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NON-FORMAL EDUCATION AS A FORM OF SUPPORTING THE DEVELOPMENT OF PROGRAMMING SKILLS IN PRIMARY SCHOOL STUDENTS

ABSTRACT

The article focuses on the impact of technological progress and the growing significance of information and communication technologies (ICT) on various aspects of human life, particularly in the field of education for primary school students. It emphasizes the need to adapt educational models to these changes, with a focus on developing programming skills among primary school students. The article discusses the role of non-formal education, especially in programming, highlighting its flexibility, individualization, and emphasis on practical skills.

Objective: The main goal of the article is to analyze the role of non-formal education in the context of teaching programming to primary school students in non-formal educational settings, considering current technological developments and the need for adaptation in educational approaches.

Methods: The text employs descriptive and analytical approaches, examining the characteristics and benefits of non-formal education in programming. The author utilizes theoretical and practical examples to illustrate the issues of non-formal education and the development of programming skills among primary school students.

Results: The conclusions highlight the advantages of non-formal education in teaching programming to primary school students, such as flexibility, individualization, and emphasis on practical skill development. The article emphasizes that through various forms of non-formal education, such as workshops, e-learning courses, webinars, and experiences in virtual reality, there is an opportunity to teach programming to primary school students in engaging and interactive ways.

Discussion: The article underscores the promising future of non-formal education in programming for primary school students, driven by technological advancements and growing interest in non-traditional educational approaches. It discusses potential tools, platforms, and methodologies that can improve programming education in non-formal settings, leading to greater accessibility and effectiveness.

KEYWORDS: *non-formal education, programming skills, primary school students, virtual reality, future perspectives*

INTRODUCTION

Technological progress and the increasing significance of information and communication technologies (ICT) have had a significant impact on all aspects of human life (Nowak, 2017, p. 82). Currently, the ubiquity of technology is an integral part of everyone's life. Based on these evolutions, significant changes are taking place in the scope of the education model, whose main task is to educate citizens who will be able to find employment and fulfill their roles in society (Stalończyk, 2014, pp. 320-324).

The current education model not only needs to be flexible and properly constructed to fulfill the programmatic assumptions but should also have tools for early educational intervention. Such tools should provide the opportunity to use additional forms of education so that students can supplement and develop their knowledge and skills (Warchoń, 2022, pp. 220-221).

It must be stated that with such rapid development of ICT, the future of education for primary school students lies in programming skills. These needs are taken into account by the current basic curriculum for primary schools (Morańska, 2018, pp. 40-41). Unfortunately, it is overloaded with content, and in the educational process, it is difficult to find enough time to develop programming skills among primary school students. Therefore, it is necessary to use other forms of education, which can be considered as tools for early school intervention in terms of content that cannot be covered during traditional lessons.

The current educational model assumes that education should be supported by non-school forms of education, such as non-formal and informal education (Sławiński, Dębowski, Michałowicz, Urbanik, 2014; Stęchły, 2021, p. 8).

In the case of purposeful organization of classes with a specific program, methods, and forms of education, special attention should be paid to non-formal education. Its theoretical assumptions, organizational and legal foundations, and forms of education are an ideal solution for enhancing students' skills in various areas. Based on this, it can be assumed that non-formal education becomes an ideal environment for supporting the learning of programming by primary school students (Warchoń, 2021, pp. 154-155).

THE CONTEXT OF NON-FORMAL EDUCATION IN PROGRAMMING

Non-formal education is a form of learning that involves consciously engaging in experiences, exercises that lead to intellectual and emotional activation, and the emergence of new behaviors, actions. It is a form of education organized outside of formal education programs, the process of which leads to obtaining registered qualifications (Rettinger, 2021, p. 223).

This type of education often takes place outside the school walls in various institutions or is carried out by private educational units that educate in a strictly defined direction. Non-formal education is carried out using modern teaching and learning methods, organizational forms that focus primarily on cooperation and action by participants. It should be added that non-formal education is associated with maximizing the use of modern technologies and teaching aids (Szłęk, 2013).

