

Multimedia Technologies as Tools for Fostering Digital Literacy in Education

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Abstract. This study explores the integration of multimedia technologies into the educational landscape of physical education in Ukraine, considering various forms of education such as face-to-face, mixed, and distance learning, especially under martial law.

The purpose of the study is to reveal the attitude of physical education teachers towards the use of MT during physical education, to determine the level of digital literacy of physical education specialists and to outline the ways to improve it.

Methodology involves analysis and synthesis of literary sources, surveys conducted among physical education teachers using Google Forms, mathematical data processing, and a pedagogical experiment. Survey results underscore the necessity of integrating multimedia technologies into physical education, with most teachers acknowledging their positive impact on teaching quality but expressing a need for enhanced digital skills. The observed digital literacy level aligns with the basic standard, prompting the development of a program utilizing multimedia technologies to shape the digital literacy of physical education teachers.

Digital literacy evaluation employs the Digital Competence Framework for Citizens rooted in UNESCO documents, categorizing competence levels as basic, independent, and professional. The resultant program for nurturing digital literacy among physical education teachers comprises theoretical-organizational, operational, methodical, and assessment components. Experimental testing confirms the program's efficacy, revealing an improvement in digital literacy from basic to independent user levels and, in some cases, professional competence.

In conclusion, this research highlights the positive impact of the program on enhancing the knowledge, skills, and professional aptitude of physical education teachers, poised to improve the effectiveness of physical education in Ukraine and address contemporary educational challenges. Furthermore, the program serves as a foundational framework for advancing multimedia support in the field.

Keywords: *digital literacy, multimedia technologies, physical education.*

I. INTRODUCTION

Multimedia technologies (MT) in education are one of the promising directions in informatization of educational process. They integrate powerful educational resources that are able to support an educational environment for the formation and development of key competencies, which primarily include information and communication ones.

MT are a system of complex interaction of visual and audio effects under the guidance of interactive software using modern digital technical and software tools. They combine text, sound, graphics, photos, videos, etc. into a single digital representation.

The application of MT in educational process has a number of advantages, namely visualisation and formation of higher interest in learning. Lessons using MT allow you to visually demonstrate the capabilities of software and save time by intensifying the study of

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educational material, as well as to strengthen the motivation of students and boost their cognitive activity through interactivity.

Ukrainian and foreign scientists have paid considerable attention in their scientific research to the problems of using MT, digital applications, and multimedia programmes in educational process lately. Scientists considered the conditions for the formation of digital literacy of a teacher in postgraduate studies [1], created an ICT model of a teacher [2], made methodological guidelines for information and communication competence of students [3] and searched for ways of their implementation [4], researched the framework of digital competences of teachers [6], [7], [8], the formation of digital competence in education [9], [10], [11], [12], the development of a valid toolkit for measuring the informational and communicative competence of primary school teachers [13], considered the structure of digital competences [14], as well as the relationship between a role model process and digital literacy of physical education teachers [15]. Despite such significant interest of Ukrainian and foreign scientists in the problem of using MT and digital applications in educational process, we believe that the issue of using various multimedia technologies, programmes and applications in physical education is not covered enough. A number of contradictions have arisen that require an urgent solution. These include contradictions between today's requirements for application of MT and devices into the practice of physical education and the digital literacy of modern teachers; between the need to introduce digital literacy during professional development courses and the desire of teachers themselves to increase their own level of mastery of MT; between the digitalization of Ukrainian society and the material and technical provision of physical education in secondary education institutions, which have enabled to formulate the purpose of this study.

The purpose of the study is to reveal the attitude of physical education teachers towards the use of MT during physical education, to determine the level of digital literacy of physical education specialists and to outline the ways to improve it.

II. MATERIALS AND METHODS

The research was conducted during 2022-2023. The level of digital literacy of physical education teachers was studied and the effectiveness of the application of the special course on the formation of digital literacy within retraining programme was experimentally verified.

