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# METHODOLOGY OF USING DIGITAL LEARNING PLATFORMS IN INFORMATICS EDUCATION

**Abstract.** *This article examines the methodology of using digital learning platforms in Informatics education and their didactic capabilities in the educational process. The use of digital technologies in Informatics education makes it possible to connect students' theoretical knowledge with practical activities, organize independent learning, complete interactive tasks, and assess learning outcomes promptly. The study analyzes the main areas of using digital learning platforms, including the provision of electronic learning materials, organization of interactive tasks, automated assessment, communication and collaboration, as well as the development of practical skills through virtual laboratories. In addition, a methodological approach based on adapting digital platforms to different stages of the educational process in Informatics education is proposed. This approach contributes to increasing students' engagement during lessons, developing independent learning skills, and integrating theoretical knowledge with practical activities. The research results demonstrate that the purposeful and systematic use of digital learning platforms contributes to improving the effectiveness of Informatics education.*

***Keywords:*** *Informatics education, digital education, digital learning platforms, teaching methodology, innovative technologies, interactive learning, virtual laboratory, automated assessment, independent learning, digital competence.*

## INTRODUCTION

Today, the rapid development of digital technologies is creating new opportunities to improve the content, forms, and methods of organizing the educational process. The widespread use of computers, the Internet, multimedia tools, and various digital learning resources makes it possible to organize the learning process in a more flexible, interactive, and learner-centered manner. From this perspective, the digitalization of education is emerging as one of the important directions in the development of the modern education system. Informatics education is particularly important in this process. Informatics not only develops students' ability to use computers and software tools but also contributes to the formation of digital competencies such as searching for, selecting, analyzing, processing, and purposefully using information. In particular, when studying topics related to computer networks and Internet technologies, it is important to connect theoretical knowledge with practical activities, model network processes, and organize students' independent learning activities.

Under traditional teaching conditions, learning certain topics in Informatics based solely on theoretical explanations may not sufficiently develop students' practical skills. In particular, topics such as "Computer Networks and Their Use" are practical in nature and require activities such as connecting and configuring network devices, observing data exchange processes, and identifying network problems. In general education schools, where it may be difficult to provide all students with real network equipment simultaneously, the use of digital platforms and virtual laboratories can be considered an important methodological solution.

Digital learning platforms provide opportunities to present learning materials in electronic form, organize assignments, monitor students' activities, conduct interactive learning activities, and assess learning outcomes. The purposeful use of such tools not only increases students' engagement in lessons but also contributes to the development of independent learning skills and the ability to apply acquired knowledge in practical situations. In addition, electronic textbooks, multimedia materials, video lectures, and interactive presentations provide opportunities to obtain information in different formats and support students' independent learning activities.

The use of digital platforms in Informatics education should not be limited to selecting a single platform; rather, it should involve selecting an appropriate digital tool according to the learning objectives and stages of the lesson. For example, educational platforms such as Google Classroom or Moodle can be used to provide electronic learning materials, tools such as Quizizz and Kahoot can be used for formative assessment and rapid knowledge assessment, while virtual laboratory environments such as Cisco Packet Tracer can be used to organize practical activities related to computer networks. At the same time, existing approaches often consider the individual capabilities of digital tools separately. In Informatics education, however, it is important to integrate electronic learning materials, interactive tasks, virtual laboratories, assessment, and monitoring tools into a unified methodological sequence. Therefore, the development of a methodological approach based on the use of digital learning platforms according to the objectives, content, and stages of the educational process represents a relevant scientific and practical issue.

## LITERATURE REVIEW

The integration of digital technologies into the educational process has become one of the important directions in contemporary pedagogical research. The development of digital learning platforms has expanded their functions beyond the electronic presentation of learning materials to include the organization of interactive tasks, monitoring of students' activities, assessment of learning outcomes, provision of immediate feedback, and support for independent learning. Therefore, recent studies increasingly examine the effectiveness of digital technologies in education not only in terms of their technical capabilities but also in relation to how effectively they are integrated into pedagogical processes.

