FACTA UNIVERSITATIS
Series: **Teaching, Learning and Teacher Education** ONLINE FIRST
https://doi.org/10.22190/FUTLTE250226004S

Review article

DISCOVERY-BASED LEARNING AND PROBLEM-BASED LEARNING IN SOCIAL SCIENCES AND NATURAL SCIENCES LESSONS

UDC

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Abstract. *The distinctiveness of the curriculum framework for "Nature and Society" lessons reflects the diversity and inclusivity of topics drawn from a broad range of natural and social sciences. Given the complexity of the material related to natural and social phenomena and processes, a research-based approach is necessary. The methodological framework must be aligned with the particularities of each science involved. This study explores the unique possibilities for implementing the curricular content of "World Around Us" and "Nature and Society" in the first cycle of elementary education. In this context, their application in lesson planning and execution can help develop a conceptual framework for understanding social and natural phenomena. Based on existing theoretical knowledge and a review of relevant pedagogical-methodological literature, it has been found that problem-based and discovery-based learning are effective teaching methods. These approaches emphasize students' active participation in the process of acquiring and developing knowledge. The insights gained from this research open new avenues for further study, with a recommendation to focus more on the practical application of these teaching methods in direct interactions with students*.

Key words: *Nature and Society lessons, curriculum content, discovery-based learning, problem-based learning, independent acquisition of knowledge*

Received February 26, 2025 / Revised April 10, 2025 / Accepted April 11, 2025
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1. INTRODUCTION

The rapid and ongoing changes across all aspects of life and work have made knowledge one of the key resources for development. Faced with the constant pressures of a global information-technological environment and the demands of the modern world, there has been a significant shift in how learning and teaching processes are perceived at all educational levels, including primary education. In this context, over the past few decades, the traditional paradigm of knowledge transfer has gradually been replaced by a paradigm centered on the learning process. This shift marks the end of the era focused solely on teaching content and the beginning of an era centered on competencies, steering the educational process toward fostering student skills and competencies (Blagdanić and Banđur, 2018).

In the contemporary approach to teaching and learning, alongside declarative, explicit, procedural, and factual knowledge - which forms as the foundation for life in modern society - there is a growing emphasis on implicit, applicative, and operational knowledge. This type of knowledge highlights its contextual application, specific skills, abilities, and competencies. It is rooted in experience, problem-solving, active participation in research, and the study and analysis of natural and social processes and phenomena (Blagdanić and Banđur, 2018; Letina, 2015). The interconnection between these two types of knowledge, forming a unified and integrative whole, helps bridge the gap between cognitive and practical knowledge, thereby addressing the inconsistency between theory and practice (Kerka, as cited in Letina, 2015). This approach to learning, viewed as a process of designing, or constructing one's own knowledge through engagement in meaningful, relevant activities and communication with others, is clearly reflected in the teaching of "Nature and Society" in the first cycle of primary education. To better understand this approach and explore its practical applications, it is important to briefly examine the key features of instruction in "Nature and Society".

"Nature and Society" instruction is grounded in the foundational scientific knowledge from a range of natural and social-humanistic sciences (Blagdanić and Banđur, 2018; Lazarević and Banđur, 2001). Its long and rich history reveals that humans have always been deeply interested in the world around them, in natural phenomena and processes, as well as in relationships with others. Over time, its role in primary education has evolved, along with its goals and objectives, didactic-methodological tools, the scope and intensity of instructional content, and the methods used for delivery. Despite these changes, the primary purpose of "Nature and Society" instruction remains essentially the same: to help students become familiar with their own identity, their immediate natural and social environment, and to acquire basic knowledge about natural and social phenomena and processes. This enables them to develop values, skills, and abilities for responsible living in the world around them (*Pravilnik o programu nastave i učenja za drugi razred osnovnog obrazovanja i vaspitanja[Regulation on the Curriculum for the Second Grade of Primary Education]*, 2018; *Pravilnik o programu nastave i učenja za četvrti razred osnovnog obrazovanja i vaspitanja [Regulation on the Curriculum for the Fourth Grade of Primary Education]*, 2019).

