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ANALYSIS OF THE IMPLEMENTATION OF DIGITAL GAMES IN MULTIMEDIA EDUCATIONAL RESOURCES

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Abstract. *The paper analyses the implementation of digital games as important interactive components of learning in multimedia educational resources (courses, complexes, etc.). It is noted that the implementation of game elements contributes to increasing user motivation and engagement, and enhances the assimilation of educational material through active and personalised interaction. It is described that the integration of digital games into the educational space of multimedia resources is most often implemented through interactive software modules created by third-party online services, as well as through the multimedia resource's own educational game elements. The advantage of using proprietary game activities in the educational space of multimedia resources is noted. Examples of the application of competency-based and structural approaches are provided to justify the inclusion of digital games in the multimedia educational resources of various subject areas.*

Key words: *digital games, multimedia educational resources, interactive software modules, proprietary educational game elements, competency-based approach, structural approach.*

Introduction.

Digital games have become an important component of the modern educational process. The integration of digital games into education has become a successful strategy for both students and teachers [1]. The potential for using digital games for educational purposes is extremely high, as it allows for a combination of active learning, gamification, and a personalised approach, which contributes to the formation and development of users' professional and personal competencies. By presenting educational material in an engaging and interactive game format, educational games facilitate their assimilation, increase motivation, and enhance user involvement in the learning process [2 – 4]. Thanks to the use of digital games, the educational space becomes more attractive for users to engage in both professional training and self-study for self-development in a specific subject area or sphere of life.

Given the positive impact of digital games on the learning process, they should be included in multimedia educational resources (courses, complexes, environments, etc.) as important interactive components that support learning playfully.

Main text.

The development of digital educational technologies has led to the active incorporation and utilisation of gaming components in the design of modern multimedia educational resources. Today, digital games are utilised as interactive elements in educational platforms [5], electronic training courses [3, 6, 7], multimedia training complexes [8, 9, 10], and other resources.

Digital games can be incorporated into the structure of a multimedia educational resource as a separate game section or block, or they can be played directly on the pages of the multimedia resource after presenting specific fragments of the training material for immediate play in an engaging game format. The integration of digital games into the educational space of multimedia resources is most often implemented through [2]: interactive software modules created using online services; proprietary educational game elements of the multimedia resource.

Special platforms and online services, such as H5P, LearningApps, and WordWall, are often used to create interactive software modules (i.e., interactive content). Such online services provide the opportunity to create quizzes, crosswords, flashcards, anagrams, interactive matching exercises, etc. Such interactive modules can be used separately (by activating, for example, a specific hyperlink from the learning space of a multimedia educational resource) or embedded in the structure of a multimedia resource, if the environment in which it is developed allows for such integration. If it is possible to embed HTML code (such as in Adobe Captivate using the «Embed Code» in the «Web object» media block), an interactive module created using an external online service can be reproduced on the multimedia resource page as an embedded game activity.

It is worth noting that if points are awarded for completing interactive software modules integrated into the educational space, they will not be automatically added to the total points accumulated for completing all interactive tasks, simulations, and other activities implemented within the single educational space of the multimedia resource. To account for the points earned by the user upon completing the built-in game, it may be necessary to engage a programmer to ensure the integration of these points with the

points accumulated for completing all interactive tasks within the multimedia resource. These are additional financial costs that may lead to the conclusion that creating such a multimedia resource is unprofitable.

This issue is resolved if digital games are implemented as proprietary educational game elements within the structure of a multimedia educational resource. Their creation, configuration of properties and actions take place directly within the multimedia resource using the tools of the environment in which this resource is created. Thus, the points earned by the user for correctly completing educational games will be added to the points earned for completing all interactive tasks, exercises, tests, and actions in simulations, etc., of the multimedia resource. Thus, if, after the user has mastered the educational material of a particular multimedia course, a certificate with accumulated points is to be issued, the points received for correctly completing digital games will also be included in the total score for the course.

