motivation to teach also negatively affect emotional exhaustion, activities and programs that would improve teachers' feelings of patience and motivation to teach can be recommended to education administrators. Considering that teachers' psychological well-being creates patience and motivation to teach, activities that provide psychological well-being may be a research topic that can be suggested to researchers.

The authors have no conflicts of interest regarding this manuscript.

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The Implementation of TPACK in Bosnian Classrooms

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Abstract

TPACK, an abbreviation for "Technological Pedagogical Content Knowledge," is a theoretical framework emphasizing teachers' skills to integrate technology into their classrooms effectively. According to Shulman (1986), these skills hold great value. This study explores technological, pedagogical, and content knowledge (TPACK) based on variables such as teachers' gender, experience, level of education, GPA (Grade Point Average), and type of education. A survey method was employed to collect data, and participants were selected via the snowball sampling technique. The research revealed no significant differences between genders within the TPACK model. However, differences were observed in teachers' experience concerning pedagogical knowledge, content knowledge, technological content knowledge, pedagogical content knowledge, and technological pedagogical knowledge. Participants with higher degrees demonstrated better performance in technological, pedagogical, and content knowledge areas. Additionally, those with a GPA in the range of 7.5 to 8.4 performed better in technology knowledge, content knowledge, and technological pedagogical knowledge. Finally, the study found the highest performance in technological pedagogical knowledge among teachers at both public and private universities. These findings suggest that resources should be allocated to organize workshops, enhance classroom technologies, and adapt the curriculum to meet teachers' needs effectively.

Keywords: TPACK, technology integration, GPA, gender, education.

1. Introduction

Teaching and learning processes have been notably evolving due to technological advancements. Teachers are increasingly required to transition from traditional teaching practices to more functional, unpredictable, and demanding technologies (Koehler, Mishra, 2009). One model used to better understand these processes and teachers' competencies is TPACK, which stands for the Technological Pedagogical Content Knowledge Framework (Koehler et al., 2014; Mishra, Koehler, 2006; Niess et al., 2018). Initially conceptualized by Mishra and Koehler (2006),

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TPACK builds on the foundational work of Shulman (1986). According to this model, the three key pillars of a teacher's knowledge are technological, pedagogical, and content knowledge (Koehler, Mishra, 2009). It is essential to consider the interactions between these components, such as PK (pedagogical knowledge), TCK (technological content knowledge), TPK (technological pedagogical knowledge), and TPACK (Koehler et al., 2014; Koehler, Mishra, 2009; Mishra, Koehler, 2006; Niess et al., 2018). The integrated blend of CK (content knowledge), PK (pedagogical knowledge), PCK (pedagogical content knowledge), TK (technological knowledge), TCK (technological content knowledge), TPK (technological pedagogical knowledge), and TPCK (technological, pedagogical, and content knowledge) forms the TPACK framework (Koehler, Mishra, 2009).

To understand its relevance, particularly in the context of teaching and learning in Bosnia and Herzegovina, it is crucial to highlight the digital transformation schools underwent during the COVID-19 pandemic (Nousopoulou et al., 2022). As stated by Canan Güngören and Isman (2014), it was teachers' responsibility to train "digital citizens," and many educators in the Western Balkans had to face the challenges of effectively using technologies with little experience (Bećirović, 2023; Nousopoulou et al., 2022). To achieve their educational goals, teachers relied on their initiative and active involvement in the teaching and learning processes. What this framework offers is both a way to identify the weak points and a wide array of resources and opportunities for educators to facilitate digitalization in the post-COVID period (Bećirović, 2023). Additionally, it recognizes the complex nature of teaching and fosters a relationship between digital competencies and TPACK elements (Çebi et al., 2022; Demeshkant et al., 2022).

Therefore, the purpose of this study is to provide insights into the factors affecting the integration of TPACK components within the Bosnian educational context. Since there are not many studies done in this area, and Bosnia is undergoing the process of modernization, the researchers found a research gap that can be filled with the current analysis. The research aims to understand trends based on specific variables like gender, age, experience, and GPA (Grade Point Average), providing valuable information on the challenges and opportunities that shape teachers' technological practices in a digital environment.

2. Literature Review

TPACK stands for "Technological Pedagogical Content Knowledge," a theory addressing teachers' capabilities to integrate technology into education and learning. It is important to define certain aspects of TPACK. One of them is pedagogical content knowledge (PCK) (Shulman, 1986). Pedagogical content knowledge (PCK) is based on the idea that teaching requires more than delivering subject content knowledge to students and that student learning is more than passively absorbing information. The second is content knowledge (CK). Content knowledge is a theoretical construct that describes the knowledge teachers need to carry out their work as teachers of a particular subject matter. This knowledge goes beyond merely understanding the subject itself. According to Shulman (1986), both PCK and CK are crucial for teacher effectiveness. CK relates to teachers' knowledge of the subject area (Shulman, 1986), while PCK, on the other hand, relates to teachers' "knowledge [of the subject] for teaching" (Shulman, 1986: 9).

Both Shulman (1986) and Mishra and Koehler (2006) concluded that the integration of ICT (Information and Communications Technology) has significant advantages and is effective for both teachers and students. TK (Technological Knowledge) relates to how teachers understand and operate the technologies used in education. PK (Pedagogical Knowledge) relates to their understanding of methods and conditions for applying these technologies, and lastly, CK (Content Knowledge) relates to the understanding of the subject matter (Shulman, 1986). Ghavifekr and Rosdy (2015) conducted quantitative research in Malaysia among 101 teachers from public secondary schools to investigate the effectiveness of ICT integration, professional development, and its role in ensuring quality student learning.

In addition, Gómez-Trigueros and Yáñez de Aldecoa (2021) conducted an exploratory and descriptive study on the differences between genders, focusing on the digital competencies of both pre-service and experienced teachers. Three different questionnaires were administered to analyze the perceptions of the groups mentioned above, and the third questionnaire was used to analyze self-perceptions of methodologies involving technology. Female participants showed low self-perception, including a lower predisposition toward technologies, indicating that tools should be inclusive for both males and females.

Similarly, Abubakir and Alshaboul (2023) examined TPACK among EFL teachers in Qatar. The study included 182 teachers and showed that teachers' knowledge across all TPACK constructs was high. Male teachers scored higher in technological knowledge than female teachers. Teachers with 1 to 5 years of experience showed the highest level of technological knowledge. Mohamad's (2021) research highlights that teachers with considerable teaching experience exhibit greater confidence in their CK (Content Knowledge), PK (Pedagogical Knowledge), and PCK (Pedagogical Content Knowledge). In contrast, novice teachers reported slightly higher confidence in their TK (Technological Knowledge).

Moreover, a study conducted by Castéra et al. (2020) empirically selected seven elements of TPACK and examined their effects based on national context, gender, age, and level of education. The validity of the TPACK seven-model framework was tested since there was no previous cross-national data. A total of 574 teachers participated in the online research. The relative stability of the model was proven, as well as the differences among university teachers across six countries in Asia and Europe. Age and TPACK factors were dependent, whereas academic level and TPACK factors were independent.

Likewise, Bozkurt (2014) carried out a study to investigate whether there was a significant relationship between academic achievement and TPACK levels among physics and science teachers and whether TPACK levels significantly predicted academic achievement. Significant results favored physics teachers regarding their academic achievements and TPACK attitudes. Shafie et al. (2023) found that the highest educational qualifications significantly influenced 21st-century Technological Pedagogical Content Knowledge (TPACK) levels, whereas teaching experience did not.

Furthermore, Katechaiyo (2021) conducted a study in a private school based on the TPACK model. The sample size included 431 private schools, and a questionnaire was used as the research method. Descriptive statistics, including frequency, mean, standard deviation, and percentage, were used to analyze the data. The results showed the desirable status and implementation of the TPACK model, especially in productive pedagogies and supportive classroom environments. The analysis of TPACK indicated the highest level of content knowledge, followed by technological knowledge.

Additionally, Mercado and Ibarra (2019) performed a study investigating the TPACK self-efficacy and ICT integration skills of 52 pre-service teachers. The participants perceived themselves as highly proficient in all areas of the TPACK model. The study also revealed a significant negative relationship between their GPA scores and the implementation of ICT-integrated instruction in the classroom environment.

Moreover, Adalar (2021) conducted research examining social studies teachers' self-efficacy beliefs regarding TPACK through a causal-comparative study using non-random sampling methods. Their knowledge of TPACK was found to be above average. There were no significant differences between their self-efficacy beliefs regarding TPACK and independent variables such as gender, GPA scores, computer ownership, and various courses.

Likewise, Alharbi (2020) aimed to explore EFL teaching knowledge according to the TPACK framework in Saudi Arabia. The study was descriptive and included 191 EFL teachers. The researcher found that the degree of teaching knowledge was high, as was the difference between male and female teachers, with results favoring female teachers.

To assess digital literacy (TPACK) and teaching performance, Muslimin et al. (2023) conducted a study among EFL lecturers from different universities in various cities in East Java Province, Indonesia. They found that participants were confident about their pedagogical and content knowledge. Additionally, Nazari et al. (2019) undertook a quantitative study applying the TPACK framework to evaluate novice and experienced EFL teachers' perceived TPACK for professional development. The participants were selected from various English language institutes in Tehran. The results showed that experienced teachers had significantly higher scores in pedagogical knowledge and pedagogical content knowledge. In contrast, novice teachers demonstrated significantly higher scores in technological knowledge, technological content knowledge, technological pedagogical knowledge, and overall TPACK.

When it comes to Bosnia and Herzegovina, no similar studies have been conducted; thus, this paper seeks to address this gap in the existing literature. The research hypotheses are:

1. There is no significant statistical difference in TPACK (technological knowledge, pedagogical knowledge, content knowledge, technological content knowledge, pedagogical content knowledge, technological pedagogical knowledge, and technological pedagogical content knowledge) based on the instructors' gender.

2. There will be significant differences in TPACK (technological knowledge, pedagogical knowledge, content knowledge, technological content knowledge, pedagogical content knowledge, technological pedagogical knowledge, and technological pedagogical content knowledge) based on instructors' experience.
3. There will be a significant difference in TPACK (technological knowledge, pedagogical knowledge, content knowledge, technological content knowledge, pedagogical content knowledge, technological pedagogical knowledge, and technological pedagogical content knowledge) based on the instructors' level of education.
4. There will be a statistical difference in TPACK (technological knowledge, pedagogical knowledge, content knowledge, technological content knowledge, pedagogical content knowledge, technological pedagogical knowledge, and technological pedagogical content knowledge) based on the instructors' GPA.
5. There will be significant differences in TPACK (technological knowledge, pedagogical knowledge, content knowledge, technological content knowledge, pedagogical content knowledge, technological pedagogical knowledge, and technological pedagogical content knowledge) based on the type of education.

3. Methodology

Participants

The research sample of the current study involved 152 participants, who were teachers or professors at the primary or secondary level, as well as university professors (Table 1). The snowball sampling method was used to select the participants through social networks such as Facebook, Instagram, and Gmail, and instant messaging applications like Viber and WhatsApp, in the quantitative research. The research sample consisted of 77 teachers (50.7 %) with bachelor's degrees, 72 teachers (47.3 %) with master's degrees, and 3 teachers (2 %) with PhD degrees. In addition, these participants, who teach in both private (N = 33; 21.7 %) and public (N = 119; 78.3 %) sectors, also work in different teaching contexts such as language courses (N = 34; 22.4 %), elementary schools (N = 102; 67.1 %), secondary schools (N = 43; 28.3 %), and universities (N = 8; 5.3%). The participants' ages ranged from 20 to 64. There were 114 female participants (75 %) and 38 male participants (25 %). The selected participants teach in Bosnia and Herzegovina. Table 1 represents a descriptive analysis of this selected group.

Table 1. Descriptive analysis of participants

Categories	Classification	N	Percent
Gender	Male	38	25
	Female	114	75
Level of Education	University	77	50.7
	Master	72	47.4
	PhD	3	2
University Type	Private	36	23.7
	State	114	75
	Both	2	1,4
Teaching Position	Language Courses	34	22.4
	Elementary school	102	67.1
	Secondary school	43	28.3
	University	8	5.3
Teaching in	Private sector	33	21.7
	Public sector	119	78.3
Total		152	100.0

Measures

The survey method was used to collect the data, which was divided into two parts. The first part provided information about the demographic characteristics of the respondents, such as gender, age, GPA, level of education, years of teaching, information about the diploma and university, current teaching position, and the average class size. The second part focuses on the TPACK elements validated by Schmidt et al. (2009), and the questionnaire items were based on a

4-point Likert scale ranging from 1 = strongly disagree to 4 = strongly agree. For example, "I feel confident learning new computer skills" and "I find it easier to teach by using ICT."

Cronbach's alpha was used to determine the data's reliability, indicating acceptable and high internal consistency levels for TPACK elements. The results indicated that technology knowledge exhibited a reliability coefficient of α = 0.935, closely followed by pedagogy knowledge with a reliability of α = 0.948. Content knowledge demonstrated a reliability of α = 0.938, while technological content knowledge had a reliability of α = 0.894. The reliability for pedagogical content knowledge was α = 0.890, and for technological pedagogical knowledge, it was α = 0.891. Lastly, the reliability for technological pedagogical, and content knowledge was α = 0.943.

Procedures

Informed consent was obtained from the participants, after which the researchers informed them about the research goals, anonymity, and confidentiality. The participants completed the online survey using Google Forms, which was distributed through various online networks. They were asked to read the questions carefully and provide the answers that best fit their opinions. The participants took 20 minutes to answer the questions. They were also encouraged to contact the researchers via email if they had any questions or recommendations.

Data analysis

The data were analyzed using the Statistical Package for Social Sciences (SPSS) version 23.0. The first step in this process was to check for missing values and outliers. Internal consistency was determined using Cronbach's alpha coefficient. A T-test was performed to test the first hypothesis. The second, third, fourth, and fifth hypotheses were tested using one-way ANOVA.

4. Results

Preliminary analysis

Skewness and kurtosis were assessed before hypothesis testing to ensure that all observed variables adhered to a normal distribution within the ranges of -2 to +2. The results in Table 2 indicate that teachers felt moderately confident about their technology knowledge, with a mean (M = 3.55, SD = 0.85), which was the lowest score recorded in the study. The findings also revealed that teachers expressed a high level of satisfaction with their pedagogical knowledge, with a mean of 4.06 and a standard deviation of 0.79. Teachers then scored similarly on content knowledge (M = 3.78, SD = 0.80). The situation was similar with technological content knowledge (M = 3.72, SD = 0.76). Teachers demonstrated a marginally higher score in pedagogical content knowledge (M = 3.81, SD = 0.78). They exhibited similar proficiency in technological pedagogical knowledge (M = 3.77, SD = 0.74). Furthermore, scores for technological pedagogical content knowledge were comparable (M = 3.78, SD = 0.75), showing no significant differences. Correlation analyses indicated a significant positive relationship among all dependent variables ($p < 0.001$). The relationships between dependent variables are presented in Table 2.

Table 2. Descriptive results and correlation

	N	M	SD	1	2	3	4	5	6	7	Sig. (2-tailed)	Skewness	Skewness	Kurtosis	Kurtosis
												Stat	SE	Stat	SE
1. TK	151	3.56	.86	1	.569	.569	.682	.567	.605	.650	.000	-.323	.197	-.312	.392
2. PK	151	4.06	.80	.569	1	.627	.544	.680	.659	.656	.000	-1.091	.197	1.347	.392
3. CK	151	3.78	.81	.569	.627	1	.689	.709	.505	.597	.000	-.619	.197	.097	.392
4. TCK	151	3.73	.76	.682	.544	.689	1	.697	.631	.652	.000	-.728	.197	.763	.392
5. PCK	151	3.81	.78	.567	.680	.709	.697	1	.722	.751	.000	-.930	.197	1.212	.392

6. TPK	151	3.77	.74	.605	.659	.505	.631	.722	1	.839	.000	-.710	.197	.845	.392
7. TPCK	151	3.78	.75	.650	.656	.597	.652	.751	.839	1	.000	-.745	.197	.726	.392
Total N	151														

Shapiro-Wilk tests

Shapiro-Wilk tests were conducted to assess normality within each group for each variable. The Shapiro-Wilk test results indicate that most knowledge domains are not normally distributed, particularly for Gender 2 (n = 114), where all p-values are below 0.05, such as Pedagogical knowledge (p = 0.000), Content knowledge (p = 0.000), and Technological pedagogical and content knowledge (p = 0.000), confirming significant deviation from normality. For Gender 1 (n = 37), normality is observed only in Technology knowledge (p = 0.270) and Content knowledge (p = 0.320), while other domains like Pedagogical knowledge (p = 0.021) and Technological content knowledge (p = 0.022) also show non-normality.

The Shapiro-Wilk normality test reveals that most knowledge domains are not normally distributed in several GPA subgroups, particularly GPA levels 3 and 4. Notable violations of normality include Pedagogical knowledge (GPA 3: p = 0.001; GPA 4: p = 0.000), Technological content knowledge (GPA 3: p = 0.000), and Technological pedagogical and content knowledge (GPA 2: p = .018; GPA 4: p = 0.006). Only GPA groups 0 and 5 consistently show normal distribution across most domains.

The Shapiro-Wilk normality test shows the same results for level of education and type of university.

The Levene's Test

The Levene's Test for homogeneity of variances across all knowledge domains yielded non-significant p-values (all Sig. > 0.05), such as Technology knowledge (p = 0.613), Content knowledge (p = 0.737), and Technological pedagogic knowledge (p = 0.965), indicating that the assumption of equal variances is met for all variables. Therefore, using one-way ANOVA for comparing group means across these knowledge domains is statistically appropriate in terms of variance homogeneity.

TPACK based on the instructors' gender

An independent T-test was performed to examine the TPACK model based on the instructors' gender.

The results of the T-test, namely t (149) = 0.507 and p = 0.613, show no significant differences. The findings indicated that there were no significant differences between males (M = 3.62; SD = 0.86) and females (M = 3.53; SD = 0.86) in technology knowledge.

Next, an independent sample t-test was carried out to check pedagogical knowledge between the genders. The findings showed that there were no significant differences between males (M = 4.00; SD = 0.68) and females (M = 4.08; SD = 0.82), t(149) = -.337, p = 0.614.

Similarly, there were no significant differences between males (M = 3.74; SD = 0.65) and females (M = 3.79; SD = 0.85) in terms of content knowledge. The results of the T-test indicate no significant findings, with t(149) = -0.337 and p = 0.737. A similar outcome was observed for the technological content variable. As such, there were no significant differences between males (M = 3.77; SD = 0.80) and females (M = 3.71; SD = 0.75). The results of the T-test indicated insignificance, as seen t(149) = 0.444, p = 0.658.

In addition, no significant difference was found in pedagogical content knowledge between males (M = 3.85; SD = 0.73) and females (M = 3.79; SD = 0.79), as indicated by the T-test results, t(149) = -.043, p = 0.676. A similar outcome was observed for technological pedagogical knowledge, with males (M = 3.76; SD = 0.66) and females (M = 3.77; SD = 0.76), where the T-test also showed no significant difference, namely, t(149) = 0.942p = 0.965.

Lastly, the independent T-test was also carried out for the technological pedagogical, and content knowledge variables and showed that there were no significant differences in usage between males (M = 3.88; SD = 0.66) and females (M = 3.74; SD = 0.77). The results of the T-test indicated insignificance, as shown by t(149) = 0.942, p = 0.348, as seen in Table 3.

Table 3. TPACK based on the instructors' gender

		F	Sig.	t	df	Sig. (2-tailed)	MD	SE
Technology knowledge	Equal variances assumed	.086	.770	.507	149	.613	.08277	.16312
	Equal variances not assumed			.506	60.919	.614	.08277	.16343
Pedagogical knowledge	Equal variances assumed	1.560	.214	-.506	149	.614	-.07624	.15079
	Equal variances not assumed			-.556	72.698	.580	-.07624	.13722
Content knowledge	Equal variances assumed	2.275	.134	-.337	149	.737	-.05149	.15296
	Equal variances not assumed			-.385	79.188	.701	-.05149	.13368
Technological content knowledge	Equal variances assumed	.123	.726	.444	149	.658	.06431	.14489
	Equal variances not assumed			.429	57.830	.670	.06431	.15000
Pedagogical content knowledge	Equal variances assumed	.265	.607	.419	149	.676	.06206	.14828
	Equal variances not assumed			.435	65.312	.665	.06206	.14269
Technological pedagogical knowledge	Equal variances assumed	.570	.452	-.043	149	.965	-.00612	.14064
	Equal variances not assumed			-.047	70.158	.963	-.00612	.13028
Technological pedagogical content knowledge	Equal variances assumed	2.067	.153	.942	149	.348	.13395	.14222

		F	Sig.	t	df	Sig. (2-tailed)	MD	SE
	Equal variances not assumed			1.020	70.537	.311	.13395	.13138

TPACK based on instructors' experience

A one-way ANOVA was performed to assess the TPACK model based on the instructors' experience. The results of the ANOVA between and within groups were not statistically significant and based on a total sample of 150 participants, as indicated by F(28,122) = 1.174, p == 0.271. The findings showed that there were no significant differences in technology knowledge between instructors with 15 years of experience (M = 3.76; SD = 0.95) and those with 2 years of teaching experience (M = 3.89; SD = 1.05).

Next, a one-way ANOVA was conducted to test the pedagogical knowledge between groups who had more or less than 15 years of teaching experience. The results of the ANOVA performed between and within groups indicated that there is no statistically significant difference based on the total sample size of 150, with F(28,122) = 1.303 and p = 0.165. The findings showed that instructors with more teaching experience (M = 4.45; SD = 0.43) performed better in pedagogical knowledge than those with fewer years of experience (M = 4.14; SD = 0.88).

Teachers with more years of teaching experience (M = 4.47; SD = 0.20) performed better in content knowledge than teachers with fewer years of teaching experience (M = 3.72; SD = 0.47). The ANOVA results indicated a statistically insignificant level of 0.567, based on a total of 150 observations, with F(28, 122) = 0.933 and p = 0.567. The situation is similar to technological content knowledge (M = 4.00; SD = 0.35) (M = 3.71; SD = 0.65). The analysis of variance (ANOVA) conducted between and within groups indicated no significant findings, based on a total sample size of 150 participants, with results showing F(28,122) = 1.333 and p = 0.145.

Following this, there was a difference in pedagogical content knowledge between participants with more years of teaching experience (M = 4.20; SD = 0.44) and those with less experience (M = 3.82; SD = 0.64). The results of the ANOVA conducted both between and within groups indicated no significant findings based on a total of 150 observations, as evidenced by F(28,122) = 1.440, p = 0.091. The situation is similar with technological pedagogical knowledge (M = 4.20; SD = 0.58) (M = 3.85; SD = 0.63).

The test conducted on technological pedagogical, and content knowledge indicated that there is no statistically significant difference between the two groups: those with more years of teaching experience and those with less. The data support this finding, with means and standard deviations recorded as (M = 4.29; SD = 0.61) for the more experienced group and (M = 4.12; SD = 0.35) for the less experienced group. Furthermore, the results of the ANOVA analysis, both between and within groups, revealed no significance based on the total of 150, as presented with F(28,122) = 1.348, p = 0.136, as shown in Table 4.

Table 4. TPACK based on instructors' experience

		Sum of squares	df	Mean Square	F	Sig.
Technology knowledge	Between groups	23.547	28	.841	1.174	.271
	Within groups	87.390	122	.716		
	Total	110.936	150			
Pedagogical knowledge	Between groups	21.826	28	.779	1.303	.165
	Within groups	72.980	122	.598		

		Sum of squares	df	Mean Square	F	Sig.
	Total	94.806	150			
Content knowledge	Between groups	17.191	28	.614	.933	.567
	Within groups	80.259	122	.658		
	Total	97.450	150			
Technological content knowledge	Between groups	20.502	28	.732	1.333	.145
	Within groups	66.990	122	.549		
	Total	87.493	150			
Pedagogical content knowledge	Between groups	22.754	28	.813	1.440	.091
	Within groups	68.867	122	.564		
	Total	91.621	150			
Technological pedagogical knowledge	Between groups	16.312	28	.583	1.077	.377
	Within groups	66.011	122	.541		
	Total	82.323	150			
Technological pedagogical content knowledge	Between groups	20.013	28	.715	1.348	.136
	Within groups	64.673	122	.530		
	Total	84.686	150			

TPACK based on the instructors' level of education

A one-way ANOVA was performed to check the TPACK model based on the instructors' level of education. There were two groups of teachers: 77 teachers (50.7 %) with bachelor's degrees, and 72 teachers (47.3 %) with master's degrees. The findings showed similar results between teachers with master's degrees (M = 3.61; SD = 0.88) and teachers with bachelor's degrees (M = 3.49; SD = 0.85). The results of the ANOVA conducted both between and within groups indicated no significant findings based on the total sample size of 150, with $F(2, 148) = 0.855$ and $p = 0.427$.

Next, a one-way ANOVA was carried out to check pedagogical knowledge across different levels of education. The findings indicated no significant difference between teachers with master's degrees (M = 4.08; SD = 0.77) and teachers with bachelor's degrees (M = 4.04; SD = 0.83). The ANOVA results showed no significant difference between and within the groups as seen with $F(2.148) = 0.113$, and $p = .893$, based on a total of 150 participants.

Teachers with master's degrees demonstrate a comparable level of content knowledge to those with bachelor's degrees, as indicated by the means (M = 3.78, SD = 0.78 for master's degrees and M = 3.77, SD = 0.83 for bachelor's degrees). The ANOVA results, both between and within groups, indicated no significance based on the total of 150, as evidenced by F(2, 148) = 0.270 and p = 0.764. The situation is similar with technological content knowledge as well, master (M = 3.77; SD = 0.70), and bachelor (M = 3.67; SD = 0.82). The results of the ANOVA between and within groups show insignificance based on the total 150, as seen in F(2.148) = 0.507, p = 0.603.

Following this, there was a difference in pedagogical content knowledge between master's degrees (M = 3.83; SD = 0.73), and bachelor's degrees (M = 3.77; SD = 0.84). The results of the ANOVA between and within groups show insignificance based on the total 150, as seen in F(2.148) = 0.186, p = 0.830. The situation is similar with technological pedagogical knowledge between master's degree teachers (M = 3.85; SD = 0.73) and bachelor's degree teachers (M = 3.67; SD = 0.73). The results of the ANOVA conducted both between and within groups indicated no significant difference based on the total of 150, as demonstrated by F(2.148) = 1.885, p = 0.155.