The curriculum for "Nature and Society" education encompasses a broad range of knowledge, facts, generalizations, and achievements from various natural and social-humanistic sciences. It involves a didactic-methodological transformation of content from subjects such as physics, chemistry, biology, geography, history, sociology, ecology,

technology, general culture, art, and other disciplines and fields of science. Few subjects within primary education, such as "The World Around Us" in grades 1 and 2, or "Nature and Society" in grades 3 and 4, address such a diverse array of content from both natural and social-humanistic sciences as “Nature and Society” instruction, which is implemented in the first cycle of primary education through these subjects (Lazarević and Banđur, 2001). The complexity and interdisciplinarity of this teaching approach require teachers to possess appropriate competencies, including adequate education, didactic-methodological and pedagogical-psychological qualifications, a commitment to continuous professional development, and the ability to enhance their own practice. Teachers must also have the motivation and creativity to plan, prepare, implement, and evaluate learning objectives - both for their own work and for students' progress – while ensuring the overall quality of the teaching process. At the same time, the complexity, diversity, and relevance of this teaching foster students' curiosity and interest in studying natural and social phenomena. This supports their development, but also demands greater effort from teachers in selecting and applying appropriate teaching methods, strategies, techniques, and approaches. The central focus of this work is to explore the potential for effectively implementing the curricular content characteristic of “Nature and Society” teaching.

2. METHODOLOGY

The objective of this paper is to explore some of the key and distinctive teaching and learning methods used in delivering the content of “The World Around Us” in Grades 1 and 2, and “Nature and Society” in Grades 3 and 4 of primary education. In the following sections, discovery-based learning and problem-based learning will be outlined and explained, as both methods emphasize student autonomy in exploring, investigating, and analyzing natural and social phenomena and processes. Rather than relying on the conventional and standard classification of teaching methods typically found in didactic and methodological textbooks, this analysis primarily draws on the classification proposed by Ivić and colleagues (2001). Additionally, the paper incorporates the insights and interpretations from other relevant authors on this subject (Blagdanić and Banđur, 2018; Vidosavljević, 2020; De Zan, 2005; Lazarević and Banđur, 2001; Cvjetićanin, 2010).In this classification, the term “method” simultaneously refers to both instructional methods and forms of teaching, focusing on how something is done, the actions the student undertakes during the instructional process, and how schoolwork is structured to encourage active student participation. This definition relates to the nature, type, and level of student engagement throughout the teaching and learning process (Ivić et al., 2001). These are strategies used by teachers to stimulate student activity, with the goal of achieving the intended learning objectives (Zlatković, 2014). From the teacher’s perspective, they are considered teaching methods, while from the student’s perspective, they represent learning methods (Ivić et al., 2001). A significant body of research highlights the positive effects of an inquiry-based approach in “Nature and Society” lessons, particularly in terms of acquiring scientific concepts and promoting long-term retention of knowledge. This approach is often shown to be more effective than traditional teaching methods (Anđić and Vidas, 2021; Veinović, 2004; Kalathaki, 2015; Letina, 2016; Pecko, 2015; Ćaleta et al., 2023). Consequently, discovery-based learning and problem-solving are recognized as teaching methods that emphasize students’ independent activities (Ivić et al., 2001), while also considering the

nature of the curriculum content in "Nature and Society" lessons, as well as the specific characteristics and methodologies of the respective sciences and academic fields to which this content belongs (Blagdanić and Banđur, 2018).

