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**USING EXPERIENCE OF PROFESSIONAL IMPROVEMENT
OF POLISH TEACHERS OF SCIENCE AND MATHEMATICS
IN POSTGRADUATE PEDAGOGICAL EDUCATION OF UKRAINE**

ABSTRACT

The article examines the peculiarities of improving the qualifications of Polish teachers as one of the conditions for their professional advancement and obtaining professional degrees.

The main tasks of the system of professional improvement of teachers in Poland are characterized – namely, helping young teachers to adapt to the profession, supporting specialists during the period of professional self-affirmation or renewal of the subject, familiarization with the achievements of science, assistance in raising and expanding qualifications.

The principles of professional improvement of Polish teachers are defined. They include the relationships between theory and practice, changeability, variety of forms, continuity, multidimensionality, multilevelness and openness. The organizational structure of the system of improving the qualifications of teachers of natural and mathematical subjects in postgraduate education in Poland, which functions at the national, regional, municipal levels, is considered. It is emphasized that the system of improving the qualifications of specialists has a public-state character, is quite variable and flexible; it is created taking into account various needs for continuous professional development and improvement of teachers.

Attention is paid to consideration of the forms of professional development of teachers in non-formal education that is aimed at strengthening the internal motivation of specialists, and development of their pedagogical creativity.

It is defined that teacher training system in Poland is aimed at the performance of tasks that include professional development, methodical work of teachers, self-education and self-improvement, as well as the implementation of general (educational, developmental, educational, diagnostic) and specific (technological, research, prognostic) functions.

Conclusions are made regarding the directions, forms, and content of advanced training of mathematics and science teachers in postgraduate education of the Republic of Poland and the need to form the readiness of Ukrainian specialists to accept European standards in postgraduate pedagogical education.

Keywords: *teachers of science and mathematics, professional advancement, development, improvement, advanced training, postgraduate education, experience, Republic of Poland, Ukraine.*



ВИКОРИСТАННЯ ДОСВІДУ ПРОФЕСІЙНОГО ВДОСКОНАЛЕННЯ ВЧИТЕЛІВ ПРИРОДНИЧО-МАТЕМАТИЧНИХ ПРЕДМЕТІВ ПОЛЬЩІ У СИСТЕМІ ПІСЛЯДИПЛОМНОЇ ПЕДАГОГІЧНОЇ ОСВІТИ УКРАЇНИ

АНОТАЦІЯ

У статті розглянуто особливості підвищення кваліфікації польських вчителів як однієї з умов їх професійного просування і здобуття професійних ступенів. Схарактеризовано основні завдання системи професійного вдосконалення вчителів Польщі – допомога молодим учителям в адаптації до професії, підтримка фахівців у період професійного самоствердження або оновлення предмета, ознайомлення з досягненнями науки, сприяння в підвищенні та розширенні кваліфікації. Визначено принципи професійного вдосконалення польських учителів – взаємозв'язок теорії й практики, змінюваність, різноманітність форм, безперервність, багатовимірність, багаторівневість та відкритість. Розглянуто організаційну структуру системи підвищення кваліфікації вчителів природничо-математичних предметів у післядипломній освіті Польщі, що функціонує на національному, регіональному, муніципальному рівнях. Підкреслено, що система підвищення кваліфікації фахівців має суспільно-державний характер, є досить варіативною й гнучкою, створена з урахуванням різноманітних потреб щодо безперервного професійного вдосконалення й розвитку вчителів. Приділено увагу розгляду форм підвищення кваліфікації вчителів у неформальній освіті, що спрямовані на посилення внутрішньої мотивації фахівців, розвитку педагогічної творчості.

Визначено, що система підготовки вчителів у Польщі спрямована на виконання завдань, які включають підвищення кваліфікації, методичну роботу вчителів, самоосвіту та самовдосконалення, а також реалізацію загальних (освітньої, розвивальної, виховної, діагностичної) і специфічних (технологічної, дослідницької, прогностичної) функцій.

