

MODELING THE PROCESS OF ORDERING THE MAIN OBSTACLES TO THE PROFESSIONAL COMPETENCE OF FUTURE TEACHERS

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INTRODUCTION

One of the most important areas of the modern stage of informatization of world education is a harmonious combination of high rates of development of information and communication technologies, those educational tasks that can be performed with their help, the worldview environment, thanks to them, the traditional innovative and humanistic principles of modern pedagogy and the search for the main obstacles, which can hinder the development of both the personal potential of the future teacher and the development of his professional competence, because it must be remembered that the purpose of educational activity is not the use of certain technologies, but the training and education of a person capable of self-determination and self-realization, which is especially difficult in world of information technology and environments. (OCHIROV, 2016; CEBRIÁN, G., JUNYENT, 2015).

The problem of forming the professional competence of a future teacher who is able to simulate the educational process, independently generate and implement new ideas and technologies of teaching and upbringing, is relevant today, since a professionally competent teacher has a

positive impact on the formation of students' creativity and achieves the best results in their professional activities. contributes to the implementation of his professional skills.

It is obvious that future teachers should become a new formation of teachers who are called upon to meet the ever-growing demands of the information society for teaching the younger generation. A teacher, like no one else, works in conditions that are constantly changing and modified, therefore his professional training requires a variety of not only forms, methods, approaches and pedagogical technologies, but also means, training, contributing to the formation of professional competence of students-future teachers. (RIZVI, NAGY, 2015).

The teaching profession requires a person to possess many non-trivial skills from many fields of knowledge, thorough preparation and constant improvement throughout the entire professional career. In addition, the professional training of a teacher cannot be only theoretical: it is necessary to constantly support theory with practice, and experience with basic knowledge. profession, the requirements for which are constantly changing.

The experience of pedagogical activity indicates that it is impossible to fully master all the skills and knowledge necessary for a full-fledged pedagogical career at one time. The teacher should be able to develop, adapt to new forms of knowledge presentation and changing working conditions, while remaining a source of social values. (HARFITT, TAVARES, 2004).

We consider the formation of the professional competence of the future teacher as a process of mastering stable, integrated, systemic knowledge in pedagogy, psychology and other

subjects, the methods of teaching it and the ability to apply them in new situations, personality traits, the ability to achieve significant results in professional activity.

Modern society's requirements for the quality of education intensify the search for ways to develop the innovative potential of secondary schools, modernization processes that accumulate in the pedagogical system of educational institutions significantly change the requirements for the professional competence of teachers. (ELMAN, FORREST, 2007).

The main provisions of the competence-based approach to education are considered in the context of searching and ordering the main threats and obstacles that affect the professional competence of the future teacher. According to Shen-Miller, Schwartz-Mette, Van Sickle, Jacobs, Grus, Forrest, (2014) and Bibik (2020) the formation of a clear systematized model of obstacles affecting the professional competence of a future teacher, to help overcome the traditional cognitive orientations of higher education, leads to a new vision of the content of education itself, its methods and technologies. This approach can preserve cultural, historical, ethno-social values. It is aimed at the active life and life creation of a person who is able to generate ideas and is able to implement them in the context of a new educational paradigm - "education throughout life".

In modern conditions of modernization of teacher education in the context of European integration, the professional competence of the teacher is of key importance. The professional competence of a modern teacher can be viewed as a kind of response to the problematic situation in national education, which arose as a result of the contradiction between the need to ensure modern quality and the inability to solve this problem in the traditional way by further increasing the amount of information to be assimilated by students. As Walberg (1999) and Hager (1999) notes, the criteria for assessing the effectiveness of the teacher's professional and pedagogical activity are indicators of the formation of the corresponding basis of the student's activity, which determine the student's ability to independently manage his own activity and himself as an object.

