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## COMPETENCE IN PEDAGOGICAL DESIGN IN THE TRAINING OF PEDAGOGICAL ENGINEERS

*Pedagogical design as a component of the professional competences of vocational education teachers and the importance of this component in the preparation of future teachers for vocational education institutions are considered. A brief analysis of the approaches of scientists to the interpretation of pedagogical design, the role and place of pedagogical design in the modern educational process, in particular, in the context of the use of information and communication technologies, was carried out. The results of a survey of vocational school teachers regarding the use of pedagogical design as a promising direction, which allows building effective online and mixed learning, are presented. It was found that the current state of training of future vocational school teachers regarding the application of pedagogical design in the educational process is ineffective.*

*A theoretical substantiation of the competence of future teachers of a vocational school in pedagogical design, which is determined by the unity of cognitive and procedural components, has been carried out. The criteria for the formation of these components are the ability to build an effective educational process based on learning goals, educational material and modern tools that can be available in the information-educational environment, as well as the ability to provide effective psychological and pedagogical interaction with those who study. The possibilities of the educational discipline "Pedagogical mastery" and pre-diploma practice for acquiring competence in pedagogical design have been identified and experimentally confirmed. During the experiment, in which students of higher education at the master's level from the specialty "Professional education (by specializations)" took part, positive changes occurred in the formation of cognitive and procedural components of competence. This confirms the expediency of further*

*use of the possibility of pedagogical mastery and pre-diploma practice for the acquisition of competence in pedagogical design by future teachers of a professional school.*

**Key word:** *competence approach, pedagogical design, competence in pedagogical design, future engineers-pedagogues.*

### **Ольга Внукова, Олена Удалова, Владислав Величко. Компетентність з педагогічного дизайну у підготовці інженерів-педагогів**

*Розглянуто педагогічний дизайн як складову фахових компетентностей педагогів професійного навчання та важливість цієї складової у підготовці майбутніх педагогів для закладів професійної освіти. Здійснено короткий аналіз підходів науковців до трактування педагогічного дизайну, ролі та місця педагогічного дизайну в сучасному освітньому процесі, зокрема, в умовах застосування інформаційно-комунікаційних технологій. Представлено результати анкетування педагогів професійної школи щодо застосування педагогічного дизайну як перспективного напрямку, що дозволяє будувати результативне онлайн навчання та змішане. Було виявлено, що сучасний стан підготовки майбутніх педагогів професійної школи щодо застосування педагогічного дизайну в освітньому процесі є неефективним.*

*Проведено теоретичне обґрунтування компетентності майбутніх педагогів професійної школи з педагогічного дизайну, що визначається єдністю когнітивних та процедурних компонентів. Критеріями формування цих компонентів є здатність побудови результативного освітнього процесу на основі цілей навчання, навчального матеріалу і сучасних інструментів, які можуть бути доступні в інформаційно-освітньому середовищі, а також здатність забезпечувати ефективну психолого-педагогічну взаємодію з тими, хто навчається. Виявлено та експериментально підтверджено можливість навчальної дисципліни «Педагогічна майстерність» та переддипломної практики для набуття компетентності з педагогічного дизайну. Під час експерименту, у якому взяли участь здобувачі вищої освіти магістерського рівня зі спеціальності «Професійна освіта (за спеціалізаціями)», відбулися позитивні зміни у формуванні когнітивних та процедурних компонентів компетентності. Це підтверджує доцільність подальшого використання можливості педагогічної майстерності та переддипломної практики для набуття компетентності з педагогічного дизайну майбутніми педагогами професійної школи.*

**Ключові слова:** *компетентнісний підхід, педагогічний дизайн, компетентність з педагогічного дизайну, майбутні інженери-педагоги.*