The use of gamification to increase students' engagement and motivation has been widely investigated in digital learning environments. A systematic review of 51 empirical studies found evidence of the positive effects of gamification on students' motivation and engagement; however, the authors also noted that empirical evidence supporting its long-term impact on learning outcomes remains insufficient (Dichev & Dicheva, 2017:1–21). This finding indicates that the use of digital platforms should not be limited to attracting students' attention; rather, the impact of digital tools on learning outcomes should also be methodologically justified.

Other studies examining the effectiveness of gamification in education have similarly emphasized that its positive effects depend largely on how game elements are incorporated into the instructional process. A systematic review of gamification research found that a considerable proportion of existing studies implemented gamification without a clearly defined pedagogical model. Consequently, the integration of game elements with learning objectives, learning activities, and assessment criteria was identified as an important requirement for effective implementation (Mora et al., 2017:82–95). This approach is also relevant to the use of interactive tools such as Quizizz, Kahoot, LearningApps, and Wordwall in Informatics education, where such tools should be employed not merely as entertaining activities but as instruments serving specific didactic purposes.

A systematic literature review of gamification in primary and secondary education analyzed 291 initially identified studies and examined 20 studies that met the established inclusion criteria in greater detail. The findings indicated that gamification can have positive effects on students' motivation, classroom participation, interaction, and, in some cases, learning outcomes. At the same time, the review emphasized the need for further empirical research to determine the long-term effectiveness of gamification in education (Vrcelj et al., 2023:13–27). This finding suggests that the effectiveness of digital platforms should be evaluated not only through students' classroom engagement but also through changes in their knowledge and practical skills.

Another important area of digital education is the use of virtual laboratories. A systematic literature review of virtual laboratories demonstrated that they provide learners with opportunities to conduct experiments independently, connect theoretical knowledge with practical activities, and model different processes in a safe digital environment. Previous studies have particularly emphasized the role of virtual laboratories in subjects that require practical activities, where they can support students' experimentation and problem-solving skills (Rosli & Ishak, 2024:81–103).

Studies examining the use of virtual laboratories in engineering education have also highlighted their importance in connecting theoretical knowledge with practical experience. Virtual environments can facilitate practical activities in situations where access to physical laboratory equipment is limited, allow students to repeat experiments, and provide a safe environment for experimentation. At the same time, the effectiveness of virtual laboratories depends on their alignment with learning objectives and their integration into the broader pedagogical process (Wahyudi et al., 2024:102–113).

In addition to their effectiveness, the technical and pedagogical limitations of virtual laboratories have also been investigated. Research has demonstrated that the development and implementation of virtual laboratories require consideration of usability, technical accessibility, students' digital readiness, and the diverse needs of users (Deriba et al., 2024:1–15). Therefore, the mere availability of a virtual laboratory does not automatically guarantee effective learning outcomes; it needs to be appropriately connected with theoretical materials, practical assignments, and assessment processes.

The literature reviewed demonstrates that various capabilities of digital learning technologies have been sufficiently investigated in separate research directions. While studies on gamification have primarily focused on motivation and student engagement, research on virtual laboratories has largely emphasized the integration of theoretical knowledge with practical activities (Dichev & Dicheva, 2017:1–21; Rosli & Ishak, 2024:81–103). However, the integration of these tools into a unified methodological system corresponding to different stages of Informatics lessons remains relatively underexplored.

Furthermore, a substantial proportion of existing studies has focused on evaluating the effectiveness of a particular digital tool, whereas the methodological integration of the sequence **digital content->interactive task-> virtual or practical laboratory->automated assessment->monitoring and feedback** has not been sufficiently generalized as a unified instructional model. In particular, there remains a need for methodological approaches that adapt digital platforms to different stages of Informatics education in general school settings while taking into account both the theoretical and practical dimensions of the subject.

## METHODS

The study employed an experimental design to investigate the effectiveness of digital learning platforms in Informatics education. The research was conducted among 29 ninth-grade students studying the “Using Networks” chapter. The students were divided into an experimental group of 14 students and a control group of 15 students.