Зроблено висновки щодо напрямів, форм і змісту підвищення кваліфікації вчителів математики і природничих предметів в післядипломній освіті Польщі та необхідності формування готовності українських фахівців до прийняття європейських стандартів в післядипломній педагогічній освіті.

Ключові слова: *вчителі природничо-математичних предметів, професійне просування, розвиток, вдосконалення, підвищення кваліфікації, післядипломна освіта, досвід, Польща, Україна.*

INTRODUCTION

The development of the modern system of advanced training of teachers of science and mathematics subjects in postgraduate education of Ukraine is directly considered in the context of the European future of the country and is connected with the integration of education into the European educational space. The European Union has long recognized the importance and relevance of the support and professional improvement of teachers as an important element of the European education system. Within the framework of our study, we turn to the analysis of the experience of the Republic of Poland, a member state of the European Union, which in a short time achieved positive changes in the issues of reforming the teacher improvement system in the context of European integration processes in education.

THE AIM OF THE STUDY

The article is aimed at studying Polish experience regarding the organization of advanced training of teachers of natural and mathematical subjects in postgraduate



education of the country with the aim of outlining constructive ideas that can be productive in the system of postgraduate pedagogical education of Ukraine.

THEORETICAL FRAMEWORK AND RESEARCH METHODS

The problems of training and professional improvement of teachers in Poland are given due attention by both Polish and Ukrainian researchers. In particular, the scientists of the Republic of Poland studied such aspects as different approaches to teacher training (M. Buczkowska-Gola (2000), R. Mushketa (2007)), organization of continuing education (P. Palicheb-Bąk and Uliszak R. (2022)), training and professional development of teachers in pedagogical theory and practice (A. Jarzębska (2014), J. Golik (2015), M. Pachocki (2019)).

As part of our research, we studied not only the works of the mentioned researchers, but also analyzed the practical experience of educational institutions in which professional improvement of Polish teachers of natural and mathematical subjects is carried out at the national level (Centre for Education Development (Ośrodek Rozwoju Edukacji, ORE), The Centre for the Development of Polish Education Abroad (Ośrodek Rozwoju Polskiej Edukacji za Granicą, ORPEG), Polonia Teachers' Center (Polonijne Centrum Nauczycielskie, PCN)). We also analyzed the activities of informal organizations on the professional development of teachers (Foundation of mathematicians of Wrocław (Fundacja matematyków wrocławskich) and Polish Physical Society (Polskie Towarzystwo Fizyczne (PTF))).

In the course of the research, we applied a number of general scientific methods, in particular pedagogical observation, study of documents and Internet resources of educational institutions and associations of teachers of mathematics and natural sciences, study of the best practices and innovative didactic solutions, processing of sociological and statistical materials, as well as systematization and generalization of data collection.

RESULTS

Polish analytical sources on the development of education (Edukacja jest w niej ukryty skarb, Raport dla UNESCO Międzynarodowej Komisji do spraw Edukacji dla XXI wieku, 1998) note that upgrading of skills today is an inevitable process caused by the need to keep up with the modern rapid socio-economic development in the society. This process of flexible response to a changing environment occurs, in particular, thanks to the work of teachers, professionally educated specialists who prepare their students to act in conditions similar to those they will encounter later in their work (Edukacja jest w niej ukryty skarb, Raport dla UNESCO Międzynarodowej Komisji do spraw Edukacji dla XXI wieku, 1998). Achieving a high level of teacher qualification is an additional value for society and should be reflected, first of all, in the improvement of the quality of education (Golik, 2015). Thus, teaching profession is characterized by the need to update existing knowledge and acquire new skills. Every teacher should be focused on improving their qualifications and developing their individuality, because the competitive labour market is constantly changing the requirements for teachers and schools. The professional promotion system also motivates teachers to improve their qualifications, which improves the quality of school work (Jarzębska, 2014).