The following methods of scientific research were applied: analysis and generalization of literary sources, surveys of physical education teachers, a pedagogical experiment and methods of mathematical processing of research results. The analysis and generalization of literary sources made it possible to reveal the arsenal of multimedia technologies used in education. The surveys of 248 physical education teachers revealed the peculiarities of the use of MT in educational process of physical education, the advantages and difficulties of their application in this domain were highlighted. The

pedagogical experiment included ascertaining and formative parts. During the ascertaining part, on the basis of entrance testing, the levels of digital literacy of teachers were determined in accordance with the European Digital Competence Framework (DigComp 2.1) for teachers. The formative part was aimed at increasing the level of digital literacy of physical education teachers after applying the authorial programme methods. The experimental testing helped to monitor the digital literacy of teachers during the experiment using mathematical calculations and to determine the effectiveness of the authorial programme.

Fifty-one physical education teachers of secondary schools took part in the pedagogical experiment.

III. RESULTS AND DISCUSSION

Currently, the Ministry of Youth and Sports of Ukraine develops a separate digital direction. As a result sports startups have begun to be actively implemented, for example "RunAn" (a sports tracker that allows you to reduce injuries and increase the efficiency of running, due to the control of running technique); "Gymcerebrum" (AI platform with unique computer vision, which is to function in a fitness club as a virtual trainer); "TenniRobo" (an innovative table tennis robot that functions as a professional coach controlled by a mobile application); "12Climb" (an interactive climbing wall with thousands of tracks controlled by a smartphone, as well as an application with the ability to track your training); "Real Talk Sport" (CRM web-system for administration of martial arts competitions and activities of sports federations); "Unior F" (sports platform for children, schools and scouts) [16].

Digital transformation in the field of physical education and sports in the world and in Ukraine in particular is implemented through a variety of software (mobile) applications that allow you to monitor the number of calories consumed, daily routine, training, calculate total physical activity during the day, thus creating the optimal content of training and activities taking into account the individual characteristics and needs of a specific person on the basis of the data obtained ("Runtastic", "Heart Graph", Google Fit, "Yoga Breathing Exercises", "HealthKit", "Yazio Calorie Counter", "MyFitnessPal", "Fatsecret, Dialife", "Fitbit", "RunKeeper", "Endomondo Sport Tracker", "Health", etc.).

Based on the Internet sources analysis, N. Grabyk and I. Grubar [17] found out that the most common multimedia resources used by physical education teachers during the lessons are:

- application programmes (MS Word, MS PowerPoint, MS Excel, web browsers, cloud technology tools);
- web servers for creating interactive tests, quizzes, discussions, surveys, educational games: LearningApps, StudyStack, EDpuzzle, Kahoot, Quizziz, Quizalize, Triventy, Plickers, Google Form, Mentimeter, ClassMarker, Master test;

– means of electronic synchronous (chats, messengers, video conferences) and asynchronous (e-mail, forums, educational groups in social networks) communication (Zoom, Google Meet, Google Classrooms, ClassDojo, Skype, Instagram, Facebook, Telegram, Viber and others);

– online learning platforms (Prometheus, Educational Era, “Na Urok”, “Osvitioria”, “Vseosvita”, LearningApps.org) that allows to get informal education, master modern trends and news, without spending excessive resources;

– software (mobile) applications intended for monitoring: daily activity (number of steps, speed, distance covered, etc.), heart rate, breathing, energy expenditure (Google Fit, Health, HealthKit, Nike Plus Running, MyFitnessPal, Samsung Health, Fitbit, RunKeeper, Endomondo Sport Tracker, Runtastic); physical condition (“Digifit i Cardio”, “Heart Graph”, “Google fit”, “Yoga Breathing Exercises”, “Breathe”, “BackExercises”); body water balance (Waterbalance, Watercheck, Water Drink Reminder, Water Your Body, Watermania, Hydro, WaterLogged); body weight, calorie content of foods, a balanced diet (Calorie table, Lifesum, Fatsecret, Myfitnesspal (Calorie Counter), Yazio Calorie Counter, Dialife, LoseIt, Eat Slower);

– video motion analysis systems and complex computer simulator complexes for tracking and capturing movements (Expert Vision Analysis, Motion Analysis Corp., Vicon, Oxford Metrics CODA, Charnwood Dynamics, BioVideo, Kinovea, Dartfish);

– web servers for creating multimedia posters (Thinglink, Glogster);

– web servers for creating memory cards, mind maps (Mindomo, Mindmeister, Spiderscribe);

– web platforms for creating animated videos, interactive infographics, presentations and video scribing (Powtoon.com, SparkolVideoScribe, PearDeck, Nearpod).

