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Opinions of mathematics students about the vocational education system for teachers

Opinie studentów matematyki na temat systemu kształcenia zawodowego nauczycieli

Abstract

This article presents a definition of the teaching situation. It characterizes two fundamental pedagogical concepts throughout history: Herbartian teaching (in the context of the Steiner school) and Deweyan teaching. Contemporary teaching is also included. Contemporary teaching systems are discussed, divided into three main systems identified in the literature: authoritarian, humanistic, and technological. This systematic approach also includes Okoń's theory of multifaceted education. The presentation includes statements from students of the second-cycle full-time mathematics teacher training program and postgraduate mathematics studies at the Faculty of Mathematics and Natural Sciences, School of Sciences, Cardinal Stefan Wyszyński University in Warsaw. During the lecture, *Fundamentals of Mathematics Didactics*, students participated in the forum "My teacher education system." The most important, most frequently occurring opinions, those that best capture the essence of the topic, were identified.

Keywords: contemporary didactics, Deweyan didactics, didactic situation, didactics system, Herbartian didactics, mathematics didactics, mathematics, Steiner's school, theory of multilateral education

Streszczenie

W artykule przedstawiono definicję sytuacji dydaktycznej. Scharakteryzowano w nim dwie fundamentalne koncepcje pedagogiczne obecne w historii: dydaktykę herbartowską (w kontekście szkoły steinerowskiej) oraz dydaktykę deweyowską. Zaprezentowano również dydaktykę współczesną, wyróżniając trzy główne systemy wskazywane w literaturze przedmiotu: autorytarny, humanistyczny i technologiczny. Takie systemowe ujęcie uwzględnia także teorię kształcenia wielostronnego autorstwa Wincentego Okonia. W pracy przytoczono wypowiedzi studentów studiów magisterskich (II stopnia) na kierunku nauczycielskim (specjalność: matematyka) oraz słuchaczy studiów podyplomowych z zakresu matematyki, prowadzonych na Wydziale Matematyczno-Przyrodniczym (Instytut Matematyki) Uniwersytetu Kardynała Stefana Wyszyńskiego w Warszawie. W ramach wykładu „Podstawy dydaktyki matematyki" studenci wzięli udział w forum dyskusyjnym zatytułowanym

„Mój system kształcenia nauczycieli". Zidentyfikowano najważniejsze i najczęściej pojawiające się opinie – te, które najlepiej oddają istotę omawianego zagadnienia.

Słowa kluczowe: dydaktyka współczesna, dydaktyka deweyowska, sytuacja dydaktyczna, system dydaktyczny, dydaktyka herbartowska, dydaktyka matematyki, szkoła steinerowska, teoria kształcenia wielostronnego

Introduction

When reviewing educational systems, it's important to consider the simplest situation, which is, in a sense, a component, a unit, of the educational system – that is, the educational situation itself. From the perspective of an external observer, this is the interplay of various components: the educational content, the teacher's methodology, and the teacher on the educational content and the organization of education. The content delivered is, to some extent, tailored to students, meaning students influence the content and the organization of education. Furthermore, students and teachers change, both under the influence of factors occurring in the educational situation and those external to it. Educational content and teaching aids are subject to historical modernization, but the means themselves (and sometimes the content itself) age. External factors regulate the organization of education.

The entire system of purposefully designed, interconnected, and mutually interacting teaching situations leads to the creation of a teaching system.

A brief description of teaching methods over the centuries

Concepts related to didactics, or the methods of teaching and upbringing, have been developed over the centuries. Modern educational systems are divided into the traditional system, Herbartian didactics (Herbartism, 8th/19th centuries); the system associated with the new educational movement-Deweyan didactics (progressivism, 19th/20th centuries); and the contemporary system-contemporary didactics.[1] Zygmunt Mysłakowski called the first two of them "two great pedagogical concepts of humanity."[2]

In Herbartian didactics (according to Czesław Kupisiewicz), the most important goal was to shape strong moral characters through guiding children, keeping them constantly occupied, that is, discipline (morality based on strong character) and the related teaching. Education cannot be separated from teaching; knowledge must be linked to feelings and will; there are no acquired or inherited psychological dispositions; life is made up of ideas. To evoke emotional experiences, one must influence

[1] C. Kupisiewicz, *Dydaktyka ogólna*, Warszawa 2000, p. 43.