Lastly, the assessment conducted on technological pedagogical, and content knowledge revealed comparable outcomes between teachers holding master's degrees (M = 3.84; SD = 0.75) and those with bachelor's degrees (M = 3.69; SD = 0.75). The results of the ANOVA between and within groups show insignificance based on the total 150, as seen in F(2.148) = 1.418, p = 0.245, as seen in Table 5.

Table 5. TPACK based on the instructor's level of education

		Sum of squares	df	Mean Square	F	Sig.
Technology knowledge	Between groups	1.267	2	.634	.855	.427
	Within groups	109.669	148	.741		
	Total	110.936	150			
Pedagogical knowledge	Between groups	.145	2	.073	.113	.893
	Within groups	94.660	148	.640		
	Total	94.806	150			
Content knowledge	Between groups	.354	2	.177	.270	.764
	Within groups	97.096	148	.656		
	Total	97.450	150			
Technological content knowledge	Between groups	.595	2	.298	.507	.603
	Within groups	86.897	148	.587		
	Total	87.493	150			
Pedagogical content knowledge	Between groups	.230	2	.115	.186	.830

		Sum of squares	df	Mean Square	F	Sig.
	Within groups	91.391	148	.618		
	Total	91.621	150			
Technological pedagogical knowledge	Between groups	2.045	2	1.023	1.885	.155
	Within groups	80.278	148	.542		
	Total	82.323	150			
Technological pedagogical content knowledge	Between groups	1.593	2	.796	1.418	.245
	Within groups	83.094	148	.561		
	Total	84.686	150			

TPACK based on instructors' GPA

One-way ANOVA was performed to check the TPACK model based on the instructors' GPA (Grade Point Average). There were 5 groups of teachers based on their GPA, ranging from 6 to 10. Next, there were 19 teachers in the range from 6 to 6.4. Next, 40 teachers are in the range from 6.5 to 7.4. There were 49 teachers in the range from 7.5 to 8.4, and 35 teachers in the range from 8.5 to 9.4. Lastly, there were 2 teachers in the GPA range of 9.5 to 10. Teachers with GPAs between 7.5 and 8.4 demonstrated higher performance in technology knowledge (M = 3.94; SD = 0.76) compared to those in other GPA groups. The subsequent group, consisting of teachers with GPAs from 9.5 to 10, had a mean of (M = 3.78; SD = 1.11). Conversely, the lowest performance was observed among teachers with GPAs ranging from 6 to 7.4 (M = 3.30; SD = 0.84) (M = 3.30; SD = 0.82). The results of the ANOVA conducted both between and within groups indicate statistical significance, as evidenced by the total of 150, with F(5.145) = 3.673 and p = 0.004.

Next, one-way ANOVA was done to check pedagogical knowledge between the different levels of education. The results of the ANOVA between and within groups showed significance based on the total 150, as seen in F(5.145) = 3.104, p = 0.011. The findings showed that the situation was similar to the previous one, where those with GPAs from 7.5 to 8.4 had the best results (M = 4.35; SD = 0.52), and those with (6 to 6.4) the lowest (M = 3.35; SD = 1.05).

Teachers with GPAs ranging from 7.5 to 8.4 exhibited better content knowledge (M = 4.06; SD = 0.69) compared to their peers. In contrast, those in the range (9.5 to 10) demonstrated the lowest content knowledge (M = 2.70; SD = 1.47). The results of the ANOVA between and within groups showed significance based on the total 150, as seen in F(5.145) = 3.200, p = 0.009. The situation is not similar with technological content knowledge because those in the range (9.5 to 10) (M = 4.37; SD = 0.88) had the best knowledge, then those in the range (7.5 to 8.4) (M = 3.90; SD = 0.64), and the group (6.5 to 7.4) had the lowest score (M = 3.50; SD = 0.84). The results of the ANOVA between and within groups show insignificance based on the total 150, as seen F(5.145) = 1.853, p = 0.106.

Following this, there was a difference in pedagogical content knowledge between those in the range (7.5 to 8.4) (M = 4.11; SD = 0.60), then those (6.5 to 7.4) (M = 3.72; SD = 0.82), and the lowest among those (9,5 to 10) (M = 3.12; SD = 1.23). The results of the ANOVA between and within groups show significance based on the total 150, as seen in F(5.145) = 2.722, p = 0.022. As for technological pedagogical knowledge, again, (7.5 to 8.4) (M = 4.07; SD = 0.56) showed better results than (8.5 to 9.4) (M = 3.86; SD = 0.86,) and the lowest were (6 to 6.4) (M = 3.36; SD

= 0.62). The results of the ANOVA between and within groups showed significance based on the total 150, as seen in $F(5.145) = 4.179$, $p < 0.001$.

Lastly, the test was done with technological pedagogical and content knowledge and showed that those with (7.5 to 8.4) had better results ($M = 4.12$; $SD = 0.62$), (8.5 to 9.4) ($M = 3.74$; $SD = 0.80$), and (6 to 6.4) ($M = 3.34$; $SD = 0.80$). The results of the ANOVA between and within groups show significance based on the total 150, as seen in $F(5.145) = 4.207$, $p < 0.001$, as seen in Table 6.

Table 6. TPACK based on instructors' GPA

		Sum of squares	df	Mean Square	F	Sig.
Technology knowledge	Between groups	12.471	5	2.494	3.673	.004
	Within groups	98.465	145	.679		
	Total	110.936	150			
Pedagogical knowledge	Between groups	9.165	5	1.833	3.104	.011
	Within groups	85.640	145	.591		
	Total	94.806	150			
Content knowledge	Between groups	9.685	5	1.937	3.200	.009
	Within groups	87.765	145	.605		
	Total	97.450	150			
Technological content knowledge	Between groups	5.255	5	1.051	1.853	.106
	Within groups	82.237	145	.567		
	Total	87.493	150			
Pedagogical content knowledge	Between groups	7.862	5	1.572	2.722	.022
	Within groups	83.759	145	.578		
	Total	91.621	150			
Technological pedagogical knowledge	Between groups	10.368	5	2.074	4.179	.001
	Within groups	71.955	145	.496		
	Total	82.323	150			

		Sum of squares	df	Mean Square	F	Sig.
Technological pedagogical content knowledge	Between groups	10.729	5	2.146	4.207	.001
	Within groups	73.957	145	.510		
	Total	84.686	150			

TPACK based on the type of education

One-way ANOVA was performed to check the TPACK model based on the instructors' type of education. The analysis included three groups instead of there were three groups: instructors who studied at public universities, those who studied at private universities, and both. The findings showed that those who studied at both universities had better results (M = 3.92; SD = 0.10) than the other two groups, public universities (M = 3.59; SD = 0.83) and private universities (M = 3.40; SD = 0.94) in technology knowledge. The results of the ANOVA conducted between and within groups indicate no significant findings, with a total sample size of 150, as demonstrated by F(2.148) = 0.825, p = 0.440.

Next, a one-way ANOVA was conducted to examine the differences in pedagogical knowledge across the various types of education. The findings showed that those who studied at public universities showed slightly better results (M = 4.09; SD = 0.79) than those who studied at private universities (M = 3.97; SD = 0.81). The results of the ANOVA between and within groups showed insignificance based on the total 150, as seen in F(2.148) = .322, p = 0.725.

Teachers who studied at public universities had better content knowledge (M = 3.86; SD = 0.79) than teachers who studied at private universities (M = 3.54; SD = 0.80). The results of the ANOVA between and within groups showed no significance based on the total 150, as seen in F(2.148) = 2.379, p = 0.096. The situation is similar with technological content knowledge as well, between public universities (M = 3.77; SD = 0.73) and private universities (M = 3.61; SD = 0.53). The results of the ANOVA between and within groups showed no significance based on the total 150, as seen in F(2.148) = 1.239, p = 0.293.

Following this, there was a difference in pedagogical content knowledge between teachers who studied at public universities (M = 3.86; SD = 0.75) and teachers who studied at private universities (M = 3.66; SD = 0.87). The results of the ANOVA between and within groups show no significance based on the total 150, as seen in F(2.148) = 1.336, p = 0.266. As for technological pedagogical knowledge, those who studied at both universities had the highest scores (M = 3.90; SD = 0.14). The results of the ANOVA between and within groups show no significance based on the total 150, as seen in F(2.148) = 0.476, p = 0.622.

Lastly, the test was done with technological, pedagogical, and content knowledge and showed that those who studied at public universities had better results (M = 3.80; SD = 0.72) than those who studied at private universities (M = 3.70; SD = 0.87). The results of the ANOVA between and within groups showed no significance based on the total 150, as seen in F(2.148) = 0.242, p = 0.786, as seen in Table 7.

Table 7. TPACK based on the type of education

		Sum of squares	df	Mean Square	F	Sig.
Technology knowledge	Between groups	1.223	2	.612	.825	.440
	Within groups	109.713	148	.741		

	Total	110.936	150			
Pedagogical knowledge	Between groups	.411	2	.205	.322	.725
	Within groups	94.395	148	.638		
	Total	94.806	150			
Content knowledge	Between groups	3.036	2	1.518	2.379	.096
	Within groups	94.414	148	.638		
	Total	97.450	150			
Technological content knowledge	Between groups	1.441	2	.720	1.239	.293
	Within groups	86.052	148	.581		
	Total	87.493	150			
Pedagogical content knowledge	Between groups	1.625	2	.813	1.336	.266
	Within groups	89.996	148	.608		
	Total	91.621	150			
Technological pedagogical knowledge	Between groups	.526	2	.263	.476	.622
	Within groups	81.797	148	.553		
	Total	82.323	150			
Technological pedagogical content knowledge	Between groups	.276	2	.138	.242	.786
	Within groups	84.411	148	.570		
	Total	84.686	150			

5. Discussion

The primary aim of this study was to examine Technological Pedagogical Content Knowledge (TPACK) among educators in Bosnia. Several significant aspects were addressed, including TPACK about the instructor's gender, professional experience, educational attainment, grade point average (GPA), and the nature of their academic background.

The study found no significant difference between genders in technology knowledge, pedagogical knowledge, content knowledge, pedagogical content knowledge, and technological pedagogical and content knowledge. These results contrast with Alharbi's (2020) study, which

favored female teachers. However, the findings are in line with Gómez-Trigueros and Yáñez de Aldecoa (2021), where female participants showed a lower predisposition towards technology use. Additionally, the results differ from Abubakir and Alshaboul's (2023) study on TPACK among EFL teachers in Qatar, where male teachers scored higher in technological knowledge than their female counterparts.

The study also found no significant difference in technology knowledge with more or less than 15 years of teaching experience. However, those with over 15 years of teaching experience performed better than those with only two years of experience in pedagogical knowledge, content knowledge, technological content knowledge, pedagogical content knowledge, and technological pedagogical knowledge. No significant difference was observed between the groups in technological pedagogical, and content knowledge. These findings differ from Nazari et al. (2019) study, which showed different results, especially in technology knowledge, content knowledge, technological content knowledge, technological pedagogical knowledge, and TPACK. Abubakir and Alshaboul's (2023) study on TPACK among EFL teachers is in contrast to this because teachers with 1 to 5 years of experience scored at the highest level of technological knowledge. Additionally, it contrasts with Mohamad's (2021) research, which highlights that teachers with considerable teaching experience exhibit greater confidence in their CK, PK, and PCK. In contrast, novice teachers express slightly higher confidence in their TK.

The study also revealed comparable outcomes between individuals possessing master's degrees and those holding bachelor's degrees in the field of education. There was no significant disparity in pedagogical knowledge between the two groups. However, differences were observed between the groups in terms of content knowledge and pedagogical knowledge. Participants with advanced degrees demonstrated superior performance in technological pedagogical, and content knowledge. In comparison with the current study, the research conducted by Castéra et al. (2020) showed different results, namely that TPACK factors and academic level were independent. It contrasts with the study done by the scholars. This contrasts with the study conducted by the scholars. The study differs from Shafie et al. (2023) research, which indicates that the highest educational qualifications significantly influence the 21st-century Technological Pedagogical Content Knowledge (TPACK) level, whereas teaching experience does not.

The study found that teachers who had GPAs in the range of 7.5 to 8.4 performed better than other groups, and the lowest scores were from 6 to 7.4 in technology knowledge. Teachers with a GPA from 7.5 to 8.4 showed better results, and those with a GPA from 6 to 6.4 showed the worst results in pedagogical knowledge. Teachers with GPAs from 7.5 to 8.4 showed better results than other groups, and groups from 6.5 to 7.4 showed the lowest scores in content knowledge. Groups from 7.5 to 8.4 performed better, and those with the lowest scores were 6 to 6.4 in pedagogical content knowledge. Also, groups from 7.5 to 8.4 showed better results, and those with the lowest were 6 to 6.4 in technological pedagogical, and content knowledge. In contrast to this study, Bozkurt (2014) concluded that teachers with higher academic achievements showed better results on TPACK attitudes. Mercado and Ibarra (2019) found a negative correlation between pre-service teachers' GPAs and their ability to teach ICT-integrated content. Additionally, Adalar (2021) showed that there were no significant differences between participants' perceptions and beliefs related to TPACK and variables such as their gender, GPA, and computer ownership.

The study also demonstrated that participants who studied at both universities had better results in technology knowledge. Participants who studied at public universities showed slightly better results than other groups in pedagogical knowledge. Participants who attended public universities showed better results in content knowledge and technological content knowledge. Those who studied at public universities showed better results than those at private universities in pedagogical content knowledge. Participants who studied at both universities had the highest scores in technological pedagogical knowledge. Those who studied at public universities had better results than the group who studied at private universities in technological, pedagogical, and content knowledge. The study contrasts with Katechaiyo's (2021), where those from private schools showed the desirable status and implementation TPACK model, especially in productive pedagogies, and supportive classroom environments. Further, it showed the highest level of content knowledge, followed by technology knowledge.

While this study offers meaningful insights into teachers' Technological Pedagogical Content Knowledge (TPACK), several limitations should be considered. The sample was not evenly distributed across key groups since there were significantly more female than male participants,

and imbalances were also present between public and private university graduates and across teaching positions. These factors may have limited the generalizability of the findings. The study also did not take into account specific contextual influences within the Bosnian and Herzegovinian education system, such as curriculum differences, access to technology, or opportunities for professional development. Additionally, since the data were self-reported, responses may reflect personal bias or overestimation. The use of quantitative methods further limits the depth of interpretation, as it leaves out the nuanced, personal experiences that qualitative data could provide. Lastly, factors like access to training or resources, which may impact TPACK, were not controlled and could have influenced the results.

6. Conclusion

In conclusion, the study focused on TPACK among Bosnian teachers, encompassing TK, PK, CK, TCK, PCK, TPK, and TPCK.

In contrast to previous studies, which favored females, this study showed no significant difference between males and females in technology knowledge, pedagogy knowledge, content knowledge, technological content knowledge, pedagogical content knowledge, technological pedagogical knowledge, or technological pedagogical and content knowledge.

Compared to earlier studies, this study showed better performance among experienced teachers in pedagogical knowledge, content knowledge, technological content knowledge, pedagogical content knowledge, and technological pedagogical knowledge.

The study also showed that groups with higher degrees performed better in technological pedagogical, and content knowledge.

Additionally, it showed that participants with GPAs in the range from 7.5 to 8.4 performed better in technology knowledge, content knowledge, and technological pedagogical and content knowledge.

Moreover, the study indicated that teachers who graduated from public universities typically achieved stronger results compared to their counterparts from private institutions, particularly in the area of pedagogical content knowledge. Notably, both groups excelled in technological pedagogical knowledge.

To conclude, the study revealed no meaningful differences across gender, education level, or teaching experience, with all related effect sizes in the small or negligible range. However, differences based on GPA showed moderate practical significance, particularly in components such as Technological Pedagogical Content Knowledge ($\eta^2 = 0.127$), Technological Pedagogical Knowledge ($\eta^2 = 0.126$), and Technology Knowledge ($\eta^2 = 0.112$), suggesting GPA may play a relevant role in shaping teachers' self-perceived TPACK. Levene's Test for homogeneity of variances indicated no significant differences across groups in any of the knowledge domains (all $p > 0.05$), confirming that the assumption of equal variances was met and justifying the use of ANOVA and t-tests from the perspective of variance equality. Although the study employed t-tests and ANOVA for group comparisons, the Shapiro-Wilk tests revealed violations of normality across several key subgroups, particularly among gender and GPA levels. As a result, the findings from parametric analyses should be interpreted cautiously, and future research is encouraged to apply non-parametric methods for more robust inferences.

This research has the potential to raise awareness among administrators and education ministers regarding the importance of allocating funds, organizing workshops, and providing support for teachers as they adapt to new classroom environments. Further studies should include a larger number of participants to either support or challenge the hypothesis of this research. Additionally, more research should be conducted across different educational courses to check whether it affects the results.

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Informed Consent

The authors have obtained informed consent from all participants.

8. Conflict of Interest

The authors declare that there is no conflict of interest.

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Educational Computer Programs as a Mechanism and Means of Mathematical Literacy Forming

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Abstract

Educational routes personalization in the direction of cognitive processes correcting for problem solving of student's mathematical literacy forming, development of complex student's mathematical knowledge through the digital technologies and computer learning systems are an important concept in mathematics education. The aim of research – to optimize and evaluate the effectiveness of student's mathematical literacy process forming by using a computer training program with animation elements. Complex knowledge forms the ability to maintain the dynamic stability of mental activity, motivation, self-organization, and creativity. Materials and methods: methodology of student's personaluzation by digital environment using with complex knowledge learning on the base of visual modeling, technology of parameterization as a resource of mathematical objects optimization, computer design of stages growth dynamics of student's mathematical literacy. Results: basis of criteria characterizing of student's mathematical literacy testing in educational process; parameters of mastering degree of educational materials by students and quality of educational materials assimilation in mathematics learning. The test establishes the statistically significant dynamics for all the studied indicators (coefficient of concepts volume assimilation and the coefficient of completeness of an ability to operate with concepts in solving problems with the depth of connections assimilation.

Keywords: computer training program, mathematics learning, complex knowledge, limit of sequence and function.

1. Introduction

UNESCO coordinates the implementation of "Education 2030" agenda to reimagine education for a sustainable future and to educate every learner, provide the quality learning opportunities for all, and empower them to be a creative and responsible global citizen.

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The problem of mathematical literacy forming in pedagogical science is not new, but extremely important and widely has reflected in scientific research on philosophy, economics, psychology and pedagogy (Yaroshenko, 2021; Konoplyansky, 2017). Scientific and methodological experience demonstrate that education today is no longer feasible without the incorporation of digitalization. At the same time, an integration of modern achievements adaptation in science with digital technologies using creates the basic aspect of student's personal development in teaching mathematics. So, formation of student's mathematical literacy should include the elements of fractal geometry, theory of encoding and encrypting information, fuzzy sets and fuzzy logic and other complex mathematical knowledge. It is realized in school mathematics course by practice-oriented subtasks, concerning with generelized constucts solving.

The decline of student's motivation, an avoiding complexity in learning mathematics and gap between the classical content of teaching mathematics and modern science leads to an increase in crisis phenomena in mathematical education, both at school and at the university. Therefore, the task is to create a rich information and educational environment for teaching mathematics by changing the content of education in the direction of mastering complex knowledge through the support of distance learning and digital technologies.

At the present stage of development of education systems in various countries, including Russia, the mainstream is the creation of an integrated textbook on mathematics and computer science for secondary school. This idea is closely related to the concept of smart-education. The prerequisites for the development of the concept of smart-education were: 1) technological factors providing new means and technologies for learning in the modern information and telecommunication environment; 2) social factors including society's need for a new quality of educational services; 3) economic factors conclude that education has always made a significant contribution to the development of macroeconomics (Dneprovskaya et al., 2015). Mathematics teaching based on the development of complex knowledge generalized constructs (for example, modern achievements in science) becomes an effective direction for the formation of school student's mathematical literacy with a significant applied and mathematical-informational potential of personal development (Smirnov et al., 2021). Today, various innovative tools, including computer tools and programs, are used to solve this problem of mastering complex knowledge. Computer software for training first appeared in the USA in the 40s of the last centuries (flight simulators). The high price of computers at the time, their massiveness, imperfect monitors, input of programs using first-generation programming languages from punch cards, and access only in computer centers were all obstacles to the mass application of computers in science, technology, and education.

In the 1960s and 1970s the main paradigms of programming languages were developed, which are still used today, and in the 1980s there was a consolidation: some languages adopted features of object-oriented and system programming, others concentrated more possibilities in the application of modules, etc. After 1980, personal computers became available and the leading companies (usually from the USA) began to specialize in educational software, the main purpose of which was to improve the efficiency of the educational process. In 2020, at the third international conference eSTARS 2020, dedicated to the study of the role of digitalization in higher education, Rector of the National Research University Higher School of Economics Ya. Kuzminov noted that many higher education institutions in the country have insufficient implementation of digital technologies due to poor professional training of teachers and the established opinion that digital education (in particular, online) is of poor quality. It is obvious that the introduction of digital components into the educational process of higher education should be based on various types of high-quality content. Today in many countries of the world there is an active search for new pedagogical methods and techniques, which together with digital technologies could ensure the universality of learning, including the activation of the learning process, individualize it, provide access to modern sources of knowledge from leading experts in their fields of activity (Romanova, 2020). The authors of a joint study by Jisc, British organization for the development of digital technologies in higher education, and Emerge Education believe that it is time to move to a complete transformation of teaching in higher education. In their research "Roadmap to 2030" (Barosevcic et al., 2021), the authors identify of three areas where digital technologies are most useful – educational content (growth in the quality of digital learning programs), its delivery through learning and assessment infrastructure, and support in the learning process.

Purpose of the study: optimization of the learning process through the use of computer learning program with animation elements in mathematical literacy formation. Development of student's mathematical activity in the context of complex stochastic processes managing will be based on the coordination of different factors and principles in three contexts: meaningful (semiotic), procedural (imitation) and social (Smirnov et al., 2021).

2. Methods and materials

One of the methods of student's mathematical literacy formation through complex knowledge mastering is the introduction of computer technologies into the educational process of mathematics teaching on the base of student's self-organization in research activity (Zayats, 2020; Kozel, 2021; Makarova, 2023; Chernyakova, 2023). We define *of student's mathematical literacy* as a socially approved of properties severity measure of individual's functional systems, manifested in the success of student's mathematical and digital activity in the development of sciences and real life. The *main characteristics* determine the essence of monitoring the formation of student's mathematical literacy:

– Understanding the plot situation and translating it into the language of mathematics with computer support, the procedure for finding a solution;
– Transitions of sign systems in the dynamics of animation;
– Visual modeling of data, quantities and units of measurement;
– Interpretation of the result based on variability and distant associations;
– Independence in the selection of mathematical and digital resources.

In our article we will use the computer training program with elements of animation, which has already been implemented in the educational. The program is focused on the propaedeutics of mathematical knowledge in the elements of higher mathematics. Cognitive mechanisms in the form of bright dynamic images, attract attention, stimulate thinking activate the cognitive abilities of students and help to better remember the material. At such moments, the emotional state is "...a multidimensional and complex process that includes a number of components, which include cognitive, motivational, motor ..." (Dvoryatkina, 2015). The training program is a set of program modules that focus the students' attention on such complex concepts of mathematics as modulus of number, limit of sequence, limit and continuity of function, points of functions discontinuity, construction of functions graphs. As an example, let us consider the module of "Limit".

3. Results

3.1. Visual modeling of pattern procedures

Example 1. The motivation for addressing this topic was the analysis of test results. It turned out that there is a global misunderstanding of an expression «$|x - 2| < 3$» meaning. Obviously, this misunderstanding is a direct consequence of competence work with absolute value. The program module "Limit" is presented in the form of 3 blocks: Module, Associations and Limit. Selecting the "Module" button, the program demonstrates to students the formula for determining the numerical module, shows and explains the conceptual error that, as evidence by extensive teaching experience, "imposes" this formula on students (Figure 1), suggests an applying another, more "universal" formula (Figure 2).

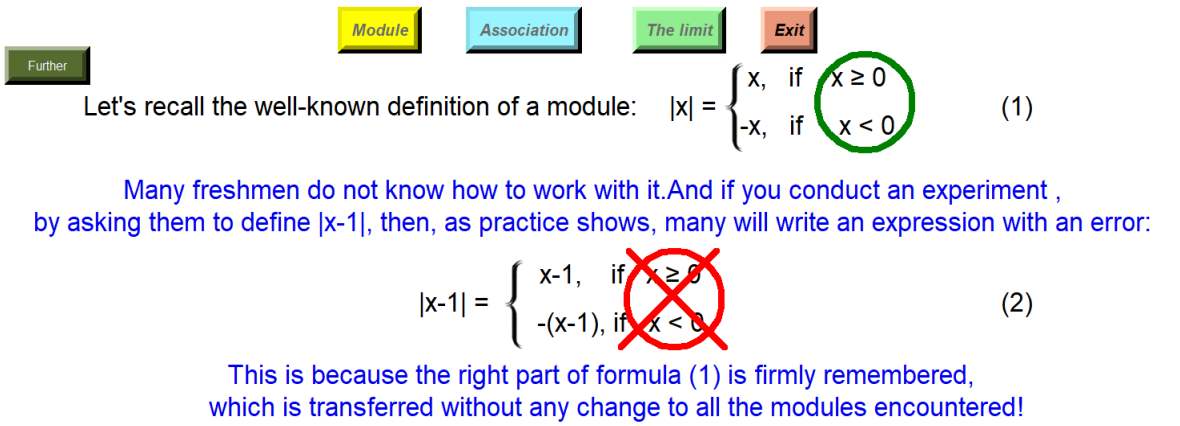


Fig. 1. A typical mistake of first-year students when working with the module

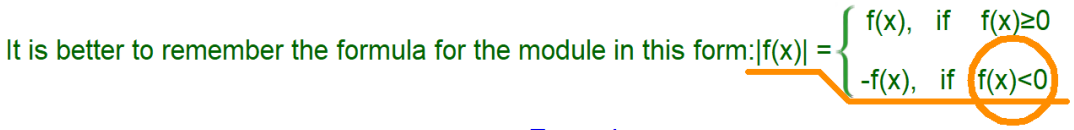


Fig. 2. The universal formula for the module

Then, various examples of modules with difference of two numbers with reference to the numerical axis, will encourage students to draw the correct conclusion (Figure 3).

