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Method of practical works in the teaching of informatics and computer science

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Abstract. The method of practical works in the teaching of informatics represents a modern approach to education in which students actively participate in the process of acquiring knowledge through independent solving of tasks, projects and practical examples. In this way, theoretical knowledge is connected with practice, and students develop not only IT, but also general competences: critical thinking, logical reasoning, problem solving and teamwork. This paper analyzes the application of the method of practical works in the teaching of informatics, its advantages, challenges and possible ways of improvement.
Keywords:Method of practical works, informatics, teaching, students, active learning, digital competences.

Introduction

Modern education requires methods that put students in an active role. Traditional teaching, in which the teacher transmits ready-made knowledge, is increasingly giving way to methods in which students independently discover and apply knowledge. Informatics, as a subject that includes computer work, programming, data processing and creative application of digital tools, is particularly suitable for the application of the method of practical works. Practical work enables students to translate theoretical knowledge into real tasks - from creating presentations and multimedia content, to programming and developing more complex projects.

Analysis and Discussions

Concept and theoretical framework of the method of practical works.The method of practical works is one of the oldest and most widespread teaching methods in teaching. Its basic idea is that students acquire knowledge, develop skills and form attitudes through active participation in solving specific tasks and performing various activities. In the teaching of informatics and computer science, practical work means that the student does not only stay at the level of theoretical knowledge of concepts, but also applies them through writing code, processing data and developing projects(see Bjekic, 2015; Marinkovic, 2018; Prensky, 2010; European Commission, 2020).

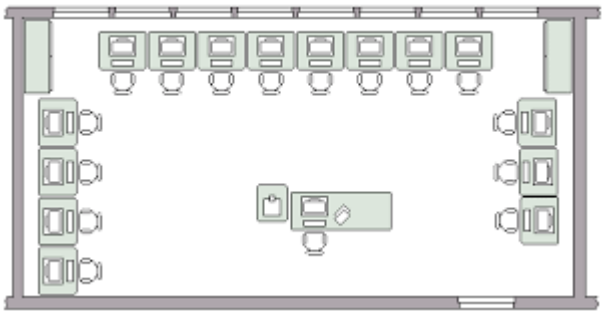

Figure 1. An example of a possible arrangement of computers in the lecture area

The theoretical framework of the method of practical works in the teaching of informatics and computer science is based on pedagogical - psychological concepts. According to Piaget (1970) and Vygotsky (1970), constructivism is reflected in knowledge that is actively built through experience and interaction with the environment.Yager (1991), connects the above and suggests the use of the following elements of constructivist strategies in teaching practice: encouraging, accepting and using student questions and ideas during the lesson; encourage cooperation, exchange of information, ideas and conceptualization between students; use the student's experiences, interests and reflections in

the teaching process; support the use of alternative sources for acquiring knowledge; encourage students to make assumptions about connections between phenomena; encourage predictions of the consequences of some events; ask students to give ideas before processing the teaching material itself; provide time for reflection and analysis; encourage self-analysis, create a database for argumentation and reformulation of ideas in the light of new knowledge; direct students to identify problems with their current interests; use local sources (human and material) as original sources of information to solve problems; to encourage students to search for information that can be applied in solving real life situations; extend learning beyond the lesson, the classroom and the school itself;focus the impact of science on each individual student; to systematically change the student's belief that the content of science (teaching content) is something that is important only to achieve school success (test success); promote professional self-awareness - especially in the field of science and technology.