### **Statement of the problem in a general form and its connection with important scientific and practical tasks.**

To ensure the sustainable development of Ukraine and its European choice, the Law of Ukraine «On Education» provides for raising the educational level of citizens. To this end, attention is being paid to the training of teachers. Teachers for the vocational education system in Ukraine are trained in the specialty «Vocational education (by specialization)» in higher education institutions. During the period of quarantine restrictions, it is difficult to acquire the necessary competencies by future engineers-teachers, in particular professional ones, which are determined by the standards of higher education in this specialty. Practitioners are looking for new opportunities to provide educational services through information and educational environments and other distance forms. But the use of modern multimedia resources, various platforms for online services, as well as other software does not guarantee the achievement of learning outcomes. Competent methodological support of selection of the content of the material and its teaching is necessary. The use of Internet technologies still has many unresolved issues in pedagogical science and practice. As a result, pedagogical design, which is already used in many countries, has become in demand, although it is not yet sufficiently theoretically sound. In Ukraine, pedagogical design is just beginning to take hold. This is not only a new trend in the development of pedagogy, but also a necessary component of the competence of the modern teacher. Through COVID-19, all Ukrainian higher education institutions, including vocational school teachers, switched to new forms of work and intensified the use of multimedia and information technologies. This determines the relevance of the study of pedagogical design opportunities for the acquisition of the necessary professional competencies by future pedagogical engineers, in particular, in online and blended learning, as well as justification of the ability to use pedagogical design as part of these competencies.

Analysis of scientific works has shown that pedagogical design is the subject of research by many scientists. It is believed that the term «pedagogical design» began to be used in the early 1960s, although the origins of pedagogical design date back to the 1940s. In the studies of M. David Merrill, Leston Drake, Mark

J. Lacy, Jean Pratt, pedagogical design was considered in terms of the most effective, rational and comfortable ways, methods and systems of teaching that can be used in professional pedagogical practice. «Instructional design is not merely philosophy; it is not a set of procedures arrived at by collaboration; it is a set of scientific principles and a technology for implementing these principles in the development of instructional experiences and environments» [1].

Since the 1980s, pedagogical design has been associated with information and communication technologies, which are contributing to the emergence of new forms, methods and tools of teaching. R. Richey noted about pedagogical design that it is the science of creating a detailed description of the conditions for the development, evaluation and implementation of situations that promote learning [2]. Pedagogical design is also defined as a systemic reflective process of translation from the language of instruction and teaching into the language of planning educational materials, activities, information resources and assessment [3, p. 4]. R. Gagné defined pedagogical design as teaching that is strictly based on pedagogical instruction. The researcher also played an important role in informatization of the educational process [4]. The importance of pedagogical design in e-learning was also emphasized by G. Siemens, who identified it as one of the largest categories, which focuses not on technology but on learning [5]. The history of pedagogical design is a theoretical justification and practical organization of the educational process using a variety of ways to convey knowledge to the learner to improve the effectiveness of learning [6].

Today, there are a number of approaches to defining pedagogical design. Mr. Reinmann sees this concept as a system of procedures that includes the analysis of learning needs and objectives, as well as the development of didactic tools to meet these needs [7]. The activity of determining adequate solutions to pedagogical tasks, the effectiveness of which has theoretical and practical confirmation, as well as their detailed, consistent and justified presentation, is considered by scientists as a process of pedagogical design [8]. It is noted that the pedagogical design of the activities of education subjects is aimed at building models of the transformation of pedagogical reality, and the essence of this process is the identification and analysis of pedagogical problems and their causes, the disclosure of value, the construction of education strategies, the search for methods and means of their implementation, etc. Also, this term is used as a collective term to define the direction of pedagogical science and practice, building an effective educational process. N. Morze considers two levels of pedagogical design [9]: the first as one of the functions of pedagogical activity (prospective planning of tasks and ways to solve them), the second as a separate type of activity that has its own structure (diagnosis, design object, conceptual modeling, system project management, project implementation stages, project success assessment criteria). Pedagogical design is considered by scientists as a special type of creative activity. Such activities include planning, programming, modeling, designing, and predicting actions or consequences. It is interesting to consider pedagogical design not only as a holistic approach to building the learning process, which builds a single system of learning objectives, teaching materials and tools available for knowledge transfer in an open information- educational environment, but also specially organized learning activities (pedagogical sound, technologically implemented, ethically verified and aesthetically designed), which has personal significance for the learner. Some aspects of pedagogical modeling are considered in the study of V. Steshenko and co-authors [10].