I. Vorotnikova notes that each of these levels is considered according to 5 aspects: understanding of MT in educational policy, curriculum and assessment, pedagogy, application of digital skills, organization and management, and professional training of teachers [1].

For the citizens of Ukraine European framework of digital competences is used as the basis for the formation of knowledge, abilities and skills in the use of MT in education. This tool is designed to improve digital literacy. This framework was adapted by Ukrainian experts and is based on the relevant The Digital Competence Framework for Citizens of the European Union (DigComp 2.1) and other recommendations on the formation of digital literacy from European and international institutions. The recommendations are adapted to the national, cultural, educational and economic characteristics of Ukraine (Table 1).

TABLE 1 CHARACTERISTICS OF DIGITAL LITERACY LEVELS CATEGORIES OF THE TEACHER

Category	Characteristics	Short description
Beginner (A1)	Awareness (knowledge acquisition level)	Understanding of basic concepts and terms related to multimedia and digital technologies. Ability to use simple programmes and applications. Ability to perform basic tasks on the Internet
Explorer (A2)	Exploration (knowledge acquisition level)	Ability to use various programmes and services. Ability to find and evaluate information on the Internet
Integrator (B1)	Integration (knowledge deepening level)	Ability to work with a huge amount of information. Ability to use specialized programmes and tools. Understanding the principles of Internet security
Expert (B2)	Expertise (knowledge deepening level)	Thorough understanding of digital technologies and their capabilities. Ability to solve complex tasks and problems using MT. Ability to analyze and critically evaluate information
Leader (C1)	Government and Management (knowledge creation level)	Ability to design and implement innovative solutions. Ability to promote digital transformation in education. Leadership in the digital environment
Innovator (C2)	Innovations (knowledge creation level)	Deep knowledge in specific areas of digital technologies. Ability to solve complex tasks and problems in education using multimedia and digital technologies. Ability to teach others

The survey of physical education teachers makes it possible to assert that the introduction of MT in physical education is essential. Most survey participants have positive attitude towards the use of MT: 30.0% of teachers have been using MT for the last three years; 34.6% of teachers use them systematically in a remote mode and occasionally in a face-to-face mode; 81.22% of the surveyed teachers note that MT allow students to immerse themselves more deeply in the educational material; 75.49% are convinced that MT increase the quality of the lesson; 45.6% of teachers indicate that they need training on improving digital skills. In addition, 47.6% note that professional development courses allow to increase your own level of digital literacy. That data became the basis for developing a special course for the formation of digital literacy within the retraining course programme, which comprises theoretical-organizational, operational, methodical, and a control block for assessing training effectiveness (Fig. 1).

Before the introduction of the retraining programme on the formation of digital literacy, we offered physical education teachers to evaluate their own level of MT proficiency.

