The Use of Modern Educational Technologies in the Process of Future Engineers-Teachers Professional Training

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Abstract

Modern professional training involves the search for new tools and techniques to optimize the educational process and aims to increase the effectiveness of professional training of future engineers-teachers. At the same time, the competition in the market of educational services has increased the requirements for the quality of professional training, which requires the introduction and implementation of modern educational technologies. The aim of the study is to study the key aspects of the application of modern educational technologies in the professional training of future engineers-teachers. Methods: analysis, synthesis, deduction, abstraction, generalization, concretization, observation, questionnaire, survey, empirical method. Results. Based on our study are allocated the key aspects of readiness of engineers-teachers for introduction of modern educational technologies. The first condition is the readiness of university teachers to organize the process of training future engineers-teachers with the use of modern educational technologies and their active introduction into the educational process. The second aspect concerns the fact that the formation of individual styles of highly qualified specialists is possible with the development of non-standard thinking and individual approaches to each student, which is impossible without the introduction of modern educational technologies. The third condition for successful training of engineers-teachers for the introduction of modern educational technologies is to develop in them a desire for continuous professional self-improvement, self-education and self-education.

1. Introduction

The national doctrine of education development in Ukraine poses new challenges to a radical rethinking of the educational paradigm, updating the content, technologies of personalities as subjects and designers of life, which is possible with the introduction of new educational technologies. Requirements for professional qualities and personalities of professionals encourage the search for a modern paradigm of education reform, the introduction of new models and technologies, the implementation of innovative approaches, the use of new forms and training methods. According to scientists and practitioners, gaining knowledge, developing skills and abilities, improving personal and professionally significant qualities during the training of future engineers-teachers will be effective only if the use of modern pedagogical technologies in the educational process (Vyshnevsky et al., 2018).

In today's conditions, manufacturability acquires a dominant characteristic of human activity and means the transition to a qualitatively new level of efficiency and optimization. Analyzing the educational space, it becomes obvious the presence of crisis phenomena, which are a consequence of the fact that education and research lag significantly behind the rapid development of industries. To overcome such gaps, it is advisable for future pedagogical engineers to ensure a close connection between theoretical approaches and practice through technological means. Using modern educational technologies provides not only the replenishment of theoretical and methodological knowledge of future professionals, but also the formation of their professional skills in designing, designing learning processes, skills to analyze its results (Clark and Mayer, 2016; Impedovo et al., 2017). Professional and pedagogical activity of future engineers-teachers in modern conditions of functioning of vocational education institutions is connected not only with the performance of their exclusively pedagogical function, but also with the practically oriented component. Current pedagogical engineers must have the skills to solve problematic pedagogical situations, understand the cause of their occurrence, analyze and predict the development and self-development of students, plan, predict and control educational processes, be able to make effective, balanced and independent decisions. Such goals determine the need for pedagogical science and practice in the use of modern pedagogical technologies in the training of future engineers-teachers (Rock et al., 2016; Yang et al., 2017).

In modern engineering and pedagogical education there are a number of contradictions that are inherent in the entire education system of Ukraine as a whole, and at the same time has specific features in this type of education. Among them there is such an inconsistency of the current state of

pedagogical and engineering industry with the global socio-economic transformation of our state, like: teaching needs and real opportunities of the already established system of engineering and pedagogical education, which in turn indicates a shortage of engineering and pedagogical staff; along with this, the expectations of society from modern teachers and the state of their training in the system of engineering and pedagogical education, which requires revision of the content and implementation of modern educational technologies to train future professionals in the current pedagogical and engineering education.

Goal: research of aspects of use of modern educational technologies in the process of professional training of future engineers-teachers. Research tasks:

1. To conduct a theoretical analysis of the literature to identify the features of modern educational technologies in the professional and pedagogical training of future engineers-teachers.

2. To find out the level of formation of future specialists of the motivational component of readiness for the introduction of modern educational technologies.

3. To determine the level of the content component of readiness for the application of modern educational technologies in future engineers-teachers.

4. To establish the level of practical readiness of future specialists for the application of modern educational technologies.