Pragmatism according to Dewey (1938) and Novak &Gowin (1984). represents the best learning is achieved through work and solving concrete problems. This often raises the question about computer science in modern education - Why is informatics important in modern education? According to La IT is crucial in education because it prepares students for an increasingly digitized society. It helps you understand and control technology, fosters critical skills such as logical thinking and problem solving, and is vital to staying competitive in a technology-driven job market.How does computing affect the teaching and learning process? Information technology is transforming teaching and learning by providing access to vast amounts of information and resources online. It promotes more interactive and personalized teaching methods, encourages collaboration and communication, and allows students to learn at their own pace. What challenges do teachers face when integrating informatics into their lessons? Teachers face challenges such as the need for ongoing training in new technologies, the costs of upgrading or acquiring new technologies, and the need to design curricula that effectively integrate computer science. In addition, they must address the technology access gap among students. How can computing help overcome barriers to education? Computing can help overcome barriers to education by offering more flexible and accessible teaching methods, such as online learning and digital educational resources. You can also encourage student engagement and interest through interactive and collaborative tools. What role does data management play in computer science education? Data management in informatics education is critical for tracking and analyzing student progress, facilitating communication between teachers, students, and parents, and improving data-driven decision-making.Data management systems also help personalize instruction and support administrative efficiency. What is the importance of computer security in education? Computer security is necessary to protect the personal and sensitive information of students and teachers. This includes protecting school networks from cyber-attacks, teaching students about online safety and responsible digital behavior, and ensuring the privacy and security of educational data.How can the integration of computing in education be improved? Improve the integration of IT in education This includes investing in technological infrastructure, training teachers in new technologies and teaching methods, developing curricula that include relevant IT skills and ensuring equal access to technological resources for all students (see Fincher et al, 2001; Kay et al, 2005; Dagienė, 2006). Kolb's (1984) experiential learning cycle: students go through the stages of experience, reflection, conceptualization, and application. Kolb's experiential learning cycle is a model that describes how students learn through experience. This model consists of four key stages: concrete experience, reflection, abstract conceptualization, and active experimentation. This cycle can be applied to different teaching units, including the methodology of practical works in the teaching of informatics and computer science. Here is how Kolb's cycle can be applied within that unit of instruction:Concrete experience - in this phase, students experience a practical activity. For example, they may work on a project that involves programming, building web pages, or working with hardware. This activity gives them the opportunity to directly experience the process of learning and applying the knowledge they have acquired; Reflection - After completing the practical activity, students should reflect on their experience. This may include discussing what they learned, what challenges they encountered, and how they overcame them. The teacher can ask questions that encourage students to reflect on their work, such as: "What worked well? What would you do differently next time?";Abstract conceptualization - in this phase, students connect their experience with theoretical concepts. For example, after completing a project, they can learn about relevant programming languages, algorithms or design principles. The teacher can provide additional resources or explanations that help students understand why certain methods or techniques work; Active experimentation - in the end, students apply what they have learned in new situations. They can work on similar projects, but with new challenges or different approaches. This phase allows students to test their ideas and skills, thereby closing the cycle of experiential learning and opening the possibility for new experiences. Using the Kolb cycle in computer science teaching allows students to become active participants in their learning, thereby fostering deeper understanding and a greater ability to apply knowledge in the real world.

As for the theory of competencies in the teaching of informatics and computer science, it focuses on the development of knowledge, skills and attitudes that

are in accordance with modern educational standards. Within the teaching of informatics and computer science, this implies: Knowledge development - students acquire theoretical and practical knowledge about information technologies, programming languages, software tools and computer science concepts.Development of skills - through practical works, students develop concrete skills, such as programming, problem solving, teamwork and communication. Development of attitudes - students learn to appreciate the importance of technology in modern society, develop critical thinking and an ethical approach to the use of technology. By combining Kolb's experiential learning cycle with competency theory, teachers can create a dynamic and interactive environment that encourages active learning and prepares students for the challenges of the technological world (see Hubwieser et al, 2011; O'grady, 2012).