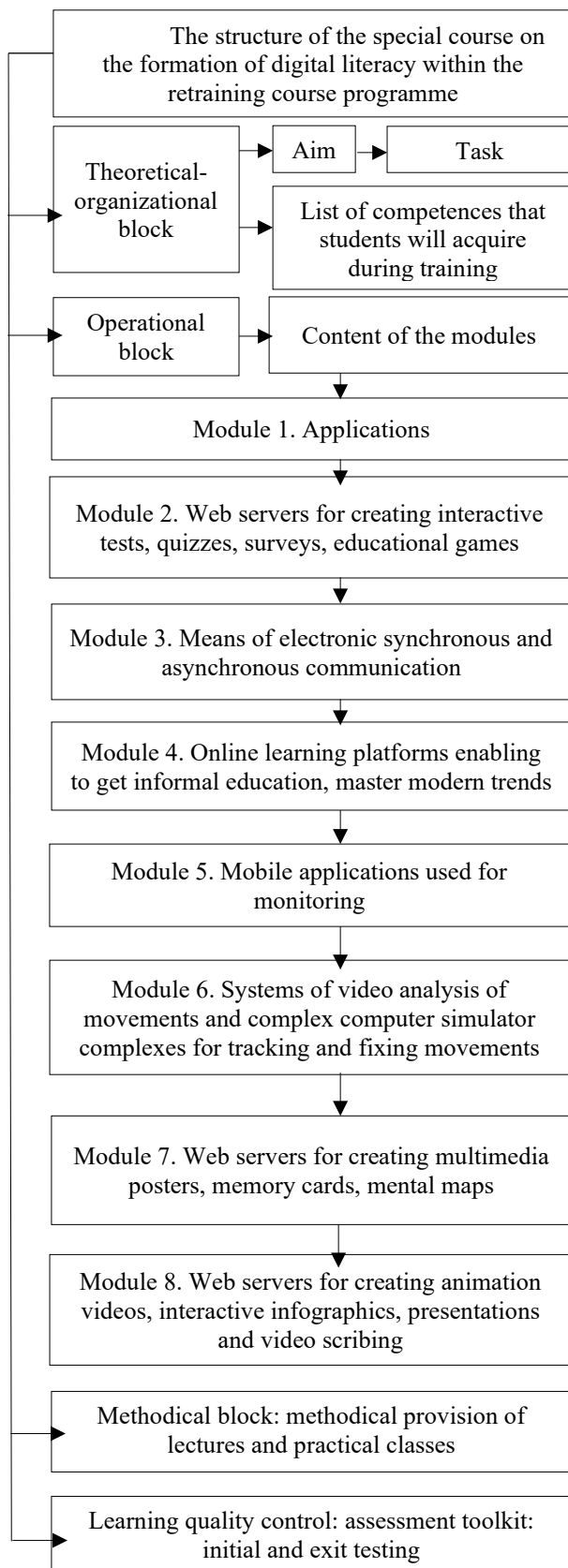


Fig. 1. Schematic representation of the special course within the retraining course programme.

It was established that before the start of the training courses, 20.5% of teachers believed that they knew no more than how to use digital applications during a physical education lesson. They realize that the use of MT

and devices during a physical education lesson can positively affect the improvement of pedagogical and professional practice. However, they do not have the practice of introducing multimedia devices in classes, and mainly use text editors to prepare the lesson, which help them to ensure organizational communications. To improve their own digital literacy skills, they need guidance and encouragement to expand their knowledge and skills and apply them in their own teaching experience. Such characteristics correspond to the first level of digital literacy “Beginner” (A1).

It was also found out that 26.9% of the teachers at the courses were not only aware of the potential of MT, but were also interested in studying digital applications to improve pedagogical and professional practice. They claimed that they sometimes used MT, devices and applications during physical education lessons, but with no systematic and consistent approach. They are convinced that they need motivation to master MT and encouragement, understanding and inspiration. To deepen digital literacy, they need the example of colleagues, involvement in the exchange of practical experience. Such characteristics indicate that 26.9% of physical education teachers defined their own level as “Explorer” (A2), which corresponds to the second level of digital literacy.

A slightly higher percentage (38.2%) of the teachers stated they were able to experiment with various MT to achieve different goals of physical education and introduce digital devices into their professional activities. They creatively use them for effective professional activity. They seek to increase the number of IT tools and their practical usage. However, they are still trying to determine which tools work best in different pedagogical situations, trying to generalize which MT contribute to the implementation of various pedagogical strategies and methods. However, they complain about the lack of time for experimentation. These characteristics indicate that almost every third participant of the courses considered his/her own level of digital literacy as “Integrator” (B1), because compared to others, they possess a level of in-depth knowledge and are able to search and experiment with the necessary digital information.