In Poland, the professional development of school teachers is closely connected with the opportunity to receive professional advancement and acquire the next professional degree, which usually affects the level of specialists' salaries. In particular, at the legislative level, the professional promotion of teachers is defined by Art. 9a of the Teacher's Card (Karty Nauczyciela, 2008) as a process of professional development by teachers, educators and other teaching staff working in institutions operating in accordance with the Act of



14 December 2016 – the Education Act (Education law, 2016). It is noted that a teacher who wants to achieve successive levels of professional advancement must constantly improve their qualifications. According to the current legislation, teachers who start working at a school are novice teachers. Having worked for at least 3 years and 9 months (or 2 years and 9 months according to the shortened procedure), they can become appointed teachers. After another 5 years and 9 months of work, they can become certified teachers, which completes their career path (Gotówka, 2023).

It is necessary to turn to the experience of the Republic of Poland concerning organizing teacher training, including specialists in natural and mathematical subjects, in postgraduate education. First of all, the process of improving the qualifications of representatives of this profession is aimed at improving the quality of the functioning of educational institutions in which teachers work, as well as at the personal development of teachers. Therefore, there is such a procedure as the need to prepare plans for the teacher's professional development and provide reports on their implementation. The professional development plan (plan rozwoju zawodowego) is formed taking into account the specifics and needs of the educational institution where the teacher works. It also contains tasks related to the professional advancement of the teacher who is being certified. The school director approves the teacher's professional development plan or returns it to the teacher for revision, indicating the necessary changes. A so-called folder with documentation of implemented projects is attached to the application (Jastrzębska, 2011).

Among the wide range of tasks set before the system of professional improvement of teachers in Poland, and, therefore, the improvement of the qualifications of teachers of natural and mathematical subjects in postgraduate education, is the provision of assistance to young teachers in adapting to the profession, supporting specialists in the period of professional self-assertion or a subject and pedagogical knowledge renewal, familiarization with the achievements of science, assistance in improving or changing the qualification/specialty. Among the principles of educational activity that are taken into account in this process are the relationship between theory and practice, changeability, variety of forms, continuity, multidimensionality, multilevelness and openness (Buczowska-Gola, 2000).

Polish scientists, in the coverage of questions regarding the definition of the main functions of the teacher training system, note that its operation is aimed at the performance of tasks that include professional development, methodical work of teachers, self-education and self-improvement, as well as the implementation of general (educational, developmental, educational, diagnostic) and specific (technological, research, prognostic) functions (Mushketa, 2007). The developmental function is considered to be the leading one among them, since the professional development of teachers in post-graduate pedagogical education "is oriented towards the recognition of the teacher as an active and independent subject of their own professional development" (Okoń, 2001).

Our analysis of scientific and pedagogical sources allows us to describe the organizational structure of the system of advanced training of teachers of natural and mathematical subjects in post-graduate education of the Republic of Poland, which is managed at the national, regional, municipal levels.

At the national level, strategies are being developed for the functioning of teacher training centers, the formation of educational spaces in educational institutions, the harmonization of legislation and the adoption of normative acts, the determination of funding sources, the coordination of the activities of regional and municipal educational institutions, and the monitoring of the process of improvement of specialists. Thus, the Ministry of



Education and Science (Ministerstwo Edukacji i Nauki) in the main areas of implementation of the educational policy of the state in the 2023/2024 school year paid attention to improving the competences of school leaders and teachers regarding conditions and methods of in-school assessment, as well as the development of the qualifications of students and teachers using equipment purchased under the "Laboratories of the Future" program (Podstawowe kierunki realizacji polityki oświatowej państwa w roku szkolnym 2023/2024, 2023). The goal of this initiative, which is implemented by the Ministry of Education and Science in cooperation with the GovTech Center at the Office of the Prime Minister of Poland, is to support all primary schools in the formation of future competencies among students in the direction of STEAM (science, technology, engineering, art and mathematics) (Ministerstwo Edukacji i Nauki, 2023).