Pedagogical functions of the method include educational, educational, developmental and motivational, because through practical work students acquire not only knowledge, but also work habits, creativity and self-confidence. Competence theory focuses on the development of the student's entire personality, not only on the acquisition of theoretical knowledge in the teaching of informatics and computer science (Rajovic, 2007; Bulatovic, 2025). Through practical work methods, students can better understand the material, apply what they have learned in real life and develop important skills such as critical thinking, cooperation and communication. The educational, educational, developmental and motivational functions of the methods enable students to be actively involved in the learning process, which further encourages their creativity and self-confidence. This approach is particularly important in modern education, where the goal is to prepare students for the challenges of the future(Bulatovic, 2025).

Goals and tasks of the method of practical works. Objectives: Connecting theoretical knowledge with practical activities, developing digital skills and the ability to use information technologies, encouraging creativity, logical and critical thinking, developing the ability to solve problems through programming and practical tasks, fostering independence, persistence and responsibility, preparing students for the further educational process and the labor market.The reform aims at improving students' practical ability and strengthening students' computationalthinking ability. The ideas of practicalteaching reform are shown in Figure 2.

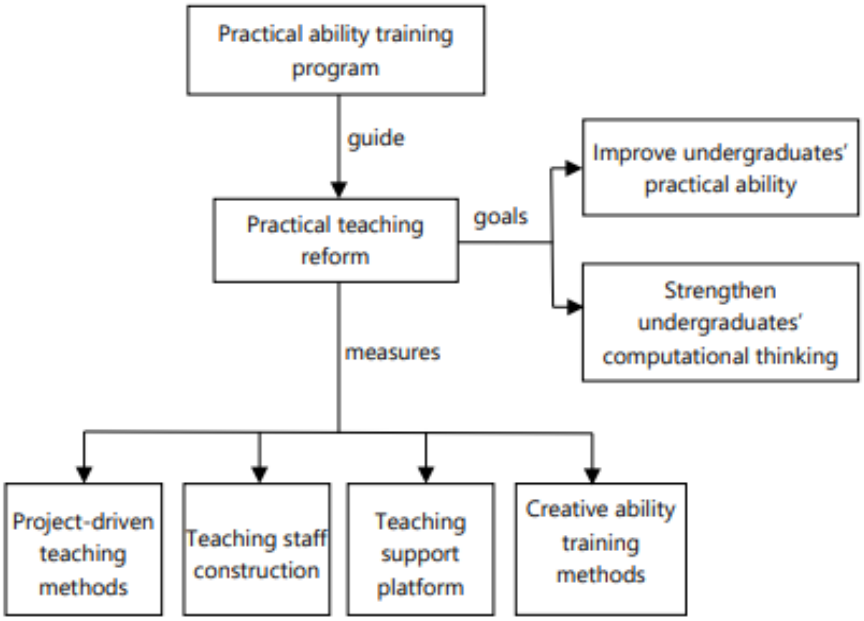

Figure 2. The ideas of practical teaching reform (Ma et al,2017)

Tasks: Enable students to apply theoretical knowledge in solving specific problems in the teaching of informatics and computer science, organize classes so that students independently perform computer activities, develop work habits, accuracy and precision, enable experiential learning through experiments and projects, encourage teamwork and cooperation among students, encourage reflection and analysis of work results, develop the ability to use different digital tools (see Nejmeh, 2012; Cassel et al, 2013).

Practical ability training program divides the training ability into three parts, i.e. basic ability, major core ability and expanding ability. The detail of ability partition in practical ability training program is shown in Figure 3.