At the initial stage, a diagnostic assessment was conducted to determine the students’ level of knowledge. During the intervention, the experimental group studied the topic using an integrated digital learning environment, while the control group followed the conventional instructional approach.

The digital learning environment combined several tools with different instructional functions. Google Classroom was used to provide learning materials, video resources, practical assignments, and homework, creating a structured digital environment for organizing students’ learning activities. As shown in Figure 1, the Google Classroom environment contained the learning materials and video lessons prepared for ninth-grade Informatics students.


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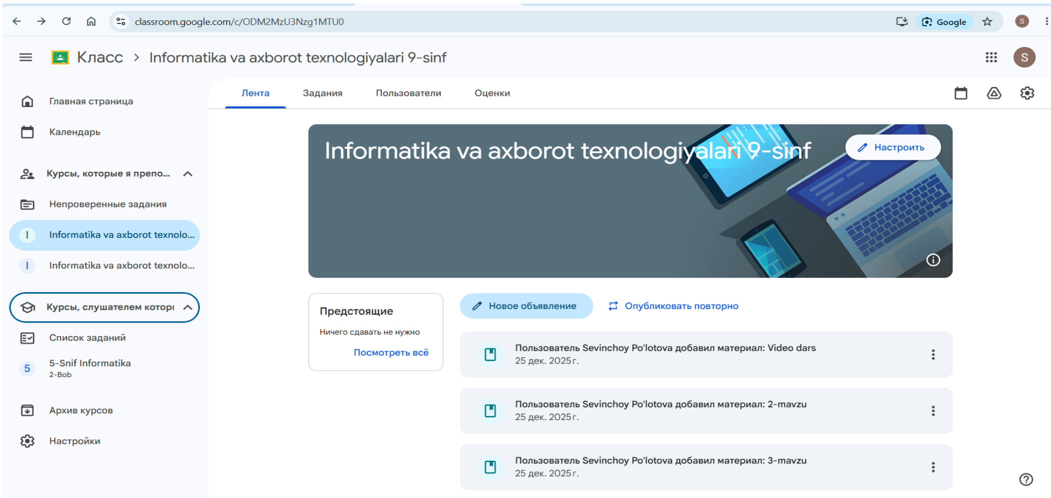


*Figure 1. Google Classroom environment for organizing digital learning materials and video lessons.*

Kahoot was used for interactive assessment, knowledge reinforcement, and formative feedback. Kahoot was particularly used to organize short interactive questions and review activities related to computer network concepts. Figure 2 presents an example of a Kahoot-based activity in which students respond to a question about the concept of a computer network.


*Figure 2. Kahoot-based interactive quiz for reinforcing students' knowledge of computer networks.*

The practical component was supported by Cisco Packet Tracer, which enabled students to apply theoretical knowledge through virtual network configuration and simulation activities. Students could construct a simple network topology, connect computers through a switch, and configure basic IP addressing in a simulated environment. Figure 3 illustrates an example of a practical network configuration created in Cisco

Packet Tracer.