Today the teacher must understand his professional activity in a new way. After all, he mainly works not with the student, but with the subject, and as the main task he still puts forward tasks for the quantitative and qualitative assimilation of educational competencies in the academic subject (PRYSTUPA, KRYSHCHANOVYCH, DANYLEVYCH, LAPYCHAK, KRYSHCHANOVYCH, SIKORSKYI, PODOLYAK, BASARAB, 2020).

The need to change this position of the teacher to the position of the so-called "pedagogical support" is dictated by modern requirements for the organization of training according to the principles of pedagogical support. For such training, the emphasis is not on the program material, but on the organization of individual intellectual activity. The teacher analyzes himself and helps to understand the student not only the meaning of what he learned, but also how he managed to do it (with the help of what methods).

In this regard, the main result of the school's activities should be a set of key competencies in the intellectual, informational or communicative spheres, including the formation of a clear and orderly system of main obstacles that can interfere with the development of the professional competence of the future teacher (EPSTEIN, HUNDERT, 2017; LIZZIO, WILSON, 2004).

Taking into account the above, the urgent need and task of modern pedagogical science is the development of appropriate teaching, educational and scientific means of educational activity that allow all subjects of the educational process to fulfill their functions most fully, including in the conditions of ultra-fast rates of informatization of the pedagogical environment.

A significant factor in bringing education to a qualitatively new level is not only the development and implementation of high-quality pedagogical software in various subjects, but also the formation of mechanisms for identifying, systematizing and further counteracting the main obstacles that have an impact on the development and improvement of the professional competence of future teachers. (JACOBS, HUPRICH, CAGE, ELMAN, FORREST, GRUS, KASLOW, 2011; PETROVICI, 2014).

In this regard, the problems of developing new content, methods and means of the main ways to identify obstacles that have an impact on the development process and increase the professional competence of future teachers are becoming acutely urgent.

THEORETICAL BASIS AND MATERIALS

The pedagogical community of the is faced with the task of permanently coordinating their own teaching and educational efforts in the context of identifying and countering the main obstacles that affect the process of increasing and developing the professional competence of future teachers with that super-fast step of implementing information and communication technologies. It has already become axiomatic that in the conditions of informatization of education the paradigm of pedagogical science is changing, the content and structure of education is changing. (LUPAK, KOPOTUN, HAMZA, ALBUL, PANOVA, 2020) Computer technologies of teaching give rise to new methods based on active, independent forms of acquiring knowledge.

The analysis of studies related to the definition of the list and content of the teacher's professional competence allows us to conclude that the formation of the teacher's professional competence presupposes the entry into deep knowledge of the academic subject, the methods of teaching it, didactics, psychology, pedagogy, the development of pedagogical skills that are associated with actions teachers in various pedagogical situations, the formation of the necessary personal qualities, communication skills, the presence of the need for self-improvement and self-development. (CHAPPELL, MELVILLE, 1995).

The teacher must be familiar with the methodology and didactic principles, be able to develop his own methodology, select and create an expedient and balanced software and methodological support of the educational process, and with an understanding of the psychological characteristics of students, the teacher must be able to help them unleash their creative potential, choose an individual educational route. (BAARTMAN, BASTIAENS, KIRSCHNER, VAN DER VLEUTEN, 2007; NOZDROVA, 2016; KLOS, KRYSHANOVYCH, MUKAN, 2020): how the future teacher is ready to fulfill his professional duties in accordance with the modern requirements of theory and practice; as knowledge and experience in the pedagogical industry; as awareness of a young teacher in the professional field.

The methodological conditionality of the use of expert assessments in science-metric studies is most evident when considering the diagnostic aspect of the examination. Therefore, as a rule, expert assessment (survey) is widely used in reconnaissance and pilot studies to obtain preliminary data about the object, the subject of analysis, to clarify the hypotheses and tasks of the main research, to develop a forecast and supplement and clarify certain processes and phenomena.