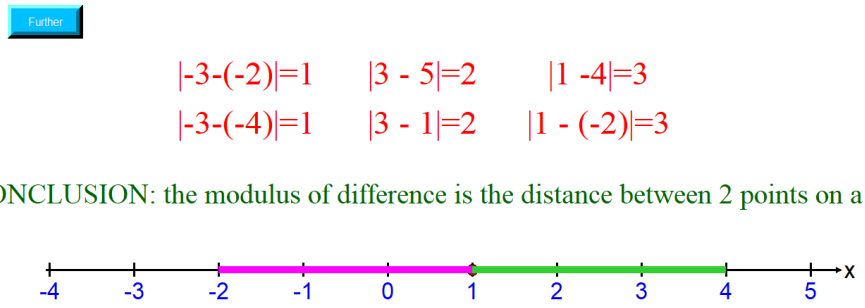


Fig. 3. Formation of modulus concept for difference between two numbers

After discussing the inequality |x - 3| < 2 on the number line (Figure 4), the geometric interpretation of the definition $|x - a| < \varepsilon$ becomes clear (Figure 5).

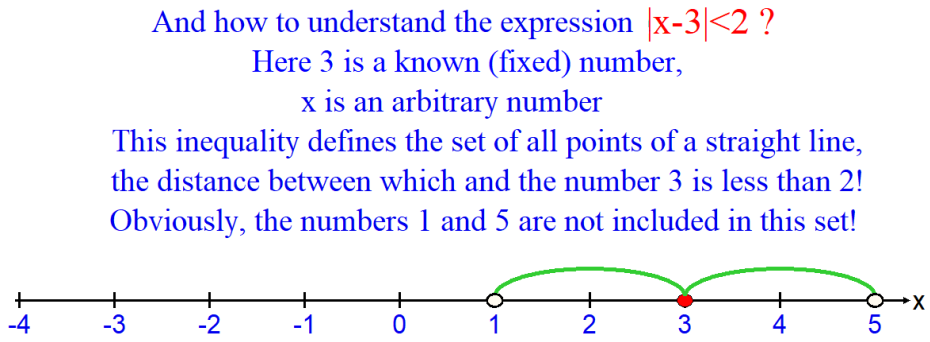


Fig. 4. Discussion of inequality $|x - 3| < 2$

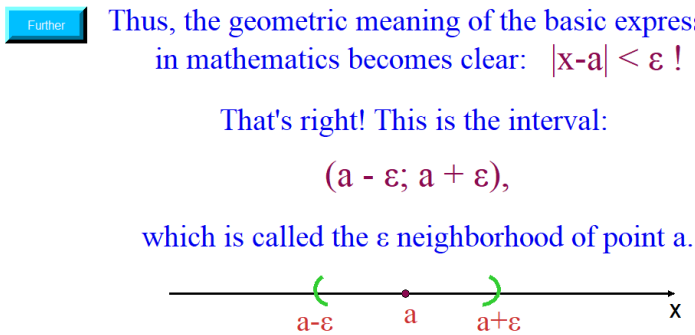


Fig. 5. The key inequality of mathematical analysis

Example 2. Next, a transition is made to the "Association" section (menu button), where Zenon's famous paradox "Achilles and the Tortoise" is presented in animated form, which "demonstrates" that Achilles will never overtake the tortoise (Figures 6 and 7).

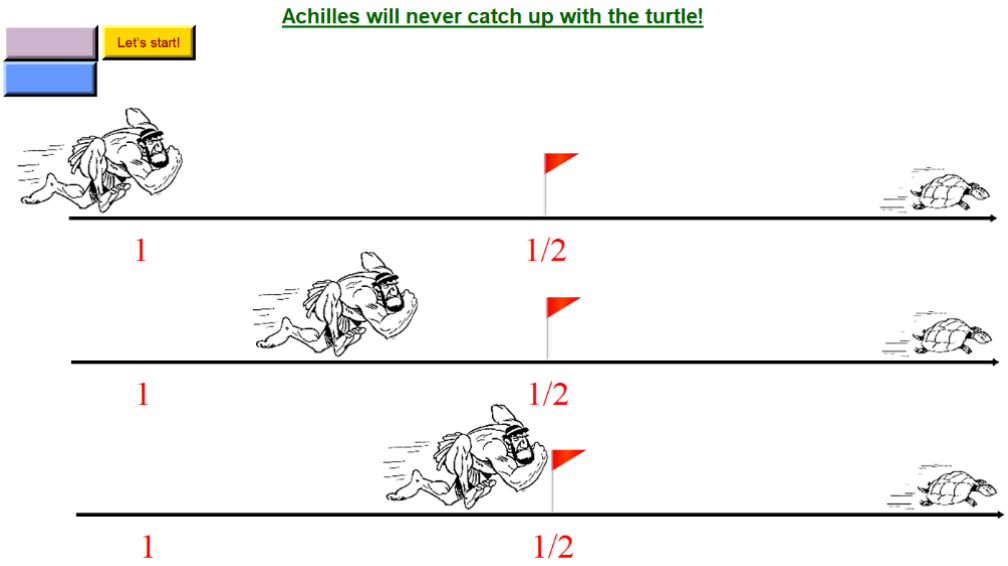


Fig. 6. The animation of Achilles

Part of the program code is presented below:

```
def clicked1():
global k, k1, q4
ac_kn(0, knop1)
ac_kn(0, knop4)
for i in range(1,250):
cnv.move(id_img1, 2, 0)
cnv.update()
sleep(0.01)
knop1.configure(text="CONTINUE!")
if q4 < 4:
t_ext(-20,-270+40*q4, spisok[q4], zw="DarkGreen", grup="group5", ti=mF2)
q4 = q4 + 1
ac_kn(1, knop2)
def clicked2():
global k, k1, tex_1, tex_2
ac_kn(0, knop2)
ac_kn(0, knop4)
cnv.delete(tex_1)
cnv.delete(tex_2)
for i in range(1,250):
cnv.move(id_img1, -2, 0)
cnv.update()
tex_1 = cnv.create_text(-540, 254, text=Fraction(k1/2), fill="red",
font=('Times', 35))   # The beginning of the path
tex_2 = cnv.create_text(22, 254, text=Fraction(k1/4), fill="red",
font=('Times', 35))   # The middle of the road
k1=k1/2
k=k+1
ac_kn(1, knop1)
if k >= 5:
ac_kn(1, knop4)
```

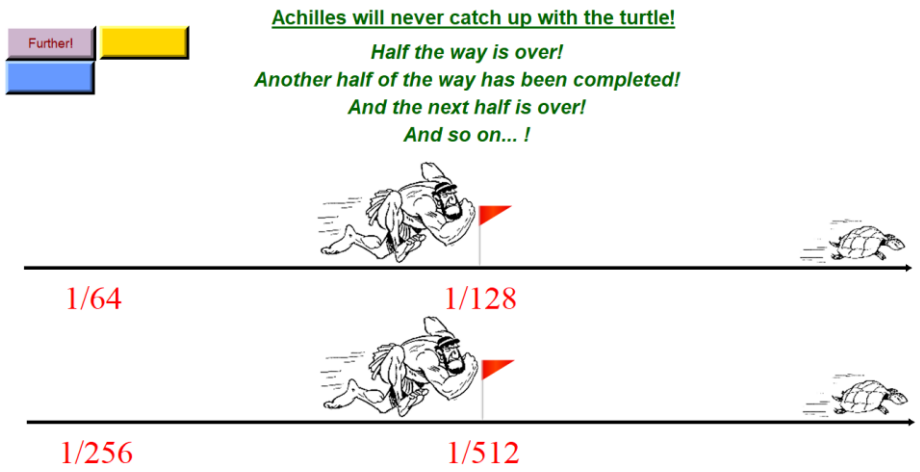


Fig. 7. The infinity of the process (the results are shown in a step)

In this context, students learn about the concept of sequence limit. Achilles can get as close to the turtle as he wishes, but he will never be able to touch it (Figure 8).

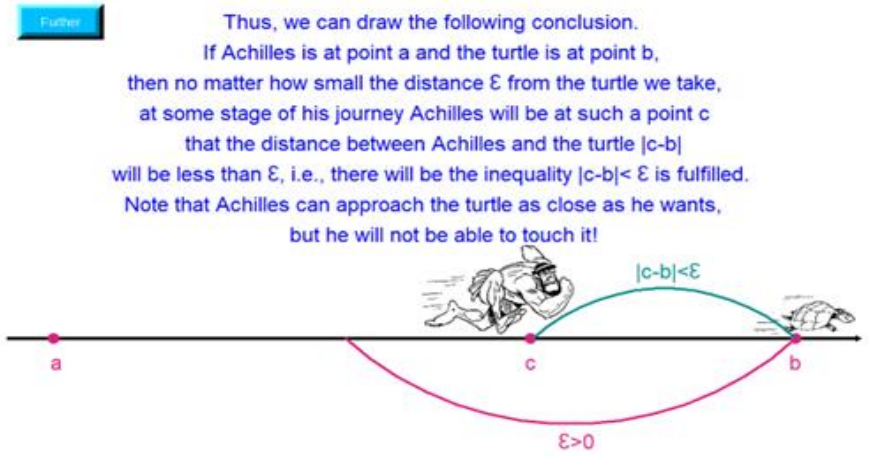


Fig. 8. The essence of the sequence limit

Example 3. In the "Limit" section, after defining the sequence, examples of various types of limits are provided (Figure 9).

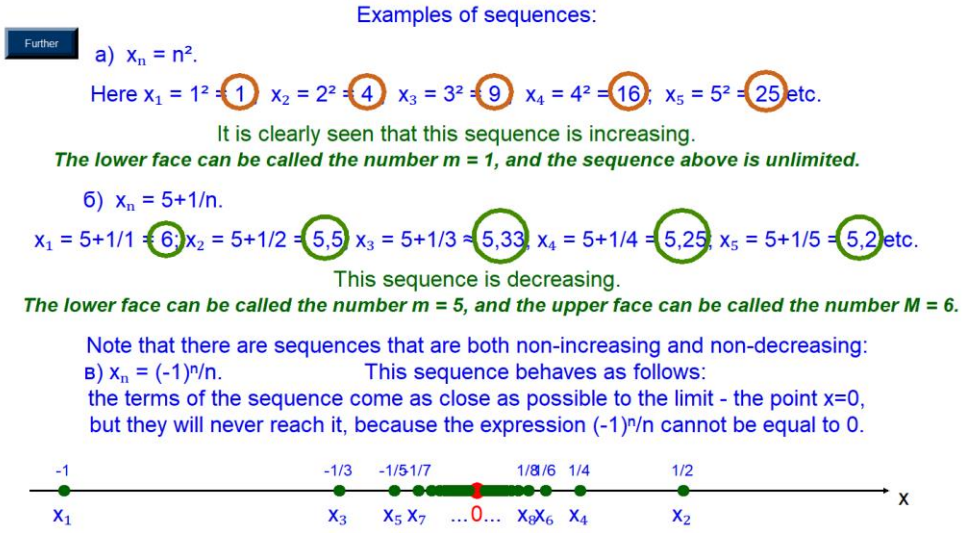
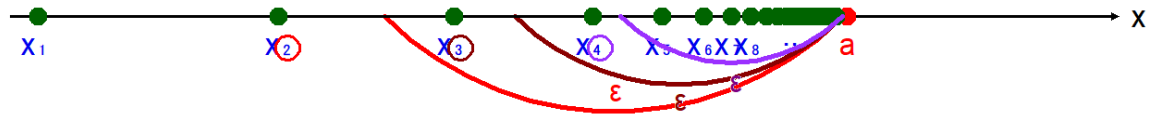


Fig. 9. Different kinds of sequences

Further, considering the increasing sequence on a straight line, the dependence is shown in dynamics N(ε) (Figure 10).



WHAT DOES THIS MEAN FROM A MATHEMATICAL POINT OF VIEW?

We have the situation observed with Achilles and the turtle. Obviously, the members of the sequence will approach point a as close as they like, but they will never reach it. If we step back from point a by an arbitrarily small distance ε, then for the number n = 2, for all n > 2, the inequality will be satisfied

$$|x_n - a| < \varepsilon.$$

($|x_3 - a| < \varepsilon$, $|x_4 - a| < \varepsilon$, $|x_5 - a| < \varepsilon$, etc. The index n = 2 is usually denoted by N = 2.)

And what will happen if we decrease the number of ε? N = 3 ! N = 4 !

Fig. 10. Dependence of the number N on the choice of a specific ε

After all that has been studied, students are fully ready to perceive and assimilate the definition of sequence limit in verbal form and in the language of mathematics, which in turn removes all problems in determining of function limit.

3.2. Experimental results

The experiment, which lasted for 2021–2024, was carried out at the beginning of first half of the year during the study of discipline "Mathematics". In order to study the motivational factors of students, interests and taking into account the individual characteristics of personatity, representative control and experimental groups of 42 peoples were formed annually, and testing was conducted to assess the level of existing knowledge. After a certain period of time a repeated control survey was conducted for experimental groups were conducted with CPC using and in control groups are in traditional way. As a result of an experimental study the indicators values characterizing the degree of student's educational material mastering and learning material quality in mathematics were obtained. It corresponds to the formation of mathematical literacy parameters.

The leading indicators for first criterion is the degree of educational material mastering are *an assimilation parameter* of concepts volume ($\overline{K_p}$) and completeness parameter of an ability formation to operate with concepts when solving problems ($\overline{K_y}$). These parameters are determined by using the following formula:

$\overline{K_p} = \frac{\sum_{i=1}^{n} m_i}{nm}$, where m_i – number of an information module concepts learned by i-th student; m – number of key concepts needed to be learned in given information module; n – number of respondents who took part in testing.

$\overline{K_y} = \frac{\sum_{i=1}^{n} p_i}{np}$, где p_i – number of information block tasks correctly solved by i-th student; p – number of tasks that needed to be solved in given information module; n – number of respondents who took part in testing.

Table 1. Dynamics of changes in the values of indicators characterizing the degree of student's educational material mastering

Modules	Control group		Experimental group	
	$\overline{K_p}$	$\overline{K_y}$	$\overline{K_p}$	$\overline{K_y}$
1. Sequence limit	0,73	0,71	0,75	0,78
2. Function of single variable	0,71	0,72	0,78	0,79
3. Function limit	0,72	0,68	0,77	0,71
4. Continuity of function	0,60	0,73	0,76	0,82
5. Derivative	0,67	0,65	0,83	0,76
6. Applications of the derivative	0,59	0,68	0,81	0,75

For the purpose of analysis, Microsoft Excel TP and the Data Analysis add-in were used in conjunction with the "Paired Two-Sample t-Test for Means" function.

The average number of key concepts learned in each module of the course was selected as an independent variable. As a result of this analysis for an assimilation parameter $\overline{K_p}$ the following statistical data were obtained: $|t_{emp.}|$ = 6,3; which significantly exceeds $t_{cr.}(0,05)$ = 2,02 (in the condition of normal distribution samples and confirmation of H_o – hypothesis). Therefore, we reject the null hypothesis. Therefore, the differences in the average values of knowledge acquisition indicators in the second sample are not random but systematic. Based on the completeness parameter $\overline{K_y}$ in the formation of skills for operating with concepts, the following statistics have been obtained: $|t_{emp.}|$ = 8,49, which significantly also exceeds the critical value $t_{cr.}(0,05)$ = 2,02.

The quality of learning of educational material in mathematics has been determined according to a methodology developed by the authors, using a coefficient that measures the depth of connections understanding between concepts. This indicator is calculated based on a definition of fractal dimension (D), which is an indicator of the interdisciplinary connectedness between concepts, and is calculated using the Hurst (H) indicator, which is related to the simple ratio D + H = 2, as presented in reference (Dvoryatkina, 2015). A detailed description of the algorithm for calculating the Hurst indicator can be found in that reference. The final formula for calculating this indicator is:

$$H = \frac{log(R/S)}{log(n/2)},$$

where S – standard deviation of learned concepts, R – scope of an accumulated deviation, n – number of respondents.

Table 2. Dynamics of values changes in H-Hurst index and indicator D of fractal dimension

Modules	Control group		Experimental group	
	H	D	H	D
1. Sequence limit	0,5037	1,4963	0,3802	1,6198
2. Function of single variable	0,4862	1,5138	0,4380	1,5620
3. Function limit	0,4879	1,5121	0,4116	1,5884
4. Continuity of function	0,5373	1,4627	0,5233	1,4767
5. Derivative	0,5663	1,4337	0,4527	1,5728
6. Applications of the derivative	0,4879	1,5121	0,4272	1,5690

Comparative statistical analysis of an interdisciplinary connectedness distribution of concepts in control and experimental groups allowed us to reject the null hypothesis - there are no reliable differences between the average values of an interdisciplinary connectedness index of concepts in control and experimental groups (t_{emp}=4,66> t_{cr} (0,05)=2,02).

The obtained result allows us to suggest that the practical implementation of CPC leads to a significant increase in the fractal dimensionality of mathematics education content, and as a consequence, to the establishment of deep connections of different levels, enhancing the quality of learning material in mathematics.

As a result of an experiment, it was proved that CPCs with the function of teaching and active animation cause a lively interest contribute to the activation of cognitive activity and significantly improve the level of student's mathematical literacy. Another advantage of this method can be considered as its application in extracurricular time.

4. Discussion

According to the results of surveys of 74 British educational organizations, it turned out that information technologies are most often used for convenience rather than for the development of teaching effectiveness (Erdem, Kocyigit, 2019). In Germany, education have been conducted to show the level of effectiveness of digital media use by university teachers and students. It turned out that both were poorly prepared to work in a collaborative digital environment (Setwyn, 2016). Things are no better in Australia, Spain, New Zealand, and the USA (Lai, Hong, 2015; Ivanovsky, 2021). American scientists led by R.E. Mayer (Mayer, 2020) saw great prospects for multimedia learning and gave a definition of multimedia learning, developed the principles of coherence,

signaling, redundancy, spatial and temporal contiguity, segmentation, modality, etc. The fact that the experience of applying multimedia technologies, for example, in a pandemic situation, is very valuable and that it should be developed and expanded, as it seems to be very relevant in the way of improving the educational process, is stated in (Vetlugina, Fominykh, 2021). Many Russian scientists see in the application of multimedia technologies a new, more progressive approach to learning (Tikhaeva et al., 2020; Shakhbanov, 2020; Bondarenko, 2017). The article (Tuzkova, Chernyavskaya, 2023) emphasizes the importance of digital technologies and systems applying in education, as it makes the learning process more effective and interesting.

Competently written computer-based training programs (CBT) with built-in animation, as mentioned above, make the learning process more visual, attractive, activate it. The effectiveness of this method is shown in the works (Bogdanov, 2023; Oleinik, 2023; Shpagina, Nesterova, 2021; Zaporozhtseva, Zvereva, 2019), CPCs (Zhabina, Milyutina, 2021; Schweigert, 2019; Bakhmetyev, 2015; Nazarenko, 2014). It should be noted that there are few effective TMCs in mathematics. This is due to the fact that programmers-professionals do not possess the appropriate methodology, and mathematics teachers are mostly not programmers.

Some scientists (Meseşan, Albulescu, 2019; Perry et al., 2017) look on this mathematical literacy problem using different aspects of practice-oriented questions (nature, society, infrastructure, science, production). However, the operationality of student's cognitive activity not always led to effective results (Smirnov et al., 2021). Such an original direction is the technology of student's mathematical literacy managing in the development of complex knowledge generalized constructs. The data obtained by us are consistent with the opinion of the authors (Hašková, Malá, 2019; Wenner, Campbell, 2017) about the weak readiness of teachers to innovate using. It is revealed that the integration of mathematics and informatics play a central role in determining the various levels of mathematical literacy success. Thus, in student's mathematical and digital literacy managing based on complex knowledge investigation, using a rich information and educational environment for mathematics teaching in the direction of computer resources involving to mastering of mathematics education becomes a priority in modern high school. This should be realized in the course of step-by-step study of complex knowledge generalized constructs with computer support and the ability to effectively interpret the tasks from real life. The priority for students become the ability to use the computer knowledge and skills to solve problems in mathematics and obtain a new information for effective growth of creativity and critical thinking.

5. Conclusion

In the course of investigation, the authors developed a computer-based mathematics learning complex system and knowledge with animation elements, which allows to comprehensively form the basic mathematical knowledge and ensure the effective development of mathematical literacy. The developed criteria and indicators are able to provide an objective assessment the dynamics of student's mathematical literacy development in the process of learning mathematics, which makes a significant contribution to the expansion of organizational and methodological support in process of teaching mathematics with using of an innovative digital technology. The analysis of an empirical results of the study using a set of mathematical and statistical methods has shown the positive dynamics of mastering level of key mathematical concepts and methods for mathematics learning in the experimental groups, ensuring the validity of theoretical conclusions obtained earlier about the improvement of mathematical literacy level in the conditions of implementation of computer-based training program.

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Parental Volunteering at Schools in the Light of a Qualitative Survey in Hungary

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Abstract

While a large body of international research deals with parental volunteering, the number of studies on the subject is low in Hungary. This paper investigates teachers' interpretations of parental volunteering. Our research involved three Hungarian counties where the proportion of schools with disadvantaged students is high. The population was composed of teachers of primary and secondary schools (n = 45) selected by means of multistage stratified sampling. We processed 36 interviews in which parental volunteering was mentioned, conducting both a thematic and a typological analysis. The thematic analysis has revealed that 'real' volunteering is rare as parents do not typically initiate any activity themselves. They are most likely to volunteer occasionally, with most of the voluntary work done by members of the Parents' Association (PA). The typological analysis has differentiated between four types of parent volunteers: (1) committed PA members who also take part in school-level decision making, (2) PA members who are involved in class-level decision making and organisation, (3) parents who volunteer occasionally of their own accord, (4) parents who volunteer occasionally, if they are requested to. Our results indicate that it is essential to motivate parents to volunteer and to promote forms of volunteering that are suited to parents.

Keywords: teachers, parents, parental involvement, volunteering, parents' voluntary work, parent volunteers, Parents' Association membership, deductive coding, thematic analyses, typological analyses.

1. Introduction

We conducted a semi-structured interview survey to investigate teachers' perceptions of the voluntary work of parents in schools in a disadvantaged region of Hungary. While this form of parental involvement in schools is examined in detail by international research (see the systematic literature

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review by Kocsis et al., 2022), we do not have sufficient data on parental volunteering in Hungary. In recent years, an increasing body of research has contributed to the Hungarian discourse on parental involvement. The main areas of investigation includes causal links between parental involvement and resilience (Ceglédi et al., 2022, Ceglédi et al., 2024), the role of school support professionals (Csók, Pusztai, 2022; Pusztai, Csók, 2023), the role of parental involvement in academic and sports achievement (Kovács et al., 2022; Kovács et al., 2024), parent-teacher communication (Major, 2023), and the impact of secondary school students' perceived parenting values on school choice (Tódor, 2023). Our work aims to enrich this discourse by focusing on volunteering.

In the literature, a volunteer is defined as a person who does non-compulsory work of their own free will, driven by some intrinsic motive, and without any remuneration. Some research narrows down the concept of volunteering to formal, organisational activities (Wilson 2000; Aydinli et al., 2015). In Central and Eastern Europe, during the socialist era, volunteering as it is known today did not exist. Instead, it was compulsory to do unpaid work for the good of the community. However, with the development of the NGO sector after the fall of socialism in 1989–1990, the first 'genuine' volunteers appeared in the CEE region (Juknevicius, Savicka, 2003). Their proportion is still below corresponding rates in Western countries, due to lower levels of economic development and urbanization as well as the fact that the non-profit sector and the culture of volunteering in the new democracies are not yet as developed as in the West (Voicu, Voicu, 2009).

Parental volunteering is considered a key factor in the literature on parental involvement (Epstein, 2010). For an international comparison of parental volunteering in schools, recent data can be obtained from the PISA 2018 study. According to the responses of the school leaders surveyed, 17 % of parents were involved in their local school councils, and 12 % volunteered for physical or extra-curricular activities (e.g. building maintenance, going on school trips). The data show that of all parental involvement variables, it is in parental volunteering that the Central and Eastern European region is not behind the West (OECD, 2019). Due to the pandemic, there is no recent data available at the moment, so the results of our current research may fill this gap as well.

In the first half of the paper, we begin with an overview of the literature that underpins the deductive coding of interviews, and then describe the research methodology. The presentation of the results consists of thematic and typological analyses of the interviews. The paper ends with a discussion section where we formulate the conclusions and limitations of the research, present our further research plans and make our policy recommendations.

2. Questions of investigating parental volunteering in the literature

Firstly, we address the definitional issues of parental volunteering, including who initiates the activity, i.e. whether it is a truly voluntary activity and whether it falls within the classical definition of volunteering. In the 2000s, research showed that more than 90 % of schools actively recruited volunteers through letters and newspapers, which suggests that schools have exhausted their volunteer base and that few schools can attract volunteers without recruitment (Brent, 2000). Aguilar (2021) stresses that in most cases, it is the school that initiates the participation of parents in volunteering. Myres (2022) points out that some parents believe that the child's education is the sole responsibility of the teacher, and thus do not participate in school-related work, respecting the teacher's educational role. According to a systematic literature review by Kocsis et al. (2022), voluntary initiatives are mainly organized from above and in response to decision-makers' needs. There are also project-based initiatives, where schools involve parents in partnership with other formal or non-formal organisations. Parent-led initiatives were rarely reported in the studies reviewed, and what were named as grassroots projects included initiatives by local teachers or school management.

One of the barriers to volunteering is that parents' involvement is limited to a specific area, with the result that only a fraction of the parent community can participate. In addition, there may be barriers due to work, time constraints, language differences or lack of information (Dietz, 1997; Baquedano-López et al., 2013; Aguilar, 2021; Myers, 2022). Another significant obstacle is that teachers do not know how to utilize parents as volunteers (Epstein, 2010; Nathans, Revelle, 2013). According to Marland-Peltoniemi (2015), the lack of opportunities to volunteer reduces the sense of cooperation and, as a consequence, reinforces the hierarchy of the school, where school staff dominate, which can increase the feeling of helplessness in parents.