In the educational space of the Republic of Poland, at the national level, the system of improving the qualifications of teachers of natural and mathematical subjects in postgraduate education of the country is ensured by the Center for the Development of Education (ORE – Ośrodek Rozwoju Edukacji). The Education Development Center is a state-owned national educational institution managed by the Ministry of Education and Science. The institution offers such forms of teacher training as electronic courses (kurs e-learningowy), webinars, trainings, conferences. The offered forms of professional development are short-term and have a general orientation, designed for teachers of various categories: electronic training courses "Planning measures in the field of health promotion. From diagnosis to assessment" (health promotion, 10 hours), "Combating domestic violence against children and implementing the Blue Card procedure in education" (education and prevention, 10 hours), webinar "The Year of Nicolaus Copernicus" (development of social and civic competences, 3 hours), "Student with migration experience at school/ regional training" trainings, training for new instructors of the "GOLDEN FIVE" program (educational and preventive under the program "Golden Five"), "Working on the positive" (identifying and strengthening the resources and potential of the student), conference "The role of SCWEW in building a friendly educational environment - summary of the project" (ORE, 2023).

Public and private institutions of higher education (publiczne i niepubliczne szkoły więzów), which provide educational services in the field of postgraduate teacher education (studia po dyplomowe), also offer various forms of professional development for teachers of mathematics and natural sciences. In particular, the Institute of Mathematics, Faculty of Mathematics and Informatics of the University of Wrocław (Uniwersytet Wrocławski, Instytut Matematyczny, Wydział Matematyki i Informatyki), with the assistance of the Foundation of Wrocław Mathematicians (Fundacja matematyków wrocławskich), which has been operating at this institution since 2007 (the founder is Prof. Tomasz Rolski (Tomasz Rolski)), organize training and improvement for mathematics teachers. Among the proposed activities is a seminar for teachers "Inspiration. Individualization. Interdisciplinarity", postgraduate education programs "Modern methods of teaching mathematics" (210 hours), a course for teachers, students and parents (help with dyscalculia), "Specific difficulties in learning mathematics" (30 hours), a course for teachers, students, teachers, parents "Programming in grades 1–3" (30 hours), professional English or German courses "English for Mathematics Teachers", "German for Mathematics Teachers" (English for Mathematics Teachers, Deutsch für Mathematik lehrer) (30 or 120 hours), project "Let's get to know mathematical Europe"



(Poznajemy matematyczną Europę). The Foundation continues the activities of the Wrocław Scholarship Mathematicians Foundation (1991-2007), awards scholarships to talented high school students, and also students of mathematical specialties and young scientists in the field of mathematics (Fundacja matematyków wrocławskich, 2023).

Poland's experience in supporting the professional development of teachers working abroad in various European cities and countries is valuable for the functioning of the Ukrainian system of professional development. Within the structure of the Center for the Development of Polish Education Abroad (Ośrodek Rozwoju Polskiej Edukacji za Granicą – ORPEG) there is the Polonius Teacher's Center (Polonijne Centrum Nauczycielskie – PCN), which provides educational services for the professional improvement of teachers, carries out methodological and substantive support in teaching subjects in Polish. PCN conducts stationary trainings and online courses, prepares educational materials and maintains constant communication with teachers. There are free trainings on the methods of teaching subjects, the use of the latest technologies and psychological support. Textbooks and didactic materials are delivered free of charge, course dates are selected according to the needs of teachers and time zones in which integration takes place, teachers choose the form of classes independently (online/offline). Thus, in 2020, 4,250 participants took part in 111 training sessions, in 2021 – 7,626 participants in 157 training sessions, in 2022 – 8,447 participants in 152 training sessions. The catalog of qualification courses conducted by PCN also includes a number of proposals for improving and expanding teachers' qualifications. In particular, an 80-hour qualification course is relevant for geography teachers, which involves preparation for teaching information about Poland (kursy kwalifikacyjne dla nauczycieli wiedzy o Polsce) for IV–VIII grades of secondary school and comprehensive lyceums abroad in accordance with the general education plan (PCN. Polonijne Centrum Nauczycielskie, 2023).