[2] Z. Mysłakowski, *Wychowanie człowieka w zmiennej społeczności*, Warszawa 1964, p. 82.

ideas. This is how a scheme of teaching levels was created: clarity (resting exploration), association (progressive exploration); system (resting understanding), method (progressive understanding); these define the course of teaching. According to them, the teaching process was to progress from ideas to concepts and to skills. A characteristic feature of this system was formalism and rigor, with a tight lesson plan.[3]

An alternative (and worth mentioning) to the above teaching approach was the emergence of the so-called Steiner school (early 19th century). Its main tenets were to develop children's skills, emphasizing their individual development in harmony with nature. Its founder believed that each separate discipline only explores and analyzes the human being and his functioning. It was a shocking change. This school offered/continues to offer three groups of subjects:

1. Core subjects – native language, mathematics, history, geography, physics, chemistry.
2. Artistic subjects – visual arts, music, elements of history, art, theatre, and eurhythmy.
3. Practical subjects – sewing, cooking, basketry, baking, stonemasonry, carpentry.

These schools still exist today, largely unchanged. Waldorf schools have their own curriculum, independent of state curricula. They do not emphasize any worldview.[4]

Deweyan Didactics: At the turn of the 20th century, Herbartian didactics became the subject of harsh criticism. Opinions condemning the rigor and authoritarianism of teaching and upbringing began to prevail, and proposals were made to create a school tailored to children, one that would take their interests and needs into account. The most radical, creative, and representative of this concept was John Dewey. At the end of the 19th century, he founded a school in Chicago where he developed and tested his educational concept.

A school tailored to the child (Édouard Claparede), an active school (Henryk Rowid), a socializing school (Peter Petersen), and a school worthy of the child's centenary (Ellen Key). It was intended to accommodate students' interests, develop their minds, wills, and feelings, teach them to think and act, serve as a place for free, creative work, encourage collaboration, individualize content and the pace of learning, and encourage activity. The goal was to develop students' innate interests and gain rich experience. Lessons should be designed to include stages in problem-solving, such as experiencing the difficulty of the problem, describing it, searching for a solution, verifying the hypothesis, and solving the problem.[5]

Contemporary didactics, although different from the didactics, do not reject all their assumptions and postulates, but do eliminate one-sidedness and promote abstract thinking. Psychology, understood as the science of the higher functioning

[3] C. Kupisiewicz, *Dydaktyka ogólna*, pp. 43–46.

[4] F. Edmunds, *Pedagogika Rudolfa Steinera. Szkoły waldorfskie na świecie i w Polsce*, Kraków 1996; J. Kiersch, *Pedagogika waldorfska. Wprowadzenie do pedagogiki Rudolfa Steinera*, Kraków 2008.

[5] C. Kupisiewicz, *Dydaktyka ogólna*, pp. 45–61.

of living beings, occupies a prominent place. It assumes that students should acquire systematized knowledge through cognitive, empirical, teacher-guided, and independent activities. It incorporates the so-called "link concept," i.e., the diversity and multiplicity of teaching tasks. When selecting content, it emphasizes the need to respect both social and individual needs. It emphasizes the purpose of holistic teaching at younger ages and subject-specific teaching at older ages. It discusses various organizational forms of teaching. It assumes that outcomes are not determined by hereditary or environmental factors (although they certainly influence the teaching process), but that the teacher's work is at least as important.[6]

Teaching systems

Simply put, a teaching system is a teacher's work plan that includes substantive content, instructional methods, and educational activities. The previously mentioned teaching situations are the lessons in which this work plan is implemented. It is created and optimized based on the adopted educational goals, that is, the precisely defined student characteristics we want to achieve upon exiting the teaching system, that is, after completing a given learning cycle.

When creating a teaching system, we must remember that it does not exist in a vacuum. Students have developed before and will continue to develop after leaving it. The broad material and social context of education constantly influences our actions. Therefore, there was a "before," there will be an "after," and our actions do not take place in isolation from other factors and variables.

When discussing contemporary teaching systems, in the literature, we often encounter a division into three main teaching systems:

a) authoritarian,
b) humanistic,
c) technological.

The authoritarian system is based on Herbart's system, in which goals are formulated from above, expressing the needs of the state and the authorities, and the teacher must adapt all his or her actions to these goals. Students must unconditionally submit to these actions, and the teacher, in a sense, represents the state. The instructional content is uniform and primarily rote. We encountered such a school in the so-called socialist system. Of course, we encounter it in all totalitarian states and wherever excessive discipline is required, such as military schools and some monastic schools.

In a humanistic system (similar, at least in part, to Dewey's model), the focus is on the student and their needs and interests. The teacher's role is to recognize

[6] *Ibidem*, pp. 51–56.

these needs, learn about students' interests and talents, and serve as a "guide" along the path to spontaneous, unfettered development. Educational content is freely selected, and teaching aids are designed to stimulate creativity.