5. Determine the level of formation of the evaluation component of readiness.

2. Literature Review

A highly efficient educational system is a key factor in ensuring the sustainable growth of the state and aims to provide quality training for future engineers-teachers in the context of European integration and globalization processes (Vyshnevsky, 2018). Therefore, the current changes in the system of higher pedagogical education in Ukraine encourage the analysis of modern educational technologies and the development of ways and means of their implementation in the training of competent professionals (Shevchuk, 2018). Modern pedagogical technologies are characterized by great opportunities for the development of creative abilities of high school students (Imran et al., 2016). A number of authors (Pathak, 2016; Mohammad et al., 2013) claim that "a creative person is an individual who has a high level of knowledge, has a desire for something new, original." It is using modern innovative educational technologies that can contribute to the formation of competencies of pedagogical engineers (Vaganova and Ilyashenko, 2018; Vyshnevsky, 2018; Shevchuk, 2018). For

future engineers-teachers, "emotional intelligence" is also important, which consists in recognizing emotions and adequately understanding human intentions; ability to control one's own emotions and states; affect emotional states surrounding. This will allow future pedagogical engineers to adapt and adapt to the social environment (Akaslan and Law, 2011; Imran et al., 2016).

Considering modern changes in Ukrainian education and in particular in training is correct opinion of scientist Zh. Smirnova and O. Krasikova (2018) on the peculiarities of training future engineers-teachers and the specifics of filling the educational field with new content, the latest requirements for training future highly qualified specialists. Modern educational technologies have been studied by a large number of scientists (Rock et al., 2016; Zyrianova et al., 2018; Prokhorova and Semchenko, 2018; Myalkina et al., 2018; Maseleno et al., 2018; Karimov and Doniyorov, 2019; Racko et al., 2019; Doniyorov and Karimov, 2020), which proved expediency of using educational technologies to improve the educational process of higher education. The concept of "Educational technology" in the psychological and pedagogical literature has a variety of interpretations:

- as planning processes for the development of students' personalities (Vyshnevsky et al., 2018);
- as organizational learning processes and selection of creative tasks for them;
- as planning to achieve goals (Vaganova and Ilyashenko, 2018); as a pedagogical technique (Swan et al., 2009; Yang et al., 2017);
- as one of the educational princes (Myalkina et al., 2018);
- as a model of learning and educational processes, which were previously called methods of teaching and education (Akaslan and Law, 2011).

According to R. Clark and R. Mayer (2016), I. Ergashev and N. Farxodjonova (2020) educational technology is a study that aims to define principles, to develop methods to optimize education by analyzing factors to improve educational performance through the design and use of techniques and materials, and evaluate the methods used. Gutmann (2016) points out that "pedagogical engineers should not only be teachers of certain disciplines, but also competent in production skills". Therefore, characterizing the professional activity of engineers-teachers, scientists clearly state the relevance of the introduction of modern educational technologies for the formation of key competencies, management of the educational process (Imran et al., 2016; Impedovo et al., 2017; Kerekesha-Popova, 2019). It is believed that "educational technologies in any field of activity largely reflect the objective laws of the subject areas, and therefore ensure the effectiveness of the goals" (Maseleno et al., 2018). Systematic educational technologies means that the educational environment sets goals, content, methods and forms of interaction between participants, the effectiveness of which

is diverse, causal, historical, semantic and functional connections (Prokhorova and Semchenko, 2018). According to foreign scientists, the use of educational technologies for professional training of pedagogical engineers aims to form professional competencies, focuses on a comprehensive combination of innovative methods and teaching aids, effective involvement of all participants in the learning process (Yang et al., 2017; Maseleno et al., 2018).

The effectiveness of training future engineers-teachers for the introduction of modern educational technologies largely depends on the conditions under which the educational process itself is organized. The use of only traditional educational technologies, forms and methods of teaching in modern higher education institutions leads to passive perception of information, inability to independently search for information, as well as further practical application of knowledge and use of modern educational technologies. After all, the effective way of activity of future engineers-teachers is the use of modern educational technologies of teaching, so their introduction in the process of studying in universities today appears as a relevant and scientifically significant problem in further discussions and research.

3. Materials and Methods

To perform the task used a theoretical method of research, namely:

- Systematic and problem-targeted analysis of the literature, generalization of theoretical and practical approaches to professional and pedagogical training of future engineers-teachers – to identify the specifics of their professional training;
- Modeling method, empirical method, questionnaire, testing, survey – to assess and determine modern effective educational technologies;
- Statistical method – to establish the probability of the results.