Regarding the motivation for volunteering, parents seek affectively rewarding experiences when doing voluntary work, which, in technical terms, refers to implicit motivation (Aydinli et al.,

2015). Volunteering allows parents to offer their expertise and physical labour, which is driven by prosocial motives and which is dominated by the intention to help. In addition, the interest of the child is also present as a motivation. Smaller children like it when their family helps in the classroom. Parents also appreciate the time spent in their child's classroom, especially if the child is young, as volunteering is one of the ways in which they can help ease their child's anxiety. Furthermore, parents have the opportunity to build trusting relationships with teachers during volunteering (Marland, Peltoniemi, 2015; Myers, 2022).

Prior to the pandemic, parents were most involved in the following volunteer activities: working as in-class assistants, helping at class trips, sports coaching, maintenance projects, fundraising, committee and supervisory work (Brent, 2000; Myers, 2022; Larracilla-Salazar et al., 2024; Poliaková et al., 2024). Furthermore, some parents also support schools by doing voluntary manual work (Lemmer, 2007; Myers, 2022). While Aguilar (2021) argues that parental volunteering has declined due to the coronavirus, Fensterwald (2022) and Myres (2022) claim that there have been efforts to adjust volunteering opportunities to allow parents to volunteer online. According to a systematic literature review by Kocsis et al. (2022), the types of volunteering activities for parents include those directly related to schoolwork, i.e. supporting children's academic achievement or remedial education, those related to school events or healthy lifestyles, and finally cultural and community experiences.

The influence of background variables on parental volunteering is also widely analysed. The results of Aydinli et al. (2015) show that age and educational attainment are significantly associated with parental volunteering. Kocsis et al. (2022) found that volunteers were typically less affluent, but in certain projects, parents with better financial circumstances were reported to have participated more actively. Volunteers were more likely to have a more flexible presence on the labour market and to have participated in civic activities in the past. Being religious and having several children from the family attending the same school also increased the likelihood of volunteering.

There are also differences by cultural and ethnic groups in parental volunteering (Huntsinger, José, 2009). Merchán-Ríos et al. (2023) emphasized the importance of developing family involvement action plans, taking into account the perspectives of families belonging to other ethnic groups and minorities. Moreover, González-Patiño and Poveda (2015) argue that in places which are socio-economically and ethnically relatively homogeneous, but where parental dynamics of school involvement are varied and shaped by a complex and heterogeneous set of interests and beliefs, it is also worthwhile to periodically reconsider school-family cooperation and its potential.

Coleman (1988), referring to his work two decades earlier, pointed out that the way to make low-status pupils successful was through parental involvement in the school community. His results showed that strengthening the school community and involving parents in school volunteering and other community activities led to improved student outcomes, and that church institutions were particularly successful in this. Research also shows that parental involvement is higher in primary schools than in secondary education, and that there are only a few studies that focus on parents' voluntary activities in the latter (Kocsis et al., 2022; Myers, 2022).

3. Research context and research design

The most important research questions are how parental volunteering is interpreted by teachers in our Hungarian sample and what types and characteristics it has. The qualitative research involved three Hungarian counties, namely Szabolcs-Szatmár-Bereg, Hajdú-Bihar and Borsod-Abaúj-Zemplén, where the proportion of schools with disadvantaged and multiply disadvantaged students is high. The population was composed of teachers of primary and secondary schools from every school providing sector selected by means of multistage stratified sampling. We created four school subsamples based on a combination of county, school type, social background-adjusted site-level achievement scores from the National Assessment of Basic Competencies and parental involvement data. Next, from each subsample, teachers were selected through non-representative sampling. Finally, the audio material of the semi-structured individual interviews, which were recorded in autumn 2021, was converted into a textual database. The length of the interviews averaged 68 minutes.

In accordance with Mason (2018), interviews considered pre-established general topics but maintained flexibility using open-ended questions, which were approved by the Education Ethics Committee of the University of Debrecen. The interview draft included the following items: teachers' self-introduction; a description of the school, community and parents; teachers' views on

the role of parents and on their communication with parents; patterns and gaps in the parent-school relationship (at the level of teachers); good practices and suggestions.

4. The methodology of the interview analysis

Out of the 45 interviews conducted, nine did not contain any relevant information on parental volunteering, so 36 interviews were processed in the end. As our main aim, in line with Creswell (2012), was to become closely familiar with the data, we used simple hand-coding, which allowed for a broad understanding of the entire interviews. First, we selected the interview parts that contained the subject of volunteering. Despite the fact that we were dealing with 36 interviews, the amount of text on parental volunteering did not become unmanageable. In the first stage of the analysis, the texts were prepared and pre-read. Manual coding was carried out using a hybrid (deductive and inductive) approach (Fereday, Muir-Cochrane, 2006; Swain, 2018). If, apart from the deductive codes derived from the literature, so-called emic (or inductive) codes emerged from the meanings of the texts, these were also marked and included in the set of codes. Afterwards, the codes were added to the relevant text passage. In the final stage of the analysis, we carried out a thematic and typological analysis, supported by interview excerpts (Creswell, 2012).

During the thematic analysis, deductive codes were developed based on the literature including the following categories: the definition, motivations, who volunteering was initiated by, frequency, intensity, barriers and forms of volunteering, as well as the effect of parents' socio-demographic characteristics, the stage of education, the school provider, and the pandemic on volunteering. Inductive codes included time (long ago, before the political transition in 1989 and now) and children's negative image of parental volunteering. These were first interpreted, analysed in text form and then supported by relevant quotes (Braun, Clarke, 2006; Delve, Limpaecher, 2020).

During the typological analysis, treating each full interview as a unit, we attempted to establish the types of parent volunteers based on the teachers' accounts. Since the greatest differences between parents were found in motivation and the frequency of volunteering, we used these two factors as a basis for the typology. At this point, we characterized the types and did not necessarily use interview quotes to support our typology. The analysis was carried out by researchers of different ages and professional backgrounds, minimizing the possible bias on the part of observers and interviewers (Delve, Limpaecher, 2023).

Table 1. The frequency of codes

Code	Frequency
Volunteering is present in the school	54
Parents' Association	44
Volunteering at events	45
Regular volunteering	40
Initiated by teachers	39
Occasional volunteering	24
The aim is community building	23
Non-typical volunteering	19
Motivated by altruism	15
Volunteering by definition	13
Physical work	13
Mixed motives	12
Volunteering activities in the past	10
Covid-19	8
Motivated by the child's interest	8
Initiated by parents	7
Motivated by pressure	6
Parents with disadvantaged backgrounds	5
Volunteering can be negative	3
Initiated by a project	2
Parents with favourable backgrounds	2

5. Results

5.1. Thematic analysis

In the first stage of the analysis, we aimed to define volunteering based on what teachers considered it to be. The frequency of the codes showed that volunteering according to the traditional professional definition appeared in thirteen of the teacher interviews. Those who understood the concept in this way said that 'genuine' volunteering hardly ever occurred, and that parents did not offer their help themselves. However, a significant number of teachers interviewed regarded participation on request or under compulsion (compulsory participation in socialism) as volunteering (this was the case in 19 interviews).

"There are some creative parents who are very good at helping the children (voluntarily), or if we ask them, they happily agree to come along, say, on a class trip. They are ready to get involved in such occasions." (I1)

"They are active, and if there is a request to them, all parents help" (I21)

"Earlier the parents were asked to do something like this, now here at this school the parents are not too keen to volunteer" (I9)

Following the definition of parental volunteering, the next important sub-theme was motivational factors. As it can be seen in the theoretical overview, volunteering is an activity that is offered voluntarily from some intrinsic motivation, so we can assume that parental volunteering is dominated by altruistic motives. However, in addition to the intention to help, the child's interest (even as an investment) may also appear as a motivation. Table 1 is presenting more information about the extracted themes, process, codes, and frequencies of evidence statements. The frequency of the codes shows that community building as a goal was mentioned twenty-three times and altruistic motives fifteen times. Mixed motives appeared twelve times in the interviews, while the interest of the child eight times (Table 1).

Table 1. Description of codes

Theme	Process	Code	Frequency
frequency of volunteering	deductive	Occasional volunteering	24
unique	inductive	Covid-19	8
definition	deductive	Non-typical volunteering	19
definition	deductive	Volunteering by definition	13
type of volunteering	deductive	Physical work	13
initiated	deductive	Initiated by teachers	39
initiated	deductive	Initiated by a project	2
initiated	deductive	Initiated by parents	7
goal of volunteering	deductive	The aim is community building	23
motivation	deductive	Motivated by the child's interest	8
motivation	deductive	Motivated by pressure	6
motivation	deductive	Motivated by altruism	15
motivation	deductive	Mixed motives	12
unique	inductive	Volunteering can be negative	3
type of volunteering	deductive	Volunteering at events	45
frequency of volunteering	deductive	Regular volunteering	40
social background	deductive	Parents with favourable backgrounds	2
social background	deductive	Parents with disadvantaged backgrounds	5
type of volunteering	deductive	Parents' Association	44

Theme	Process	Code	Frequency
frequency of volunteering	inductive	Volunteering is present in the school	54
frequency of volunteering	inductive	Volunteering activities in the past	10

"They like to come to the school. We have charity afternoons organized by the PA. At those times, parents are involved in a lot of activities such as coordinating the event. They help with the buffet or the raffle draw." (I4)

"Parents are very helpful, supportive, and willing to help with any kind of event, whether it's a Santa Claus or carnival party. They readily help with the purchase of gifts, and they are happy to participate in the baking of carnival doughnuts, or in cooking and baking on family days." (I15)

Especially parents from more favourable backgrounds were also aware that parental involvement in school life was in the interest of their children, so in this case volunteering was also a kind of investment.

"...if it is in their children's interest, I think I can count on some people, but it is usually a small core from each class that can be firmly relied on. It depends on the background of the parents." (I7)

There were also some respondents who felt that pressure could be a motivating force in volunteering, which appeared in six interviews.

"... Some people genuinely want to join, and they do have fun with us, others are forced into it, while others don't go along with the majority even despite pressure." (I24)

The interviews also reveal that the motivation to volunteer is related to who initiated the volunteering, whether it was teachers, parents, or whether volunteering was part of a project. The majority of respondents stated that it was teachers who asked parents to help. The frequency of codes (39 mentions) clearly shows that this type of initiative was the most prominent. One teacher mentioned parents' self-organisation, and a few also said that parental volunteering was part of a project.

"There are classes that organise small gatherings for themselves even outside scheduled events, coming together as a small group of friends somewhere in the parish yard, or if someone has a farm or a place where they can receive people, they invite the parents from the class. I think that parents can work together very well." (I15)

"We have occasional project events. Let's say we have a European Union project week right around December, where a couple of parents help out by preparing some local food or something like that. This is how they get involved in such events." (I25)

Another subject we analysed was the frequency, intensity and barriers of volunteering. We examined whether parental volunteering occurred at all, how many people participated, and whether teachers found it was mainly regular (e.g. done by PA members) or occasional. In terms of the intensity of participation, there were some teachers who said that they did not have active parents and any parental volunteering at all, the reason being that parents worked long hours, multiple shifts and did not have the time. Only one teacher mentioned that all parents in the class were involved.

"Well, parents are quite overwhelmed, and they have a lot on their plates. They're really busy. They're completely consumed by the stress of work and day-to-day problems." (I7)

"I am very lucky because the parents in my class are so active, devoted and helpful. They are available and supportive no matter what event it is." (I26)

In most cases, it is practically PA members who do (regular) voluntary work. Most teachers reported the number of active parents being 3 to 4 per class. It was rarely possible to mobilise masses of parents successfully for an event.

"This also depends on the class in question. There are parents who really go to great lengths; they're the ones from the PA, aren't they? But I would say others are really hard to get going." (I27)

The significance of PAs is demonstrated by the fact that they were mentioned as many as 54 times in the interview. Data show that in Hungary, Parents' Association membership is not only related to the frequency and intensity of volunteering, but also appears itself as a special type of parental volunteering.

Next, we analysed the forms of parental volunteering. One type of activity, as we have already seen, is PA membership, which mainly involves managing the finances of the class, but in most

cases, members also participate in other volunteering activities. They are involved, either voluntarily or on request, in the organization of school events and community life as well as in mediating between parents and teachers in major discussions concerning the institution. Tutoring or teaching, which are mentioned in the literature, were not referred to in the interviews, nor were extra-curricular activities outside school. The most common parental activity mentioned was participation in or organization of school events (e.g. family days, trips, proms), which was mentioned in almost all interviews and which is supported by the frequency of the code. Physical work, which used to be widespread even in state schools due to lack of resources, is no longer common, except for a few mentions. One teacher pointed out that certain tasks requiring physical strength also required the parents' professional skills or social capital.

"Earlier, we built the playground, cut fallen trees after storms or painted the fence together with the parents. Now, instead, they are happy to accompany children to competitions, for example, or to donate equipment to us. If necessary, they can go with the class on a bike trip or even on overnight trips." (I15)

According to the literature, parental volunteering is influenced by gender, age, social status, contacts, civic activity and religiosity, but our interviewees gave prominence to social status as the main factor. Presumably, teachers had less insight into other circumstances. The interviews suggest that parents from better backgrounds were considered more active by the teachers, and the interviewees also mentioned that in some cases the large number of parents with low educational attainment hindered the functioning of the PA, because it was difficult to involve them in the tasks at hand.

"There were three or four of the PA members who were leading the way, they knew each other well, one of them was a parent from a very well-off Roma family, and the other three parents didn't come from poor families either." (I11)

"Parents are reluctant to take on PA membership, but this is also due to the social composition. Well, it's all about low educational levels and carelessness. PA parents don't want to communicate and talk with other parents." (I16)

Parental volunteering was significantly impacted by the level of education as well as the school provider. Teachers reported that parents were much more active in primary schools, especially in lower grades, than in secondary institutions. Due to the sample size, we refrain from drawing any far-reaching conclusions, but the current interviews revealed that in church-run schools there were slightly more school events, community building was more of a priority and therefore parents were slightly more active.

"In lower grades, parents are more active, and one or two of them carry on in the upper grades as well.... However, it's lower-grade PA members who are enthusiastically involved. Later, if children lose interest in learning or have conflicts at school, parents withdraw from the school." (I11)

"I must mention family days, which matter a lot because families can also bring their little ones here. We have a playground, kids can play there. Another thing is parents' charity fundraising to collect donations, e.g. bottle caps for sick children. We have second-hand days, when parents can come and bring clothes. We usually receive other donations from a charity, which is not only important in social terms, but also because families get them from the school rather than from strangers. We are open and parents can come to look at their children or even record the events with a camera." (I11)

In the international literature, we have already found data on the impact of Covid-19 on parent volunteering. In total, the pandemic period was mentioned eight times in the interviews. At that time, parents were hardly involved in school life. It was a rare occurrence that PA members continued to work online (e.g. on Facebook), but in many schools they suspended their activity.

"The virus upset our system compared to previous years" (I2)

"Because of Covid, we only had online parent-teacher meetings. Or we talked in the street in the rain as we were not allowed to enter the school." (I3)

"The PA could not meet because of the pandemic." (I20)

As mentioned in the research methodology section, two inductive codes emerged during the analysis, one of which was time. In this regard, we found that in the past, years or even decades ago, parents were more involved (especially according to some older teachers), whereas nowadays parents typically excuse themselves on grounds of lack of time. Interviewees often mentioned that in the socialist era parents had been summoned to work together on a compulsory basis, and many helped as a result, but fewer do so voluntarily today.

"Maybe it was a bit easier to mobilise people before, now they indulge in comfort too much or maybe they just have more to do." (I15)

"When my daughter was at primary school and parents were asked to participate in a joint project, quite a lot of parents did so, some with financial support, some with personal, manual work to make the school and its surroundings more beautiful... What I see here in this school is that parents are not in the least eager to help with anything." (I9)

Our second inductive code was the negative effect of parental volunteering on children. One of the respondents pointed out that if there are only a few parents going on a class trip with the children, it might evoke negative feelings in the others because they will wonder why their parents cannot participate. In contrast, older children, e.g. in secondary school, do not need parental involvement and even feel uncomfortable if they are accompanied by parents.

"It can create some tension if one pupil's parent is there and the other's is not". (I13)

"When there was an opportunity, they came to help... mostly with the preparation of the trip, organising the bus or preparing the meat for cooking that we took on the trip. They didn't come with us, but the children wouldn't have liked that anyway." (I39)

In the next section, we give a more nuanced picture of parental volunteering through a typological analysis.

5.2. Typological analysis

Based on the 36 interviews, we distinguished four types of parental volunteering according to the intensity and motivation of involvement in volunteering. When establishing the types, we also tried to take into account the statistical data available on schools (type of settlement, school provider, size of school, proportion of pupils with disadvantages and multiple disadvantages), which helped to characterise the groups more precisely. The first two groups were composed of PA members, the difference being whether parents were also involved in school-level decision making or only volunteered in their children's classes. The other two groups were made up of parents who volunteered occasionally, either of their own free will or only when they were asked to. Table 2 summarizes the main characteristics of the four types.

Table 2. The main characteristics of the types

	Intensity	**Motivation**	**Characteristics of types**
Committed PA members who are involved in school-level decisions, as well	Active involvement at the school level and strong commitment	To take part in decision making at the school level To help the school professional development	PA members Main activities: To provide suggestions on issues affecting the life of the school and help in the development of pedagogical programs
PA members involved in class-level decisions and organisational tasks	Active involvement at the class level and strong commitment	To take part in decision making at the class level To take part in organizational and planning tasks	PA members Main activities: To manage the life of the class (managing the class money or helping with other activities)
Parents volunteering freely for occasional tasks	Low involvement at the school and the class level and low commitment	To help others To feel better To make themselves useful	Not PA members Main activities: To help at the school and class events (decorating, painting, or selling goods)

	Intensity	Motivation	Characteristics of types
Parents volunteering occasionally on request	Low involvement at the school and the class level and low commitment	Extrinsic motivation (request of teachers)	Not PA members Main activities: To help at the school and class events (decorating, painting, or selling goods)

Type 1: Committed PA members who are involved in school-level decisions, as well

This group of parents is made up of PA members who are actively involved in school decisions in addition to class matters. The schools, where this type was mentioned are typically located in a village or small town and are mostly state-run with a small or medium size student population. They have below 20 percent of disadvantaged pupils and a below 5 percent of pupils with multiple disadvantages.

The main characteristic of the parent volunteers is that they are all members of the PA and are much more committed than other parents to volunteering in the school. PA members are delegated by each class to represent their interests, and in most cases, they are selected by class vote. In the absence of new candidates, it is common for previously elected parents to be re-elected year after year. It is also common for PA members to be the first to be informed directly by school leaders about decisions affecting the school. Parents attending management meetings have decision-making rights at the school level, and the school management seeks the ideas and suggestions of PA members on issues concerning the life of the school and its pupils. There are schools where the educational programme is discussed with parents, or parents are consulted on the introduction of new subjects. In addition to their decision-making role, these parents are also actively engaged in the organisation of school life. They are of great help to teachers, as they volunteer their time to facilitate teachers' work both in and out of class.

Type 2: PA members involved in class-level decisions and organisational tasks

The second type of parent volunteers includes those who are also members of the PA, but who are only involved in decisions at the class level and in various organisational and planning tasks. The background data suggest that while the previous type was mainly typical of schools located in smaller settlements, those belonging to this group were mainly from schools in medium or larger towns with more than 200 pupils and a low proportion of disadvantaged pupils (below 5 %).

Here, PA members are no longer necessarily elected by the other parents through a vote, but this role is taken on by the parent who volunteers for it. Parents have a lower level of decision-making power than in the previous group, as they do not usually have a say in major decisions affecting the school. Their most important task is to manage the life of the class, including managing the class money or helping with other activities (e.g. providing escort on the way to the swimming pool and help with hair-drying, organising events). Wherever the system works well, they can be relied on for practically everything.

These parents are to serve as a bridge between the class teacher and the other parents. This mostly means passing on information from the class teacher to the parents or informing the class teacher of the parents' suggestions on certain class-level issues. The interviews reveal that teachers derive tremendous support from parent volunteers' work.

Type 3: Parents volunteering freely for occasional tasks

The third category of parents is composed of those who are not members of the PA but are actively involved in the life of the school and class. They do not participate in the decision-making process but are happy to help out occasionally at various events.

The background data show that, while the previous types were mainly found in state schools, this one occurred in higher proportions in church-run schools. The majority of schools are located in county seats, with a small to medium number of pupils and a low proportion of disadvantaged pupils (under 5 %).

Most of these parents offer their help voluntarily, and alongside the importance of helping. However it is not only important for them to help their children, but also to have good feelings

about the task and to do something useful themselves. Most of their voluntary work is related to school events. They mainly give a hand with tasks where several helpers are needed, such as decorating, painting, or selling goods. While the previous parent types only meant a few people per class doing the work, parents in this category are involved in larger numbers.

Type 4: Parents volunteering occasionally on request

Parents in the fourth type are not members of the PA, either, but they get involved in school activities only at the request of teachers or the school management, or perhaps under pressure. This group of parents is mainly present in state schools. The majority of schools are located in villages and are small or medium in size, with a medium to high proportion of disadvantaged pupils. From a socio-demographic point of view, this parent type was mentioned in the most disadvantaged school types.

While in the case of type 3, a relatively large number of parents are involved in the tasks, here teachers mentioned a few parents per class who can be mobilised, albeit on request. The nature of the tasks is similar to what is described in type 3. Typically, parents help at school events.

6. Discussion

Recent research has emphasised the importance of parental volunteering as it is one of the six types of Epstein's (2010) typology. While internationally, a wide range of studies focus on parental volunteering and its types (Lemmer, 2007; Marland, Peltoniemi 2015; Myers 2022 etc.), there is little research on the subject in Hungary. The present study aim to fill this research gap and add the element of volunteering to the existing Hungarian discourse.

The main objective of our research was to explore parental volunteering in schools through data from a disadvantaged region of Hungary based on 36 semi-structured interviews with teachers. We conducted thematic and typological analysis, which was complemented with interview excerpts. Based on the literature reviewed, deductive codes were developed. The inductive codes used in the analysis were the temporal dimensions of volunteering (past and present) and the possible negative impact of parental volunteering.

The study has come to the conclusion that parental volunteering in Hungarian schools differs from the tendencies described in the international literature. Our results suggest that in Hungary, traditional forms of parental volunteering known from the literature are less prevalent; parents are mostly involved in the organisation of school events or very rarely in physical work, but the most common form is PA membership. The thematic analysis of our current data shows that in most schools it is only the PA members who do voluntary work.

A further finding was that, apart from a few cases where volunteering was defined as it is used in the literature, teachers also often identified volunteering as work that parents were asked or required to do. One reason for this may be a distinctively Central and Eastern European feature, namely that in the socialist system there was no real volunteering but compulsory work for the good of society, which meant, as some interviewees mentioned, that parents were summoned to do obligatory work together. Our respondents felt parents did little 'genuine', intrinsically motivated voluntary work which they also offered to do themselves. Although some parent initiatives were highlighted by interviewees, occasional help on request was the most common.

Some elderly teachers found that in the past, parents had been involved in voluntary activities more often and in greater numbers. Declining volunteering rates may be rooted in a number of causes, but our results have confirmed that the main barrier to parental involvement today is lack of time. Moreover, several interviewees felt that nowadays it is difficult to persuade parents to become involved in PAs. This is due to the fact that they would also have to carry out delicate, confidential tasks such as managing finances and to work under the constant criticism of other parents. It is also often their responsibility to mobilise other parents for various activities, which is not very easy to do, especially when it comes to disadvantaged parents. In addition, especially in secondary schools, it was found that PA members were not active in other tasks, possibly because older children no longer required the presence of parents at school.

Our results are consistent with previous findings that the frequency of participation is associated with parents' educational attainment, and that parental involvement is more frequent at lower educational levels and in church-run institutions (Lemmer, 2007; Aydinli et al., 2015; Kocsis et al., 2022), although we cannot confirm or refute this in a qualitative small sample study. We also found that our interviewees reported a decline in parental volunteering during the Covid-19

pandemic, which was not replaced by other new forms of engagement, contrary to the international trends (Myers, 2022). The interviews suggest that the tradition of parental volunteering is not so well-established as in other countries, which is why no initiatives were launched to involve parents during the Covid period.

An important finding of our research is that, based on the interviews with teachers, we were able to distinguish four parent types, which differed in the frequency and characteristics of volunteering and also in the characteristics of the school. The first type is made up of highly committed PA members who are involved in school-level decisions in small to medium-sized schools in small settlements, with relatively low proportion of disadvantaged pupils. The second type includes PA members involved in class-level decisions and organisational tasks, whose presence was mainly observed in large schools in medium-sized or large towns, with very low proportion of pupils with disadvantaged background. The third type is parents volunteering for occasional tasks, who are likely to be parents of children attending church-run schools with a low proportion of disadvantaged. The fourth type is parents volunteering occasionally on request, who are mainly from disadvantaged schools.

All in all, our results give new insight into the interpretation of parental volunteering in schools. While the international literature shows that parental volunteering has a strong tradition and parents' work is held in high esteem, in Hungary it seems to be a limited and unexploited area. Teachers' interpretations give the impression that parents are primarily motivated by their children's interest, but the intention to help also plays a part, which is something schools can rely on. The interviews suggest that being indispensable for school life, parents' voluntary work is in great demand.

However, it is to be noted that the results of our research can be interpreted with certain limitations. One limitation of the study is the sample size, which does not allow for broad generalisations. Secondly, in the current research phase, we interpreted the voluntary work of parents only through the experiences of teachers. Thirdly, the data used in the current analysis were part of a larger qualitative study which aimed to explore the forms and barriers to parental involvement. Parental volunteering constituted only part of that study, so the amount and depth of information available to us was limited.