In **the technological system**, the emphasis is on the effectiveness of mastering selected educational content, both knowledge and (perhaps especially!) skills. This system is the primary focus today. The teacher selects appropriate educational content, including its scope and level of mastery. Teaching aids, appropriately matched to the established learning objectives, play a crucial role, and the organization of education is carefully planned. Monitoring student achievement is crucial, and it occurs at various stages of education – this is where we see the most applications of educational measurement. It can be called the most "practical," though it also carries certain risks that limit educational outcomes.

It is worth noting here **the theory of multilateral education** according to one of the leading Polish educators, Wincenty Okoń. Already in the 1950s, he stated that the goal of education is personality development, and we should develop each of the personality spheres: mental – a person experiences the world and the values accumulated in it, intellectual – a person learns about the world and themselves, and physical/practical – a person changes the world.[7] His concept opposes both didactic sensualism (the cult of the principle of visualization), one-sided abstractionism (the cult of book knowledge), and didactic instrumentalism (the cult of practice).[8]

Mathematics students specializing in teaching and their teacher education system

The research was conducted among 51 future mathematics teachers – students of the second-cycle teaching specialization in mathematics and postgraduate studies in mathematics at the Faculty of Mathematics and Natural Sciences of the School of Sciences of the Cardinal Stefan Wyszyński University in Warsaw. Over the years (since 2008), while lecturing on *Fundamentals of Mathematics Didactics*, the author has hosted a forum where she asks students the question: "My teacher education system."[9] The research was limited to the years 2023–2026.

Qualitative analyses are quite difficult. They cannot be presented numerically and carry a certain element of subjective choice – why these responses and not others? The selection of respondents depended on the number of mathematics teaching students in each year. Their number was as follows: 2023 – 5 people,

[7] W. Okoń, *Podstawy wykształcenia ogólnego*, Warszawa 1987, p. 196.

[8] W. Okoń, *Słownik pedagogiczny*, Warszawa 1992, p. 135.

[9] J. Kandzia, *Podstawy dydaktyki matematyki*, Forum: *Mój nauczycielski system kształcenia*, https://e.uksw.edu.pl/course/view.php?id=53893, https://e.uksw.edu.pl/course/view.php?id=46805, 2024/2025/2026 and earlier.

2024 – 4 people, 2025 – 11 people in full-time studies and 21 in postgraduate studies, 2026 – 10 students. Due to the article's limited size and readability, it was necessary to make some selections from the collected material. In the following years, 2, 1, 6, 4, and 4 statements were selected, respectively, that were not merely repetitions of the information contained in the lecture and were unconventional.

Student statements

"When I think about how I would like to teach, I'm most drawn to a concept that combines different approaches/different systems. Contemporary teaching doesn't reject earlier systems but strives to overcome their one-sidedness. Of particular importance to me are the principles of Okoń's multifaceted learning theory, which emphasizes the development of various areas of a student's personality and the use of associative, problem-based, emotional, and operational strategies in the teaching process. This approach has proven effective during my tutoring sessions, where I've observed how various forms of activity help students better understand mathematics."

"I draw heavily from the humanities system, which focuses on the student, their needs, interests, and talents, and assigns the teacher the role of a guide supporting the student's development. This role of the teacher is particularly close to my heart because I want students to feel safe and be able to openly discuss difficulties, especially when they stem from previous deficiencies, which perfectly aligns with the need to recognize the initial state in the teacher education system."

"The technological system also cannot be dismissed; it involves planning the teaching process, clearly defining content and goals, and regularly assessing students' achievements at various stages of education. It is consistent with my own style of work – orderly, consistent, and based on a clear line of reasoning. In mathematics, I need to show students that many tasks are based on similar patterns/algorithms, and that an insignificant change in data leads to a different, but logically related, situation."

"I would use Herbart's system to structure the teaching process, which stems from a pattern of progression from ideas to concepts and skills, though without the formalism and rigor typical of that system. The element of clarity and logical structure is particularly dear to me because I never demand anything from a student that I haven't already shown and organized."

"I'm inspired by Dewey's concept of problem-based learning, which involves moving through successive stages: recognizing the problem, describing it, finding an idea, verifying the hypothesis, and solving the problem. This method of working allows students to independently discover relationships, which is especially valuable when working with more mathematically advanced students."