3. Discovery-Based and Problem-Based Learning: Current Approaches in Implementing Curricular Content in "Nature and Society" Lessons

The new curricula for "The World Around Us" and "Nature and Society", introduced in the 2018/19 school year, place primary emphasis on the learning process and outcomes, with curricular content no longer holding a central role. Instead, content serves to support the attainment of the expected learning objectives (*Pravilnik o planu nastave i učenja za prvi ciklus osnovnog obrazovanja i vaspitanja i programu nastave i učenja za prvi razred osnovnog obrazovanja i vaspitanja [Regulation on the Teaching and Learning Plan for the First Cycle of Primary Education and the Curriculum for the First Grade of Primary Education*, 2017). This curriculum approach promotes teaching that moves away from presenting content in a pre-packaged form, focusing instead on fostering and mastering knowledge that is functional and applicable. Consequently, the methods chosen by the teacher to organize the learning process – where the student actively participates – are of great significance. By considering students' experiences, needs, abilities, and age-related developmental characteristics, contemporary teaching of "Nature and Society" incorporates a variety of methods. These methods are combined and integrated to complement each other, ensuring the achievement of optimal outcomes and the realization of planned learning goals.

To achieve the objectives and outcomes outlined in the new "Nature and Society" curriculum, which also emphasize fundamental research skills, active student engagement is essential. Therefore, the teacher's primary responsibility is to encourage students to take an active role in the teaching and learning process (Bulić and Blažević, 2020). The core principle of learning and exploring the laws of nature, natural phenomena, and processes is the active participation of students in the educational process (Kostović-Vranješ et al., 2019). In line with the principles of modern education, which emphasize inquiry, critical thinking, and creative application, an important task for teachers is to prepare students for independent learning (Kostović-Vranješ, 2015). One effective method to motivate students and promote their active involvement is *discovery-based learning.*

When the knowledge that students are meant to acquire is not presented in its final form but instead discovered independently by the students, this process is known as discovery-based learning (Vilotijević and Vilotijević, 2008; Zlatković, 2014). For students to be independent in their learning process, it is necessary to create an appropriate and stimulating environment, as well as design situations that will guide them toward discovering knowledge. This learning model is effective even at the preschool level, as it stimulates and nurtures children's curiosity for exploration and learning, thereby promoting their creativity. In this way, children become more confident in tackling tasks and problems, drawing conclusions, and generating new ideas (Anjari & Purwanta, 2018). Discovery-based learning involves the process of acquiring knowledge through the analysis of data, facts, and information, and the development of concepts that emerge from recognizing and establishing common characteristics of events and experiences (Vilotijević and Vilotijević, 2016).The established facts and data are examined and analyzed, then connected to form new combinations that can reveal missing information and establish new relationships. This process integrates the new knowledge with previous concepts,

making it applicable in other new learning situations (Ivić et al., 2001; Spasić Stošić, 2019). With this method, the focus is not on overwhelming students with large volumes of information but rather on offering examples that encourage exploration and intellectual engagement (Vilotijević and Vilotijević, 2008). Through various research activities typical of "Nature and Society" lessons - such as observation, monitoring, classification, hypothesizing, testing hypotheses, measurement, experimentation, explanation, and conclusion (Blagdanić and Banđur, 2018; De Zan, 2005) - students should independently discover and grasp the essential content. In the knowledge discovery process, the teacher, as the architect of learning situations, is responsible for guiding and motivating students to engage in research, construct knowledge, and develop cognitive frameworks and concepts about natural and social phenomena and processes.

Discovery-based learning encourages greater student involvement in the educational process, stimulates curiosity, and leads to more enduring knowledge retention. This method helps students develop independent, creative, and inventive thinking, as well as problem-solving skills (Matijević and Radovanović, 2011). At its core, discovery-based learning supports project-based and research-oriented teaching (Ivić et al., 2001). In subjects like "Nature and Society", it is often combined with other teaching approaches. For instance, outdoor education, which is well-suited for studying biological and geographical content, can, when integrated with discovery-based learning, offer students meaningful opportunities to solve problems that are applicable to other challenges in everyday life (Ćaleta et al., 2023).In addition to biology and geography, environmental topics also provide opportunities for the application of this method. Students can engage in solving current environmental problems, such as discovering the causes of air pollution in their area during the winter months and creating a program to address it. They may also find it engaging to investigate endangered species in their vicinity and propose protection measures (Spasić Stošić, 2019). It is important to emphasize that discovery-based learning is grounded in students' independent, inductive reasoning to arrive at knowledge. "Nature and Society" education, this method is often applied when exploring program content through experiments, which exemplifies this form of learning (Blagdanić and Banđur, 2018; Ivić et al., 2001). While discovery-based learning in teaching cannot be directly equated with scientific research, there is a tendency to align them in some respects. This alignment stems from the experiences associated with the research process—curiosity, motivation, the desire to explore, and the satisfaction that arises from realizing students have independently investigated and uncovered knowledge that benefits not only the individual but the entire class (De Zan, 2005).