The study took into account the results obtained in 2018 by the University of Applied Sciences Zittau / Görlitz (Germany) and the Autonomous University of Chile (Universidad Autónoma de Chile), which related to the use of educational innovations and were based on empirical data collection (Drummer et al., 2018). These empirical studies have served as a basis for the development of curricula in the field of engineering pedagogy, which in recent years have gained popularity and success in German, Chinese and Chilean universities (Maseleno et al., 2018).

To the research were involved 80 students of 2-4 years of educational and scientific professional pedagogical institute of the Ukrainian Engineering and Pedagogical Academy (Ukraine) and 96 students of 2-4 years of Ternopil Volodymyr Hnatiuk National Pedagogical University

(Ukraine). The study was conducted during 2020 and covered several stages: the first stage – finding out the formation of future specialists' motivational component of readiness for the introduction of modern educational technologies; the second – determining the level of formation of future engineers-teachers of the content component of readiness for the use of modern educational technologies; third – identifying the practical readiness of future professionals to use modern educational technologies; fourth – determining the levels of formation of the evaluation component of readiness. To conduct the study, a questionnaire of four stages was developed, which allowed analyzing the motivational, semantic, operational and evaluative components to determine the essence of preparing students for the implementation of modern educational technologies. During the third stage of the study, the aim was to identify the practical training of future engineers-teachers to apply modern educational technologies (operational component of readiness). For this purpose, the most important qualities and skills required for the application of modern educational technologies are ranked (Table 1).

Table 1 - Ranking of the Most Important Qualities and Skills

| Qualities and skills	Rank
Using modern educational techniques to obtain information	1
Skills to bring started cases to a logical conclusion	2
Ability to overcome difficulties	3
Desire to engage in research activities	4
Ability to extract professionally relevant information	5
Produce new ideas	6

Source: formed by the authors.

From the given Table 1 it is visible that to qualities, which are required for application of modern educational technologies by students, are called ability of application of modern techniques for reception of the information; skills to conclude started cases; ability to overcome difficulties. However, students as insignificant consider the motivational component (the desire to engage in research activities) and innovation (the ability to extract professionally relevant information and produce new ideas).

4. Results and Discussion

During the first stage of the study, according to the results of the survey, it was found that 17% of students have a negative attitude to modern educational technologies, because they do not

know how to use them, and therefore do not want to implement. 31% of respondents have a low level of readiness. They are characterized by a passive attitude to modern educational technologies, poor orientation in them and misunderstanding of their application. 39% of students can be attributed to the average level of readiness, because they approve of innovations, understand the importance of modern educational technologies, however, see the use of fragmented applications in further professional activities due to lack of training and note their complexity during use. Only 13% of respondents indicated a positive and active attitude to the use of modern educational technologies. Students' answers about their attitude to modern educational technologies shown in Figure 1.

Figure 1 - The results of finding out the formation of future specialists' motivational component of readiness for the introduction of modern educational technologies
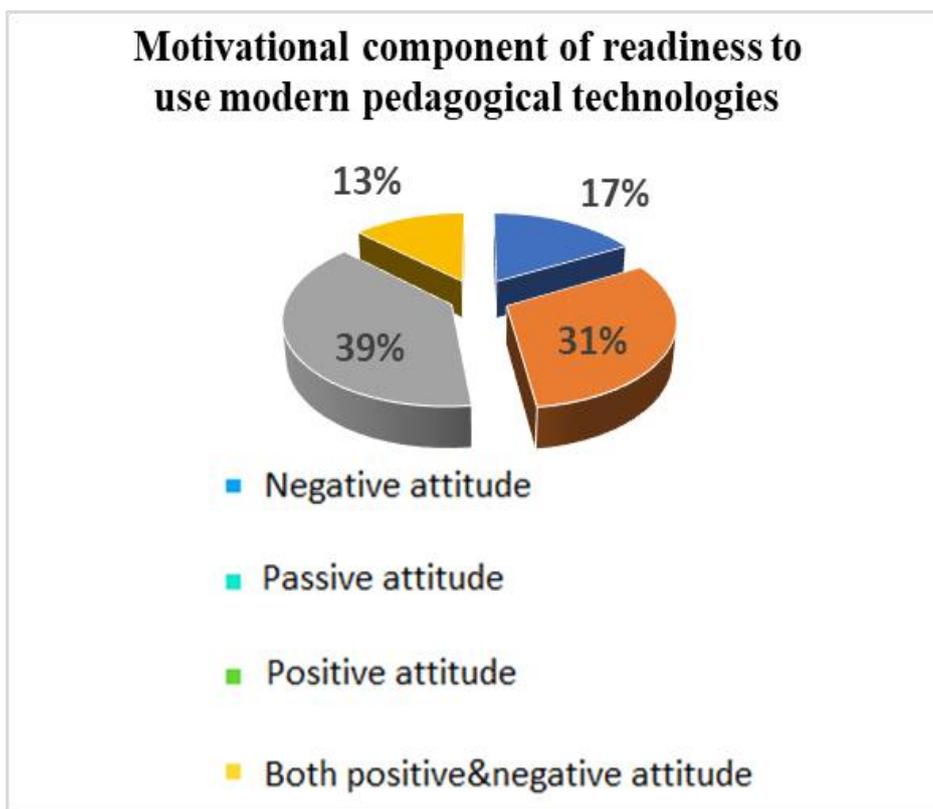
Source: formed by the authors.