An important point in conducting this kind of survey is the selection of experts, primarily according to their level of competence. At the first stage of selection, we used two criteria as a criterion: occupation and length of service in a teaching profile. In addition, we also took into account the nature of education, experience, age. But the main among all the criteria for selecting experts is their competence. To determine it, one uses - with varying degrees of accuracy - methods of self-assessment of experts, assessment of the results of past activities of candidates for experts and collective assessments of the authority of experts. In the course of the study, we selected 30 representatives of higher education institutions in Eastern Europe (Poland, Ukraine, the Czech Republic), who have all the criteria of experts, which are listed above. Taking into account the existing unstable epidemiological situation in the world, the method of remote questionnaires and interviews, which were developed according to a special program, became the main tool for expert interviews, the survey procedure consists either in questioning and interviewing experts.

Accordingly, as a result of the expert assessment methodology, the experts identified the following main obstacles that have the greatest impact on the development and improvement of the professional competence of future teachers.

- Pandemic Covid-19

- Quality and level of education
- misunderstanding education in general
- Social and racial inequality
- Attitude towards young, inexperienced personnel and their innovative views on education
- Outdated teaching methods
- Dismissive pupil and student attitude

Having compiled a list of external and internal obstacles that affect the development and improvement of the professional competence of future teachers, the next step of our research is the application of graph theory and hierarchical ordering methodology, with the help of which we can visually depict the level of impact of all the presented obstacles.

METHODOLOGY

Graph theory belongs to the branch of mathematics in which graphs and their properties are studied. Graphs are usually depicted as points (vertices) connected by segments (edges). Graphs can be defined graphically, in the form of lists of edges, using incidence and adjacency matrices, which greatly simplifies the creation of mathematical models based on visual representation. Using graphs, you can visually represent objects and relationships, or connections between them (SYLKIN, KRYSHCHANOVYCH, ZACHEPA, BILOUS, KRASKO, 2019).

Consequently, in order to form a model of the hierarchical influence of the main obstacles affecting the development and increase of the professional competence of future teachers, it is first necessary to build the above-mentioned graph of connections, for this it is necessary to establish for the main threats identified by us, based on the results of an expert assessment, which today have the greatest influence on the development and improvement of the professional competence of future teachers, mathematical notation, which will be displayed in the constructed graph of connections.

Suppose that the set of certain obstacles is a certain set. From this set, we select a subset of significant threats. For clarity, the mathematical designation of each factor will be supplemented by its mnemonic name (Table 1).

Table 1. A list of the main negative factors affecting the education in the preparation of future teachers

Mathematical notation	Thr name of obstacle	Mnemonic name
Z_1	Pandemic Covid-19	PC
Z_2	Quality and level of education	QLE
Z_3	Misunderstanding education in general	FSS
Z_4	Attitude towards young, inexperienced personnel and their innovative views on education	AI
Z_5	Social and racial inequality	SRI
Z_6	Outdated teaching methods	OTM
Z_7	Dismissive pupil and student attitude	DA

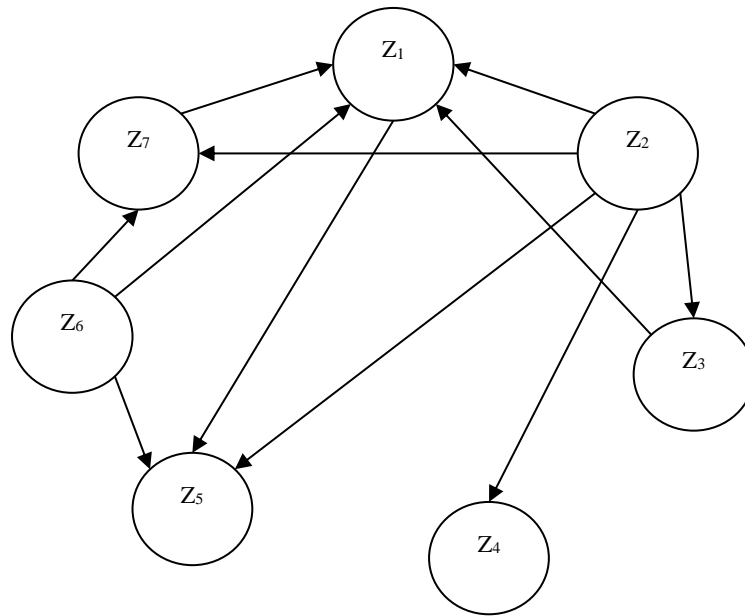
Source: Search data.