Problem-solving is rooted in discovery-based learning, but unlike the inductive discovery of knowledge, it encompasses a variety of approaches to solving problems and problem-based situations. In academic literature, this teaching and learning method is described by various terms, including learning through problem-solving, learning through discovery, insight-based learning, discovery teaching, problem-solving strategy (Vidosavljević, 2022; Pecko, 2015), problem-based model (Blagdanić and Banđur, 2018), or problem-based instruction (Vilotijević and Vilotijević, 2016), among others. The foundation of this method lies in presenting students with a relevant problem connected to real-life scenarios, tied to curricular content, and aligned with the intended learning objectives (Blagdanić and Banđur, 2018; Ivić et al., 2001).

During the problem-solving process, students can work entirely independently, engaging in a form of learning that allows them to choose not only the problem itself but also the methods, procedures, and ways of determining, verifying, and presenting the outcomes (Ivić et al., 2001). In classroom teaching, especially in subjects such as "Nature and Society", simpler forms of

problem-based learning are often utilized, typically structured as guided inquiry. Throughout this process, the teacher subtly leads the students, offering limited freedom in selecting problems, tasks, or working methodologies (Vilotijević & Vilotijević, 2008). Regardless of whether the inquiry is autonomous or guided toward solving a specific problem, this method is considered a distinct instructional system characterized by the following features:

- A problem exists – an identified gap to be filled, a new situation, obstacle, or challenge that needs to be overcome and resolved.
- Solving the problem requires independent student activity: this involves a creative approach and experiential learning.
- The student is an active participant in the problem-solving process: engaging in independent cognitive activities such as analyzing and deconstructing the problem, identifying missing elements and data, formulating and comparing hypotheses, drawing conclusions, verifying solutions, and generalizing new facts (Vlahović, 2012).

During problem-based learning, students can tackle various types of problem situations: structured or semi-structured. Semi-structured problems offer the possibility of multiple solutions, which significantly contributes to the development of flexible thinking (Smaldino, Lowther & Russell, 2012). It is also important to consider analytical problems and perception problems, which require a higher level of engagement and persistence from students in resolving them. These types of problems present a challenge for students, as the solution is not immediately apparent and is often reached unexpectedly. Finding alternative approaches is necessary to effectively resolve the problem (Miščević Kadijević, 2014).

As problem-solving fosters the development of critical thinking and independence – key values of contemporary education – it is employed at all stages of teaching "Nature and Society". This approach is utilized not only during content delivery but also in practice, revision, and knowledge assessment. Typically, six stages are distinguished through which the teacher guides and directs students in the problem-solving process:

1. Creating a Problem Situation (Formulating and Defining the Problem) : This is the initial and crucial stage where the teacher establishes a problem situation designed to stimulate students' curiosity, interest, and cognitive engagement. In teaching "Nature and Society", the problem can be introduced in various ways – by presenting opposing viewpoints on a particular issue or phenomenon, conducting experiments, posing questions that provoke contradictory opinions among students, displaying photographs, or using applications that illustrate specific phenomena or processes without clearly identifiable characteristics, among other strategies.
2. Formulating a Hypothesis: The second stage involves proposing an assumption related to the identified problem situation. Students are encouraged to engage in critical thinking to explore potential solutions to the problem. The teacher should facilitate the expression of various student hypotheses that could lead to problem resolution while continuously guiding them toward a more precise hypothesis, which will be verified in subsequent stages.
3. Decomposition Stage (Breaking Down the Problem into Subproblems) : With the teacher's guidance, students examine the problem by analyzing the given and known elements while identifying missing information necessary for solving the problem. This process helps break down the main issue into smaller, more manageable subproblems, facilitating a clearer understanding and a structured approach to finding a solution.