While examining the attitude of students to the need to use modern educational technologies, it was found that 17% of respondents find it difficult to respond, 39% see difficulties in their implementation and 28% have a positive attitude to use, and the remaining 16% said their effectiveness in the educational process (Figure 2).

Figure 2 - Assessment of the Need for Modern Educational Technologies
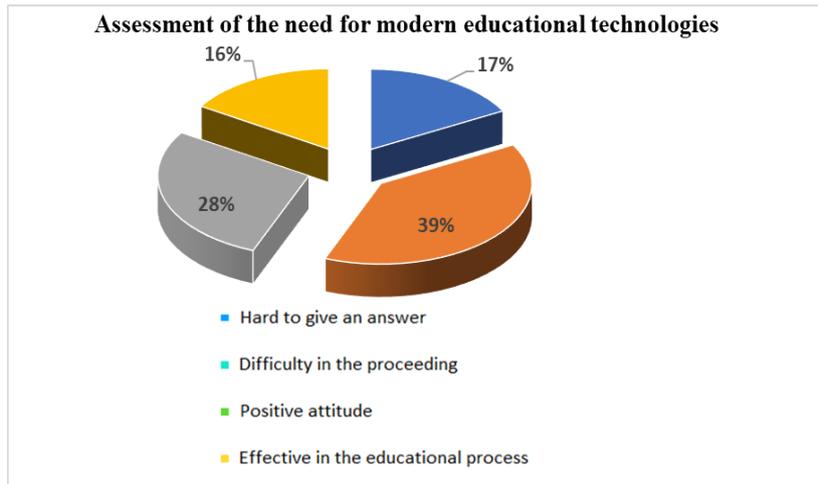
During the second stage of the study, we found out the level of formation of future engineers-teachers of the semantic component of readiness for the introduction of modern educational technologies, i.e., their understanding. Thus, 12% did not provide an answer, because they do not have knowledge of modern educational technologies (basic level), 31% have a low level of content components and are unfamiliar with technology, 43% – intermediate level – identify modern educational technologies with changes and updates of educational system and improvement, 14% of students have a high level and are convinced that current technologies are formed in the educational system due to modern challenges and through creative search for the best in the educational process (Figure 3).