So, thanks to such activity, geographical and interdisciplinary mobility of the improvement process of Polish science and mathematics teachers who work outside the country is achieved. In Ukraine, these issues require attention in connection with forced migration related to the war, labor migration of the able-bodied population, and the formation of the Ukrainian educational diaspora.

In general, at the regional and municipal levels, educational services are provided by 42 teacher training institutions subordinated to or controlled by the Ministry of Education and Science (Ministerstwo Edukacji i Nauki, 2023). Thus, the Małopolskie Centrum Doskonalenia Nauczycieli (MCDN, a state-accredited institution for the improvement of teachers, the governing body of the Małopolska Voivodeship) includes educational institutions Ośrodek w Krakowie, Ośrodek w NowySóńcu (Ośrodek w Nowym Sączu), Ośrodek w Oświęcimiu, Ośrodek w Tarnowie. The goals of the MCDN are to support the professional development of teachers, educational management personnel and the organizational development of schools and educational institutions in the implementation of tasks that follow from current legal norms, directions of the state's educational policy, and regional policy in the field of education. Among the tasks performed by the educational institution is the organization and functioning of the network for cooperation and self-education; implementing forms of improvement for teachers and headmasters of schools/educational institutions, including workshops, seminars, courses (qualification, assignment and improvement of qualifications), conferences, trainings and lectures for pedagogical teams, held at the request of the headmaster of the school/educational institution; provision of consultations; dissemination of examples of



best practices; informing teachers about the forms of education available in the voivodship, obtaining further education and improvement (MCDN. Instytucja Wojewudztwa Małopolskiego, 2023).

Among the planned events organized by the Improvement Center in Krakow for one month, short-term offline forms of advanced training are provided. In particular, the seminar "Eco-logical ("Eko-logicznie") on the implementation of selected areas of the state's educational policy in the 2023/2024 school year (3 hours) is offered for elementary school biology and nature teachers. Its content is related to diagnosing the needs of biology teachers, discussions on the selected issues of the educational policy of the state, and ecological support of students' interest. Classes in the network of cooperation and self-education on the topic "Eco-inspiration - a network of cooperation and self-education of biology and nature teachers" (2 hours) are also offered, the content of which is diagnosis of teachers' needs, exchange of experience and plans for the new academic year, suggestions for eco-inspiration. For mathematics teachers, the workshop "Student activity is a condition for effective mathematics learning" (4 hours) is offered. Its content covers the questions of the influence of group work on the activation of students, the ability to learn as a task/challenge for the teacher, the essence and purpose of using the selected methods and techniques of learning activation, the use of selected methods and forms of work in school practice (Ośrodek w Krakowie, 2023).

The regional project "Academy of Equal Chances – Support for the Development of Key Competencies of Students of Primary Schools and Gymnasiums in the Kamiona Wielka Gmina" (Akademia Równych Szans – Wspieranie rozwoju kompetencji kluczowych uczniów szkół podstawowych i gimnazjów w gminie Kamiona Wielka) with the support of the Regional Program of European Funds (Fundusze Europejskie Program regionalny) provides training for teachers aimed at the development of professional skills in the areas of teaching natural sciences and mathematics, work with the application of the experimental method, and the use of modern tools and information and communication technologies. Networks are organized for cooperation and self-education, developing the skills of teachers in both areas. The project envisages the equipping of school science and mathematics laboratories with means and various devices for teaching, as well as the purchase of ICT tools to increase the use of information and communication technologies in the educational process (Projekt – Akademia Równych Szans, 2023).