Our recommendations for future research are derived directly from these limitations. Future research should be based on parents' experiences in order to fully explore the motivation, purpose, forms and barriers to parental volunteering, on which we hardly have any research data. The characteristics of parental volunteering could primarily be explored with qualitative methods, followed by a larger-scale quantitative study to investigate this important and, in Hungarian terms, under-researched area of education research. We believe that research on parental volunteering in Hungary should be encouraged in order to utilise the results in support of local and national policymakers, education professionals and school staff. In addition, the results could contribute to enriching the wide spectrum of international education research with data on parental involvement in Hungary.

Our findings suggest that parental involvement in schools could be promoted by popularising voluntary work. Lack of free time, in spite of being the primary barrier to volunteering (of which teachers are also well aware), can serve as a basis for developing solutions and recommendations. Parents' time limitations can be related to their position on the labour market, the distance between their residence and the school and the number of people they have to take care of apart from their school-age child (e.g. younger siblings or grandparents). For this reason, it is advisable to find out about families' capacity for free time before inviting them to volunteer. It is also worth assessing parents' interests and strengths that can be counted on in order to make involvement more flexible. Our most important conclusion is that schools and families should foster an unprejudiced and trusting relationship which enables parents to offer their help whether it is simple physical work or a more complex organisational task.

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Professional Competence of Teachers in the Context of STEM Education

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Abstract

Introduction: The article deals with the quality of technical education at the kindergarten level, in context of the kindergarten teachers' professional competence and the training programs they graduated from. The main research question is how the relevant university programs are prepared to educate the teachers for the STEM concept.

Methods: On the one hand, using the method of content analysis, the authors examine in detail the study programs of pre-primary education at three universities in Slovakia, which provide training programs for the profession of a work-based education teacher for kindergarten. On the other hand, by means of a questionnaire the authors investigated preschool teachers' awareness of the concept of STEM and their competence to implement this education in their practice.

Results: Results of the content analysis have revealed inconsistencies manifested in the structure of bachelor's study programs, which only partially follow the topics of technical education in kindergartens. Results of questionnaire investigation point to insufficiencies in professional training of teachers to apply STEM as well as on their weak general information in the given field.

Conclusion: Based on the above-mentioned findings, the authors point out potential strengths and areas for improvement in teacher training at the respective higher education institutions.

Keywords: pre-primary education, technology education, STEM, professional competence of teachers.

1. Introduction

The STEM educational model belongs to the modern means of innovation at all levels of education. The basic principle of STEM education is based on integrated inter-subject teaching (Science, Technology, Engineering, Mathematics), thanks to their natural continuity (Lutkevich, 2022). Since the beginning of the 21st century, this concept has attracted a lot of attention all over the world and is considered one of the main points of education and curriculum. The need to

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integrate STEM education is an up-to-day requirement that is stated by various authors and studies (Bybee, 2006; Kim, Kim, 2016; Nuangchalerm et al., 2020; Samara, Kotsis, 2023) due to the demand for STEM skills to solve different economic challenges is becoming more and more serious (English, 2016; Marginson et al., 2013; Wei, Chen, 2020).

STEM attracts attention of people of all ages because it increases motivation, interest, curiosity and desire to learn (Amiruddin et al., 2019). It improves the way of engaging in the process of own learning (Razi, Zhou, 2022), uses innate curiosity, what leads to recommendations to familiarize already pre-school children with the given concept (Aktürk, Demircan, 2017). STEM is a modular field of education, the purpose of which is to develop possibilities to engage a child's intellectual abilities into scientific and technical creativity (Abdumajitova, 2022). As the teacher is one of the most important implementers of STEM education (Siekmann, Korbel, 2016), therefore it is important that s/he understands this concept, is sufficiently informed about it and is relevantly prepared to apply it in practice. As argued by Rifandi et al. (2019), teachers are expected to be able to design for children (pupils, students) learning process that is fun and of high quality to achieve valuable learning goals. Teachers need at first knowledge on the integrated subjects, and secondly knowledge on the relevant pedagogical content to be able to deal with this (STEM) concept in classes they teach or will teach (Kurup et al., 2019). However, the concept of STEM is not a fixed curriculum. It is not intended to replace national curriculum frameworks or state curriculum standards (Wei, Chen, 2020). The role of the teacher in teaching in the 21st century is expected to shift from an expert to a facilitator, and the focus of teaching moves from knowledge to the ability to use and apply information in a relevant way. Bell (2016), and Harris & Sass (2011) therefore emphasize that the training of qualified teachers is a principal necessity to implement STEM education.

Teacher Training in Slovakia

As it has been already above-mentioned, we are facing an ever-increasing demand to implement the STEM concept into education at almost all levels of education. However, for teachers this can be a hard task, requiring from them cross-disciplinary work, increased workloads, and an understanding of the nature of STEM integration (Boice et al., 2021). The undergraduate system of education has the task to equip future teachers with the necessary competencies so that they can handle this task as best as possible (Anisimova et al., 2020). In Slovakia the undergraduate teacher training is characterized by a high level of autonomy of universities, what causes that each of the universities has its own model of practical teacher training (Ďurjaková, 2019). Education of teacher trainees in the field of science, technology, engineering and mathematics has received increasing attention in the last decade, and there are calls to increase emphasis given to these fields, and to increase quality of training in them. Qualified teachers are essential for teaching STEM (Polgampala et al., 2017). They must be adaptable in their teaching strategies and respond to the needs of children during the teaching process (Ejiwale, 2013), they must be flexible and open to innovations in education (Nagdi et al., 2018). Educational institutions that provide teacher training must therefore constantly adapt their teaching modules, courses, seminars, in order to achieve the practical sustainability of their programs in accordance with current socio-economic requirements (Oraison, et al., 2019). Teacher training in Slovakia is regulated by the Ministry of Education, Research, Development and Youth of the Slovak Republic and is subject to certain standards and regulations. Currently, future students – teacher trainees can choose different fields and specializations according to their interests and future career goals.

In Slovakia, there are 35 universities that offer a number of specialized programs and fields of study, which rake them among the highly recognized institutions providing professional education for various areas of life. However, none of them provides systematic STEM education or teacher training for this education concept. Only the study programs in teaching mathematics, natural sciences, technology, or informatics are available. Gradually, only new teaching materials and courses providing this education are created, but not comprehensively. For the most part, these initiatives address STEM subjects separately. Our goal was to examine whether, at least in individual fields, students are informed about the STEM concept. We focused on the training of teacher trainees for kindergartens, in relation to the part of their preparation for insurance of technical education in their future profession. The preparation consists in the acquisition of theoretical expertise in the field of pedagogy, psychology, and in scientific fields of technical school subjects. The goals and tasks of this education should reflect the emphasis that is placed on the development of competencies necessary for performance of these teacher trainees' future

profession (Bahodirovich, Romilovich, 2021). The concerned pre-gradual education is carried out at 3 universities in Slovakia, namely at the Constantine the Philosopher University in Nitra (CPU), at the University of Prešov in Prešov (UP), and at the Matej Bel University in Banská Bystrica (MBU). Inclusion of technical education into the university study program for teacher trainees for pre-primary education is carried out at the given universities in frame of the study branch Teaching and pedagogical sciences in the study programs Preschool and elementary pedagogy (bachelor's degree).

2. Methodology

For each part of the research another methodology was used.

On the one hand evaluation of the professional training of preschool teacher trainees was done by means of the content analyses (Crowe et al., 2011). The aim of the content analyses was to compare subjects included in the study programs of the study branches of preschool and elementary pedagogy (PEP) at the concerned three Slovak universities (CPU, UP, MBU). Subsequently, the achieved results were confronted with the content and goals of the State Educational Program (SEP) in the educational area Man and the world of work. The stated means that the whole analysis was done in two stages context.

As the object of our content analyses were austere official documents of the given higher education institutions (basically curricula of the compulsory and optional subjects included into the study programs of the given study branches), the content analysis used by us was of thematic kind (thematic analysis). The thematic analysis of the stated documents followed occurrence, in meaning of presence, of lexical units related to the content and goals of the State Educational Program (SEP) in the educational area Man and the world of work. Based on the occurrence of the relevant lexical units our goal was to identify whether some STEM education elements are or are not integrated in the pregradual teacher training. There was no need to quantify the numbers of the particular lexical unit occurrences (i.e. to use the content analysis of qualitative kind, qualitative content analysis), as the question was whether the particular issue, or the particular component of some issue is included in the study program or is not.

On the other hand, the evaluation of the in-service preschool teachers' awareness on the STEM concept was done by means of a questionnaire. The purpose of the questionnaire, which we designed, was to answer following three research questions:

– What is the level of teachers' awareness of the STEM concept,

– Whether and to what extent teachers apply STEM education in their educational work with children,

– What would contribute to increase applications of STEM concept in teachers' activities.

As the questionnaire consisted of only three questionnaire items, there was no sense to analyse its reliability or test suspiciousness of its items. However, what was checked was its validity. For this purpose, a group of several in service teachers (participants of a further education of primary and lower secondary school teachers) were asked to express their opinions to the given three items (to verify comprehensibility and clarity of their formulation).

A research sample of 300 kindergartens all over Slovakia was addressed to take part in an online form of the questionnaire survey. The addressed kindergartens were chosen on basis of a random choice. Based on the obtained returned questionnaires the total number of the teachers who responded to our questionnaire call was 372 respondents. At this point it is necessary to mention that the presented study has served as a pilot (with a pilot research sample), for a more complex one, in frame of which all kindergartens in the whole Slovakia have been planned to be involved in (i.e. 3326 of these educational institutions of all kinds, either public or private or church ones). In case of this planned more complex research there are planned also more detailed analyses of the collected data.

After processing both sets of the above-mentioned collected research data, the findings resulted from both of these investigations were compared.

Results of the Analyses of the Study Programs of Preschool Teacher Trainees

The educational area Man and World of Work incudes in itself a broad range of work activities and technologies based on a creative team cooperation. By means of the technical education the pupils are led to acquisition of basic user's skills in different areas of human activities and elementary technical thinking. The stated area creates a space for technology and engineering implementation of the STEM concept.

At first, the technical subjects included in the teacher trainees study programs, their content focus (curriculum) and learning outcomes (performance standards) were examined. Subsequently, we compared them with the educational area's objectives and its content focus (sub-areas). The stated was done in relation only to compulsory subjects of a technical nature at all three concerned universities (Table 1).

Table 1. Comparison of the subjects included in PEP study programs corresponding with the educational area Man and the world of work

Man and the world of work		**CPU**	**UMB**	**UP**
		Working techniques in pre-primary education	**Science and technology education**	**Work-technical education**
Themes arising from the SEP	Objectives of the educational area	✓	✓	✓
	Developing skills in working with tools	x	x	x
	Household activities	x	x	x
	Development of elementary technical thinking	x	x	✓
	Development of creativity	x	x	x
	Investigating the properties of materials and objects (trial, error, experiment)	✓	✓	x
Sub-areas	Materials and their properties	✓	✓	✓
	Constructing	x	✓	✓
	User skills	✓	x	✓
	Production technologies	✓	✓	x
	Crafts and professions	x	x	✓

From the comparison of the content of the subjects included in the PEP study programs, with the educational area Man and the world of work resulted following main findings:

– None of the universities has a complete alignment of its programs with the standards of the relevant educational field, there are no differences across the universities in terms of meeting subject objectives. The stated indicates that all universities have the same intent in preparing student, and that s to meet the educational objectives. The themes focused on application of methods of investigation, research and experimentation are evident in the study programs of CPU and UMB. UP forms an exception in developing elementary technical thinking in relation to area Man and the world of work. Further target requirements in the contents of compulsory subjects at the particular universities in comparison with the area Man and the world of work targets were not found out.

– Within the sub-areas resulting from area Man and the world of work, the topic „Materials and their properties“ is consistently included in the compulsory subjects at all universities. According to the information lists of the study subjects, the issue of “Construction” is absent at CPU, issue of “User Skill’s at UMB and issue of “Production Technology” at UP. The area of “Crafts” is absent at CPU as well as at MBU. The analysis also recorded topics beyond the requirements of the area Man and the world of work: at CPU it is the issue of safety and hygiene at work with technical materials; at UMB the topic of strategies and methods of science or technical education; and in UP the topic of work-technical interest activities at school educational institutions. There were recorded no topics nor concepts related to STEM in any of the analysed programs.

– The comparison shows that students acquire basic knowledge about the content of the educational area, the individual sub-areas, and the content and performance standards necessary for teaching. However, insufficient attention is paid to developing strategies for supporting creativity, skills, and technical thinking resulting from the educational area Man and the world of work. Nevertheless, we can assume that the missing components of area Man and the world of work are included in the compulsory elective subjects of the individual universities (CPU – Working skills with materials, Methodology of work-based education; UMB – Working with technical materials; UP – Natural, geographical and technical interest activities, Transport education).

Results of the Evaluation of the Teachers' Awareness on the STEM Concept

Based on the research data collected from the total number of 372 respondents (teachers who responded to our questionnaire call) the hereinafter findings were obtained.

In the first part of the administrated questionnaire, we were interested in awareness of the respondents (kindergarten teachers) of the STEM education concept (whether they have some information about this phenomenon, whether they read or heard something about it). As the results presented in a graphical form in Figure 1 show, even 54 %of the respondents have no information about this concept of education. This proved our assumption that the STEM concept is among the kindergarten teachers in Slovakia relatively unknown phenomenon.

In relation to the professional teacher training, we were interested whether the respondents (pre-primary teachers) have heard about this concept or education already during their higher education studies. The results again confirm our assumption that higher education preparation of teachers dealing with STEM education is insufficient. However, we were surprised by the very low number of the respondents who really met with this concept, or heard something about it, during their university studies (Figure 1 – 5.4 %). Mostly the respondents have obtained some information about this phenomenon from the study of professional literature (22.2 %). More or less equal number of the respondents have obtained some information either within some further education they passed, e.g. some courses or webinars (14.3 %), or from their colleagues (13.0 %).

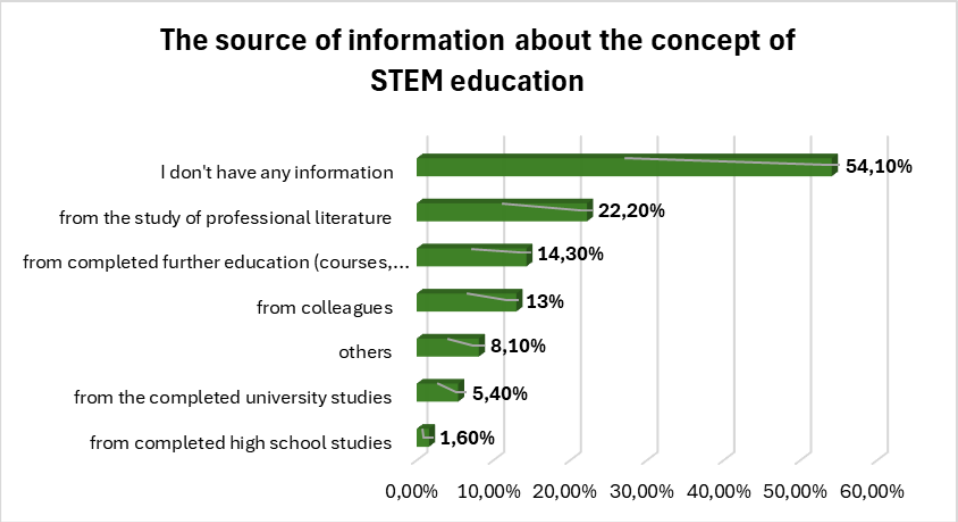

Fig. 1. The source of information about the concept of STEM education

The quality of teacher preparation is key to them applying the STEM education. In the next part, we therefore asked the opinions of the respondents (pre-primary teachers) about their training in relation to STEM. That is, if they encountered the term either during university studies or a course, how do they evaluate their readiness for STEM teaching in frame of the education of the in the children attending kindergartens.

As the results presented in a graphical form in Figure 2 show, only 25 % of the respondents are of the opinion that they are well or sufficiently prepared for STEM learning. However, almost 35 % of teachers could not comment on this question, and almost 40 % of teachers feel that they are poorly or insufficiently prepared for STEM teaching. Several conclusions can be drawn from the above:

– Teachers have a lack of knowledge about STEM subjects;

– Teachers lack information about STEM;

– Teachers have heard about STEM, but have not applied it in practice and therefore cannot assess their training;

– Teachers encountered STEM only theoretically in the framework of various courses, webinars and other education, so they did not have the opportunity to create activities and thus verify their competences or preparation for STEM;

– Teachers received low-quality education.

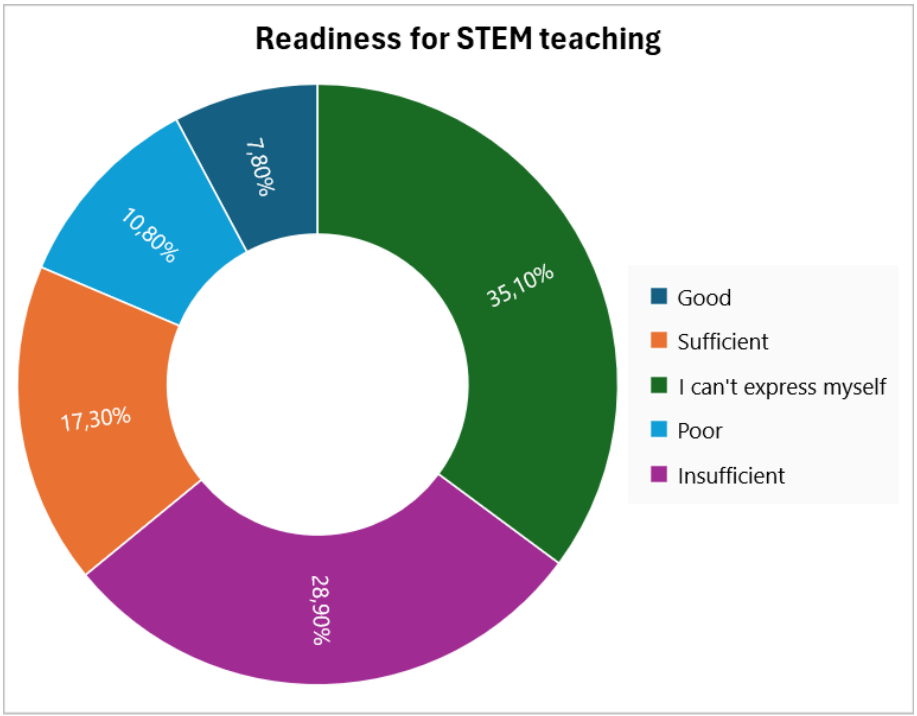

Fig. 2. Readiness for STEM teaching

Feeling insecure about the ability or competence to teach STEM, resulting from insufficient training, could lead teachers to have low self-confidence, what could have a negative impact on their teaching effectiveness in general (Bagiati, Evangelou, 2015; Clark, Andrews, 2010; Holstein, Keene, 2013).

3. Discussion

From the point of view of teachers' awareness, it was found that up to 54 % of kindergarten teachers have no information about the STEM concept and have not even met it yet. On the other hand, the most information for 22 % of the respondents comes from an independent study of professional literature. This suggests a proactive approach by a subset of teachers who took the initiative to learn about STEM through self-directed learning what raises concerns regarding adequacy of the curricula of the teacher trainees' professional development in the area of STEM teaching. Reasons of this lack of teacher training in STEM require further investigation as they may stem from a variety of factors. These findings underscore the need for targeted interventions, professional development initiatives, and a more systematic approach to familiarizing and equipping teachers with the knowledge and skills necessary for effective early childhood STEM instruction. The results showed that STEM education in Slovakia is not sufficiently incorporated in the professional training of future teachers of technical subjects. Lack of special training can affect the process of STEM integration into the education done in kindergartens (Weng, Li, 2020). Absence of the specific professional training can influence implementation of STEM education to kindergartens (Weng, Li, 2020). Well organized and often available possibilities of professional education would support effective application of STEM education in a class (Margot, Kettler, 2019). Necessary is also continuous professional development of teachers, based on participation of a team of teachers who will use the curricula (Nadelson et al., 2012). At this point it is important to stress that it is necessary to enable teachers to gain experiences with STEM concept and to it relevant pedagogy in a meaningful way. Improvement of the professional training could lead to a

higher confidence of teachers in relation to their readiness or competency to teach STEM (Lesseig et al., 2016; Nadelson et al., 2012; Nadelson et al., 2013; Nadelson, Seifert, 2013). A problem is also non-integration of the particular STEM subjects in professional teacher training as well as the lack of information regarding STEM, which is proved also by the foreign studies (Margot, Kettler, 2019). So we need to change approach to the professional training of teachers not only at universities but also in frame of the insurance of the professional and practical development courses focused on STEM education concept: different forms of trainings or webinars (Türk et al., 2018; Shernoff et al., 2017). Teacher's approaches and opinions on STEM education have a strong impact on children's opinions and approaches. Children' motivation to learn the STEM branches depends on the teacher's personality, his/her ways of teaching, interest, opinions (Dökme et al., 2022). Insufficient professional preparation of teachers for STEM teaching was proved by the results of the comparison analysis of the study programs of the concerned universities. Students obtain knowledge on materials, technologies of their processing, options of these materials for the given level of education, and so they will be able at least to apply the acquired knowledge at designing and creating of situational learning tasks for children, corresponding with the educational field Man and the world of work. However, as a problem we perceive absence of any integration of any innovative education strategies such as, e.g. STEM or STEAM, and that into all of the given study programs. The European Union (2016) encourages its member states to better prepare young people for changing labor markets, to develop their STEM competencies and 21st century skills (EU 2016; Dede, 2007). STEM skills and qualified teachers in the given field are seen as the key elements by which these goals can be achieved. Some topics of the bachelor's study programs can be included in the given field (Materials and their properties, Investigation of the material properties – trial, error, experiment, Designing), but they are too general and therefore it is not clear whether universities deal with the issue of STEM integration. It is therefore necessary to ensure that this education becomes an integral part of pre-gradual training of teacher trainees what would enable them to acquire knowledge about the appropriate teaching methodology, and to develop relevant competencies. In order to finalize comprehensive results and for purposes of setting out the consequent research strategy, further analysis will be conducted to specify what in-service teachers actually lack in practice, or what they, based on their in-service experiences, retroactively lack. Complete processing of all of the results of the partial kinds of research will serve as a platform to specify and develop proposed measures of the teachers further education.

4. Conclusion

The presented results show that the preparation of future teachers in Slovakia to apply STEM education in their future career is very weak. There is absence of any preparation in subsequent acquiring of knowledge focused on integrated approach to the STEM education, which is most important for learning and understanding STEM. More connected teaching of the particular subjects of STEM can make STEM concept, as well as the particular STEM subjects, more friendly to both students and teachers (Sarac, 2018), and this in turn can increase the number of students considering careers in a STEM-related field (Schweingruber et al., 2014). In order to develop a generation capable to create innovations, the scope, theory and practice of science, technology, engineering and mathematics education, which is at the center of reforms, STEM should be studied at the school and university level (Cavas et al., 2013; Marculu, Sungur, 2012). STEM education should be included in country national school policies. The mentioned study also encourages further investigation of teaching strategies in the context of technical education of future kindergarten teachers. The presented issue thus paves the way for a further discussion of the complexities of teacher preparation and offers valuable insights into existing and potential areas for improvement within the observed study programs. Results of the presented research can be used as a platform for proposals of innovative study programs reflecting the current social demands regarding the field of technical education at both pre-primary institutions and schools, as well as a platform for creation of practical teacher training methodologies emphasizing STEM education.

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Comparison of Digital Skills Upgrading of Students and Teachers in the Digital Transformation of East-Central Europe

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Abstract

In 2023, the twelfth cycle of monitoring knowledge and digital skills in various IT areas was held under the name IT Fitness Test. Pupils/students of primary, secondary and university schools and their teachers tested their skills not only in Slovakia, but also in the neighbouring Czech Republic, Hungary, Poland and Ukraine. The aim of the IT Fitness Test is to objectively test and evaluate the digital skills of the respondents that are expected of them at the next level of study or in their professional as well as civilian life. In this way, respondents are motivated to actively deepen their practical IT skills, which they will be able to apply practically not only today, but especially in the future. Almost 150 thousand respondents in five countries tested their knowledge and digital skills. There was considerable divergence in success rates between the IT areas tested from a country perspective. Students excelled in working with the Internet but performed less well in critical thinking and complex problem solving. The results from the testing presented teachers with a relevant picture of their current level of digital skills. However, it is not possible to draw firm conclusions from the results, as they also reflect the determinants that could influence these changes to a greater or lesser extent.

Keywords: digital skills, pedagogical innovation, pupil/student, teacher, East-Central Europe, testing, education.

1. Introduction

Quality education is the foundation of any successful society and modern state and is the starting point for the future prosperity of a country. The current era inevitably requires ever higher digital literacy for people of all ages. As this trend will only increase in view of the current global

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development of society, it is important continuously to improve educational processes, especially in connection with the effective application of digital technologies and, above all, to adapt them to the current requirements of the digital age (Imran, Almusharraf, 2024). We agree with Jurinova's (2023) opinion that one of the key determinants of the success of the process of digital transformation of traditional education into modern education for the 21st century is the achievement of an appropriate level of digital skills of both pupils/students and their teachers as the main participants of the educational process.

The Member States of the European Union (EU) have the possibility to participate in various international or national studies monitoring the current level of knowledge and digital skills of their primary and secondary school pupils/students and their teachers on a regular basis (OECD, 2020). Examples include ICILS – *The International Computer and Information Literacy Study, PIAAC – Programme for the International Assessment of Adult Competencies, TALIS – The Teaching and Learning International Survey or* the IT Fitness Test project, as the largest free digital skills test in the V4 countries. The findings provide pupils/students with objective feedback on how prepared they are for their further studies at higher education level or for their professional life in the era of digital technologies. As a result, such measurements can also have a positive impact on education providers because they show them a clear vision towards quality improvement in the education system.

At this point we consider it necessary to note that the paper is a follow-up to an article published in European Journal of Contemporary Education (Záhorec, Kuruc, 2023). The current paper discusses results from the testing conducted within the twelfth cycle of the test based on their comparison with the results achieved in the previous year by the individual groups of solvers not only with respect to the required IT thematic areas but also with respect to the nationalities of the solvers.