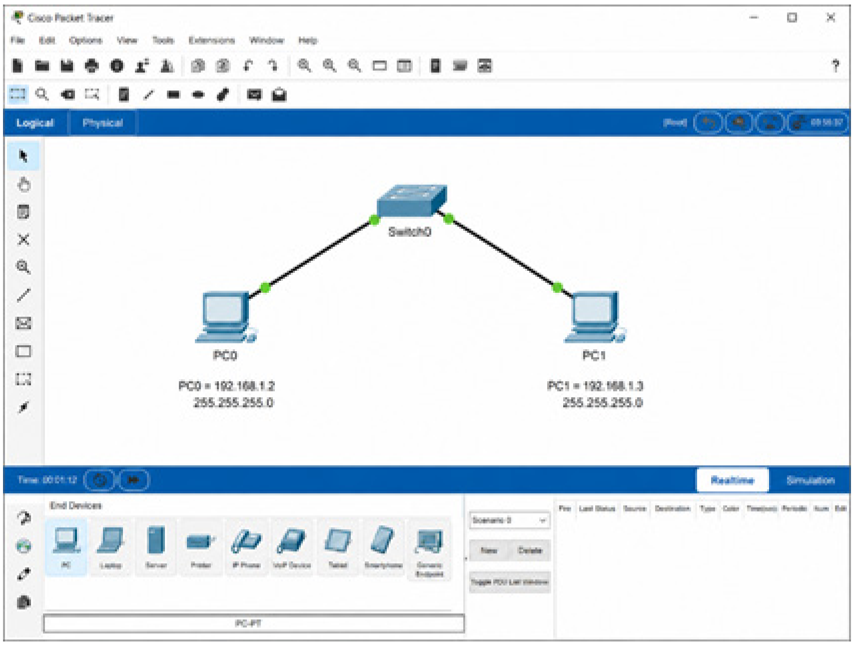


*Figure 3. Cisco Packet Tracer virtual environment for designing and configuring a computer network.*

The instructional process followed the sequence of **learning material-> interactive activity-> practical task-> assessment->feedback**. At the final stage, both groups completed a post-test, and their results were compared with the initial assessment results. The changes in students' achievement levels were analyzed to determine the effectiveness of the proposed digital learning methodology.

## RESULTS AND DISCUSSION

The The results of the experimental study demonstrated a positive change in students' learning achievement following the implementation of the integrated digital learning environment. The study involved 29 ninth-grade students, with 14 students in the experimental group and 15 students in the control group. The initial diagnostic assessment showed relatively similar achievement distributions in the two groups, providing a basis for comparing the results obtained after the instructional intervention.

Before the intervention, 14.3% of students in the experimental group demonstrated an unsatisfactory level, 50.0% a satisfactory level, 28.6% a good level, and 7.1% an excellent level. In the control group, the corresponding results were 13.3%, 46.7%, 26.7%, and 13.3%, respectively. Thus, both groups had comparable distributions of achievement at the beginning of the study, although the control group had a slightly higher proportion of students at the excellent level. After the instructional intervention, a considerable improvement was observed in the experimental group. The proportion of students at the unsatisfactory level decreased from 14.3% to 0%. The proportion of students at the satisfactory level decreased from 50.0% to 21.4%, while the proportion at the good level increased from 28.6% to 42.9%. The most substantial change was observed at the excellent level, which increased from 7.1% to 35.7%.

In comparison, the changes in the control group were more limited. The proportion of students at the unsatisfactory level decreased from 13.3% to 6.7%, while the satisfactory level remained almost unchanged at 46.7%. The proportion of students at the good level increased from 26.7% to 33.3%, whereas the excellent level remained unchanged at 13.3%.

***Table 1. Comparison of students' achievement before and after the intervention***

| Achievement level | Experimental group: Pre-test | Experimental group: Post-test | Control group: Pre-test | Control group: Post-test |
|---|---|---|---|---|
| Unsatisfactory | 14.3% | 0% | 13.3% | 6.7% |
| Satisfactory | 50.0% | 21.4% | 46.7% | 46.7% |
| Good | 28.6% | 42.9% | 26.7% | 33.3% |
| Excellent | 7.1% | 35.7% | 13.3% | 13.3% |

The results indicate that the digital learning methodology produced a stronger shift toward higher achievement levels than the conventional approach. In the experimental group, the combined proportion of students achieving good or excellent results increased from **35.7% to 78.6%**, representing a substantial improvement. In the control group, the corresponding proportion increased from **40.0% to 46.6%**. This difference suggests that the integrated use of digital learning resources had a stronger effect on the distribution of higher achievement levels than conventional instruction. The observed improvement can be associated with the methodological integration of several digital tools. Google Classroom provided an organized environment for accessing learning materials, video lessons, and assignments, while Quizizz and Kahoot supported interactive assessment and immediate feedback. Cisco Packet Tracer enabled students to transfer theoretical knowledge about computer networks into practical virtual activities. Consequently, the learning process was not limited to the presentation of theoretical information but incorporated reinforcement, practice, assessment, and feedback.