It follows from the above that there is still no clear idea of pedagogical design, although scholars are unanimous about its feasibility. Today, in theory and practice, pedagogical design is used in several senses. It is interesting to classify the consideration of the concept: 1) as a process – analysis of learning goals and characteristics of students, designing the educational process, development of optimal pedagogical solutions that improve the quality of education; 2) areas of knowledge about effective strategies of training programs; 3) as a reality – a continuous and non-linear process where planning and development takes place as a result of a series of successive approximations, taking into account the context and feedback to the result. As a process of designing educational materials, pedagogical design is a procedure for solving a learning problem, analyzing the needs and goals of learning, as well as developing a teaching system to meet these needs.

The field of pedagogical design includes analysis of learning problems and performance, as well as the creation, development, implementation, evaluation, management of educational and non-educational processes and resources aimed at improving the educational process in various situations (especially in educational institutions and the workplace) [11, p. 53]. There are a number of pedagogical design models, including: ASSURE, 4C-ID Model, Instructional Systems Design (ISD), Backward Design, Dick and Carey, Gerlach-Ely Model, Spiral Model, Rapid Prototyping, Kemp Design Model, Organizational Elements Model (OEM) and others. ADDIE Model is the most popular, it includes stages: analysis, design, development, implementation, evaluation, and aims to ensure the effectiveness of educational activities in learning with the use of information and communication technologies.

In recent years, pedagogical design has become the main direction of informatization of education, which contributes to the design of pedagogical technologies focused on the formation of skills to carry out various types of independent activities. The emphasis of pedagogical design is shifted from the sequence of presentation of educational materials and their quality to the learning environment, the interaction of different participants in the educational process. Wasson B., Kirschner P.A. analyzed the design of teaching in the European context and stressed that the focus is on teaching design based on the needs of modern teachers. «Research on instructional and learning design is 'booming' in Europe, although there has been a move from a focus on content and the way to present it in a formal educational context (ie, instruction), to a focus on complex learning, learning environments including the workplace, and access to learner data available in these environments... While instructional design is an often heard term in the United States» [12, p. 815].

«The creative and deliberate act of devising new practices, activity plans, resources and tools aimed at achieving particular educational goals in a given context» [13, p. 89]. Also in the focus of European research in recent years – the relationship between learning design and learning analytics [14].

Currently, the focus of researchers is on the educational aspects of disciplines that provide specific ways of learning to acquire certain competencies. But this diversity does not provide efficiency in acquiring knowledge and skills. «In short, next to the uncontested trend of disciplinary specialization in research and education, the complexity of nowadays problems calls for engineers able to integrate simultaneously multiple and diverse types of input with a high degree of synthesis. This is the reason why the 'design driven' approach is increasingly gaining interest; design is par excellence a synthetic way of communicating and can be an important vehicle of communication when working with different disciplines in cross-disciplinary projects» [15, p. 839].

We support the view that «Engineering pedagogy has therefore to balance the need for learners to gain a deep understanding of the theoretical basis of the problem domain whilst grasping its practical implications. However, little is known as to the most effective sequence of delivery: is it better to begin with theory and build up to practice or vice versa?» [16, p. 981]. That is, engineering pedagogy today must take into account the design of the educational process. At the same time, modern researchers point to arguments about the integration of engineering into science education, namely: how curricula that reflect the integrative nature of engineering help students to establish links with scientific concepts; whether students involved in engineering projects develop stronger scientific and technical literacy, whether they can maintain such competencies over time; whether students are aware of the design process as a set of strategies that can be adapted to different types of problem solving, etc. [17, p. 7].

Today it is important to expand the capabilities of teachers, including pedagogical engineers, as designers of learning (educational components, learning environment, new pedagogical technologies, participants in the educational process based on teachers' ref But pedagogical design was not considered in the perspective of training pedagogical engineers in today's online learning and blended learning based on information technology. Insufficient attention is also paid to pedagogical design in the structure of competencies of future engineers-teachers of vocational education, there is a lack of experimental data that would demonstrate the success of the application of this competence in pedagogical practice. Therefore, today it is necessary to analyze and formulate criteria and methods for the formation of professional competence in pedagogical design, in particular for teachers of vocational schools. This led to the relevance of the research topic.