Theoretical framework

The global trend of digital *transformation* of education has also become a priority for the Ministry of Education, Research, Development and Youth of the Slovak *Republic* (MERD&Y), which has been intensively supporting implementation of digital technologies in the education system through various national projects and initiatives for some time. The National Project *Digital Transformation of Education and Schools* (DiTEdu) can be characterized as the driving force and conceptual platform for building a sustainable system supporting digital transformation of education in Slovakia. DiTEdu's intention is to reflect to the dynamic changes that the digital era is bringing to society. In this meaning, the national project is based on the strategic document of the MERD&Y *Programme of the Informatisation of the Education until 2030*. One of the pillars within the DiTEdu project is to build a sustainable system of support for schools and teachers on the path to digital excellence, in which professional continuous support, training and resources will be provided for educational actors in line with the latest trends in digital education (NIVAM).

Within the framework of the national project IT Academy – education for the 21st century, the Ministry of Education, Research, Development and Youth of the Slovak Republic is continuously involved in other activities for primary and secondary school teachers with the intention to support the digital transformation of education in primary and secondary schools, as well as in activities involving the general public in digital lifelong learning. The concept of these activities places a strong emphasis on raising awareness and digital skills, particularly in the areas of cyber security, virtual reality and the Internet of Things (National project...). Last but not least, attention is paid to activities supporting the transition of secondary school graduates to higher education institutions with focus on IT fields of study programs, with a view to their employment in IT sector professions in the European/national labour market (Andres, Hrmo, 2020).

In all four Visegrad Group countries (the Slovak Republic, the Czech Republic, Hungary and Poland), digital means play an important role in the reform of education systems, with an increased emphasis on supporting the development of digital skills not only of young people but of the whole society through lifelong learning (Esses et al., 2021). The continuous acquisition and development of digital skills is a prerequisite for the successful continuation of the young population in higher education or in professional careers within society (Frolová, Roháč, 2023). All four Visegrad Group countries share common challenges in the digital transformation of education, such as modernising infrastructure, improving the digital skills of pupils, students and teachers, and integrating the means of digital technologies into the classroom (Mhlanga, 2024).

We share the view of Frolova et al. (2020) that investing in teacher professional development and ensuring equity of access to technology are key to further progress. Overcoming these challenges is essential to better prepare pupils/students for the demands of the digital era.

In general, one can proclaim that without sufficient knowledge and skills in various IT areas it is currently very difficult to get a professional job. Therefore, to be successful in the labour market one has to know his own strengths and weaknesses, and knowing one´s weaknesses one has to educate himself continuously in the proper areas. One of the largest (free) digital skill testing in East-Central Europe offered to the target group of pupils and students, and teachers of primary and secondary schools is carried out within a project entitled IT Fitness Test. Through this testing teachers can gain an overview of the digital skill levels of their pupils and students, they gain information in which areas their pupils and students are well prepared, and in which they need further training to be improved. However, by means of this online tool, besides the above-mentioned target groups whoever has the opportunity to (voluntarily) test his or her knowledge and digital skills in different IT areas to get a realistic picture of their level internationally. Participation in these testing is at the discretion of each participant.

The IT Fitness Test questions are compiled annually by a Slovak team of teachers, academics and IT experts. They are practical, focusing mainly on specific skills, reading comprehension, the ability to use the acquired knowledge in practice, as well as the latest trends in the digital field. The IT Fitness Test does not copy the curriculum and does not only focus on theoretical knowledge, but also reflects the requirements of the modern, ever-changing digital age.

The IT Fitness Test is published annually on a publicly accessible portal, so anyone who has filled in the required data can take part. In 2022, thanks to the financial support of the Visegrad Grants from the International Visegrad Fund, the IT Fitness Test has been successfully extended to all V4 countries. In addition to Slovak, the test was also available in Czech, Hungarian and Polish for the first time in history, with an English version as a bonus. The largest and most comprehensive digital skills test was extended beyond the borders of the European Union in 2023. For the first time, the twelfth edition of the IT Fitness Test was also open to Ukrainian pupils and students located in Ukraine or outside of Ukraine.

2. Results and discussion

Research design

The purpose of the presented study was to answer research question RQ: *What is the position of the Slovak target group participants among the target groups of the participants from the other V4 countries (i. e. from the Czech Republic, Poland and Hungary) and Ukraine*?

Description of the research approach to the relevant research data collection

For the knowledge and competence part of the IT Fitness Test, which focuses on the actual verification of the respondent's digital skills in various IT areas, two variants of testing tools were administered.

The first variant of the test was for the age groups of the youth from 14 to 16 years. This means it was designed to test the key digital competences of pupils in the ninth grade of primary schools (which in Slovakia integrates in itself primary and lower secondary level of education) or graduates of these schools aged 14 to 16 years of age continuing their studies at a higher level of education or including already in professional life. This version of the test focuses, among other things, on students' understanding of problem-solving contexts, their ability to apply what they have learned in practice and their critical thinking skills. Tasks at different, but rather higher, cognitive levels were represented in the test.

The second test instrument is primarily intended for the target group of test takers over 15 years of age. The testing within this group involves (upper) secondary school and university students and their teachers, as well as various age categories of other interested members of the public in Slovakia. This more challenging version of the test allows verification of skills that are focused on practical basics and more advanced competences in the field of application of digital technologies in everyday life conditions. This test will give the school leaver a clear idea of whether he or she can work with computers and the Internet at the level commonly demanded by employers today. If the teacher or the school's digital technology coordinator has had the opportunity to manage the student testing process in his/her classroom/school, he/she can use the results of the testing in the educational process. Of course, the test can also help working or unemployed people of different ages to identify areas where they need to improve their IT skills.

The tasks and questions in the IT Fitness Test related to observed areas of the digital literacy come from five thematic areas (Table 2).

Two types of tasks were used in the test. Tasks with a choice of one correct answer from four answer alternatives and more complex tasks, designed as a cluster of dichotomous tasks. These tasks had several sub-questions/statements that had to be individually decided. The correct answer was the complete sequence of answers to the sub-statements, i.e., the respondent was scored if he/she answered all sub-questions correctly (i. e., chose the correct answer from a pair of choices).

Description of the processing of the collected data

Each respondent's score was continuously calculated during testing and finally converted into a percentage of success achieved in each subject area. Based on this, the respondent was classified into one of five levels – Excellent level of IT knowledge and skills (percentage success rate 100 % – 95 %); Above average level of IT knowledge and skills (94 % – 81 %); Average to above average level of basic IT knowledge and skills (80 % – 51 %); Lower to average level of basic IT knowledge and skills (50 – 21 %); Low level of basic IT knowledge and skills (percentage success rate 20 % – 0 %). At the end of the testing, the respondent was not only informed of his/her result in the form of his/her pass percentage, but was also shown the level achieved, together with a corresponding characterizing verbal comment as a recommendation on what he/she should work on improving.

Compliance with ethical standards

Participants of the stated testing were both minors as well as adults (students and teachers). However, the informed consent for their participation in these testing was not required, even in the case of the adult participants, as participation was completely voluntary, although subject to mandatory registration. The purpose of the mandatory registration was to determine the basic characteristics of the participating individuals (e.g. gender or type of the school attended), while maintaining their anonymity (no personal data involved). Compliance with data confidentiality principles was respected throughout the entire process of data collection, storage, processing and sharing. Additionally, as it results already from the above-mentioned (testing the participants´ sufficient knowledge and skills in various IT areas as a current precondition of getting an appropriate job), research based on the given testing is guided by an effort to benefit both the individuals involved and society at whole. What means, the good of all the participants was kept as the main ethical principle of the designed research.

Test results, comparison of country results and their discussion

Nearly 150 thousand respondents in five participating countries tested their digital skills in the twelfth edition of the IT Fitness Test. It is a significant achievement that Slovak respondents performed the best among the participating countries. In both versions of the test they had a higher success rate than respondents from the Czech Republic, Hungary, Poland or Ukraine. The stated finding offers us an answer to the research question RQ: *What is the position of the Slovak target group participants among the target groups of the participants from the other V4 countries and Ukraine*?

On a positive note, the overall average pass rate of all respondents, i.e. without distinguishing by nationality, was above 50 % for both test variants. Looking at the test results from a global perspective, the overall average pass rate of respondents in the easier version of the test designed for primary schools was 54.14 %. Compared to 2022 (48.25 %), there was a slight improvement of almost 6 percentage points (5.89 %). The overall average pass rate of respondents in the harder version of the test for secondary school and university students and their teachers was 50.37 %. There was an increase of more than 6 percentage points (6.12 %) compared to 2022 (44.25 %).

In the easier version of the test for primary schools, Slovakia achieved an average pass rate of 58.17 % for 7 – 16-year-olds (55.03 % in 2022 and 39.99 % in 2021). Second place was taken by Ukraine (56.04 %), third place by the Czech Republic (53.04 %), fourth place by Hungary (52.63 %) and last place by Poland (50.84 %).

The pass rate for the primary age group 14 – 16 is 61.51 % for Slovak test takers (58.72 % in 2022 and 42.53 % in 2021), which means that it is slightly above the required interval. The success rates for Czech, Hungarian and Polish researchers are 54.96 %, 50.42 % and 49.93 % respectively.

The overall sensitivity of the easier version of the test for primary schools was around 60 % in each country. We deduce from this that the test differentiated the test sample very well into solvers with good knowledge and skills and solvers with poor knowledge and skills in the different IT areas tested. More detailed basic psychometric parameters of the IT Fitness Test 2023 achieved in its easier version are tabulated from a country perspective in Table 1.

As can be seen from Table 1, the largest number of respondents participating in the monitoring of knowledge and digital skills in various IT areas was in the Czech Republic (44,041), the second largest number of respondents tested was in Slovakia (18,186). The smallest group involved in testing was the 361 Ukrainian respondents (Table 1).

Table 1. Country results for the easy version of the test

Test for solvers aged 7 to 16 years	Czech Republic	Hungary	Poland	Slovak Republic	Ukraine
Number of test solvers aged 7 – 16 years	33 784	1 868	6 361	13 240	270
Average success rate of solvers aged 7 – 16 years	53.04 %	52.63 %	50.84 %	58.17 %	56.04 %
Average success rate of solvers aged 7 – 13	49.32 %	54.02 %	51.38 %	54.36 %	–
Average success rate of solvers aged 14 – 16	54.96 %	50.42 %	49.93 %	61.51 %	–
Sensitivity of the test	56.90 %	60.80 %	58.60 %	61.68 %	60.56 %
Average success rate of teachers	71.58 %	73.39 %	62.80 %	71.91 %	–
Test Reliability (Cronbach's alpha)	0.77	0.79	0.78	0.81	0.80

Based on the statistical data obtained, we can conclude that in Hungary and Poland the largest age group was 13-year-olds. In the Czech and Slovak Republics the largest group was 14-year-old pupils. Ukrainian researchers had the highest representation of 15-year-old pupils. Based on the success rates of pupils participating in the easier version of the test by age, it is evident that in the Czech and Slovak groups the pattern of pupils' success rates in the test by age is roughly similar, in contrast to Hungary and Poland. Interestingly, in the Hungarian and Polish groups the success rate of the oldest pupils is not higher compared to the younger age groups. However, it is possible that the misreported age of the respondent is reflected here. For the Ukrainian pupils we see more pronounced fluctuations in the success rates achieved in the different age categories, which may be due to the small number of respondents (Kučera, Jakab, 2023).

In all participating countries there was a slight male predominance. From the data published in the final report of the IT Fitness Test 2023, it can be seen that the most significant differences in the representation of males and females were between Ukrainian pupils and Polish pupils. For Slovak pupils the groups were almost equally large. However, the difference in representation between male and female is smaller (except for Ukraine) than the number of respondents who did not indicate their gender (Kučera, Jakab, 2023).

As mentioned above, the easier version of the test for primary schools was divided into five thematic categories, each category containing four test items. As shown in Table 2, the highest difference in the countries' performance in each category of the test is between Slovakia (63.7 %) and Poland (50.7 %) at 13 percentage points in the thematic area of *Collaborative tools and social networks*. Conversely, the smallest difference in country performance was achieved in the *Digital safety and computer systems* category, namely between Hungarian (51.8 %) and Ukrainian (52.8 %) solvers. Pupils from Slovakia had the highest success rates in almost all areas of testing, with only Office Tools having a higher success rate among pupils from Ukraine (52.9 %). In the *Office software tools* category, pupils from Poland had the lowest pass rate (40.4 %) compared to other countries (Table 2).

The discriminatory ability of all five IT domains of the test was about the same across countries. The largest differences in sensitivity were in the topic area *Complex tasks*. This area was the least divisive for pupils in the Czech Republic, compared to other countries, despite its good sensitivity. A detailed picture of the average percentage of success in two successive cycles (2023 *vs*. 2022) in each participating country achieved in the easier version of the test with respect to the subject area queried is tabulated in Table 2.

The highest average success rate of respondents across all five countries is achieved in the *Internet* category (Slovakia – 70.5 %, Ukraine – 67.4 %, Czech Republic – 66.7 %, Poland – 64.6 %, Hungary – 62.1 %). Looking at test results achieved in previous years, we can see that the *Internet* category tends to have the best results in the long term, and this was also the case in 2023. In 2022, exceptionally, the best results were achieved in the *Digital safety and computer systems* category

(Table 2). We dare to say that the success rate in searching for information on the Internet decreases significantly if pupils have to find the source and evaluate some information in it and decide for the truth of the statements made.

The second most successful category in the easier version of the test for primary school pupils was *Collaborative tools and social networks* (Slovakia – 63.7 %, Ukraine – 62.6 %, Hungary – 58.9 %, Czech Republic 58.4 %, Poland – 50.7 %). The exception is Poland, where the second most successful category was *Digital safety and computer systems* (54.3 %). However, despite the positive results achieved, this does not mean that pupils cannot improve in this area. Overall, pupils were able to use collaboration and sharing tools and to find information on social networks. They were also able to use tools to communicate and understand the information displayed by the tool.

The easier version of the IT Fitness Test 2023 test again revealed, as every year, large reserves in the area of working with office software tools, understanding and working with structured data and their graphical visualizations, while digital skills in this IT area are one of the basic conditions for successful assertion on the labour market. Pupils also have reserves in the use of collaborative tools in office software applications. The results table shows that the *Office software tools* category was one of the least successful categories, with the lowest average success rate across countries (Poland – 40.4 %, Czech Republic – 42.1 %, Hungary – 43.9 %, Slovakia – 49.6 %, Ukraine – 52.9 %). We believe that this topic is probably also less attractive to pupils, so we need to look for appropriate methods and contexts that will be of more interest to pupils (Kelecsényi, Páleníková, 2019).

In the *Complex tasks* category, the average success rate per country ranges from 42 – 49 %. This category contained tasks with an algorithmic character. Compared to the other categories, countries (except Slovakia) scored the second lowest in this category (Czech Republic – 42.1 %, Poland – 44.2 %, Ukraine – 44.5 %, Hungary – 46.5 %, Slovakia – 49.3 %). On the basis of the results, we can devduce that pupils in all five countries participating in the IT Fitness Test have more significant reserves in solving complex problems with algorithmic character.

Table 2. The average success rate of each country in relation to the area studied

	Average success rate of researchers in participating countries								
Thematic area / Country	Czech Republic		Hungary		Poland		Slovak Republic		Ukraine
	2023	2022	2023	2022	2023	2022	2023	2022	2023*
Internet	67 %	59 %	62 %	43 %	65 %	46 %	71 %	61 %	67 %
Digital safety and computer systems	56 %	63 %	52 %	55 %	54 %	57 %	58 %	64 %	53 %
Complex tasks	42 %	48 %	47 %	43 %	44 %	45 %	49 %	50 %	45 %
Office software tools	42 %	42 %	43 %	33 %	40 %	38 %	50 %	44 %	53 %
Collaborative tools and social networks	58 %	48 %	59 %	39 %	51 %	39 %	64 %	51 %	63 %

* In 2022, the IT Fitness Test was not administered to a group of Ukrainian respondents; for the first time, Ukrainian pupils and students located in or outside Ukraine could participate in the test only in 2023

In the implementation of the test tasks in the area of *Digital safety and computer systems*, pupils from all participating countries except Poland achieved the third best success rate (Slovakia – 57.7 %, Czech Republic – 55.8 %, Poland – 54.3 %, Ukraine – 52.8 %, Hungary – 51.8 %). From Table 2 we can see a trend of year-on-year decrease in the average success rate of the whole corpus of respondents. Therefore, the achieved result cannot be assessed as pleasing. The authors Kučera and Jakab (2023) in the final report of the IT Fitness Test 2023 state that pupils have a relatively good understanding of the IT security warnings they commonly encounter. Pupils can respond appropriately to basic IT security situations and predict system behaviour based on these. They are able to make links between basic knowledge and apply it to the solution of a less standard situation. They have gaps in recognising how to properly protect sensitive data. They are not good at evaluating whether an implemented procedure will only visually obscure a particular sensitive data or make it completely inaccessible. They may also have less understanding of the principles and context of how information is stored in a data structure.

From the testing results tabulated in Table 2, it can be detected that the difference in the year-to-year success rate of solvers (2023 *vs*. 2022) achieved in the different IT areas of the easier version of the IT Fitness Test varies from 0 (Czech Republic: *Office software tools*) to 20 (Hungary: *Collaborative tools and social networks*) percentage points. However, based on the comparison of the results of the average success rate in two consecutive testing cycles (2023 *vs*. 2022) achieved in each country with respect to the queried subject area, no firm conclusions can be drawn, as other factors are also reflected, such as the change of the sample of respondents, minor changes in the wording of the questions, which may have influenced these changes more or less significantly (Kučera, Jakab, 2022). Nevertheless, the trends remain the same and the need to continue to invest capacity in building these skills in both formal and non-formal education is confirmed.

A more challenging version of the IT Fitness Test 2023 was administered to secondary and higher education students, teachers and other employed citizens of different age categories, i.e. to solvers older than 15 years of age. This version of the IT Fitness Test was divided into five thematic areas (as in the case of the test for primary school intended for ninth graders and graduates of primary school), with each thematic area containing five tasks. In terms of the success rate of respondents in this more challenging version of the IT Fitness Test, Slovakia achieved the best average success rate (57.17 %) (as in the easier version). Compared to 2022 (52.55 %), the success rate of Slovak respondents in the test increased by almost 5 percentage points (4.62 %). In terms of the next ranking in terms of achievement, Ukraine (51.24 %), the Czech Republic (49.57 %), Hungary (47.20 %) and Poland (46.67 %) followed (Table 3). This means that the success rate in verifying the digital skills and knowledge of this group of solvers is again, as in 2022, in the range of the optimal test pass rate of 50 % – 60 %.

If we look at the results in more detail, Slovak students and teachers achieved the highest average success rate in terms of individual countries (students – 55.70 %; teachers – 64.64 %). The target group of other employed citizens of different age categories participated in the testing only in Slovakia and the Czech Republic. The test for the over 15 age group was completed by 6 699 respondents who indicated that they were teachers (4 048 teachers in 2022). Teachers from the Czech and Slovak Republics participated in the teacher testing the most (Czech Republic – 3,576 teachers, Slovak Republic – 2,540 teachers). The average age of teachers involved in the testing was 45 years in the Slovak, Czech and Hungarian groups, and 44 years in the Polish group.

The overall discriminatory power of the test was around 55 % in each country, which can be considered very good sensitivity. In Table 3, we present in more detail the basic psychometric parameters of the IT Fitness Test 2023 achieved in its more challenging variant from a country perspective. Table 3 tabulates the results, separately for the group of secondary and university students, separately for the group of teachers, and separately for the group of other employed citizens of different age categories.

Table 3. Country results for the more difficult version of the test

Test for solvers over 15 years old	Czech Republic	Hungary	Poland	Slovak Republic	Ukraine
Number of test solvers over 15 years of age	37 405	4 913	9 533	30 060	249
Average success rate of all solvers	49.57 %	47.20	46.67	57.17	51.24
Average success rate of students from secondary schools/universities	47.89 %	46.39 %	45.02 %	55.70 %	51.24 %
Average success rate of teachers	63.61 %	64.53 %	60.12 %	64.64 %	–
Average success rate of others of citizens of different age categories	62.77 %	–	–	64.39 %	–
Sensitivity of the test	54.84 %	55.24 %	57.19 %	58.73 %	56.27
Test Reliability (Cronbach's alpha)	0.80	0.80	0.82	0.84	0.82

Although the more challenging version of the IT Fitness Test was designed primarily for solvers over 15 years of age, i.e. for high school and university students, there were also younger or older age groups among the respondents. If we look at the solvers of the more challenging version of the test from a global perspective, the strongest age category consisted of respondents aged 15 – 18, corresponding to high school students. In Poland and Hungary, 15-year-old students were the

most represented, with participation decreasing with increasing age. In Slovakia and the Czech Republic, 16-year-old students had the highest representation. In the Ukrainian group, 17-year-old students were overrepresented in the more difficult version of the test administered.

Regarding the participation of respondents in the more difficult variant of the IT Fitness Test depending on gender, in the Czech and Slovak Republics men and women are almost equally represented. On the contrary, in the group of Hungarian, Polish and Ukrainian students, the representation of males is significantly higher. In the group of Hungarian students, the difference in the representation of men and women is the highest at almost 24 percentage points.

Based on the results tabulated in Table 4, we can conclude that the highest average success rate in testing respondents' digital skills depending on their nationality was achieved in four out of five countries in the *Internet* category (Slovakia – 68.84 %, Ukraine – 59.76 %, Czech Republic – 58.66 %, Poland – 55.28 %, Hungary – 53.56 %). Despite the fact that similar skills have been tested in the IT Fitness Test in Slovakia in previous years, the results do not see a significant improvement in these IT skills (2022 – 65.60 %). In Hungary, the highest average success rate was achieved by respondents in the *Collaborative tools and social networks* category (55.86 %). Students' success rate decreases when they have to compare the information they have searched for on the Internet with each other, critically evaluate it and make clear statements. Pupils also have less experience in searching for information in a specific text document.

The lowest average success rates of the respondents are in the category *Office software tools* (Hungary – 35.83 %, Poland – 36.03 %, Czech Republic – 37.15 %, Ukraine – 39.36 %, Slovakia – 42.15 %) and in the category *Complex tasks* (Poland – 39.62 %, Hungary – 41.03 %, Czech Republic – 44.36 %, Ukraine – 47.79 %, Slovakia – 52.67 %). On the other hand, we can observe a year-on-year increase in the success rate of respondents in both categories in all participating countries. This can be seen as a positive development. Despite the observed year-on-year improvement, knowledge and skills in office tools have long been weak and insufficient, e.g. for employers' requirements. Students have gaps in skills and knowledge of working in vector graphics, and they do not know how to use adequate digital tools for multi-person collaboration in office software applications. They are relatively proficient in using simple digital tools to work with tabulated data. However, they have considerable margins when applying the filtering conditions and then evaluating the tabulated data. Observations from practice during test solving show that students are willing to work their way to a more laborious and incompetent solution. They do not think about the efficiency and reliability of the solution, they do not know how to use efficient tools, they lack the ability to question the correctness of the solution method and look for a method that leads to less error. It is questionable whether they are guided to do this in the school classroom or whether the school system is just focused on getting to the result.

The thematic area *Complex tasks* included tasks focused on complex skills when working with files, tasks for searching information in an interactive graph and their subsequent evaluation, and last but not least, tasks for detecting the control and setting of a certain sequence of commands in a program notation. The *Complex Tasks* topic included tasks focused on complex skills in working with files, tasks to find information in an interactive graph and then evaluate it, and last but not least, tasks to investigate the control and setup of a certain sequence of commands in a program notation. Despite the fact that we observe a year-on-year increase in the success rate of respondents in the *Complex Tasks* topic area, we see that high school and university students completing the more difficult version of the IT Fitness Test have deficiencies in solving tasks with higher cognitive demand. We share the view of the authors of the IT Fitness Test 2023 that we still see a lot of room for improvement and refinement of respondents' skills in solving complex algorithmic tasks. We believe that to improve future testing results, tasks of this nature need to be included more frequently in the primary school curriculum.

The category *Collaborative tools, and social networks* was the second most successful category in the four participating countries (Slovakia – 65.69 %, Ukraine – 57.99 %, Hungary – 55.86 %, Czech Republic – 55.13 %, Poland – 51.34 %). The exception was the respondents from Hungary, who achieved the highest success rate in this category (55.86 %). From the table of results, it is possible to observe, for example, a year-on-year increase in the success rate of approximately 21 percentage points in the group of Hungarian respondents, and an increase in the success rate of approximately 15 and 13 percentage points in the group of Polish and Czech respondents, respectively. Based on the results achieved in the individual tasks in this area of testing, we can conclude that basic knowledge and working with cloud-based tools for collaborative

online document creation and management are also at a good level. At this point we consider it necessary to note that it was the tasks in the area of Collaborative tools and social networks that best divided the sample of tested respondents, when the sensitivity in this area reached the highest value in all participating countries (Poland – 71.28 %, Ukraine – 68.41 %, Hungary – 67.81 %, Slovakia – 66.54 %, Czech Republic – 62.66 %) (Kučera, Jakab, 2023).

The *Digital safety and computer systems* category was the third most successful category in all countries (Slovakia – 56.48 %, Czech Republic – 52.56 %, Ukraine – 51.33 %, Poland – 51.08 %, Hungary – 49.71 %). Also in this category, Slovak solvers were the most successful among all countries, but the average success rates of individual countries were more balanced among themselves. If we look at the results of the Slovak solvers retrospectively, we can see that this category has one of the highest success rates for a long time. Based on testing the same skills compared to 2022, we see a slight deterioration of 3 (Slovakia) and 2 (Czech Republic, Poland) percentage points in this category in the group of Slovak, Czech and Polish respondents, respectively. Based on the results of solving tasks from the thematic area of *Digital safety and computer systems*, we can say that students have a relatively good understanding of what security warnings mean, which they commonly encounter when working with digital information. Students are good at identifying a fraudulent message and know how to respond to it Reserves in recognising how to properly protect sensitive data. Students are less successful in situations of securing sensitive information that they have not encountered before and that are less talked about in society.