Based on the constructed graph, we construct a binary dependence matrix A for the set of vertices Z_1 as follows (1):

$$a_{ij} = \begin{cases} 1, & \text{if criterion (vertex) } i \text{ depends on criterion (vertex) } j; \\ 0, & \text{if criterion (vertex) } i \text{ do not depends on criterion (vertex) } j \end{cases} \quad (1)$$

At the first stage, we represent the subset of threats Z_1 and possible relationships between them in the form of a directed graph (Fig. 1), at the vertices of which the elements of the subset Z_1 are located, arcs connect adjacent pairs of vertices (z_i, z_j) , for which the connections are determined. It indicates a certain dependence of one threat (beginning of the arrow) on another (end of the arrow).

Figure 1. Graph of connections between of the main negative factors affecting the education in the preparation of future teachers



Source: Search data.

We place the matrix A of 7 × 7 elements in the table, adding to it an information line and a column with the names of threats (Table 2).

Table 2. Binary Dependency Matrix

		1	2	3	4	5	6	7
		PC	QLE	FSS	AI	SRI	OTM	DA
1	PC	0	0	0	0	1	0	0
2	QLE	1	0	1	1	1	0	1
3	FSS	1	0	0	0	0	0	0
4	AI	0	0	0	0	0	0	0
5	SRI	0	0	0	0	0	0	0
6	OTM	1	0	0	0	1	0	1
7	DA	1	0	0	0	0	0	0

Source: Search data.

Based on the binary matrix of reachability, we build the reachability matrix. We form a binary matrix $(I + A)$, where I is the identity matrix. As a result, the reachability matrix must satisfy condition (1):

$$(I + A)^{k-1} \leq (I + A)^k = (I + A)^{k+1}. \tag{2}$$

The actual construction of a binary matrix is reduced to filling in a table (Table 3), similar to the one given above, the binary elements of which are determined by the following rule (2):

$$b_{ij} = \begin{cases} 1, & \text{if from } i \text{ it is possible to pass to } j; \\ 0, & \text{otherwise} \end{cases} \tag{3}$$

Table 3. Rach Matrix

		1	2	3	4	5	6	7
		PC	QLE	FSS	AI	SRI	OTM	DA
1	PC	1	0	0	0	1	0	0
2	QLE	1	1	1	1	1	0	1
3	FSS	1	0	1	0	0	0	0
4	AI	0	0	0	1	0	0	0
5	SRI	0	0	0	0	1	0	0
6	OTM	1	0	0	0	1	1	1
7	DA	1	0	0	0	0	0	1

Source: Search data.

The vertex z_j is reached from the vertex z_i if there is a path in the graph (Fig. 3.1) that leads from the vertex z_i to the vertex z_j . Such a top is called reachable. Let us denote the subset of such vertices by $S(z_i)$. Similarly, the vertex z_i is in front of the vertex z_j if it reaches its vertex. Let the collection of predecessor vertices form a subset $P(z_i)$.

Finally, a section of subsets of reachable and predecessor vertices, that is, subset (4):

$$R(z_i) = S(z_i) \cap P(z_i), \quad (4)$$

Vertices that are not reached from any of the remaining vertices of the set Z_1 determine a certain level of the priority hierarchy of the threats associated with these vertices. An additional condition is to ensure equality (5):

$$P(z_i) = R(z_i). \quad (5)$$

Using these formulas and the calculation of the table, in the "Results" section, we formed a hierarchy of the influence of the main negative factors affecting the education in the preparation of future teachers.