## **Research Methodology**

### *General Background*

The methodological basis of the study is a systematic analysis of the content and organization of training of future engineers-teachers on the basis of the competence approach. A set of interrelated theoretical and empirical research methods is used according to the goal. Psychological and pedagogical works, normative documents on the problems of pedagogical design and formation of professional competencies of future engineers-teachers were analyzed. The research was conducted using the methods of pedagogical experiment, observation, analysis of the results of higher education, questionnaires, testing, interviews, the method of expert assessments, methods of mathematical statistics. Verification of the formation of competence in pedagogical design was carried out in the real educational process. Longitudinal and comparative methods were used to summarize the results of the experiment. Using the longitudinal method, changes in the formation of competence in pedagogical design of higher education students were

monitored, and with the help of the comparative method, the results obtained at different stages of the experiment were compared.

### *Sample*

To identify the attitude of teachers of vocational schools to the problem of forming competence in pedagogical design, a survey of 34 masters of industrial training and teachers of special disciplines of Kyiv Higher School of Sewing and Hairdressing (KVUSHPM), Kyiv Higher School of Technology and Clothing Design (KVUTDO) with different experience specialty (20 people – work experience over 10 years, 8 – from 5 to 10 years, 6 – up to 5 years). During the study in 2017/2020, 54 graduates of the Kyiv National University of Technology and Design of the second (master's) level of higher education in the specialty «Professional education (by specialization)» took part. The representativeness of the sample of respondents is justified by the representation of students from different regions of Ukraine in educational institutions of Kyiv. Experts in assessing the formation of competence in pedagogical design were teachers - leaders of student practice.

The aim of the study was to reveal the feasibility of forming competence in pedagogical design in the process of training future teachers of vocational training, as well as ways to acquire students this competence. The main tasks were: 1) clarification of the concept of «competence in pedagogical design», 2) definition of its components, 3) verification of the effectiveness of the acquisition of this competence by future teachers of vocational schools.

### *Instrument and Procedures*

Questionnaires were developed for masters of industrial training and teachers of special disciplines, with the help of which we determined the attitude of teachers to the problem. A thematic lecture on the concept and importance of pedagogical design in the modern educational process was also prepared. The concept of «competence in pedagogical design» was clarified, the components of this competence were determined based on the analysis of the relevant standard of higher education and a survey of teachers of vocational education institutions.

The cognitive component (CC) of pedagogical design competence was measured by testing students in pedagogical design theory (50 test questions were prepared). The criterion for the formation of the QC was the level of knowledge and skills (low (1-35 points, medium – 36-70, high – 71-100 points). Criteria for the formation of the procedural component (PC) determined the ability to plan and conduct educational activities during the practice (within 60-100 points, which corresponded to the assessment for practice), according to the combination of educational projects and practical tasks in pedagogical skills (from 1 to 40 points). 100) To establish the reliability of the results obtained, a constant method was used, which does not involve the creation of control groups. Conventionally, we considered the group of applicants from different academic groups in the specialty Vocational Education (by specialization) of one course by year of admission: 1st group – 12 people (2017 admission), 2nd – 22 (2018), 3rd – 20 (2019).

### *Data Analysis*

In order to summarize the quantitative characteristics of indicators and reduce the impact of random individual deviations, the average score for the performance of tests, practical tasks, and projects during practice was used to characterize the levels of competence in pedagogical design. The average score was calculated separately for Kk and Pk as the arithmetic mean by the formula:

$$\bar{x} = \frac{\sum f x_i}{N} \quad 1)$$

where  $\bar{x}$  is the average score in the group;  $f$  – frequency of manifestations of individual scores;  $x_i$  – the value of individual points;  $N$  is the number of students in the group.

The dynamics of the formation of competence in pedagogical design was determined by comparing the results of measurements at the ascertaining (F1), intermediate (completion of the course of pedagogical skills) (F2) and final (F3) stages (undergraduate practice) pedagogical experiment.