If desired, teachers can join other educational projects organized at the international and national levels. For example, the project "Biology Educators Shaping Tomorrow" is implemented within the framework of the Program "Erasmus +" and operates in Poland with the support of the Polish Association of Science Teachers (Polskie Stowarzyszenie Nauczycieli Przedmiotów Przyrodniczych – PSNPP). One of the forms of cooperation among specialists from different countries is the organization of meetings where teachers have the opportunity to improve their professional level and exchange experience (Polskie Stowarzyszenie Nauczycieli Przedmiotów Przyrodniczych, 2023). In particular, during the meetings organized in the city of Krakow (19.05–22.05.2022), teachers improved their pedagogical skills, and also got acquainted with the history of the city. The teachers presented the main goals and results of the activities of the associations to which they belong, took part in the discussion on the education systems of the countries participating in the project, worked in international groups to create notes for biology lessons. The proposed topic for creating lessons was the concept of "biodiversity in the environment" and the use of modern technologies aimed at increasing students' awareness



of this topic, namely, application programs for recognizing plant and animal species. The practical part of the activities was field training at the artificial reservoir Zakzuwek in Krakow (Palicheb-Bąk & Uliszak, 2022).

It should be noted that thanks to the implementation of the Erasmus+ program, a key program implemented by the European Union in education, participating teachers improve their skills in foreign languages and study other cultures. According to the assumptions of the Erasmus+ program, educational trips of school education employees contribute to the international mobility of people (Pachocki, 2019).

As part of the cooperation between the European Commission and Esri Inc. (Komisji Europejskiej i Esri Inc.), Educational team of "Esri Polska Sp. z o. o." firm (Zespół Edukacji firmy Esri Polska Sp. z o.o.) has been participating in the program for schools called "The Digital Skills and Job Coalition" for several years. This program is successfully implemented in the USA, Canada, Australia, New Zealand and a number of European Union countries. The main goal of the project is to introduce geographic information systems (systemy informacji geograficznej – GIS) into education by providing free software and materials useful for teachers and students. Workshops for teachers organized under this program help those who wish to learn about the possibilities of using GIS tools in school activities with students. At the same time, contact is maintained with institutions of higher education concerning professional improvement of teachers – the "Summer School 2023" training (Warsaw city) is organized in cooperation with teachers of the Faculty of Geology of the University of Warsaw (Wydział Geologii Uniwersytetu Warszawskiego) where free classes are conducted in the form of mixed education. During remote communication, the Microsoft Teams platform is used, and special field days are being prepared for teachers to get acquainted with the possibility of using the ArcGIS platform to conduct such field classes with students (Polskie Stowarzyszenie Nauczycieli Przedmiotów Przyrodniczych, 2023).

Improving the qualification of physics teachers with the help of forms of informal education implemented with the assistance of the Polish Physical Society (Polskie Towarzystwo Fizyczne (PTF)), aimed at strengthening the internal motivation of specialists, promotes the development of creativity in pedagogical activities. On the initiative of the community, thematic contests are held for teachers and their pupils – "Contest for the best didactic poster", contest "Festivals of Physics", "Competition for the mascot of the 48th Congress of Polish Physicists", contest "Physical Reports" (Konkurs "Migawki z fizyki"). The purpose of PTF activity is popularization of physics, development of connections between physicists working in education, science and various branches of the economy (Polskie Towarzystwo Fizyczne, 2023). In the meeting of the Warsaw branch, within the framework of the First Warsaw Conference (I Warszawska konferencja nauczycieli, 2023), such forms of training for teachers as "active workshops" (practical masterclasses) are provided. Micro-mentoring and individual consultations with experts, presentation of proposals for daily use in modern teaching of physics and other exact and natural subjects from student organizations and companies that support education, meetings with special guests, for example, Sławosz Uznański – a Polish candidate for a space mission to the Moon, are organized. Active exchange of experience of Polish specialists takes place at systematic conferences of physics teachers held once every three years. In particular, the 48th Congress of Polish Physicists (Zjazd Fizyków Polskich) will be held in September 2023 (Gdansk), which has been declared the year of the outstanding Polish scientist Nicolaus Copernicus.



CONCLUSIONS AND PROSPECTS OF FURTHER RESEARCH

Summarizing, we note that modern system of improving the qualifications of Polish teachers of natural and mathematical subjects in postgraduate education of the country has a public-state character, is quite variable and flexible, and created taking into account various needs of specialists regarding their continuous professional improvement and development.

The prospect of further research is the analysis of the legal framework for in-service training of teachers of science and mathematics in postgraduate education in the Republic of Poland.

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