The development of programming skills for primary school students in non-formal education brings significant benefits. Given that the assumptions of non-formal education aim to maximize flexibility and individualization, it provides an ideal environment for learning programming. Students participating in non-formal activities can adjust their pace to individual needs and interests. In such activities, students undertake exercises with a set goal, but it can be achieved not only by solving what the instructor presented. Students learn to achieve goals through their own actions, such as defining their own path, building a mechanical structure to meet specific goals. Each action leads to achieving the goal but can be carried out according to the student's individual predispositions. In this way, non-formal education allows adapting the process of learning programming to the individual needs and interests of students. It also provides the opportunity to learn at their own pace tailored to the student's abilities and level of advancement (Pajk, Van Isacker, Aberšek, Flogie, 2021).

Non-formal education bases its process on the innovation and experimentation of students. Within such classes, often through very well-equipped workshops, students use the latest programmable kits (Lohnes, 2022, p. 23). They can use them to conduct their own experiments. With basic knowledge of programming individually or in groups, they come up with different

problem-solving solutions, thus learning cooperation and innovation (Mopara, Sanrattana, 2023, pp. 96-97). This organization allows students to experiment with the latest technologies and programming tools. In this way, students become more open to innovation and new possibilities in the technological world (Gorzeńska, Radanowicz, 2019).

A characteristic feature of non-formal education in the context of teaching programming is also the diversification of teaching methods and the development of purely practical skills (Raczykowska, 2019, p. 67). In the first case, the use of various methods can support various learning styles of students. In this aspect, non-formal education in teaching programming can be more effective. This allows for faster assimilation of topics, and consequently, higher effectiveness of classes. A significant value of non-formal education in the field of programming for students is also the fundamental assumption of developing practical skills, which are absolutely necessary in the programming area (Kuźmińska-Solśnia, 2018, p. 125). During non-formal education classes, knowledge is conveyed through practical actions, solutions that students quickly memorize and practice.

Traditional formal education is focused on developing specific languages indicated by the curriculum and teaching program. In non-formal education, the student can enroll in programming classes in a language that is important to them. This is undoubtedly a huge advantage in terms of developing students' cognitive interests.

Non-formal education focused on learning programming can also lead to the formation of strong social bonds between participants (Rettinger, 2021, p.225). This results from the fact that people with similar interests participate in such classes, which facilitates building relationships and interpersonal contacts.

Another important aspect of non-formal education in teaching programming is responsiveness to technological changes. Non-formal education, being organized by external institutions, can quickly respond to changes in the world. Mainly, it concerns modern equipment, which can be flexibly adjusted in non-formal education because external institutions have more financial resources than traditional formal education. This results in students being educated in non-formal education using the latest devices (Ostrowska, Poziomek, Studzińska, 2015, p. 23).

Non-formal education is a great way to support traditional education; however, it is important to remember that its implementation is not easy, as it often involves additional financial costs, usually borne by parents, which means not all students can benefit from it. Additionally, it should be noted that financial resources are not the only obstacle, as the most important factor is students' internal motivation, without which the process will not yield results (Warchoł, 2021).

Due to the presented advantages in the context of programming education, non-formal education seems to be an ideal support for expanding students' horizons in the field of programming.

FORMS OF NON-FORMAL EDUCATION SUPPORTING THE DEVELOPMENT OF PROGRAMMING SKILLS

Among the main characteristics of non-formal education are various forms of learning that are not as popular as in formal education. It is precisely through this aspect that non-formal education brings significant effects in teaching programming among primary school students.

The general definition of organizational forms indicates how to organize work according to who, where, when, and for what purpose education is to be the subject (Kupisiewicz, 200, p. 157). Organizational forms clearly define the conditions for conducting the educational process, and their proper application is a guarantee of the success of the educational process. Proper organization of the educational process through the selection of an appropriate form provides an opportunity for full personal development and the proper acquisition of skills (Wiśniewska, 2017, p. 149).

Currently, one of the most popular forms of organization in non-formal education in the context of teaching programming is workshops. Education in this form is described as interactive and practical. Didactic activities focus on the practical application of knowledge through the implementation of specific tasks, projects (Kim, Gibbons, Speed, Macaulay, 2013, pp. 644-652). In this form, students are engaged in problem-solving and creating specific products. The main focus in this form is on interaction, which is intended to encourage discussion among students and dialogue with the instructor (Weenusk, 2023, pp. 1-8).

Workshops are an ideal way to teach programming to students. They allow for the development of all necessary competencies for further learning at a higher level of education. Additionally, workshops aim to simulate various scenarios reflecting real situations. This is essential in programming education, where accuracy, precision, and effectiveness count. Workshops prepared for non-formal education focus on the development of specific skills, thus allowing students to address their deficiencies. Due to their flexibility and adaptability, they can be tailored to the needs and level of advancement of the participants (Bayanova, Chichinina, Veraksa, Almazova, Dołgich, 2022).