### *Research Results*

The study began with a survey using Google Forms at <https://forms.gle/BP2Ex9Zeb1Aiw7Dg6>. The results of the survey showed that respondents have sufficient experience in teaching (from 10 years – 57.1%), used electronic resources during epidemiological restrictions (the answer is 88.6%) and well adapted

to quarantine conditions (good – 54.3 %). However, they do not feel successful enough during their studies and have various technical problems on this issue (Fig. 1).

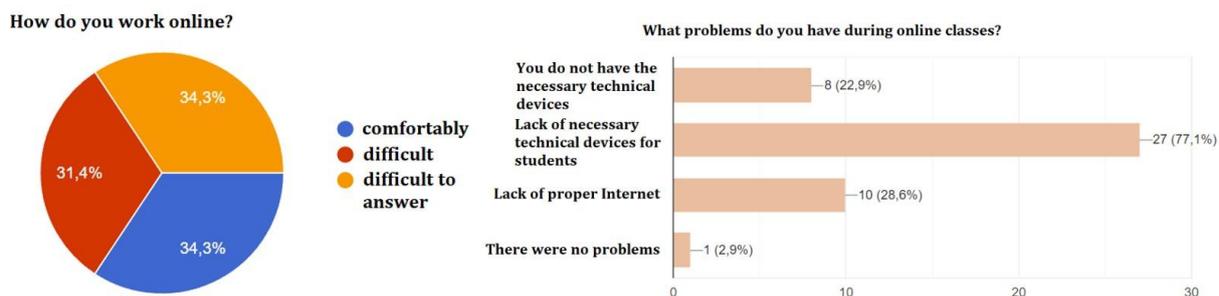


Figure 1. Ancillary survey results

Our study showed that teachers of special disciplines and masters of industrial training rated their level of mastery of remote technologies on 4 points out of 5, and constantly use electronic resources 88.2% of respondents. Only 35.3% of respondents answered in the affirmative that it is convenient to work online, and it was difficult for many to say that 29.4% have difficulties. ZOOM (88.2%), Google Meets (14.7%), Viber (85.2%), Telegram (50%), Webex (5.9%), Skype (20.6%) platforms are used for online learning. %, Whatsapp (14.7%). All interviewed teachers use the electronic educational environment that exists in the educational institution. During online classes, teachers have problems due to lack of necessary technical devices (23.3%), lack of such devices for students (76.5%), lack of proper Internet (29.4%). Online classes are organized by teachers and masters of industrial training through video communication with all students through special platforms (64.7%), through the placement of educational materials in the educational environment (52.9%), in a special group on social networks (61.8%), via e- mail (14.7%). Students submit tasks to teachers via Viber (67.6%), e-mail (52.9%), a special educational platform (58.8%), a special group in educational networks (32.4%). 20.6% of respondents noted difficulties in organizing and conducting classes online, 29.4% found it difficult to answer, although 50% have no problems. Almost all respondents (94.1%) spend more time preparing for online classes than usual.

Educators believe that with the help of certain tools they could make the online learning process more comfortable and productive. This would be facilitated by presentations and multimedia materials (noted by 21 people (61.8%)), changes in forms of student activity (18 (52.9%)), a successful organizational structure of the lesson – (6 (17.6%)). To the question: «Do you agree that the design of the educational environment, both virtual and in the educational institution, has an impact on learning outcomes?» – 30 people. (88.2%) gave a positive answer. Educational institutions attach importance to the artistic design of the educational environment, in particular, the interior design of classrooms, workshops, landscapes, graphic design of educational materials, clothing style of teachers and students (this was confirmed by 65% of respondents).

79.4% did not know about the new direction in education - pedagogical design, 20.6% – had some idea. The interviewed teachers connect the components of competence in pedagogical design with: 1) possession of educational information technologies (47.1%); 2) the ability to effectively plan and conduct classes (44.1%), 3) the ability to organize appropriate psychological and pedagogical interaction during the class (38.2%); 4) practical implementation of effective online learning, including the use of graphic design in the development of online courses or classes (35.3%). Survey participants believe that they have competences in pedagogical design at a sufficient level (38.2%), low (38.2%), others (23.5%) – do not have at all. 94.1% need to increase the level of competence in pedagogical design. When asked whether competence in pedagogical design should be part of pedagogical skills, 82.4% of teachers gave a positive answer.