However, it should be noted that in any case, whether interactive software modules are used or educational games are created using software in which the multimedia resource is developed, game-based learning provides a more thorough understanding of the educational material and a better degree of its assimilation due to the support of a high level of interaction with the user. Based on the experience gained during interactive play with educational material, individual user experience is formed because «the user performs these actions independently, reflects on and analyses their results, and strives to do better» [2, p. 60].

Within the framework of this study, in the process of analysing the state of implementation of digital games in the space of multimedia educational resources, attention was explicitly focused on the game activities created in the structure of such resources and implemented as their proprietary elements (as a separate section/block or as games placed according to the logic of the presentation of educational material directly on the pages) within a single educational space of a multimedia resource.

In the process of justifying the feasibility of incorporating digital games into the structure of specific multimedia resources, competence-based and structural approaches were most frequently employed. Let us consider this issue in more detail.

The approach proposed by the author of the work [11] to forming a conceptual basis for creating a multimedia complex of the educational space of dual education for educational programmes in the speciality «Publishing and Printing» made it possible to determine the requirements for the structure and composition of the multimedia complex, as well as to identify four categories of knowledge for forming the content of the complex. The author analysed the relationship between didactic tasks and categories of knowledge. For each category of knowledge, multimedia didactic interactive tools were proposed, «which make it possible to fully transfer knowledge in the subject area and form one or more competencies» [11, p. 108]. The tool «Simulation game (T07)» was assigned to two categories: «Unformalized knowledge about the activity and its results» and «Weakly formalised knowledge, normative (operational) knowledge», which it is able to implement most effectively when forming the user's competence component. The author of the work demonstrated an example of the implementation of a multimedia training complex as part of a personal training system in the LMS Moodle environment for the discipline «Multimedia Publishing».

When developing a course to teach users digital literacy and responsible behaviour on the Internet, the authors [7] thoroughly examined the issue of course design with the implementation of digital games in lessons. When describing the lessons, the authors defined the learning objectives and a list of learning activities. The list included digital games such as «Matching real-life scenarios and netiquette rules»; «Be an «online socialite» when chatting with people of different identities»; «An alien called QI learns about Earth». The proposed learning activities aimed to achieve learning objectives and develop competent digital citizens in terms of responsible behaviour on the Internet. The authors note that learning based on digital games contributed to increased literacy, motivation and user engagement.

The section of the monograph [12] focuses on analysing the feasibility of including various structural elements, including educational games, in the structure of the multimedia educational publication «Colour Theory». Within the framework of the proposed methodology, it is possible to determine the most suitable structural elements for a multimedia publication through a component that encompasses 10 key

competencies. The analysis of structural elements through the prism of the competency component enabled the identification of the most important structural elements for implementation, which include educational games (as components of the interactive element E3). The work substantiates the feasibility of implementing a series of interactive educational mini-games as part of the multimedia educational publication «Colour Theory», including the following: a thematic puzzle in the form of a colour wheel, with time limits and control over the correctness of the puzzle assembly; an interactive mini-game for matching colours and geometric shapes; an interactive mini-game for placing coloured rectangles on a musical stave in the correct relation to the notes.

When analysing potential structural elements suitable for use in graphic design training, «mini-games for relaxation» were included among these elements [10]. The results of the calculations presented in this work confirmed the importance of implementing mini-games as an element of a relaxation space that also has a clear educational focus. The implementation of this mini-game in the multimedia educational publication «Graphic Design» allowed users to express their creative talent, making them feel like designers while creating graphic illustrations using the built-in graphic editor. The mini-game allows users to simulate the process of drawing on paper with familiar tools. Users have access to brushes and geometric primitives, and they can save the graphic illustrations they create. The logic of access to the mini-game, as conceived by the authors of the multimedia educational publication, is that it is a kind of bonus that is visualised after the user has worked through the material in the first chapter of the electronic textbook. However, if the user has not worked through the material in this chapter and has not passed the test at the end of the chapter, the mini-game will not be available.