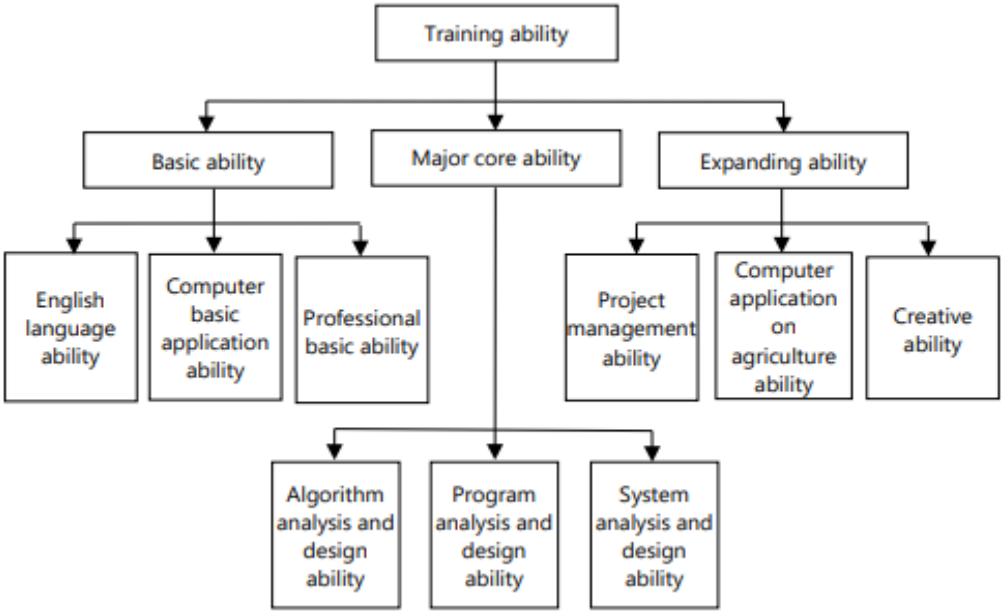

Figure 3. The ability partition in practical ability training program (Ma et al, 2017)

Here are some examples of how the goals and objectives of the practical works method can be applied in the teaching of informatics and computer science: Connecting theoretical knowledge with practical activities - in the programming class, students can work on a project in which they develop a simple application. In that process, they apply theoretical knowledge about programming languages, algorithms and data structures. Developing digital skills - students can participate in workshops where they learn how to use different data processing tools, such as Excel or Google Sheets. For example, they can analyze a set of data and visualize the results through graphics. Encouraging creativity, logical and critical thinking - students can work on team projects where they develop websites or games. During the process, they must make decisions about design, functionality and user experience, which encourages creativity and analytical thinking.Developing problem-solving skills - in computer science classes, students can program robots to perform specific tasks, such as navigating obstacles. This hands-on work teaches them how to identify problems and develop solutions through programming. Fostering independence, persistence and responsibility - students can receive individual projects that are evaluated based on independent work. For example, they may develop their own software or application, where they must plan, execute and present their work. Preparing students for the further educational process and the labor market - organizing interview simulations for jobs in the IT sector, where students can practice their presentation skills, write CVs and talk about their projects and experiences. Through these examples, students not only acquire knowledge, but also develop important skills that will benefit them in the future (see Degtyareva, 2014; Caspersen et al, 2018).

Svetsky (2025) based on research Mark (2015) and Serfaty(2016) concludes that the integration of the WPad/WPad BVI desktop application with PIKS channels significantly enhances the efficiency of a teacher's workflow by automating educational activities and accelerating the flow of information to the computer. This level of automation is increasingly critical in today's educational environment, as it supports multitasking- allowing teachers toswitch seamlessly between different types of content-while maintaining a primary focus on entering selected educational material into WPad tables. By working with specific, curated content rather than computer files, this approach effectively reduces the risk of information overload for teachers. Advantages and disadvantages of the method of practical works. Advantages: Active learning and experiential acquisition of knowledge, linking theory and practice in the teaching of informatics and computer science, development of digital competences, encouragement of creativity and independence, motivation through visible work results, development of social skills through teamwork, preparation for further education and the labor market. Here are some examples of the advantages of the method of practical works in the teaching of informatics and computer science: Active learning and experiential acquisition of knowledge - students actively participate in the process, which improves information retention. Example - students work on projects such as creating web pages or applications, which helps them apply theoretical knowledge. Linking theory and practice - theoretical concepts can be directly applied in practical situations. Example - learning about algorithms through programming simple