Another form of non-formal education specifically designed for primary school students is e-learning courses. The organization of such classes involves students using their own equipment, usually at home, where they connect to a chosen e-learning platform to participate in a programming course. This organizational form differs significantly from the previous one, but it is increasingly being used. Within such classes, students typically have their own programmable kits, and the e-learning platform serves as a place for instruction, inspiration, and learning through available lectures and presentations (Tuczyński, 2021, Le, Tran, 2023). Additional support for this form comes in the form of synchronous connections with a trainer who appropriately motivates and encourages work (Keskin, Yurdugül, 2022, pp. 1-13). Such forms of non-formal education became popular with the onset of the Covid pandemic.

A form of non-formal education gaining popularity is webinars combined with discussion groups. Increasingly, primary school students learn programming through live meetings or by watching recordings of educational sessions, during which they gain knowledge and skills in programming without the need to be in a specific location. An important aspect of such webinars is integrated online and offline discussion groups that allow students to exchange experiences and ideas about a particular webinar. Within the group, they discuss their mistakes, problems, and share experiences (Mabuan, 2022).

Currently, due to very advanced technologies, non-formal education is increasingly moving into the area of virtual reality, where students also design, construct various models, and have the opportunity to program them. It seems that the assessment of activities in the field of virtual reality through artificial intelligence is also a matter of time.

PERSPECTIVES ON THE DEVELOPMENT OF NON-FORMAL EDUCATION IN PROGRAMMING

The rapid technological advancement is paving the way for promising developments in non-formal education, especially concerning the teaching of programming to primary school students.

Due to logarithmic technological progress, non-formal education will be equipped with the latest tools, platforms, and technologies supporting programming learning. This will significantly bolster formal education, making non-formal education sessions popular among students and a prevailing standard.

With the advancement of artificial intelligence, augmented reality, and machine learning, new opportunities will emerge for teaching programming and supporting various learning styles (Tapalova, Zhiyenbayeva, 2022). This will enable the creation of more advanced projects and the organization of significantly more complex experiences.

The development of e-learning will lead to non-formal education being primarily conducted through various platforms. This will spur the growth of e-learning and significantly impact remote education in the form of non-formal education, offering a plethora of programming courses for primary school students. Consequently, it will expand the range of programming languages taught (Bahçekapili, 2023, pp. 1-9).

With the development of such education, there will be a significant increase in interest from a business investment perspective. Private companies will increasingly organize sessions in this form due to their effectiveness, which will translate into popularity and financial gains.

Non-formal education will continue to seek new, more innovative and effective teaching methods. Currently, one intensively developing trend in teaching programming is the use of gamification methods, where students learn to program various computer games. As a result, they immediately verify the effects of their work through a graphical interface (Thuratham, 2022).

Of course, by utilizing the Internet and its capabilities, non-formal education will rely on online communication and create global-scale activities. This means that students will participate in various projects and events organized by institutions from different countries, leading to the expansion of students' knowledge and experiences.

CONCLUSION

The dynamic technological development and significant interest in non-formal education indicate broader prospects for the future in teaching programming using non-formal education. Anticipated changes include the introduction of newer tools and platforms that will further support programming learning. This will make non-formal education even more attractive to students and become the norm. Learning programming is becoming a fundamental skill for today's students due to the ongoing digitization of the economy, which requires future employees to possess skills in logical and analytical thinking. Additionally, the pervasive technology that surrounds us, which is based on programming, allows for a better understanding of how internet services work as well as how to operate electronic devices.

The evolving technology of artificial intelligence, augmented and virtual reality, will open new horizons for programming education. Students will have the opportunity to engage in more demanding projects and experiences.

The development of e-learning will bring changes to non-formal education in terms of the number of courses and innovative platforms, providing new learning opportunities in programming.

Non-formal education will evolve on a global scale, enabling students to participate in projects and events organized by institutions from various countries. This will lead to the expansion of students' knowledge and experiences and promote international cooperation. Non-formal education in programming for primary school students has a promising future.

The proposals for implementing non-formal education discussed in the article are only possible through widespread media education, which allows for the elimination of misinformation, the development of communication skills, and proper education regarding safety in the area of devices and information systems

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