Figure 3 - The results of the level of formation of future engineers-teachers of the content component of readiness for the introduction of modern educational technologies
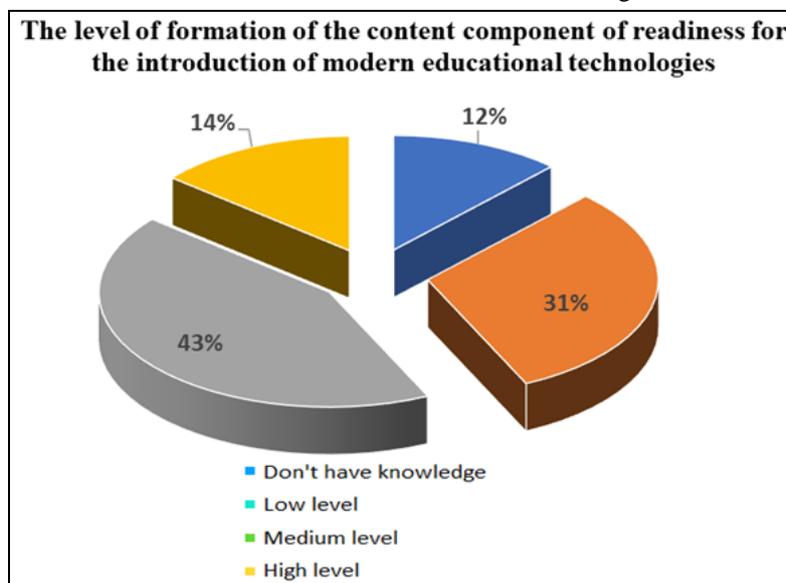
Answering the question "What modern educational technologies do you know?" some students showed a lack of understanding of the essence of educational technology. Yes, 9% of respondents did not answer; 38% showed a low level due to ignorance of modern educational technologies and their replacement by traditional forms and methods of teaching. 41% belong to the middle level and have demonstrated a general idea of modern educational technologies, however, are not fully able to explain their essence. The rest of the respondents – 12% have a high level of awareness of modern educational technologies, understanding of their essence, and are able to describe in detail (Figure 4).

Figure 4 - The Results of Clarifying Students' Awareness of Existing Modern Educational Technologies
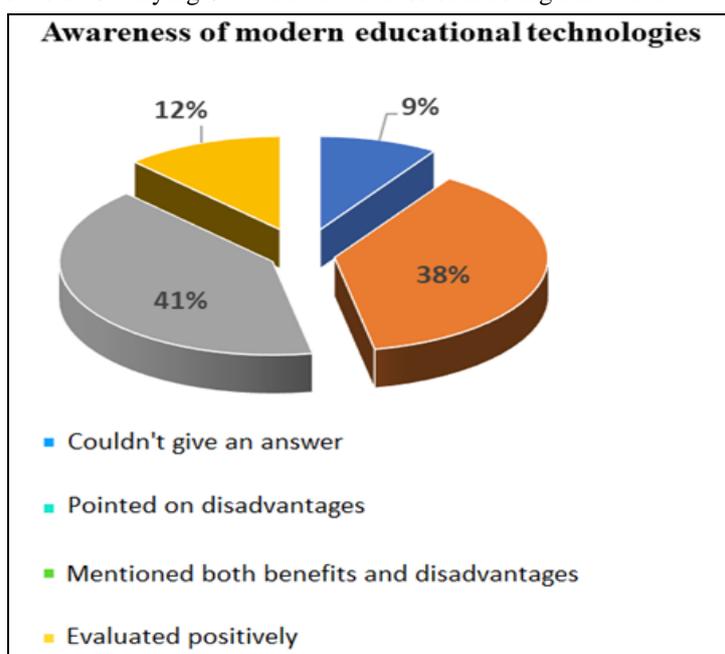
Exploring the advantages of modern educational technologies, 9% of students lack an elementary level; 48% – low, and therefore prefer traditional methods and are convinced of their negative impact on educational processes, however, are not able to justify their answer. 34% of respondents say that modern educational technologies have both advantages and disadvantages. They are convinced that traditional educational approaches are more in line with the domestic education system, so the application of modern education will disrupt the educational process and it will require a lot of time and effort. Only 9% of students have a positive perception of innovation processes and say that their use is much more effective to help ensure quality and effectiveness (Figure 5).

Figure 5 - The results of the evaluation of the advantages of modern educational technologies are generalized
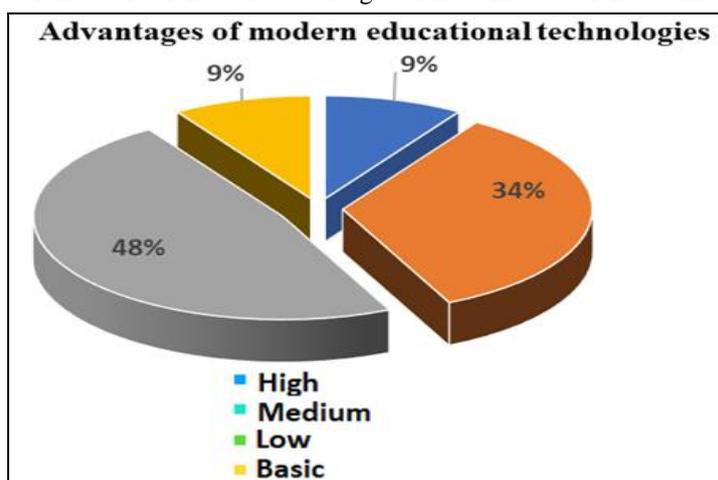
Source: formed by the authors.