RESULTS

The implementation of the set of the above actions gives the first level (the lowest in terms of the importance of influencing the process under study) of the hierarchy of the main obstacles that affect the development and improvement of the professional competence of future teachers. To determine it based on the preliminary matrix, we build the Table 4.

Table 4. Calculation table for building the model of the hierarchy of the influence of the main obstacles affecting the development process and increasing the professional competence of future teachers

i	$S(z_i)$	$P(z_i)$	$S(z_i) \cap P(z_i)$
1	1, 5	1, 2, 3, 6, 7	1
2	1, 2, 3, 4, 5, 7	2	2
3	1, 3	2, 3	3
4	4	2, 4	4
5	5	1, 2, 5, 6	5
6	1, 5, 6, 7	6	6
7	1, 7	2, 6, 7	7

Source: Search data.

The second column of this table is the numbers of the unit elements of the corresponding rows of the access matrix, the third is the numbers of the unit elements of the columns of this matrix. Equality (5) is fulfilled for the 2nd - quality and level of education (QLE) and the 6th - outdated teaching methods (OTM) obstacles. Next, we remove rows 2 and 6 from Table 4, and cross out numbers 2 and 6 in the columns. We obtain Table 5, which is the basis for calculating the second iteration of finding the threat numbers that determine the next level of the hierarchy.

Table 5. Calculation table for building the model of the hierarchy of the influence of the main obstacles affecting the development process and increasing the professional competence of future teachers

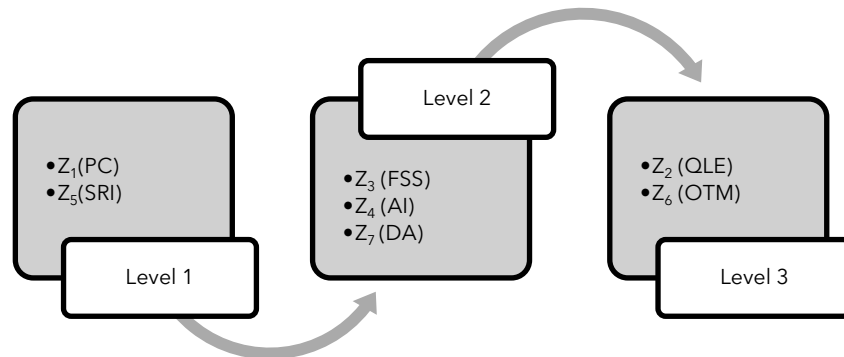
I	S(z _i)	P(z _i)	S(z _i) ∩ P(z _i)
1	1, 5	1, 3, 7	1
3	1, 3	3	3
4	4	4	4
5	5	1, 5	5
7	1, 7	7	7

Source: Search data.

In the second iteration, equality (5) is fulfilled for the third - Misunderstanding education in general (FSS), the fourth - attitude towards young, inexperienced personnel and their innovative views on education (AI) and the seventh - Dismissive pupil and student attitude (DA) obstacles. These obstacles to the development and increase of the professional competence of future teachers determine the next level of the hierarchy. Therefore, from Table 5 we delete rows 3, 4 and 7, and in the 2nd and 3rd columns - numbers 3, 4 and 7. Without further calculations, it can be argued that the first ones will occupy the highest level of the hierarchy - pandemic of Covid-19 (PC) and fifth - social and racial inequality (SRI) obstacles to the development and increase of professional competence of future teachers .

Arranging the obstacles to the development and improvement of the professional competence of future teachers at certain levels, we obtain a hierarchically structured model (Fig. 1), imitating the priority of their influence on the development and improvement of the professional competence of future teachers.

Figure 2. Impact hierarchy model of influence of the main obstacles affecting the development process and increasing the professional competence of future teachers



Source: Search data.

Using graph theory, we were able to hierarchically organize the main obstacles we identified that have the greatest impact on the development and increase of professional competence and prioritize the influence of each of them on the above process. The results of this study make it possible to form, in the future, mechanisms to counter these obstacles and significantly improve the process of developing the professional competence of future teachers .