games or applications. Development of digital competences - students acquire skills that are needed in the modern working environment. Example - working with different software and tools such as programs for data processing or graphic design. Encouraging creativity and independence - students have the freedom to explore and develop their own ideas. Examples - creating innovative solutions for tasks, such as mobile applications that solve specific problems. Motivation through visible results of work - students are more motivated when they see concrete results of their efforts. Example - presentation of projects in front of the class or teachers. Development of social skills through teamwork - working in groups helps students develop communication skills. Example - teams work together on a common project, such as developing a software solution. Preparation for further education and the labor market - students acquire practical knowledge that is relevant for future careers. Example - learning about best practices in the industry through cooperation with local firms (see Rakhimov, et al, 2021; Oleksiuk et al, 2022).Disadvantages: more time and demanding organization of teaching, the need for material and technical resources, individual differences between students, the need for an expert and competent teacher of informatics and computing, the possibility of routine, mechanical work, more complex assessment of knowledge and results. Here are examples of the disadvantages of the method of practical works in the teaching of informatics and computing: More time and demanding organization of teaching - preparation of practical works may require more time than traditional methods. Example - planning and organizing workshops or projects can take a significant amount of time. The need for material - technical resources - it is necessary to provide appropriate equipment and software.

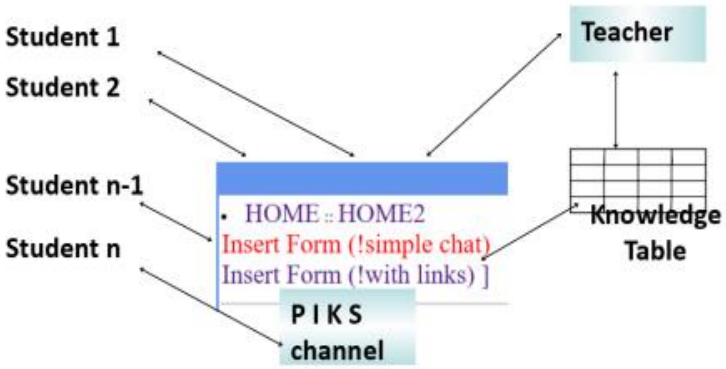

Figure 4. Model of teaching students using a PIKS channel (Svetsky,2025).

Example - the necessity of computers, programming software and other resources which can be expensive. Individual differences among students - different levels of knowledge and skills can make working in a group difficult.Example - students with different previous experience may have different needs and learning speed. The need for a professional and competent teacher - teachers must have the appropriate knowledge and skills to conduct practical work. Example - teachers must be trained to use modern technologies and teaching methods. The possibility of routine, mechanical work - if care is not taken, students can become passive and do only what they are told.Example - students can only follow the instructions without understanding the essence of the task. More complex assessment of knowledge and results - evaluation can be more difficult in practical papers than in traditional tests. Example - assessment of teamwork and creativity can be more subjective and difficult to standardize. These examples can help in understanding how practical work can influence the educational process in the field of informatics and computing (see Dongol et al, 2024). Karabin et al., 2025).

Comparison with other teaching methods.The method of practical works in the teaching of informatics and computing differs from other teaching methods in that students actively participate in the learning process. Compared to lectures, practical work enables the application of knowledge in real tasks and develops creativity and independence. Discussions and debates develop critical thinking, but often do not involve all students equally. Games and simulations motivate students through experimentation, while practical work in the teaching of informatics and computer science provides direct application of theory. Project teaching develops complex competencies through larger tasks, while practical work is often shorter and more focused, but can be combined with project methods for maximum effect. A comparison of the method of practical works with other teaching methods shows several key differences and