To the reasons that hinder the use of modern educational technologies, students called the lack of experience, lack of time, limited resources, material disinterest and low awareness. After analyzing the completed questionnaires of self-assessment of skills that are necessary for the implementation of modern educational technologies, can be shown in the diagram (Figure 6).

Figure 6 - Self-assessment of Skills Necessary for the Implementation of Modern Educational Technologies
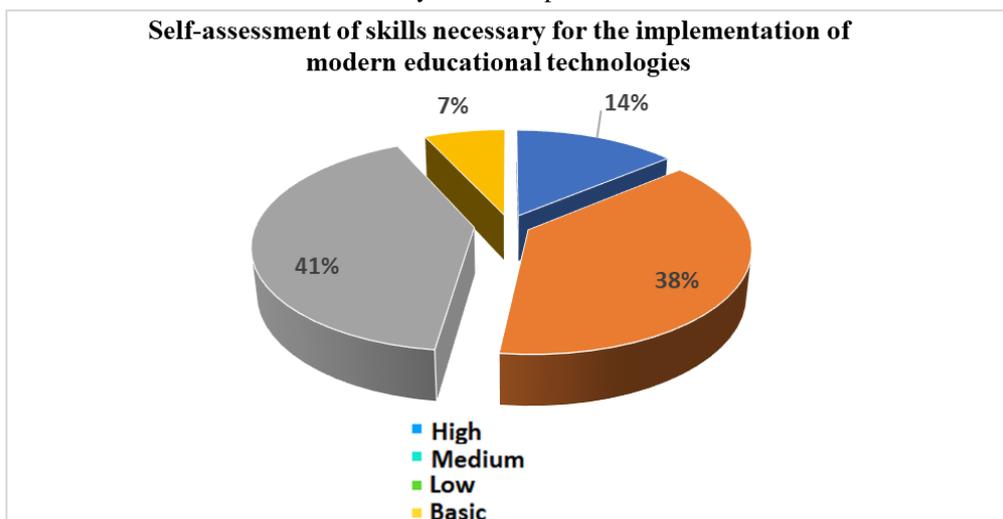

Source: formed by the authors.

As can be seen from results 14% of future professionals are convinced that they have all the necessary skills to apply modern educational technologies; 38% of respondents have an average level of developed skills, 41% – low, 7% – elementary. The fourth stage of the study made it possible to

determine the level of the assessment component of student readiness. (Figure 7), 12% have a high level, 46% – medium, 34% – low, 8% – elementary.

Figure 7 - The Results of the Level of Readiness to use Modern Educational Technologies
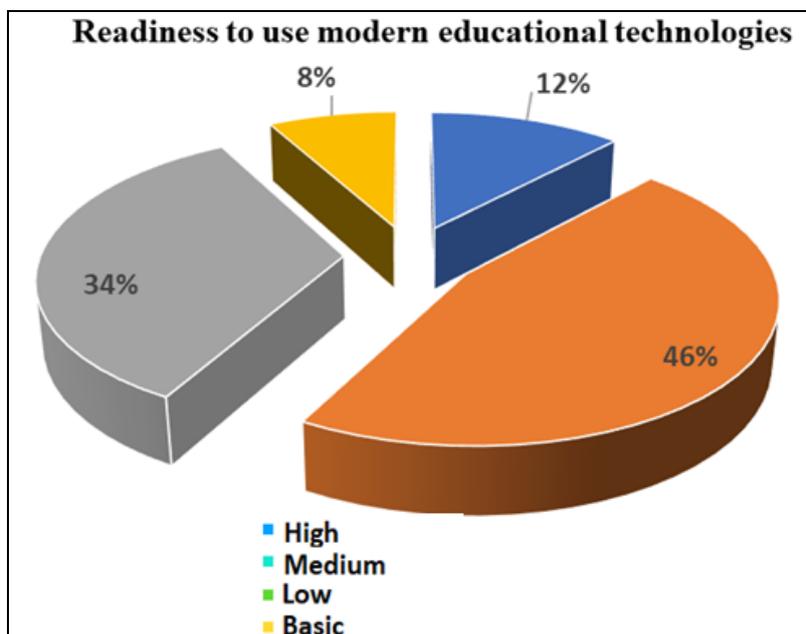
Summarizing the data, we can conclude that students are mostly low level of preparation for the introduction of modern educational technologies (41%) and medium – 37%. The curricula of Dresden University of Technology largely implement modern educational technologies through the activities of university scholars in the training of pedagogical engineers. Their range was determined empirically by analyzing activities, requirements and needs. Due to this, the developed structure of the study focuses on the applied aspect, although partly systematic. This is the basis for the study of microdidactic issues, including psychological background (Smirnova and Krasikova, 2018; Racko et al., 2019;). Comparing the three projects of the educational programs IGIP, TU Dresden and IPW, we can trace a number of similarities and differences, but the most important common feature is the emphasis on formation of future specialists' motivational component of readiness and knowledge and practical components of the use of modern educational technologies (Drummer et al., 2018). We are convinced that the use of modern educational technologies by engineers-teachers, as a specially organized activity, will ensure a guaranteed high level of training of students, i.e. achieving their projected goal for a certain period with predetermined resource costs.