These findings are consistent with previous research emphasizing that the effectiveness of digital technologies depends not simply on their availability but on their pedagogically appropriate integration into the learning process. Research on gamification has demonstrated that interactive elements can increase student engagement and motivation, although their educational effectiveness depends on their connection with clearly defined learning objectives (Dichev & Dicheva, 2017:1–21). Similarly, research on gamification has emphasized the importance of integrating game elements with instructional activities rather than using them solely for entertainment (Mora et al., 2017:82–95). The improvement observed in the experimental group is also consistent with findings concerning virtual learning environments. Previous research has shown that virtual laboratories can provide opportunities for students to connect theoretical knowledge with practical activities, repeat learning tasks, and experiment in a safe simulated environment (Rosli & Ishak, 2024:81–103). In the present study, the use of Cisco Packet Tracer served a similar function by allowing students to construct and configure computer networks in a virtual environment.

The findings also correspond with research emphasizing that digital learning environments can support students' active participation and learning outcomes when technological tools are integrated into a coherent pedagogical model. Studies of virtual learning environments have highlighted the importance of accessibility, usability, students' digital readiness, and alignment between technological tools and learning objectives (Deriba et al., 2024:1–15). In the present study, the combination of digital materials, interactive quizzes, practical simulation, and assessment created a structured learning sequence that addressed both theoretical and practical aspects of Informatics education. An important finding is that the greatest improvement in the experimental group occurred at the excellent achievement level. The proportion increased fivefold, from 7.1% to 35.7%. At the same time, no student remained at the unsatisfactory level after the intervention. This pattern suggests that the digital learning environment was beneficial not only for high-achieving students but also for students who initially demonstrated lower levels of achievement. The availability of digital materials, repeated practice, interactive assessment, and immediate feedback may have provided additional opportunities for students to learn at their own pace and correct misunderstandings.

However, the findings should be interpreted within the limitations of the study. The sample consisted of only 29 students, and the intervention focused on a single Informatics topic, namely the "Using Networks" chapter. Therefore, the results should not be generalized to all students or all Informatics topics without further investigation. In addition, the available data allow comparison of achievement distributions, but they do not provide sufficient information for calculating statistical significance or effect size. Further research with larger samples, longer intervention periods, and statistical testing would strengthen the evidence for the effectiveness of the proposed methodology. Overall, the results support the effectiveness of integrating digital learning platforms, interactive assessment tools, gamification, and virtual laboratory activities into Informatics education. The stronger improvement observed in the experimental group compared with the control group indicates that a structured digital learning methodology can contribute to higher student achievement, greater practical engagement, and more active participation in the learning process. This finding supports the broader conclusion of the literature that digital technologies are most effective when they function as interconnected components of a pedagogically designed learning environment rather than as isolated technological tools.

## CONCLUSION

This study has demonstrated that the integrated use of digital learning platforms can improve the effectiveness of Informatics education, particularly in teaching the "Using Networks" chapter. The experimental group, which studied the topic through an integrated digital learning environment, demonstrated a substantially greater shift toward higher achievement levels than the control group. The proportion of students achieving good or excellent results increased from 35.7% to 78.6% in the experimental group, compared with an increase from 40.0% to 46.6% in the control group.

The findings indicate that the effectiveness of digital technologies is associated not simply with their individual use, but with their methodological integration into the learning process. Google Classroom supported the organization and distribution of learning materials, while Quizizz and Kahoot facilitated interactive assessment, reinforcement, and feedback. Cisco Packet Tracer provided opportunities to connect theoretical knowledge with practical network configuration activities. The combination of these tools created a learning sequence that integrated theoretical learning, interactive practice, practical application, assessment, and feedback.

The study therefore suggests that integrating digital learning platforms into Informatics education can contribute to higher student achievement and more active participation in the learning process. However, the study was limited by its relatively


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small sample of 29 students and its focus on a single topic. Further research involving larger groups, different Informatics topics, longer intervention periods, and statistical analysis is needed to provide stronger evidence of the long-term effectiveness of the proposed methodology. Despite these limitations, the findings provide a practical basis for the systematic integration of digital learning platforms into Informatics education.

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