The study [13] proposes a methodology for creating a multimedia complex on the subject of «Informatics» for teaching schoolchildren with hearing impairments. The implementation of the methodology's stages enables the determination of the most appropriate structural elements for this multimedia complex. The authors formed a criteria-based framework for evaluating the elements of the multimedia complex and

justified the expediency of selecting elements for inclusion in the complex's structure. As a result of the evaluation, the element «Educational games (R7)» (weighted score = 0.13) was identified as appropriate for reproduction as part of the multimedia complex.

In scientific work [14], the authors propose a methodology that is also aimed at identifying the most appropriate structural elements for creating a multimedia self-teacher for teaching primary school children to play the piano (beginner level). The methodology includes three stages, the implementation of which allows: 1) to determine the criteria based on the functions that the multimedia self-study guide should perform; 2) to determine the priority level of the criteria; 3) to select the most significant structural elements according to the identified criteria and their weight. As a result, the structural elements «educational mini-games» (weight coefficient = 0.16) and the game relaxation space «minute of rest» (weight coefficient = 0.11) were identified as important structural elements for implementation in a multimedia self-study guide for piano playing.

The authors of [6] note that the «Game» element was incorporated into the structure of the multimedia training course «Caring for succulents», designed for user self-development in plant care. The «Game» element was practically recreated as a dialogue game called «Correspondence with a friend». The interactive game was developed as part of a multimedia course created using Adobe Captivate, providing users with the opportunity to receive advice on the proper care of succulents.

Thus, based on the implementation of competency-based and structural approaches in the aforementioned works, the feasibility of incorporating digital games into the structure of various multimedia educational resources was confirmed.

Conclusion.

The analysis reveals that digital games are a vital and effective interactive tool for modern multimedia educational resources. The use of digital games contributes to increased motivation, user engagement, a deeper understanding of the learning material, and the development of personal and professional competencies.

The study identified two main approaches to implementing gaming activities in

multimedia resources: the integration of interactive software modules created using online services, and the development of proprietary educational games within the environment used to create multimedia resources (such as courses, complexes, etc.). Both options are effective in improving the quality of learning through game interaction.

An analysis of scientific works reveals that the use of digital games is suitable in various educational contexts – from developing digital literacy to learning graphic design, piano playing, and computer science, among others. The use of competency-based and structural approaches in designing the structure of multimedia educational resources allows to confirm that the implementation of game elements in these resources is important and appropriate for achieving goals (educational, personal, etc.). Thus, educational mini-games, simulation games, relaxation game spaces, and interactive dialogue scenarios, among others, not only increase interest in learning but also ensure the individualisation and practical orientation of the educational process.

Thus, digital games should be considered a scientifically based, important elements of multimedia educational resources. Their implementation contributes to the creation of a dynamic, adaptive, and motivating educational space within a multimedia resource that supports active and effective learning by users.

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Анотація. *В роботі наведено аналіз стану впровадження цифрових ігор, як важливих інтерактивних складників навчання, у мультимедійні освітні ресурси (курси, комплекси тощо). Зазначено, що реалізація ігрових елементів сприяє підвищенню мотивації та залученості користувачів, посилює засвоєння навчального матеріалу через активну та персоналізовану взаємодію. Описано, що інтеграція цифрових ігор до освітнього простору мультимедійних ресурсів реалізується, найчастіше, через інтерактивні програмні модулі, створені сторонніми онлайн-сервісами, та за рахунок власних навчальних ігрових елементів мультимедійного ресурсу. Зауважено про перевагу застосування власних ігрових активностей в освітньому просторі мультимедійних ресурсів. Наведено приклади застосування компетентнісного і структурного підходів для обґрунтування доцільності включення цифрових ігор в структуру мультимедійних освітніх ресурсів різного предметного спрямування.*

Ключові слова: *цифрові ігри, мультимедійні освітні ресурси, інтерактивні програмні модулі, власні навчальні ігрові елементи, компетентнісний підхід, структурний підхід.*

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