The most acceptable ways for interviewed teachers to increase the level of competence in pedagogical design: listening to lectures on pedagogical design (66.6%), participation in seminars, webinars (50%), self-study through Internet resources (14.7%). Motivational factors for the acquisition of competence in pedagogical design for respondents were increasing the level of teaching (70.6%), the quality of training (58.8%), the quality of training courses (35.3%). We prepared and conducted a lecture at KVUTDO for teachers on the topic: «Peculiarities of pedagogical design in vocational education institutions», which revealed the interpretation of the concept of «pedagogical design», lesson objectives in the context of pedagogical design, principles of pedagogical design. During the conversation, masters of industrial training

and teachers of special disciplines expressed the need to use pedagogical design, especially in online and blended learning.

The study analyzed the competencies and learning outcomes of future teachers in the specialty «Vocational Education (by specialization) in accordance with the standards of higher education for the second level of higher education, which are approved in Ukraine. We have identified those competencies and learning outcomes that include aspects of professional activity related to pedagogical design» [18, p. 9]. In our opinion, the competence in pedagogical design integrates the selected competencies, as well as those identified by the surveyed teachers, and can be provided by certain learning outcomes, as shown in Table 1.

At the ascertaining stage of the pedagogical experiment, the predominance of a low level of competence in pedagogical design of future teachers of vocational schools in terms of cognitive and procedural components was revealed (Table 2).

The formation of competence in pedagogical design was carried out in the process of studying the discipline «Pedagogical Skills» (6 ECTS credits) and undergraduate practice (15 ECTS credits). Means were provided to ensure the components of competence in pedagogical design and achieve relevant learning outcomes, in particular, through the possibilities of training courses «Pedagogical Skills» and «Undergraduate Practice». The content of these educational components was strengthened with materials on pedagogical design, emphasis was placed on interactive teaching methods and project methods, exercises on forming elements of educational classes, including online classes, in compliance with the principles of pedagogical design, etc. were introduced into practical classes. In particular, during the lectures of the course «Pedagogical Skills» while studying the topic «Social significance of professional activity of teachers» students were provided with information about the concept of pedagogical design, history, modern understanding and the need for pedagogical engineer skills in pedagogical design. The topic «The concept of pedagogical skills» revealed in detail the above competencies as components of pedagogical skills. Lectures «Pedagogical technique» and «Interaction in pedagogical communication» provided consideration of external and internal techniques of the engineer-teacher in terms of ensuring effective interaction of participants in the educational process and ways to build appropriate pedagogical communication

Table 1

*Providing components of competence in pedagogical design with learning outcomes*

	Competences according to the Standard	Learning outcomes according to the Standard
1	Ability to apply and develop new approaches to solving research and / or innovation problems and problems of vocational education	Know at the level of the latest achievements the basic concepts of sustainable development of society, education and methodology of scientific knowledge in the field of vocational education
2	Ability to take into account the diversity of students in planning and implementing the educational process in vocational education	To organize the educational process in the field of vocational education on the basis of human-centered approach and modern achievements of pedagogy and psychology, to manage cognitive activity, to carry out effective and objective assessment of learning outcomes of students
3	Ability to apply and create new educational tools and technologies and integrate them into the educational environment of vocational education	Effective use of modern digital tools, information technology and resources in professional, innovative and/or research activities
4	Ability to analyze, predict, critically comprehend problems in vocational education, make effective decisions to solve them	Create an educational environment of vocational education that is favorable for students and ensures the achievement of certain learning outcomes
5	Ability to develop and implement projects in vocational education, including interdisciplinary, to provide information, methodological, material, financial and staffing	To choose the optimal strategy of collective activity, interpersonal communication and interaction for the implementation of complex projects in vocational education and interdisciplinary projects taking into account ethical, legal, social and economic aspects