"My system would have to be flexible, in line with the procedures for creating a teacher education system, which include recognizing the initial state, identifying contributing and disruptive factors, and adapting methods to the current classroom situation. When working with students with varying levels of knowledge and skills, this flexibility can be crucial, so it would naturally become part of my system. Monitoring the learning process both during and at its conclusion would also be an essential element, allowing for modifications and refinement of working methods."

"My goal would be to create lessons in which students actively seek solutions, so I would utilize elements of methods focused on action and discovery, not just on receiving ready-made content. In many situations, I would draw on Dewey's ideas because experiential learning helps students better understand the meaning of learning. At the same time, I would want to introduce some order, so I would also reach for solutions inspired by Herbartian didactics, such as short introductory stages that help students get a foothold. An individual approach would also be important in my work - this is the element I value most in the humanities system. I want students to be able to express their emotions and opinions, so I would often use methods that require discussion and collaboration."

"I see great value in clear organization and setting specific goals, which is typical of a technological system. I believe that thanks to such solutions, students know where they are going and what skills they are developing. I wouldn't give up on practical activities either-I would be inspired by both Okoń's operational strategy and more contemporary activation methods. When introducing my own system, I would ensure it wasn't closed or rigid; I would want to be able to respond to what's happening in the classroom. Therefore, my system would be a mix of different concepts, but one consciously chosen to suit me as a teacher and the needs of my students."

"When developing my vision for the learning system, I would like to combine a clear lesson structure with opportunities for more independent student work. In my opinion, individualization is key – students have diverse needs and learning paces, so the system should account for this. I envision this as a set of materials with varying levels of difficulty, allowing people to work at their own pace. I'm also thinking about shorter modules with clearly defined goals, so that students know exactly what they need to learn and how to assess it."

"I attach great importance to clear feedback, because well-formulated feedback can facilitate further learning. Shorter assessments and point-based guidance seem particularly helpful. Logical arrangement of material and fostering systematicity are important to me – in mathematics, everything is based on previous steps, so order and repetition are crucial. I want lessons to provide space for collaborative problem-solving, because such tasks allow for the comparison of different strategies and teach step-by-step thinking."

"I'd like to create an atmosphere where mistakes are a natural part of the process, not a cause for stress. In the long run, I'd like students to gradually take more responsibility for their learning and be able to assess what they're still missing."

"In the current reality, I have been working for many years with classes that occasionally lack special education decisions or opinions regarding learning difficulties. Therefore, the teacher's educational system will depend on the group (class) I work with. Currently, I prioritize the associative strategy alongside the operational strategy. Students remember much more easily when the material is consolidated through action. The more independent, the better. The teacher should be a «compass» at every moment of the student's independence and point the right direction of action or correct inappropriate deviations."

"Constructive discussion and a cultured exchange of observations between students and teachers are particularly important in my work – this allows for an interdisciplinary approach to science, while also strengthening students' social skills. In today's world, teachers should also be sensitive to all social relationships within a given group and support positive ones, regardless of the subject being taught. I also reward student activity and enthusiasm – nothing can clip a young person's wings like not being able to appreciate their efforts."

"When creating my own teacher education system, I take into account the subject I will be teaching. I believe that, in the case of mathematics, it is necessary to combine an associative strategy, which means learning through the acquisition of ready-made knowledge – the foundations of the subject that teachers should cover. Another significant element will be a problem-based strategy, meaning learning through independent exploration of knowledge. We use this element when students already possess basic knowledge. The final strategy will be operational – learning by doing, which I would use to consolidate existing knowledge and expand it according to my own needs. I would adapt it to the educational goals I have set for myself and to the group of students for whom it was created. Mathematics is a subject that requires, above all, intellectual and practical activity, which allows students to acquire knowledge and improve their performance."

"When creating my own teacher education system, my priority would be to create an educational environment that takes into account the needs, interests, and pace of development of each student. Modern education should put students first – their activity, curiosity, and development should be the primary goals. A key element of my system would be the idea of comprehensive education, which integrates intellectual, emotional, and practical activity. In accordance with the theory of multifaceted education outlined by W. Okoń, I believe students should learn through discovery, experience, and action. Striving to intellectually activate students by solving real-world problems and considering problem-based strategies not only allows them to develop cognitive skills but also shapes their ability to think independently and overcome difficulties."

"A crucial element in my teaching system would be students' emotional engagement. I believe that education cannot be limited to merely conveying facts but must also engage emotions so that students deeply experience the learning process.

Only then will they be able to fully grasp the concepts discussed and build values that will guide their future actions. In an era of dynamic technological change, I would like to introduce technological elements into the system that will enable students to learn by doing. Learning through experimentation, the use of digital tools, and project work will allow them to understand better not only theory but also the practical application of knowledge in everyday life and in the professions of the future."