For 6.4% of physical education teachers claimed there is no difficulty to confidently use MT during various forms of physical education. They creatively and critically raise the level of their professional use by recording their own videos and placing them on the Internet. They purposefully select MT for specific situations, determine the advantages and disadvantages of various digital strategies. However, they are open to new ideas, knowing that they have not yet tried many things. They use experiments as a means of expanding, structuring and consolidating a list of their own pedagogical practice. Since all innovations, including digital applications, are the main driving force in the organization of the educational process for them, they are open to the introduction of innovative practices into their own pedagogical experience. These indicate that 6.4% of the course participants are believed to have digital

literacy at the fourth level of competence (“Expert” (B2)).

It was established that 5.2% of physical education teachers stated they mentor other teachers and willingly share knowledge and practical skills of using MT in the physical education of students with their colleagues. They have a consistent and integrated approach to the use of MT to increase the level of professionalism, and they are confident that they have a wide range of digital strategies from which they know how to choose the most suitable ones for a specific situation. They are constantly analyzing, synthesizing and implementing new digital practices, organizing the exchange of ideas with colleagues, constantly inform about new events, ideas, resources. They are convinced that they are a source of inspiration for those to whom they impart their knowledge. This characteristic corresponds to the fifth level of digital literacy (“Leader” (C1)).

A small percentage of teachers (2.8%) are said to question the adequacy of modern digital pedagogical practices and the possibility of their use during the physical education lesson, although they themselves are leaders. They are concerned about the limitations or shortcomings of these practices and are open to innovation to improve resources and tools. They note that they are in a systematic search for new digital applications, constantly experimenting with highly innovative and complex MT. They claim that a large number of colleagues take an example from them. This characteristic corresponds to the highest level of mastery of MT (“Innovator” (C2)).

The introduction of the special course within the retraining programme has contributed to improving the level of digital literacy of teachers, updating their skills and providing access to current IT tools in the educational process. After the introduction of the programme, each of the levels of digital literacy has undergone significant changes. In particular, the “Beginner” level got decreased by 18.1%, while the indicators of other levels of MT proficiency have improved significantly: “Explorer” - by 8.5%; “Integrator” - by 5.9%; “Expert” - by 4.1%; “Leader” - by 2.4%, which proves the effectiveness of our programme (Fig. 2).

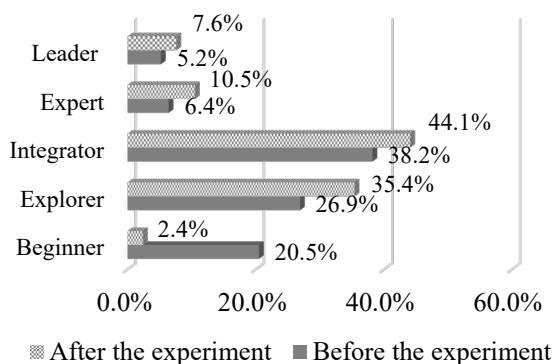


Fig. 2. Dynamics of changes in the digital literacy levels of physical education teachers during the experiment.

IV. CONCLUSIONS

The conducted research makes it possible to state that the problem of MT introduction in education is an important and urgent issue. The positive attitude of physical education teachers to the use of MT, programmes and digital applications in physical education was established. Respondents claim that over the past three years they have started to use MT more often in their own pedagogical practice (30.0% of teachers have been using MT over the past three years; 34.6% of teachers use it systematically in a remote mode and occasionally in a face-to-face mode of learning; 81.22% of the surveyed teachers note that MT allows students to immerse themselves more deeply in the educational material; 75.49% are convinced that MTs increase the quality of the lesson; 45.6% of teachers indicate that they need training on improving digital skills. In addition, 47.6% note that advanced training courses allow them to improve their own level of literacy. Our designed programme of the special retraining course on the formation of digital literacy significantly improved the level of mastery of MT, programmes and digital applications. All levels of the Digital Literacy Framework, except for the “Beginner” level, have increased. The “Beginner” level decreased by 18.1%. Other levels indicators improved as follows: “Explorer” by 8.5%, “Integrator” by 5.9%, “Expert” by 4.1%, and “Leader” by 2.4%, which proves the effectiveness of our program.

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