4. The Problem-Solving Stage: This is a critical phase where the proposed hypothesis is tested. The problem is addressed piece by piece, with each segment being discussed, observed, measured, and tested through experiments. A plan and appropriate strategy are implemented to validate the hypothesis and draw conclusions.
5. The Conclusion Stage: In this phase, students synthesize the collected data and formulate a conclusion, with the teacher's assistance if necessary. During this phase, the teacher ensures that all terms used are correctly defined and positioned within the broader system of knowledge.
6. The Testing (Verification) Stage: In this stage, students assess and apply the acquired knowledge to new problem situations. It is expected that they can easily solve problems based on previously gained knowledge and experiences (Blagdanić and Banđur, 2018; Vidosavljević, 2022; Vilotijević and Vilotijević, 2016).

In a problem-based learning approach, the student is at the center of the educational process, actively participanting in their learning. The student assumes the role of a researcher, testing hypotheses in various ways (Vidosavljević, 2022). This is typically done by engaging prior experiences and knowledge, viewing the problem from different perspectives, recognizing connections and relationships between known and unknown data and elements, and through observation and monitoring of the phenomena or processes under investigation. Methods such as measurement, experimentation, and evidence-based explanations derived from data collected during observation are also employed.

Problem-solving, as a significant teaching method that meets the demands of contemporary society, fosters the development of students' independent thinking and creative abilities. Additionally, as an effective form of learning, problem-solving is believed to contribute to a better understanding of the phenomena, processes, theories, or laws being studied, resulting in more lasting retention and greater applicability of acquired knowledge. It also helps develop abstract thinking. Its impact extends beyond academic knowledge, shaping important personality traits such as perseverance, persistence, motivation, and independence in work and learning (Veinović, 2004). By using a methodical and organizational approach based on problem-solving and its associated teaching and learning strategies, a diversity of activities and the dynamism in the teaching process are achieved. This is essential for fostering an interest in exploring the natural and social world, enriching students' experiences, and shaping their attitudes toward life and work (Pecko, 2015).

It is important to emphasize that, in a problem-based learning strategy, the process of problem-solving, discovering knowledge, and developing abilities, skills, and competencies is just as important as the final learning outcome (Terhart, 2001). For this reason, the teacher’s role in this approach is highly complex. The teacher is no longer the primary source of knowledge; instead they become the organizer and facilitator of the learning process. Their role shifts to encouraging and guiding students in their research, with a focus on the process of investigation rather than on the results. The teacher's attention, and the core objective of problem-based teaching, is not centered on memorizing and reproducing content, facts, or data, but on motivating students to find solutions to problems, formulate hypotheses, and create research plans that include activities such as data analysis, exploring different sources of knowledge, conducting experiments, building models, and more (Pecko, 2015).

4. CONCLUSION

Among various teaching methods, discovery-based learning and problem-solving hold a prominent position in contemporary "Nature and Society" education. Their implementation plays a key role in achieving the outlined outcomes in the new teaching and learning curricula. Over the past few decades, there has been a clear shift from traditional lecture-based teaching to one that emphasizes active student engagement. In this context, the specific teaching and learning methods discussed in this paper deserve special attention. These methods ensure that students take an active role and are deeply involved in the learning process. By engaging actively, students contribute to the comprehensive development of their personalities. A review of relevant theoretical sources indicates that the core values of discovery-based learning and problem-solving include independent knowledge acquisition, sustained motivation, and the enhancement of students' cognitive abilities, with a particular emphasis on logical reasoning, critical thinking, and creativity. Encouraging research and active participation in knowledge discovery and problem-solving leads to more durable knowledge that can be applied more easily and quickly in practice, thereby contributing to the development of essential skills and competencies for daily life.