"In my education system, I would place particular emphasis on project work, which develops creativity, collaboration, and practical problem-solving skills. All these elements, combined with flexibility, allow the creation of a system that is not rigid but adapts to students' individual needs. By continuously monitoring progress, as indicated by the educational system development procedure, I adapt my work methods to students' changing needs and learning pace and respond to any difficulties. I believe that a 21st-century teacher is one who not only imparts knowledge but also supports students in their individual development, creates space for creative thinking, engages them emotionally, and develops practical skills. It is crucial that we, as teachers, be flexible, open to change and innovation, but always place students at the centre of the learning process."

Conclusions

Analysis of the responses allowed us to understand students' and future mathematics teachers' opinions regarding the teacher education system. The young people's opinions are balanced. They do not glorify any teaching system or method. In each, they found values they would like to apply in their future work. They draw on their own experiences – as students, tutors, and teachers. The content of the lectures took on a real dimension. It's not just dry theory and a passing exam. The question posed provoked them to connect theory with reality and to delve deeper into the issue.

When teaching mathematics, we combine/select from each system what seems most beneficial. Methods that allow for the most transparent and understandable presentation of concepts and problems, developing mathematical skills that enable us to solve many of the problems of the modern world. Working in a school, and especially teaching mathematics, is a huge challenge. Reluctance to approach this subject is widespread in our society. In many cases, this stems from a fear of it, the belief that children and young people must somehow overcome it (like a disease), and inadequate teaching in the early years. Each didactics, each educational system, highlights crucial elements that are helpful in the work of a mathematician. Therefore, it is encouraging that future mathematics teachers (familiar with scientific assumptions) will strive to incorporate diversity in their work, rejecting the stereotype of one-sided approaches.

It's worth mentioning that to achieve full student development, we should utilize various strategies (**APEO**): **A** – associative strategy (association – Herbart), **P** – problem-based strategy (Dewey), **E** – emotional strategy, **O** – operational strategy.

Certain forms of learning characterize each of these strategies. For example, strategy A – learning through the acquisition of ready-made knowledge, strategy P – learning through independent acquisition of knowledge, strategy E – learning through experience, and strategy O – learning through action.[10]

Summary

In Poland, we are witnessing and participating in a strong trend toward the humanization of pedagogy. The time of authoritarian, instrumental pedagogy, which produced "builders of socialism," is over. Today, two great schools are vying for superiority: the humanistic school, focused on students' needs and self-development, primarily on the experience of values, and the technological school, which demonstrates how to use theory, tools, and interpersonal communication to improve the effectiveness of education.

Both groups seek to empower students in some way: by equipping them with spiritual values or by arming them with strategies for achieving goals. The battle is between authoritarian relics in pedagogy: the forced acceptance of outdated values of previous generations, the overly strong influence of charismatic teachers, and the moral nihilism of mass culture and its media.

Relations between representatives of these two schools are not the best, and humanists do not feel comfortable in the company of technologists. Nevertheless, it is important to note the "complementarity" between these schools. Both groups strive to empower students in some way: by instilling spiritual values or by equipping them with strategies to achieve their goals.

Focusing on the student evokes a deep interest in their development. It elevates educational diagnosis from a kind of didactic "materials science" to the recognition of the profound values that guide the partner in the educational process.

The importance of humanizing pedagogy for the development of educational diagnosis cannot be overstated. Choosing the right direction, however, is not enough. Appropriate technology is needed to develop a program for obtaining useful information.

In a knowledge society, we are unable to isolate ourselves from the media, information technology, computer science, and artificial intelligence that have infiltrated our lives. Teaching methods are also changing, including personalization, project-based learning, and gamification,[11] and SEL (Social and Emotional

[10] W. Okoń, *Wprowadzenie do dydaktyki ogólnej*, Warszawa 1995, p, 196.

[11] Gamification is a teaching method that uses mechanisms known from games: points, levels, rewards, and rankings.

Learning) – these are solutions that combine technology, emotions, and practice. The best are those that prepare students for life – interdisciplinary, relationship-based, and new-technology-oriented.

Schools must provide students with extensive development opportunities so that they can pursue their interests and use the most beneficial learning methods, enabling them to develop and shape their personalities. It highlights the importance of the teacher – they must be versatile, able to observe students and guide them appropriately. Teachers are a key group that shapes a school's character. The level of mathematics education for children and young people depends on their collaboration, teaching, and nurturing.

Of course, the school structure must enable both teachers and students to function effectively.

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