Table 4. Average achievement of each country in the more difficult version of the test in relation to the subject area queried

	Average success rate of researchers in participating countries								
Thematic area / Country	Czech Republic		Hungary		Poland		Slovak Republic		Ukraine
	2023	2022	2023	2022	2023	2022	2023	2022	2023*
Digital safety and computer systems	59 %	63 %	54 %	50 %	55 %	52 %	69 %	64 %	60 %
Complex tasks	53 %	65 %	50 %	46 %	51 %	53 %	57 %	60 %	51 %
Office software tools	44 %	42 %	41 %	31 %	40 %	34 %	53 %	44 %	48 %
Collaborative tools and social networks	37 %	36 %	36 %	25 %	36 %	26 %	42 %	33 %	39 %
Digital safety and computer systems	55 %	42 %	56 %	34 %	51 %	36 %	66 %	51 %	58 %

* In 2022, the IT Fitness Test was not administered to a group of Ukrainian respondents; for the first time, Ukrainian pupils and students located in or outside Ukraine could participate in the test only in 2023

Regarding the sensitivity of the more challenging version of the test in the IT categories, we can conclude that each of the categories differentiated the test sample very well into solvers with good knowledge and skills and solvers with poor knowledge and skills. The *Collaborative tools and social networks* category had the highest sensitivity. The lowest, if still good, sensitivity was for the *Digital safety and computer systems* for Ukrainian students (Kučera, Jakab, 2023).

The highest differences in achievement in the individual categories of the test achieved within the participating countries are at the level of 26.69 percentage points in the group of Slovak respondents between the category *Internet* (68.84 %) and *Office software tools* (42.15 %). When comparing the results between the participating countries, we see that the highest differences in achievement are recorded at the level of 15 percentage points in the *Internet* category between the Slovak (68.84 %) and the Hungarian (53.56 %) and at the level of 14 percentage points in the *Collaborative tools and social networks* category between the Slovak (65.69 %) and the Polish (51.34 %) solvers. On the contrary, the lowest differences in success rates between countries are at 0.20 percentage points between Hungarian (35.83 %) and Polish (36.03 %) researchers in the *Office software tools* category and at 0.25 percentage points between Polish (51.08 %) and Ukrainian (51.33 %) researchers in the *Digital safety and computer systems* category. A detailed percentage picture of the average success rate of two consecutive testing cycles (2023 *vs.* 2022) in

each participating country achieved in the more challenging variant of the test with respect to the queried subject area is tabulated in Table 4.

If we look at the results achieved in the more challenging version of the IT Fitness Test 2023 designed for solvers over 15 years of age, then we can proclaim that students perform well in activities they encounter more often, are better at solving tasks with lower cognitive demand, where reading comprehension and the use of critical thinking are not required. They have mastered knowledge from their schooling at a more formal and theoretical level, with little ability to link and apply it to practical situations. Many students have gaps in digital skills and competences that are not only essential for their further studies, but also in digital skills that are needed in everyday life or required by employers in the labour market.

3. Conclusion and recommendations

The differences in achievement between the assessed IT domains within countries, or between countries, are relatively large. In terms of the whole corpus of respondents, the best results were achieved by respondents in the area of working with the *Internet*. On the contrary, reserves were noted among pupils and students in working with office tools, but also in understanding how to work with structured data, in working with tabulated data and their graphical visualizations. Educational experts agree that young people should be most concerned with developing critical thinking, quantitatively evaluating information, assessing its quality, credibility or truthfulness (Lombardi et al., 2021; Ma, et al., 2023; Idil et al., 2024). We are convinced that the testing results achieved in the IT Fitness Test 2023 can help the governments of the participating countries to take effective measures that will lead to the improvement of the education system and digital skills not only of the youth but of the whole society.

The necessity of reforming the Slovak education system is also highlighted by the latest results of the international PISA measurement, which showed a significant decline in the performance of pupils. Fifteen-year-old pupils had worse results in mathematics and reading literacy. Thus, one in three pupils did not even reach the basic level when tested (OECD, 2023a; OECD, 2023b).

The long-term conceptual goal of the Slovak Ministry of Education, Research, Development and Youth was to prepare a reform of the educational content, the so-called curricular reform of the Recovery and Resilience Plan of the Slovak Republic, which focuses on meeting the needs of education for the 21st century. One of its main objectives is to prepare educational institutions in the field of regional education to implement concrete steps towards their digital transformation into schools that develop digital competences of their pupils and teachers, effectively use digital technologies in communication with the community of educational actors, in teaching and in active pupil cognition (Pupala et al., 2022). The pilot launch of the reform has already started in 40 primary schools in the school year 2023/2024, while from September 2026 all Slovak primary schools should follow the new curriculum. We firmly believe that the curriculum reform of education will gradually bring positive results in relation to the education of young people.

In this context, we share the views of education policy experts that it is not only about improving results in international measurements, but mainly about ensuring that our pupils understand the content they learn in school and are able to apply it in their future and professional life (Hall et al., 2019; Brečka et al., 2022). If we want to cope well with the digital transformation of society, high-quality digital skills are a necessity. And not only in terms of mastering new digital technologies, but also in terms of working with digital content. We believe that the IT Fitness Test takes this aspect into account. In fact, proper evaluation of content on social media, critical thinking, and the ability to distinguish between true and false information are also key to protecting the democratic values of our society.

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The History of Education

Education of Regional Identity Among Soviet Children, Youth and Youth through Radio Broadcasting (based on Materials from the Penza Region)

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Abstract

The article examines the mechanism of the formation of regional identity in the minds of the younger generation in the Soviet period through one of the types of media – radio on the example of the Penza region. Regional identity is characterized by the identification of a person with his place of residence, his connection with the territory, during which a sense of belonging to his region and the social community inhabiting it develops. The result of this process is the formation of a sustainable view, associations and image of their region, an emotional positive attitude towards the region, an awareness of a sense of pride and involvement with their territory, a motivation to constructively participate in the social, social and political life of the region.

Penza broadcasting (regular broadcasting – since 1927), despite its ideologized nature, in the context of the spread of the norms of the Soviet way of life, contributed to the designing of regional identity among the local population, his children's and youth audience, including broadcasts on the socio-economic and cultural development of the region, its history, people who glorified the Penza region, etc. The content of programs for the younger generation was compiled taking into account the psycho-age features of radio listeners so that the material was accessible, understandable and interesting. Various types of radio broadcasts were used: reporting, interviews, essay, short story, etc., and such a variety of information genres helped maintain the interest of listeners. Particular attention was paid to feedback from listeners in order to interest them more.

Keywords: USSR, regional identity, broadcasting, child age group, youth, Penza region.

1. Introduction

In the modern realities of globalization, there is a crisis of social identity, including national and regional, because many people do not identify with a particular social group (Lapkin, 2008;

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Miklyaeva, Rumyantseva, 2008). The main danger of this is the deepening of historical, civil, and social fragmentation and the interruption of continuity with traditional norms and values of society; the loss of significance and transformation of public institutions (family, state) that used to be important to people (Danilova, Yadov, 2004; Eremina, 2012). But identity is very important for every state, because it ensures the integrity, social unity, and stable progressive development of society. Based on this, the study of identity issues becomes particularly relevant. In this regard, the subject of the formation of regional identity is of great importance, which means identifying oneself with a specific place of residence, classifying oneself as a fellow citizen of a certain area.

By identity, researchers mean the social sense of an individual, which makes them correlate themselves to a certain social group on the basis of their common interests and signs. Identity models sociocultural space as the realm of a person's life priorities; specifies a kind of coordinate system in defining its principal points; forms the scheme of interaction of the individual with the outside world, encourages it to internal changes based on collectivism, social justice, solidarity and mutual assistance. Social identity has multiple manifestations – family, professional, ethnic, etc. In many ways, identity is determined by collective memory, which includes stable formations in the public consciousness.

The Soviet model of identity, on the one hand, focused on achieving global political tasks, such as building communism, on the other, ensured the inclusion of the «common man» in major socio-economic events, a sense of emotional involvement in the creation of a new «future». In the Soviet state, an integral system of institutions and mechanisms of political socialization and civil identification functioned. In the USSR, a policy of forming a single Soviet identity was pursued – a new historical community «Soviet people», which was based on the provisions of Marxism-Leninism proclaimed by the CPSU, the development of personality (primarily labor), Soviet moral and cultural values. The new Soviet man needed to be committed to the ideals of the party, the working class and collectivism; he was aimed primarily at fulfilling the tasks determined by the Soviet-Party leadership, in which his involvement in «great deeds» would be manifest. The most important component of Soviet identity was patriotism, which consolidated and united the interests of various social groups and movements, state and social forces; citizen's care for their country was positioned as self-care. As part of the formation of identity, Soviet values were introduced, the ideal of a communist future was broadcast, a comprehensive and systematic «policy of historical memory» was carried out, heroes and political symbols were created.

Based on the community, which acts as the basis for identification, different types of identity are distinguished: ethnic, regional, etc. Regional identity is understood as associating an individual with a particular territorially restricted community – a region that is characterized by territorial, historical, cultural, political, legal and linguistic integrity. Collective living in general socio-cultural and natural-geographical conditions, maintaining a homogeneous type of economy was reflected in the nature of the interaction of the population, their traditions, lifestyle; collective memory manifested itself in reaction to historical events, joint experience of painful trials, difficult and joyful events, in positive memories, pride in outstanding fellow countrymen, local symbols close and understandable to the population, etc.

Mass media, including radio broadcasting, have played and continue to play an important role in the formation of regional identity. They act as one of the channels of its formation through awareness of regional culture and history, determining the importance of their region in the past and present events of their country and the group past of the inhabitants of the region, consolidating the practice of social communication and human interaction with the unique environment and cultural landscape of the region. It should be borne in mind that in the USSR the official media offered a model of identity, including a regional one, preferred exclusively by the authorities, otherwise they simply could not function.

2. Materials and methods

The theoretical and methodological basis of the research and the involved source base provided an opportunity to conduct an objective and complete study of the designated issue. The methodological basis of the research was primarily based on the general scientific principles of universal connection and development, objectivity, consistency, scientific approach, and determinism. In addition, the research was based on the principles of historical science and pedagogical science: historicism, genesis, comparison. The authors relied on philosophical and psychological concepts of interaction as a multicomponent process carried out in joint activities

and communication. We proceeded from the idea of humanizing the educational process; modern concepts of the development of society, in which radio acts as a mechanism of influence on personality. These methods made it possible to study the mechanism of formation of regional identity among residents of the Penza region through local radio broadcasting, taking into account the specific historical situation and development, interrelation and interdependence with other changing phenomena. These methods made it possible to analyze the problem based on the available factual material and determine the objective patterns of the process of educating Penza residents' regional identity through radio broadcasting, taking into account the economic, political and cultural characteristics of the region's development. The information was evaluated by the authors in terms of its reliability. The systematic approach contributed to the theoretical understanding of radio broadcasting and its role in constructing the identity of citizens as a set of interconnected links that had resources, communication with the external environment and feedback. The use of these methods made it possible to study the phenomenon of regional identity in development; to present the forms and methods of its implementation through radio; to identify the features of this process; to see the causal relationships between the Soviet state policy in the field of radio and radio broadcasting in the region. The main trends, internal logic and patterns of the Soviet model of identity education through radio broadcasting at the regional level were identified.

The source base is based on unpublished documents from the collections of the Penza Region State Archive (PRSA). A large block of sources consists of periodic and planning documents that make it possible to make a comparative analysis and determine the main directions of development of radio broadcasting in the region; to consider the content (subject matter, quality of broadcasts, etc.); to study the practices of local radio on the formation of regional identity among the population.

These sources include orders on the regional radio committee and reports on its activities; information on ensuring the implementation of party and government decisions on radio broadcasting and communications and support for various ideological and political campaigns; information on the main performance indicators of radio organizations and the communications department; extracts from minutes of meetings of Penza provincial and regional executive committees on various aspects of broadcasting and radio in the region; information from party district and city committees on the forms of mass propaganda and the state of ideological and cultural work in the region, etc. These materials are in the funds of the Penza Regional Committee on Television and Radio Broadcasting (Fund r-2474. Op. 1) and the Penza Regional Committee of the CPSU (Fund p–148).

3. Discussion

The study of various aspects of identity was carried out by E.P. Belozertsev (Belozertsev, 2014), V.G. Bogomyakov (Bogomyakov, 2007), N.A. Galaktionova (Galaktionova, 2010), E.V. Dzyakovich (Dzyakovich, 2012), L.M. Drobizheva (Grazhdanskaya, etnicheskaya..., 2013), E.V. Eremina (Eremina, 2012), D.N. Zamyatin (Zamyatin, 2006), K.V. Kiselev (Kiselev, 2006), S.A. Konovalov (Konovalov, 2019), G.S. Korepanov (Korepanov, 2009), M.P. Krylov (Krylov, 2013), A.E. Kuznetsov (Kuznetsov i dr., 2022), A.N. Makhinin (Makhinin, Kovalenko, 2021), L.V. Sagitova (Sagitova, 2018), Yu.G. Chernyshov (Derendyaeva, Chernyshov, 2021), etc. (mechanism for constructing regional identity, regional political symbols, image or positioning of the region, etc., using the example of republics, individual territorial subjects of the federation).

The issues of social identity, the value-affective significance of belonging to a certain social group, and the consequences of positive or negative identity were the focus of attention of foreign researchers: N. Tajfel (Tajfel, 1974; 1982), S. Trepte, L.S. Loy (Trepte, Loy, 2017), and others. N. Tajfel proposed the Social Identity Theory. This theory initiated the consideration of identity as a person's awareness of belonging to certain groups of people, who at the same time determine the «radius of trust».

The significant role of regional mass media in the spatial and regional identity, the relationship of the media with the territorial and administrative structure within the regions was pointed out by foreign researchers: N. Coldry, A. Hepp, A. McCarthy (Couldry, Hepp, 2017; Couldry, McCarthy, 2004), A. Paasi (Paasi, 2009) and others. The history of Soviet radio broadcasting was in the focus of the study of many researchers: M.S. Glazer (Gleizer, 1989), T.M. Goryaeva (Goryaeva, 2009), P.S. Gurevich (Gurevich, Ruzhnikov, 1976), Yu.A. Letunov (Letunov, 1974), V.I. Shamshur (Shamshur, 1960), A.A. Sherel (Sherel', 2004), etc.). Specialists were seriously interested in the development of certain types of broadcasting, especially with the

diverse use of specific expressive means of radio – children's, youth, literary and dramatic (Men'shikova, 1966; Rudenko, 1984: 75-92; Do vstrechi v efire..., 1986).

4. Results

In the USSR, especially until the 1960s, broadcasting was in demand by the population due to its unique properties: mobility, accessibility of perception, emotional intensity. Throughout the functioning of Penza broadcasting, editorial structures and key areas of its broadcasting were constant: socio-political, industrial and agricultural, literary, dramatic, musical, children's, etc. This principle of work made it possible to cover almost all social and age groups of society with information and ideological influence. Local radio broadcasting contributed to the construction of regional identity among the population, including young people, through the materials of programs about the Penza Territory in the context of all-Russian and Soviet history; on the current socio-economic and cultural state of the region; about the geographical space of the area; on the attitude of the region to other geographical objects – neighboring regions, Russia as a whole, etc., i.e. the introduction of a value system for this territorial social group. As a result, the introduced identity made it possible for a resident of the Penza region to find a connection with the place of his birth and residence, to realize himself as part of his region, to participate in the development of his region. The Soviet authorities understood the need for «correct» upbringing of the younger generation as an indispensable condition for the progressive development of society.

From the very beginning of the work of the Penza radio broadcasting, a part of the airtime was necessarily allocated to the children's and youth audience. For example, the ten-day broadcasting schedule of the Penza province radio station, which began regular broadcasting in 1927, along with Moscow programs and the release of special local programs (peasant and Red Army newspapers), provided for broadcasts of children's programs, performances of the Blue Blouse, etc. The Penza Regional Communications Department, which led all types of communications, including broadcasting, created with the formation of the Penza Region in 1939, and the editorial board of broadcasting under the regional executive committee also produced programs for children. And during the Great Patriotic War, as far as possible, radio sought not to «forget» the younger generation. So, in 1944, taking into account the wishes of the population, 2 youth programs were organized in January, and 7 in June. However, the chairman of the regional committee pointed to «weak literary processing of the material»; insufficient coverage of the cultural life of the region; almost absolute lack of music broadcasts for schoolchildren and primary school children.

In the second half of the 1940s. the main forms of local radio broadcasts were youth rallies, literary almanacs, «At the Microphone», thematic evenings, etc. District radio broadcasts consisted mainly of political broadcasting (the main thing is «Latest News» – information about the life of the district); art programs were extremely rare. Political broadcasting necessarily included transmission cycles for young people, schoolchildren, pioneers, etc. Radio correspondents prepared for the broadcast materials about the activists of local educational institutions, the achievements of children in various spheres of life, etc.

In 1950–1952 the editorial offices of the regional radio broadcast daily programs of 30 minutes. The thematic plan of the regional committee provided for socio-political programs for young people, pioneers and schoolchildren, which were supposed to «show the selfless work of young people, the avant-garde role of Komsomol members, study and cultural leisure of young people» (Informatsionnyi otchet..., 1952: 36). Programs of a youthful and children's, cultural and educational nature, subtly or directly in the forehead spread the values of socialist society: patriotism, collectivism, self-sacrifice for the interests of the state, admiration for the Soviet past of the country and its leaders, primarily V.I. Lenin, etc.; telling on the air about Penza residents who, by their actions, proved the importance of the propagandized attitudes and «gave all their strength to the great cause of communism». For example, in 1951, the essay by Krylov's correspondent «Kuzmich» spoke of Mikhail Bobrov, demobilized from the Soviet Army, who graduated from the school of leading collective farm personnel in 1949 and was elected chairman of the board of the collective farm named after S.M. Kirov, who now works for the common good to strengthen the artel economy. The names of many programs sounded pretentious and pathos: «The first commandment is fulfilled» (on the participation of young people in the export of bread, 1951), «For the honor of the factory brand» («on the struggle of young workers of the factory "Lighthouse of Revolution" for the production of excellent quality products», 1952), etc. Thus, the formation of

regional identity took place through the demonstration of political and historical events of the Penza Territory, famous people and ordinary workers of the region, the definition of a typical natural and cultural landscape. Nevertheless, the inspection commissions noted the standardness and schematism of radio transmissions, the minimum broadcast of youth and literary and artistic programs, etc. The certificate of the regional radio committee identified shortcomings in the programs: a small number of «live examples»; «sparse and dry, clerical» language of radio broadcasts (Spravka..., 1951: 13). The instructor of the press sector of the regional committee of the CPSU(b) N. Krayushkina emphasized that the programs for young people were practically no different from the usual socio-political ones; no music and educational programs were organized for children and youth.

On January 4, 1952, an order was issued by the regional radio information committee «On measures to improve the quality of transmissions», where special emphasis was placed on programs for young people and their broadcast was streamlined. The order on the Penza Radio Information Committee № 8 of February 20, 1953 stated the need to improve the quality of children's programs, which «should instill in pioneers and schoolchildren a love for the Motherland, for the Communist Party, instill an interest in science and the expansion of knowledge, a love for work and production professions» (Prikaz..., 1953: 8ob.). The regional radio committee took measures so that the broadcasting network for the younger generation was built taking into account the age of young radio listeners, with a creative and educational orientation, so that, based on the socio-psychological characteristics of the radio, the child could be interested, and he would be not only a passive listener, but also an active participant in the broadcast, involved in communication. According to the age criterion of the children's audience, the programs were targeted – for preschoolers, primary schoolchildren, adolescents, high school students.

The specifics of broadcasting for children and adolescents were a high degree of its emotional saturation, the numerous use of literature and music in programs, figurative and artistic expressive means, therefore, reports, sketches, etc. were often given in programs. In almost every children's and youth program, including through the selection of artistic and musical works for broadcast, on the examples of the life of radio heroes, often real ones who lived in the Penza region, preferred models of social behavior were introduced, love for the Fatherland was brought up, respect for the revolutionary history. For example, in 1960, the stories of the Komsomol Penza members of the first years of Soviet power sounded on the air – K.I. Melnikova, V.S. Sukhanova, A.A. Medvedev, M.F. Sorokina and others, memoirs of the participant of the third congress of the RKSM K. Ulybin.

To attract an extensive asset of authors from students, a section «Chronicle of Pioneer and School Life» was introduced into each children's program. The information report emphasized that in the radio broadcasts «schoolchildren were instilled with a sense of love for our beautiful homeland, the Bolshevik party, the government, comrade Stalin» (Informatsionnyi otchet..., 1952: 38). Pioneer and school programs also aimed to help students gain and consolidate knowledge, for which teachers often spoke on the radio, especially before final exams. The programs used performances by participants in amateur art circles, recordings with children's musical numbers. In the programs, using examples from the life of local schools and pioneer squads, they talked about the reform of educational institutions, the acquisition of labor skills by children, the victories of participants in amateur art circles, naturalists, etc. The programs sought to instill in the younger generation the best qualities of a Soviet person: diligence in study, honesty, respect for elders, etc. Programs for young people came out once a week.

In the decree of the Central Committee of the CPSU of January 29, 1960, «On Improving Soviet Radio Broadcasting», it was stated that «many radio programs are poorly connected with life, are conducted ineptly, templatelly and therefore do not arouse much interest among listeners» (Sovetskaya pechat'..., 1961: 130). The report at the regional meeting of radio and television workers on May 30, 1961 emphasized that individual programs lack specificity and purposefulness, they have an abstract character, they contain many general appeals and slogans, propaganda. In line with the concept of building communism in the USSR, a resolution of the Central Committee of the CPSU «On the further development of social principles in the Soviet press and radio» appeared (June 28, 1960), which contributed to the organization of amateur radio broadcasting in the region (Ocherki istorii..., 1986). The «Regulation on the District Editorial Board of Broadcasting on a Voluntary Basis» (1962) emphasized that their main task was to foster a communist attitude to labor and public property among people, including the younger generation, promote sprouts of new experience in public relations, develop friendship and

camaraderie, public condemnation of idlers and lazy people. To improve the efficiency and quality of work, the regional committee carried out systematic and comprehensive work to increase the number of correspondents and participants involved in the programs.

Local radio broadcasts regularly featured materials dedicated to great people – writers, composers, artists, etc., whose biographies were associated with the Penza Territory, and whose names glorified him and were associated with it (M.Yu. Lermontov, A.A. Arkhangelsky, A.I. Kuprin, A.N. Radishchev, V.O. Klyuchevsky, K.A. Savitsky, I.S. Goryushkin-Sorokopudov, V.E. Meyerhold, etc.). For example, in June 1961, on the occasion of the 150th anniversary of the birth of V.G. Belinsky, a number of radio programs were dedicated to him: «Literary readings in memory of V.G. Belinsky» (June 2 and 7), «Transfer dedicated to the memory of V.G. Belinsky» (June 9 and 13), «Bibliography. Books about Belinsky» (June 12), «Transfer for high school students "In the homeland of Belinsky"» (June 12), «Program dedicated to the 150th anniversary of the birth of V.G. Belinsky» (June 13), «Program "The whole country celebrated the 150th anniversary of the birth of V.G. Belinsky"».

Such programs not only contributed to the education and enlightenment of listeners, but also created a feeling of involvement in the regional and world cultural and historical heritage.

The decree of the Central Committee of the CPSU «On measures to further improve the work of radio broadcasting and television» (1962) determined the key tasks of grassroots radio broadcasting: motivating the population to fulfill and overfulfill plans for the development of the economy, culture, and science; active dissemination of best practices, best examples of labor and communist principles in the life of Soviet society; assistance in the upbringing of a comprehensively developed Soviet citizen – the builder of communism. Much attention was paid to the need to organize a diverse range of radio programs for children and youth, to strengthen the role of radio in the moral and aesthetic education of the masses, etc. Understanding the specifics of such a contingent, radio workers sought to use various formats of work: radio newspapers «Friendly Guys» (for children of pioneer age), «School Life», «Guys walk along the road of fathers» (for high school students), etc. Thematic cycles of programs for young people included «Club of the Young», «Teenager, Wednesday, Future», «Hello, dear fellow countrymen» (about young fellow countrymen working on virgin soil and construction sites of the seven-year plan), the radio magazine «Student Life», radio almanacs «Literary Penza», etc. The program «Club of the Young» received approval from Central Radio. «Radio Club» was conceived as a club of interesting meetings, where young men and women would get acquainted on the air with the successes of their peers «in work, study, on treadmills and in gyms, theater and club stages, discussed the works of writers, practical issues of the activities of Komsomol organizations» («What should be a person of the future», «What is Komsomol honesty», etc.); young workers of the village and industry performed; creative groups presented their works, etc. (Vyezdnaya redaktsiya..., 1964).

In programs for children and adolescents, young people, using examples from the life of schools, pioneer detachments of the region, they talked about the activities of educational institutions, children's «problems», the achievements of young technicians, tourists, etc. They often featured children's voices; read out the letters of young listeners on the air and commented on them, the children themselves performed in the recording. For example, in 1960, Komsomol members of the Penza region organized a debate on the topic «Heroic in our everyday life». The report of the Penza edition of broadcasting noted: «The atmosphere that reigned on it, the statements of the youth were recorded on tape, and then broadcast on the radio. In the same way, thousands of boys and girls attended the disputes held in Penza, Kuznetsk, Bashmakov. Their topics were different: "Are you ready to live under communism?", "What is happiness?", "Every profession is good"» (Otchet..., 1960: 77). Sometimes essays were prepared directly by children – young correspondents. Young authors wrote about their friends, about familiar people with an interesting fate.

The editors asked to send letters to the radio under various pretexts: to suggest the topic of discussion, talk about their favorite book, authoritative friend, interesting journey, etc., thereby not only offering original ideas for the air, but also understanding the vectors of the needs and interests of the audience to release socially significant programs. So, in 1964, the youth editorial office of the regional radio appealed to radio listeners to take part in the creation of programs «dedicated to the work and life of your peer»: send information about the patriotic affairs of young workers, workers of state farms and collective farms, collectives of communist labor, about the competition for the delivery of defect-free products, about «the daily struggle for the successful completion of the

agricultural year», about «the noble deeds of your comrades», about spending their leisure time (K molodomu radioslushatelyu..., 1964).