	Competences allocated by teachers-practitioners	Learning outcomes
6	Ability to apply educational information technology in the educational process	Knowledge of informational educational technologies and the ability to use them for online and offline learning
7	Ability to effectively plan and conduct training sessions with students	Knowledge of didactics and features of the organization of classes in professional and higher education and the ability to implement an educational project
8	The ability to organize psychological and pedagogical interaction during the lesson	Understanding the features of communicative processes in pedagogical activities and the ability to use techniques of psychological and pedagogical interaction
9	Ability to conduct effective online learning	Practical implementation of creative approaches in the development of online courses or classes, including through graphic design

Table 2

*The Results of the Ascertaining Stage of the Pedagogical Experiment (persons)*

Components of ability Group	Levels of formation								
	Low			Average			Hight		
	1	2	3	1	2	3	1	2	3
Cognitive (Cc)	9	5	4	4	6	5	3	1	1
Procedural (Pc)	15	8	5	20	3	5	1	1	0

In practical classes, students developed the design of pedagogical stories, conversations, classes with students; carried out the analysis of pedagogical situations from the point of view of application of principles of pedagogical design; learned to construct the design of their own pedagogical self-development and programs of psychological adjustment to pedagogical activities, etc. The main focus was on interactive teaching methods, where students could interact, evaluate each other's achievements.

The project method was actively used, which allowed students to present their understanding of pedagogical design for the development of educational activities, classes, research (during the course work). We used the design process as typical strategies that can then be used to solve various pedagogical problems. Students developed a design of pedagogical situations, which used the techniques of «Active Listening», «We-interaction», various strategies of behavior in conflict situations: avoidance, compromise, competition, adaptation, cooperation. They determined: under what conditions the choice of a particular strategy in a given situation will be effective; what are the consequences of the teacher's re-use of the same strategy; what individual characteristics of students and their own should be taken into account by the teacher in using a particular strategy.

During the practical classes on «Pedagogical Skills», as well as in undergraduate practice, future pedagogical engineers learned to use different models of pedagogical design, in particular, ADDIE Model, to develop training sessions, including – using information and communication technologies, modeling individual and group discussions, educational activities, development of syllabi for lessons of industrial and theoretical training as a dialogic interaction with students. In vocational education institutions, where undergraduate practice was organized, students had the opportunity to conduct planned lessons and other activities during the real educational process, analyze their results, to carry out self-reflection.

In the Table 3 presents the results of measurements of the cognitive component at the beginning of the school year (F1), at the end of the course «Pedagogical Skills» (F2), after undergraduate practice (final assessment) (F3).

The dynamics of development of competence in pedagogical design of future engineers- teachers during the pedagogical experiment can be traced in Table 11, comparing the results of the statement (F1), formative stages: F2 – study of pedagogical skills, F3 – undergraduate practice.

Visually, the results of the pedagogical experiment are illustrated in Figure 2.

### Discussion

Our study took into account that education is now very dynamic, closely related to information technology, which is reflected in the technical equipment of educational institutions and their access to

information resources. Pedagogical design contributes to the design of pedagogical technologies focused on various types of educational activities for the collection, processing, transmission of information.

Table 3

*Cognitive component (Cc) of competence in pedagogical design*

Number of applicants for higher education by years of admission	F1			F2			F3		
	Low	Avr	Hight	Low	Avr	Hight	Low	Avr	Hight
12(2017)	11	1	0	1	6	4	0	6	5
22(2018)	16	5	1	2	16	4	1	17	4
20(2019)	17	3	0	1	16	3	0	17	3
54(total)	44	9	1	4	38	11	1	40	12

Table 4

*Procedural component (Pc) of competence in pedagogical design*

Number of applicants for higher education by years of admission	F1			F2			F3		
	Low	Avr	Hight	Low	Avr	Hight	Low	Avr	Hight
12(2017)	7	4	1	2	8	2	0	8	4
22(2018)	11	10	1	3	16	3	1	14	7
20(2019)	15	5	0	3	15	2	0	15	5
54(total)	33	19	2	8	39	7	1	37	16