In addition to their significant importance and numerous benefits, it is essential to highlight that discovery-based learning and problem-solving present real challenges for teachers in their implementation (Blagdanić and Banđur, 2018). Successfully applying these methods requires a thorough analysis of curricula to select appropriate content that aligns with the goals of these approaches within "Nature and Society" lessons. Many teachers are not effectively trained to carry out and implement these methods (Anđić and Vidas, 2021; Niemi, 2002). A potential barrier to their use is the perceived loss of authority, as well as the fact that, these approaches may be unfamiliar to some educators (Pickford, Garner & Jackson, 2013), requiring a significant investment of time and effort to master (Anđić and Vidas, 2021; Ćaleta et al., 2023). In addition to concerns about inefficiency (Veinović, 2004), other challenges include underdeveloped cognitive abilities and skills in students, occasional indiscipline, and difficulties in classroom management (Niemi, 2002). Furthermore, there is often a tendency to assess student achievement based on memorization and the reproduction of content, rather than through active engagement and problem-solving (Blagdanić and Banđur, 2018). Despite these challenges, the value and significance of the methods discussed should not be overlooked.

It is widely accepted that one of the fundamental objectives of modern education—promoting the active involvement of students in the teaching and learning process—can be effectively realized through inquiry-based instruction, which is rooted in problem-solving and discovery-based learning models (Anđić and Vidas, 2021). Active learning and inquiry-driven approaches, aligned with the methodologies of both natural and social sciences, are integral components of contemporary teaching in "Nature and Society" education (ibid.). The teaching frameworks discussed in this paper support impactful learning, where students are at the heart of discovering and expanding knowledge, collaborating with peers and teachers, and engaging in a stimulating environment where "Nature and Society" lessons hold significant relevance. Drawing upon data from related research, it is evident that discovery-based learning and problem-solving not only help achieve predetermined goals and objectives but also foster deeper exploration and inquiry. These methods promote research activities and diverse forms of cooperative learning. Problem-solving, rooted in independent research rather than relying solely on external experiences or pre-existing knowledge, prepares students to address real-life challenges. This approach contributes to the development of self-aware,

autonomous, and liberated individuals.The insights presented in this study stem primarily from the analysis of theoretical reserach, which limits the scope of this work. However, it is important to emphasize that the conclusions drawn are consistent with previous studies and underscore the significant positive impact of discovery learning and problem-solving as active teaching and learning methods. This paper serves as a foundation for further research, paticularly in exploring the direct implementation of these methods in interaction with students.

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UČENJE PUTEM OTKRIĆA I REŠAVANJA PROBLEMA U NASTAVI PRIRODE I DRUŠTVA

Specifičnost programske građe nastave prirode i društva ukazuje na raznovrsnost i zastupljenost sadržaja većeg broja različitih prirodnih i društvenih nauka. Kompleksnost sadržaja o prirodnim i društvenim pojavama i procesima podrazumeva primenu istraživačkog pristupa i usklađivanje specifičnosti pojedinih prirodnih i društvenih nauka kojima ti sadržaji pripadaju sa metodičkim pristupom nastavnom predmetu. Rad se bavi karakterističnim mogućnostima realizacije programskih sadržaja predmeta Svet oko nas i Priroda i društvo u prvom ciklusu osnovnog obrazovanja i vaspitanja, čija primena u planiranju i ostvarivanju nastave može omogućiti razvijanje i izgrađivanje sistema pojmova o prirodnim i društvenim pojavama. Na temelju postojećih teorijskih saznanja i proučavanja relevantne pedagoško-metodičke literature, utvrđeno je da dobre rezultate daju učenje putem otkrića i rešavanja problema kao metode nastave i učenja koje potenciraju aktivnu ulogu učenika u procesu otkrivanja i razvijanja znanja. Saznanja do kojih se došlo otvaraju prostor za nova istraživanja o ovoj temi, uz smernicu da veća pažnja bude posvećena implementaciji navedenih metoda nastave i učenja u neposrednom radu sa učenicima.

Ključnereči: *nastava prirode i društva, programski sadržaji, učenje putem otkrića, rešavanje problema, samostalno sticanje znanja*