The content of many radio programs aimed listeners at cultivating hard work, collectivism, courage, etc. («All works are good, choose for taste», «On youth corn plantations», «We are builders», «Remove a plentiful harvest», «Youth at Penza construction sites», etc.). Radio editorial began to organize radio tours to local enterprises for schoolchildren of the regional radio for career guidance from the beginning of the 1960s. – to the Compressor Plant, Penzmash, Himmash, etc. («Come to our factory»). In the 1960s the radio meetings of school Komsomol organizations aroused some interest among listeners (Khovrin, 1961). In the 1960–1970s on the Penza radio went «Pedagogical readings» in order to help teachers and parents in the upbringing of the younger generation (radio essays about teachers, «Working class – a worthy shift. Conversation about the labor affairs of school students», «What path will you choose, friend?» (vocational guidance in rural schools), «On labor education of children in the family», etc.). Teachers, head of the regional department of public education, employees of the Penza Institute for Teacher Improvement, scientists of the Pedagogical Institute. V.G. Belinsky spoke to the microphone on the radio (Pedagogicheskie chteniya..., 1964). In the 1970–1980s. for the little ones, the program «Merry Teremok» was broadcast, for older children – the radio newspaper «School Life» («We are your faithful shift, Komsomol», «Study and work – they live nearby», etc.); for young people – weekly issues of the radio station «Molodost» («They were raised by the Komsomol», «So our heart told us», «I ask for a word!», etc.), the military-patriotic magazine «Rocket» (about the labor and military exploits of fellow countrymen, about people who immortalized their name on the fronts of the Great Patriotic War, about the service of our fellow countrymen), radio magazine «Golden Hands» (about vocational school students, about new specialties, about the employment of young specialists), «To the working class – a worthy shift (Conversations on the labor affairs of school students)», etc. (Kharlova, 1977). In 1985, journalist I.I. Ponomarchuk, together with sound engineer E.V. Utenkov created a radio animated film «In a Forgotten Museum». Penza broadcasting, within the framework of the permitted scheme of the All-Union Radio Committee, sought to focus on «a sense of place» – «a feeling that is based on the need to belong to a certain territory, home, and not society in an abstract sense» (Salovaara-Moring, 2004).

Broadcasting in the USSR was ideologized. The attitudes of Marxism-Leninism, Lenin's theme were present as a «leitmotif» in weekly radio programs – industry magazines «Industry», «Rural Life», «Friendly Guys», «Literature and Art»; cycles became permanent: «Pages of Leniniana», «Lenin's Fridays», «Lenin University of Millions». The leadership of the region recommended to fill the programs with local history material as much as possible in order to «reveal the life-giving power of Lenin's ideas, using vivid examples from our Penza reality to show how Ilyich's covenants are being implemented by the workers of our region» (O rabote..., 1969: 86). The regional committee's certificate highlighted that in radio broadcasts for the younger generation, examples were given of how party organizations took care of young workers, district committees created universities of military glory and military-patriotic lecture halls, etc. Programs with Komsomol and Soviet-party leaders, broadcast cycles demonstrating the help of local authorities and the state of youth in satisfying requests, formed a positive appearance of regional and district leaders, were aimed at fostering respect and trust in the leadership of the region. For example, in 1966, the microphone was «visited» by the heads of the department of Komsomol organizations of the Komsomol regional committee V.V. Korolev, departments of the CPSU regional committee B.G. Perminov and G.N. Polozov; Deputy Department of Culture V.M. Trushnin; First Secretary of the Kuznetsk City Committee of the CPSU M.S. Chistyakov; Chairman of the Regional Committee of National Control N.V. Khristoforov and others.

In order to improve the quality of the broadcast, the State Committee for Broadcasting and Television sent to the regions for acquaintance and use in practical work the texts of programs and reviews of children's programs, recordings of programs and musical fragments of the Recording House of the All-Union Radio.

5. Conclusion

Penza radio broadcasting in its various forms of presentation of information (radio magazine, radio essay, note, interview, report, etc.) programs for children and youth helped its audience to form a regional identity through stories about the positive features of the region, the significance of the region, instill love for the region, building a connection among residents with a place in the

country and the world. In children's radio programs, the main genres of radio were presented: informational, artistic and journalistic, etc. Based on the socio-psychological features of the children and youth audience, the editors determined the form of presentation, structure and volume of transmission, sufficiency for full perception, accessibility and clarity. Children's programs had a clear age positioning.

The young listeners felt proud of their «little Motherland» and its famous people, felt their belonging to the Penza community and aspired to take an active part in the life of their region as a result of such radio practice. Children and young people identified themselves and their peers with the past, present, and potential future achievements and virtues of the area where they lived. Cultural continuity (traditions, symbols, historical knowledge about their territory) was carried out through radio broadcasting, and thus the younger generation was constructing a regional identity.

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A Social Portrait of Students at Ukrainian Universities in the 19th century

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Abstract

The article is devoted to a comprehensive study of the social composition of the student body of Kharkiv Imperial University and St. Volodymyr's Imperial University in Kyiv during the nineteenth century. Based on the analysis of statistical materials, university reports, and official documents, the article reveals the dynamics of changes in the social structure of students, mechanisms of access to higher education for different social groups, and the peculiarities of the formation of the educated elite of the Ukrainian lands within the Russian Empire.

The study demonstrates the evolution of the social composition of the student body from the class-oriented system of the first half of the nineteenth century, dominated by nobles (60-65 %) and clergy (20-30 %), to a more democratic structure at the end of the century, characterized by an increase in the share of students from peasant families to 16-19 %. Particular attention is paid to the impact of the Great Reforms of the 1860s and 1870s on the transformation of the university environment and the expansion of the social base of higher education.

A comparative analysis of the two universities reveals both common patterns of development, driven by a unified state educational policy, and regional peculiarities that reflected the ethnic and religious composition of the population of different regions.

The article reveals the mechanisms of state regulation of the social composition of students through the system of scholarships, class restrictions and criteria of “political trustworthiness”. The internal social stratification of the university environment is analyzed.

The study confirms the role of universities as important channels of social mobility, especially for representatives of non-privileged classes. Statistical analysis of academic performance shows higher rates of students from peasant and clergy families compared to noble families, which is explained by their greater motivation and more serious attitude to learning as a means of social advancement.

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The materials of the study expand the understanding of the processes of formation of the intellectual elite of Ukraine in the nineteenth century, the mechanisms of social integration in a class society, and the role of higher education in transforming the social structure of Ukrainian lands within the Russian Empire.

Keywords: social structure, students, higher education, nobility, clergy, bourgeoisie, social mobility, educational policy.

1. Introduction

The 19th century was a period of intensive development of higher education in the Russian Empire, particularly on Ukrainian lands. The establishment and functioning of universities in Kharkiv (1805) and Kyiv (1834) marked a new stage in the formation of the region's intellectual elite. The social composition of the student body of these educational institutions reflected not only the peculiarities of the social structure of the era, but also the state policy on access to education, regional differences, and the evolution of social processes over the course of the century.

The relevance of the study of the social composition of students lies in the possibility of tracing the process of formation of the educated stratum of society, the mechanisms of social mobility and the impact of educational policy on the transformation of the social structure of Ukrainian society in the nineteenth century.

2. Materials and methods

The study of the social portrait of students of Ukrainian universities in the nineteenth century is based on a comprehensive methodological approach that combines the principles of historicism, objectivity, and systematic analysis.

The principle of historicism involves considering the social composition of students in the context of historical development, taking into account the evolution of the social structure of society during the nineteenth century and the impact of government reforms on access to higher education.

The principle of objectivity is ensured by the use of a wide source base, including official statistical materials, university reports and regulatory documents, which avoids subjective interpretations.

The systemic approach allows us to consider the social composition of students as an integral system that is formed under the influence of various factors: economic, political, social and cultural.

Statistical analysis is used to process quantitative data on the social background of students, their regional and ethnic composition, and their financial situation. This method allows us to identify the dynamics of changes in the social structure of students over the course of a century.

The comparative-historical method is used to compare the social composition of the student body of Kharkiv and Kyiv Imperial Universities, to identify common patterns and regional peculiarities.

The sociological approach provides an analysis of the university environment as a special social group with its inherent characteristics, internal structure and mechanisms of functioning.

The research is based on various types of sources, such as official documents: university statutes, annual reports of the Ministry of National Education, statistical reviews; university documentation: annual reports of universities, lists of students, information on scholarships; periodicals and other official publications; reference books, biographical dictionaries, historical overviews of universities.

3. Discussion

The study of the social composition of the student body of universities in the Russian Empire has a long tradition. As early as the pre-revolutionary period, the first works devoted to the analysis of the student body appeared. Among the most important works of that time are “History of Kharkiv University for the first 100 years of its existence (1805–1905)” and “History of the Imperial University of St. Vladimir”.

A comprehensive study of the development of the university system in the Russian Empire was conducted by A. Avrus (Avrus, 2001). The author analyzes the evolution of the university system, the legal status of universities, and the relationship between the government and academic corporations. Special attention is paid to the social composition of students, their rights and obligations.

V. Andreev provides a general overview of the development of the educational system in the Ukrainian lands as part of the Russian Empire. The author examines the creation and functioning of educational institutions of various levels, including universities, analyzes the social composition of students of Kyiv, Kharkiv and Odesa universities, shows the dynamics of changes in the social structure of students during the XIX century (Andrieiev, 1998; Andrieiev, 2000).

A valuable source for studying the environment in which students of Ukrainian universities were formed is the work of D. Bagaliy, V. Ikonnikov, M. Vladimirskii-Budanov, and others. They describe in detail the peculiarities of the organization of the educational process, the composition of the teaching staff, the peculiarities of student life at imperial universities, etc. (Bagalei, 1904–1906; Vladimirskii-Budanov, 1884).

A. Ivanov analyzes in detail the social composition of students, their financial situation, everyday life, political attitudes, and conducts a comparative analysis of different universities of the Russian Empire (Ivanov, 1999).

L. Ivanova explores the role of students in the national and cultural life of Ukraine. The author examines the participation of students in cultural and educational societies, their contribution to the development of Ukrainian culture and science, and analyzes the formation of national consciousness among student youth (Ivanova, 2006).

P. Pirog in his works analyzes the peculiarities of the economic situation of students, shows the standard of living of students of different social strata, analyzes the issues of social origin of students, their financial situation, everyday life and political sentiments. The evolution of the student environment over a long period is analyzed (Pyroh, 2009; Pyroh, 2010).

S. Posokhov analyzes the quantitative and qualitative changes in the development of university education in Ukraine. The author shows the growth in the number of students, changes in their social composition, and the expansion of the geography of student recruitment. The mechanisms of state control over universities and social policy towards students are considered (Posokhov, 2008; Posokhov, 2009).

Posokhova L. studies the students of provincial universities, which included Ukrainian universities. The author analyzes the peculiarities of the formation of student corporations, their differences from the capital's universities. The role of provincial students in the cultural life of the regions is also considered (Posokhova, 2009).

Contemporary Ukrainian historiography seeks to objectively cover the social structure of the student body, using a comprehensive approach to analyzing archival sources and statistical data.

4. Results

Kharkiv University is one of the oldest universities in Eastern Europe. It was founded in November 1804 on the initiative of the prominent educator V. Karazin, in accordance with the Charter of Tsar Alexander I. The grand opening of the university took place on January 29, 1805. The founding of Kharkiv University was the result of educational reforms of Alexander I and met the needs of the empire in training qualified personnel for the civil service. Karazin proposed to start with a university staff of 60 teachers and 200 “state-funded” students. He also managed to convince the nobility of the need to support the new educational institution.

The number of university students in the nineteenth century was constantly changing: in 1805 there were 57 of them (33 of them studied at the expense of the state, the rest at their own expense). Such a small number of students was explained by several factors: the novelty of the institution, the limited material capabilities of the population, and the lack of secondary education in the region. Already in 1810, the number of university students was 118; in the 1860s – about 450, in the 1880s – more than 1.5 thousand. These statistics demonstrate the rapid growth in the popularity of higher education and the expansion of the social base of the Imperial Kharkiv University.

The social composition of the Imperial Kharkiv University in the first half of the nineteenth century was as follows: nobility and officials (60-65 %); clergy (25-30 %); bourgeoisie and merchants (8-12 %); peasants (3 %). At the beginning of the nineteenth century, the majority of students were representatives of the nobility. According to university reports, nobles accounted for about 60-65 % of the total number of students. This was due to several factors:

1) The material capabilities of noble families to provide education;
2) The traditional orientation of the nobility toward public service, for which higher education was a must;
3) The existence of privileges for nobles when entering university, etc.

Among the student nobility, representatives of the petty and middle nobility predominated (about 75 %), for whom university education was a way of career growth and social affirmation. Large landowners rarely sent their sons to the Imperial Kharkiv University, preferring metropolitan educational institutions or home education.

A significant portion of the student body came from clergy families. According to statistics, representatives of the clergy accounted for 25-30 % of the total number of university students. This was explained by the traditionally high level of education of the clergy; the existence of theological seminaries that prepared young people for university; and the desire of some clergy for secular education and careers. An important factor was also economic motives, such as the opportunity to get a better-paid position.

Students from religious families often chose medical (40 %) and law (35 %) faculties, and less often philosophy (25%), reflecting the practical orientation of their educational interests.

With the development of trade and industry, the proportion of students from bourgeois and merchant families increased. In the first half of the nineteenth century, this category accounted for 8-12 % of the total number of students. People from these social groups had sufficient material resources to finance education; they understood its importance for future commercial activity and sought to improve their social status through education. Like representatives of the clergy, burghers and merchants mostly chose law and medical faculties for further practical activities.

The least represented group among the students of the Imperial Kharkiv University during this period were people from peasant families - less than 3% of the total number of students. Among the reasons for this phenomenon were the limited material resources of peasant families; lack of educational traditions in the peasant environment; restricted access to higher education, etc.

Let us now consider the social composition of the student body of the Imperial University of St. Volodymyr and compare the positions of the two universities in this regard. The university in Kyiv was founded in November 1833 by a decree of Emperor Nicholas I, who supported the proposal of Minister of Education S. Uvarov to establish a university on the basis of the Polish Kremenets Lyceum, which had been moved to Kyiv.

At the end of July 1834, the university was opened, and 62 students were admitted to its only faculty (the Faculty of Philosophy). The first students of the university studied at two departments of the Faculty of Philosophy: History and Philology and Physics and Mathematics.

The peculiarities of the social composition of the students of the Imperial University of St. Volodymyr should be considered in the context of Polish influence in the region. The foundation of the university in Kyiv had special circumstances that affected the social composition of the student body. The basis for the imperial decree was the submission of the Minister of Public Education S. Uvarov on the establishment of the Imperial University of St. Volodymyr on the basis of the Vilnius University and the Kremenets Lyceum, which were closed after the Polish uprising of 1830–1831.

This circumstance led to several important features. In particular, some students and teachers came from liquidated Polish educational institutions, which created a specific social and national structure of the university – in the first years of its existence, Polish students accounted for about 30-35 % of the total number.

The social composition of the student body of the Imperial University of St. Volodymyr in the first two decades had the following structure (Table 1).

Table 1. Social structure of the student body of the Imperial University of St. Volodymyr in the first half of the 19th century (Zhurnal..., 1834–1899; Obzor..., 1863; Obzor..., 1886; Otchet..., 1876; Otchet..., 1881)

Nobility, %. (65-70)			Clergy, %. (20-25)		The bourgeoisie and other classes, %. (8-12)		Peasantry, %.
Polish	Russian	Ukrainian	Orthodox	Catholic	Burghers	Merchants	
25-30	20-25	15-20	15-18	5-7	6-8	2-4	2

As for the confessional composition of the Imperial University of St. Volodymyr and its features, it directly reflected the religious diversity of the region. The vast majority of the university's students were Orthodox (60-65 %), mostly ethnic Ukrainians and Russians. Catholics (mainly Poles) accounted for 25-30% of all university students. Protestants from among the German colonists made up 5-8 %. Jews – 2-5 %, and then with certain restrictions.

Comparing the social composition of the student body of two Ukrainian universities in Kyiv and Kharkiv in the first half of the nineteenth century, we can note an approximate coincidence in the proportion of social groups represented (Table 2). Although there was some regional specificity that determined the social portrait of the universities, it was mostly determined by a number of common factors. These include the central government's policy of unification in education, social opportunities and preferences for higher education, etc.

Table 2. Social structure of the student body of the Imperial Kharkiv University and the Imperial University of St. Volodymyr in the first half of the 19th century (Zhurnal..., 1834–1899; Obzor..., 1863; Obzor..., 1886; Otchet..., 1876; Otchet..., 1881)

	Imperial Kharkiv University, %.	Imperial University of St. Vladimir, %.
Nobles	60-65	60-65
Clergy	25-30	20-25
The bourgeoisie and merchants	8-12	8-12
Peasantry	3	2

The second half of the nineteenth century saw a transformation in the social composition of the student body of both universities. The changes were caused by the government-initiated Great Reforms of 1860–1870. They significantly altered the social structure of the Russian Empire and, accordingly, the social composition of university students. Thus, the abolition of serfdom opened access to education for new social groups. In particular, the share of students from the peasantry increased significantly (Table 3).

Table 3. The share of students from peasant families at the Imperial Kharkiv University and the Imperial University of St. Volodymyr in the second half of the 19th century (Zhurnal..., 1834–1899; Obzor..., 1863; Obzor..., 1886; Otchet..., 1876; Otchet..., 1881)

	Imperial Kharkiv University, %.	Imperial St. Vladimir University, %.
1860	2,3	1,8
1870	8,7	7,2
1880	12,4	11,6
1890	18,9	16,3

The judicial reform of 1864 created a demand for university-educated lawyers, which increased the prestige of legal education among various social groups.

Similarly, the creation of zemstvo institutions in the context of the 1864 zemstvo reform required educated personnel, which also stimulated an increased interest in higher education among the local nobility and bourgeoisie.

These and other factors determined the peculiarities of the social portrait of students at the universities of Kyiv and Kharkiv in the late nineteenth century, which changed significantly. In particular, there was a steady decline in the number of people from the nobility among higher education students and an increase in the share of representatives of peasant families. At the same time, the representation of the clergy, bourgeoisie, and merchants is more or less stable (Table 4).

In order to objectively study the peculiarities of the social portrait of the students of the Imperial Kharkiv University and the Imperial University of St. Volodymyr in the period under consideration, it is advisable to consider it taking into account regional and ethnic characteristics. Each of the universities had its own specifics in terms of the regional and ethnic composition of the student body (Tables 5, 6).

Table 4. Social structure of the student body of the Imperial Kharkiv University and the Imperial University of St. Volodymyr in the late 19th century (Zhurnal..., 1834–1899; Obzor..., 1863; Obzor..., 1886; Otchet..., 1876; Otchet..., 1881)

	Imperial Kharkiv University, %.	Imperial St. Vladimir University, %.
Nobility and bureaucracy	45-48	47-50
Clergy	18-20	16-18
The bourgeoisie and merchants	22-25	20-23
Peasantry	18-19	16-17

Table 5. Regional characteristics of the student body of the Imperial Kharkiv University and the Imperial University of St. Volodymyr in the 19th century (Zhurnal, 1834–1899; Obzor..., 1863; Obzor..., 1886; Otchet..., 1876; Otchet..., 1881)

Imperial Kharkiv University, %.	Imperial St. Vladimir University, %.
Kharkiv governorate, 35-40	Kyiv governorate, 30-35
Poltava governorate, 15-18	Podillia governorate, 18-20
Chernihiv governorate, 12-15	Volyn governorate, 15-18
Kursk governorate, 8-10	Chernihiv governorate, 10-12
Voronezh governorate, 6-8	Poltava governorate, 8-10
Another governorate, 12-15	Another governorate, 10-12

Table 6. Ethnic composition of students of the Imperial Kharkiv University and the Imperial University of St. Volodymyr in the 19th century (Zhurnal..., 1834–1899; Obzor..., 1863; Obzor..., 1886; Otchet..., 1876; Otchet..., 1881)

	Imperial Kharkiv University, %.	Imperial St. Vladimir University, %.
Ukrainians	55-60	50-55
Russians	25-30	15-20
Jews	8-12	5-8
Poles	3-5	20-25
Other	2-3	2-3

As we can see, there is a correlation between the ethnic composition of students at both universities and their geographical features. This can be seen most clearly in the difference in the representation of students of Polish origin and, to some extent, Russian origin.

We can also observe certain correlations at the level of the financial situation of students of the Imperial Kharkiv University and the Imperial University of St. Volodymyr and its impact on the social portrait of students. In particular, students of both universities had different sources of funding for their education, which to some extent determined their social composition.

Among the main sources of funding for education was family support. For the most part, this source was typical for people from noble families, partly for the clergy, and minimally for other groups. In total, up to 65 % of the total number of students at both universities received family support for their studies.

Slightly less than a quarter of students received state scholarships that to some extent covered their tuition costs (Table 7).

Table 7. Scholarships for students of the Imperial Kharkiv University and the Imperial University of St. Volodymyr in the second half of the 19th century (Zhurnal..., 1834–1899; Obzor..., 1863; Obzor..., 1886; Otchet..., 1876; Otchet..., 1881)

	Imperial Kharkiv University, hon.	Imperial University of St. Vladimir, hon.
State scholarships	150	130
Special scholarships	60	60
Benefits for excellent students	100	90

The state actively used the system of scholarships to influence the social composition and attitudes of students. Appropriate criteria for granting scholarships were developed. They took into account the applicant's social background , political trustworthiness, and academic success. There was also a regional component to the scholarship award (preference was given to local applicants). Thus, financial support from the state took into account various aspects of a student's life. And in part, academic success was not the only criterion for granting it.

About half of the students at both universities were actively engaged in tutoring, which was the most common way to earn money. However, depending on social background, tutoring took on different forms and content. In wealthy families, tutoring was primarily done by students from noble families. Those from clergy families were engaged in preparing for admission to seminaries. And peasant students taught elementary literacy and numeracy to children of the lower classes of the population, such as bourgeois and peasants.

Charitable assistance made up a certain part of the material support for students. It was expressed in the form of patronage, church and zemstvo support for gifted students, etc. Material differences created the internal social structure of the university environment. This to a certain extent determined their lifestyle and attitude to learning. The children of large landowners, government officials, and wealthy merchants constituted the so-called “golden youth”, who accounted for approximately 10 % of the total number of students at both universities. They led luxurious lifestyles, enjoyed influential family ties, but at the same time showed minimal interest in learning.

Representatives of the petty nobility, clergy, and middle-class merchants made up the so-called “middle class” of students, whose number varied between 50-60 %. This group of students was characterized by a more serious attitude to their studies and a focus on a professional career.

One third of the students were poor students. These were people from poor families who were active in political movements and wanted radical changes in society.

The social composition of students significantly influenced the nature of academic life, including the level of academic performance (Table 8).

Table 8. Academic performance of students of the Imperial Kharkiv University and the Imperial University of St. Volodymyr in the late 19th century (Zhurnal..., 1834–1899; Obzor..., 1863; Obzor..., 1886; Otchet..., 1876; Otchet..., 1881)

	Imperial Kharkiv University, grade point average	Imperial St. Vladimir University, grade point average
Nobility	3,2	3,1
Clergy	3,8	3,7
The bourgeoisie	3,6	3,5
Peasantry	3,9	3,8

It is worth noting that the government actively intervened in the processes of shaping the social composition of students through a system of legislative and administrative measures. In particular, the University Statute of 1835 established the preferential right of admission to universities for nobles, limited this opportunity for people from the taxed classes, prohibited education for serfs without the permission of the landlord, etc.

The University Statute of 1863 somewhat liberalized access to university education. It abolished direct class restrictions, introduced uniform requirements for educational attainment, and declared equal opportunities for education for all segments of the population.

5. Conclusion

The study of the social portrait of students of Ukrainian universities of the nineteenth century allows us to draw a number of conclusions about the peculiarities of the formation of the educated elite of the region and the mechanisms of social mobility in the Russian Empire.

The social structure of the student body of Kharkiv and Kyiv Imperial Universities during the nineteenth century demonstrates the evolution from a closed class system to a more democratic system of higher education. The first half of the century was dominated by representatives of the privileged classes – the nobility (60-65 %) and the clergy (20-30 %), reflecting the class nature of Russian society and the limited access to education for the lower classes.

The second half of the nineteenth century was characterized by significant changes in the social composition of students under the influence of the Great Reforms of the 1860s and 1870s. The abolition of serfdom and the liberalization of educational policy led to an increase in the share of students from peasant families from 2-3 % to 16-19 % by the end of the century, which indicates the expansion of the social base of higher education.

A comparative analysis of the two universities reveals both common patterns and regional specifics. Common features include the similarity of the social structure of the student body, mechanisms for financing education, and criteria for academic success. The regional specificity is most evident in the ethnic composition: the significant Polish presence at Kyiv University (20-25 % vs. 3-5 % at Kharkiv University) reflected the peculiarities of the region's historical development and the consequences of the Polish uprisings.

University education was an important channel of social mobility, especially for members of the clergy and petty nobility. The system of state scholarships and benefits allowed talented representatives of the lower classes to obtain higher education, although this process was regulated by the state through the criteria of “political trustworthiness” and class origin.

The state educational policy significantly influenced the formation of the social composition of the student body through a system of legislative and administrative measures. The university statutes of 1835 and 1863 demonstrate the evolution from strict class restrictions to relative liberalization of access to higher education, although the system never became fully democratic.

The study reveals an internal social differentiation of students: “golden youth” (10 %), “middle class” (50-60 %), and poor students (30 %). This stratification influenced the lifestyles, attitudes toward learning, and political attitudes of different groups of students.

Statistical analysis shows a correlation between social background and academic achievement. Students from peasant (3.8-3.9 points) and clerical (3.7-3.8 points) families demonstrated the highest academic performance, which is explained by their greater motivation and serious attitude to learning as a means of social advancement.

The formation of the social portrait of students at Ukrainian universities in the nineteenth century reflects the general processes of modernization of society at that time and the formation of a new social structure. Universities were not only centers of education, but also important institutions of social integration that contributed to the formation of the general imperial elite while preserving regional characteristics.

The study confirms that the social composition of the student body of Ukrainian universities in the nineteenth century was the product of a complex interaction of state policy, socio-economic processes, and regional characteristics, which together determined the specifics of the formation of the region's educated elite and the mechanisms of social mobility in a class society.

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