similarities: Active learning - the method of practical works is characterized by the fact that students actively participate in the process, while traditional teaching in informatics and computer science classes often implies passive acceptance of information. Practical work allows students to directly apply knowledge in real tasks, which engages and motivates them. Application of knowledge - compared to lectures, where theory is often presented without practical application, practical work allows students to see how theoretical knowledge is used in practice. It contributes to better understanding and retention of information. Development of skills - while discussions and debates encourage the development of critical thinking, they often do not involve all students equally. Practical work, on the other hand, enables all students to be actively involved in the teaching of informatics and computing and develop creativity, as well as digital competences. Motivation - games and simulations also provide motivation through experimentation, but practical work often results in visible and tangible outcomes, which further encourages students. Complexity of tasks - project teaching focuses on the development of complex competences through larger tasks, while practical works are usually shorter and more specific. However, practical work can be combined with project methods to achieve maximum effect, allowing for a deeper understanding and application of knowledge. In short, the method of practical works provides a unique opportunity for active learning and development of skills that are crucial for future education and the labor market, while it can be supplemented and connected with other teaching methods for better results (see Jarilkapovich, 2024; Susilawati, et al, 2025).

The role of the teacher. The role of informatics and computing teachers in the method of practical works is crucial for the success of the entire learning process. Here are some concrete examples of how the teacher can perform his role: organization of teaching and preparation of tasks - the teacher should design clear and concrete tasks that are adapted to the level of knowledge of the students, as well as provide the necessary resources and materials for the performance of practical works. Mentoring support for students during work - during practical work, the teacher should be present and available to help students, providing them with advice and guidance to overcome the challenges that arise. Motivation and encouragement of creativity - the teacher can encourage students to explore different approaches to the solution of the task, giving them the freedom to use their imagination and creativity. Evaluation of the process and results of the work - the teacher should monitor the progress of the students, provide feedback and suggest areas for improvement, so that the students can reflect on their work and learn from the experience.Encouraging teamwork and cooperation - by organizing work groups, the teacher can encourage students to work together, exchange ideas and help each other, thus developing social skills. An example of expertise in the use of digital tools - the teacher should be skilled in the use of modern technologies and digital tools, so that he can effectively integrate them into practical work and show students how to use them. In short, the teacher in this method plays a vital role in creating a stimulating environment that supports active learning and the development of various competencies in students (see Kaddoura and Al Husseiny, 2023; Holmes and Tuomi, 2022).

Challenges and applications.The challenges and applications of the method of practical works are very important for the success of the teaching of informatics and computer science. Challenges: Time and class limitations - it is often difficult to provide enough time for the realization of practical works, which can limit the depth of learning. Lack of technical resources and software tools - in some schools, the availability of the necessary equipment and tools may be limited, which makes it difficult to implement practical activities in the teaching of informatics and computer science. Iindividual differences of students and the need for additional support - students have different learning styles and speed of acquiring knowledge, which can be a challenge for the teacher of informatics and computer science in approaching each student individually. The need for high competence of teachers - teachers must be trained to use different tools and techniques, which requires continuous training. The complexity of evaluation and assessment of knowledge - practical works often require a more complex approach to evaluation, because the results are not always easily measurable.Practical applications: Programming and developing applications or games - students can work on concrete projects, developing their coding and creativity skills. Data processing and working with databases - practical work may include data analysis and learning about data structures. Multimedia and creative projects - students can create video content, presentations or art projects, which encourages creativity and innovation.With simulations and experiments in software environments, these activities allow students to explore theoretical concepts through practical application in a safe environment. Team projects and collaborative work - students learn to work together, developing communication and teamwork skills. The hands-on method provides students with the opportunity to actively participate in the learning process, which can lead to deeper understanding and retention of knowledge (see Gong, 2021; Sanusi et al, 2022).

Conclusion

The method of practical works in the teaching of informatics is an effective way of acquiring knowledge and skills, because students actively apply theory through practical tasks. It encourages independence, creativity and critical thinking, develops digital competences and

prepares students for further education and the labor market. Its successful application depends on the expertise of teachers, technical resources and adequate organization of teaching. The method works best when combined with other forms of teaching, such as projects, simulations and discussions.

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