The data presented in this article may be relevant for representatives of higher educational institutions who are interested in both the development of the professional and personal potential of students, as well as an overall improvement in the quality of education in each individual university.

CONCLUSIONS

Today, the world's pedagogical community is faced with the problem of training teachers who can work in the context of the rapid development of information and communication technologies. Considering this, the identification, analysis and systematization pedagogical aspect of identifying of the main negative factors affecting the education in the preparation of future teachers of is one of the main tasks facing representatives of higher educational institutions in the context of a modern informatized society. In the context of verified topical issues, we are looking, using the methodology of expert committees, which clearly show the transition, which can be the largest in the development process and a lifelong use of special future organizations. These representatives were selected at their training sessions, which took place and worked on a professional basis.

The next step in our research was the ordering of these obstacles to professional competence using graph theory and hierarchical ordering methodology. Having carried out all the necessary calculations, we found that the following obstacles have the greatest influence on the development of the professional competence of future teachers today: pandemic of Covid-19; social and racial inequality and misunderstanding education in general. The practical significance of the obtained research results lies in the development of a hierarchical model of the basic obstacles that affect the development and improvement of the professional competence of the future teacher. The results obtained will be relevant for representatives of higher educational institutions and other stakeholders in the context of the implementation of their own mechanisms in countering these obstacles.

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Modeling the process of ordering the main obstacles to the professional competence of future teachers

Modelagem processual dos principais obstáculos à competência profissional dos futuros professores

Modelado del proceso de los principales obstáculos a la competencia profesional de los futuros profesores

Resumo

O problema de compreender o aspecto pedagógico do processo de formação da competência profissional de um futuro professor que seja capaz de modelar o processo educacional, gerar e implementar de forma independente novas ideias e tecnologias de ensino e formação, é hoje relevante, desde um professor profissionalmente competente tem um efeito positivo na formação do processo educacional. O artigo oferece uma generalização teórica e uma solução prática para o problema de compreensão do aspecto pedagógico do processo de compilação dos principais obstáculos à competência profissional dos futuros professores de cultura física. A relevância do estudo reside na formação de uma avaliação do nível e nos principais obstáculos que afetam o desenvolvimento e a melhoria da competência profissional de um futuro professor.

Palavras-chave: Pedagogia. Educação. Instituições superiores. Competência profissional. Obstáculos profissionais.

Abstract

The problem of understanding the pedagogical aspect of the process of forming the professional competence of a future teacher who is able to model the educational process, independently generate and implement new ideas and technologies of teaching and upbringing, is relevant today, since a professionally competent teacher has a positive effect on the formation of the educational process. The article provides a theoretical generalization and practical solution to the problem of understanding the pedagogical aspect of the process of compiling the main obstacles to the professional competence of future physical culture teachers. The relevance of the study lies in the formation of an assessment of the level and the main obstacles affecting the development and improvement of the professional competence of a future teacher.

Keywords: Pedagogy. Education. Higher institutions. Professional competence. Professional obstacles.

Resumen

El problema de comprender el aspecto pedagógico del proceso de formación de la competencia profesional de un futuro docente que sea capaz de modelar el proceso educativo, generar e implementar de manera independiente nuevas ideas y tecnologías de enseñanza y educación, es relevante hoy, ya que un docente profesionalmente competente tiene un efecto positivo en la formación del proceso educativo. El artículo ofrece una generalización teórica y solución práctica al problema de comprender el aspecto pedagógico del proceso de recopilación de los principales obstáculos a la competencia profesional de los futuros profesores de cultura física. La relevancia del estudio radica en la formación de una valoración del nivel y los principales obstáculos que inciden en el desarrollo y mejora de la competencia profesional de un futuro docente.

Palabras-clave: Pedagogía, Educación. Instituciones superiores. Competencia profesional. Obstáculos profesionales.