We see the prospect of further research into the use of modern educational technologies in the search for effective ways to form the readiness of future engineers-teachers for their implementation

in professional activities. The analysis of the current state of training of future engineers-teachers and the problem of using modern educational technologies allowed to identify the following shortcomings: the content of engineering training of future engineers-teachers does not differ from the training of engineers in the relevant field, which leads to contradictions; the increase of psychological and pedagogical readiness of engineers-teachers is due to the number of pedagogical disciplines, and not due to the introduction of modern educational practices and technologies. Pedagogical engineers, as specialists with dual competence, must have integrated knowledge and skills to solve typical problems of both pedagogical and engineering specialties, and this is impossible without the use of modern educational technologies. However, in modern conditions of binary education, these competencies will be formed separately from each other. That is why the problem of improving the educational process, with a deeper integration of modern educational technologies and the introduction of methods of their use is of particular importance.

The professionalism of pedagogical engineers lies in integrated activities, as they must have both theoretical and practical competencies and the ability to communicate them. Therefore, we can conclude that the professional activity of engineers-teachers largely depends on their awareness and ability to use modern educational technologies. After all, the professional activity of specialists is based on professional competence. Introducing modern educational technologies into the educational process will significantly improve productivity and increase productivity and reliability during the rapid increase for information that is processed to reduce educational costs. New educational technologies will allow for constant dynamic updating of organizational aspects of educational processes, their forms and methods of implementation, will provide constant adaptation processes of educational institutions to changes in external conditions and features of the students themselves. It will allow pedagogical engineers themselves to take an active part in creating these changes. The considered aspects of the use of modern educational technologies in the process of professional training of future engineers-teachers allowed us to combine these objects with the educational purpose.

5. Conclusions

The results of the study of the state of implementation of modern educational technologies in the process of training students of engineers-teachers of technology indicate an insufficient level of their competence. The study found that 41% of respondents have a medium level of readiness and have a positive and passive attitude to modern educational technologies, 14% have a low level and

believe that modern educational technologies are too complex in the implementation process, and therefore believe in the feasibility of more traditional. Interviewed middle-level respondents indicated that readiness is related to innovation processes. The analysis revealed that 14% of students show a good desire to implement modern educational technologies and have a high level of competence; however, it not meets modern social demand.

The main factors that hinder the formation of highly qualified engineers-teachers are lack of sufficient literature on this issue; insufficient level of theoretical knowledge; lack of experience in practicing and applying a particular educational technology; a limited number of manuals, which explain in detail the essence of a particular educational technology, and describe methods of their application. The level of readiness of students of engineering and pedagogical orientation to the introduction of modern educational technologies today does not fully meet the social needs of society. This, in turn, is reflected in the contradiction between the creative, innovative characteristics of the educational process and the reproductive nature of the training of pedagogical engineers, between the complexity of their professional functions and the low level of their readiness. The success of the educational process depends on the extent to which the teacher shows a willingness to move to personality-oriented learning using modern educational technologies and authorial creation.

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