Table 5

*The Results of the Pedagogical Experiment (In %)*

Components of ability Group	Levels of formation								
	Low			Average			Hight		
	1	2	3	1	2	3	1	2	3
Cognitive (Cc)	81	17	2	7	70	20	2	74	22
Procedural (Pc)	61	35	4	15	72	13	2	69	30

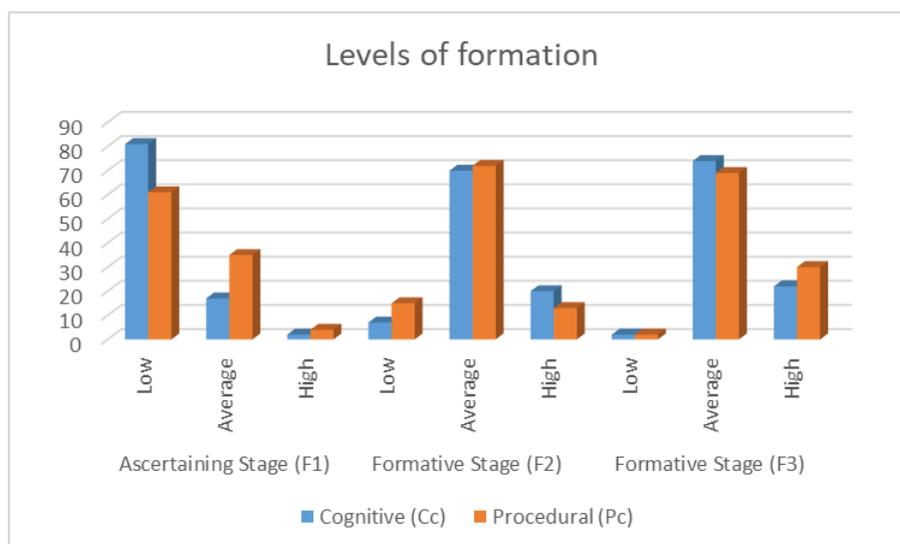


Figure 2. The Results of the Ascertaining (F1) and Formative Stages (F2, F3) of the Pedagogical Experiment.

In recent years, textbooks have been devoted to the problems of pedagogical design, dissertation research in the field of pedagogical design has been defended, in particular, for the training of future teachers. There is also a growing interest in data to improve learning and pedagogical innovation. Despite the fact that there is some experience in the application and study of pedagogical design, there is still little teaching and empirical material on this topic. Teachers-practitioners of vocational education institutions, with whom we studied the state of the outlined problem, noted that they have a further need to acquire competence in pedagogical design. Thus, we are convinced that there is a need for competence in pedagogical design in engineers-teachers of vocational education institutions.

Our research focused on ways to acquire competence in pedagogical design by future pedagogical engineers in the process of studying the discipline «Pedagogical Skills», as well as undergraduate practice. The concept of «competence in pedagogical design» is defined as the ability to build an effective educational process based on learning objectives, learning materials and modern tools that may be available in the information-educational environment, as well as the ability to provide effective psychological and pedagogical interaction with learners. The abilities provided by the relevant standard of higher education were analyzed, and the results of the survey of teachers-practitioners were taken into account and the components of competences in pedagogical design and learning outcomes that can provide them were identified. With the help of certain tools and evaluation criteria, the levels of formation of competence in pedagogical design in the real environment of training future teachers of vocational schools during the pedagogical experiment were tested. We proved the effectiveness of purposeful formation of competence in pedagogical design by means of educational components, in particular, «Pedagogical skills» and undergraduate practice.

### **Conclusions and Implications**

Pedagogical design has become an actively developing field of pedagogy due to the increasing role of informatization of education. Therefore, the study substantiated the concept of «competence in pedagogical design» for future engineers-teachers, identified the components, criteria and ways to acquire this competence while studying at the master's level of higher education. The research was conducted during the real learning process. The successful acquisition of this competence through the discipline «Pedagogical Skills» and undergraduate practice was experimentally proven.

Further research on the possibilities of pedagogical design to increase the efficiency of the educational process in the new environment, when the coronavirus pandemic forced educational institutions, including vocational, to move to online learning or blended form with the active use of information technology.

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