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INTEGRATIVE TRAINING OF MASTER'S DEGREE STUDENTS IN PHYSICS AND MATHEMATICS

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Abstract

The rapid development of educational technologies and new requirements for quality of vocational education determine the relevance of the issue of pedagogical training of master's degree students. The article examines an integrative approach as one of the effective ways to implement the master's degree program in physics and mathematics and investigates the problem of professional development of future teachers who are ready to work in psychological and pedagogical, methodological, project, research and management areas. The purpose of the article is to describe effective experience of using an integrative approach to teaching master's degree students in physics and mathematics. The integrative approach to the implementation of a master's degree program implies the organic combination of fundamental and practice-oriented aspects of education. Integration is considered at various levels: bases of the profile and pedagogical training of master's degree students; content of various disciplines; interrelationships between theoretical material and practical aspects of training. Attention is drawn to the integration of activities of educational organizations and activities of various subjects involved in the training of a master's degree student as a teacher. The study used the following general scientific methods: analysis of theoretical sources, collection of information, comparison, and generalization. The research results obtained at the Transbaikal State University are presented. The educational activities of master's degree students were based on the following scheme: "theory - practice - research - final qualification work". The integrative approach made it possible to change the learning process and improve the teacher's development management process.

Keywords: Integrative approach, master's degree, physics and mathematics education

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1. Introduction

Structural transformations in higher education reduced the number of students and divided master's programs into fundamental (scientific) and practice-oriented ones. The first innovation created a sharp shortage of specialists in the field of education, which was felt by Russian educational organizations of various levels.

In the current conditions, the process of forming the readiness of master's degree students in pedagogical education to implement modern teaching approaches is relevant. The problem of training teachers of physics and mathematics is especially acute. Therefore, the focus of universities implementing relevant educational programs is the design of an educational space, which would not lose the fundamental nature of physics and mathematics education and have a pronounced practice-oriented character. The implementation of an integrative approach will change the learning process and contribute to more effective management of professional development of students (Dugarova et al., 2016; Starostina et al., 2016; Yermentaeyeva et al., 2014).

2. Problem Statement

At present, the academic revolution is taking place at all levels of education: one educational standard is being replaced by another one. Despite these ongoing changes, the most important component of any education and general culture of a modern person is mathematical and natural science education. Universities face the problem of training a competitive teacher of physics and mathematics. The issues of training masters in pedagogical education, who can bring modern pedagogical ideas and educational technologies to educational organizations in accordance with the National Doctrine of Education in the Russian Federation until 2025, are relevant.

3. Research Questions

The educational space of the university, which implements master's degree programs in "Pedagogical Education", is undergoing transformations. Under these conditions, an integrative approach to the educational process can be used for the effective training of master's degree students in physics and mathematics. The issue of sufficient and effective steps in the field of training students to integrate fundamental knowledge and a practical component of pedagogical education is relevant.

4. Purpose of the Study

The purpose of the article is to describe effective experience of using an integrative approach to teaching master's degree students in physics and mathematics.

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5. Research Methods

The research was carried out at the Transbaikal State University in 2017–2020. The study used the following general scientific methods: an analysis of theoretical sources, collection of information, comparison, and generalization.

6. Findings

Intensive changes in the socio-cultural and economic life of Russian society, the process of Russia's entry into the unified European education system have required the Russian system of higher pedagogical education to make qualitative transformations at all educational levels (Lubkov, 2020; Sazonova, 2014). This also affected goals, content and process of training master's degree students in pedagogical education in physics and mathematics. The integrative approach to the implementation of this program combines fundamental and practice-oriented aspects.

Modern legislation allows people who have a Bachelor's or Specialist's diploma in the field which coincides or does not coincide with the field of the chosen master's degree program to enroll in a master's degree program. It is enough to pass entrance tests. Taking into account the basic education, the following versions of the bases can be distinguished (Fig. 1).

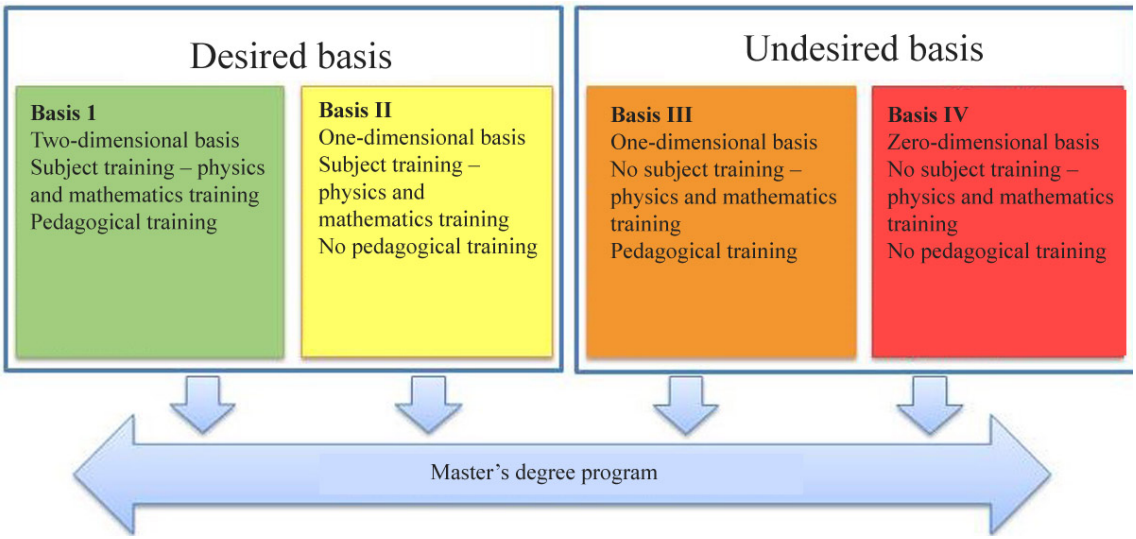

Figure 1. Basis for the master's degree program

Depending on the basis, various approaches to the educational space design, including individual educational routes (Nagovitsyn et al., 2020; Starostina & Tokareva, 2017), should be considered. The ideal basis is basis I, when professional disciplines and pedagogy are taught. Basis II is aimed at strengthening psychological and pedagogical training; basis III is aimed at strengthening subject training. The most difficult option for all participants is basis IV, when students have neither a subject nor a pedagogical base. In this case, when implementing an integrative approach, it is necessary to increase the load on the individual training trajectory. Bases I and II are desirable bases, while bases III and IV are

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undesirable ones. The latter are a prerequisite for significant difficulties in mastering the educational program.

The main purpose of master's degree training in pedagogy is to prepare for professional activities in educational organizations. One of the requirements of the National Doctrine of Education in the Russian Federation concerns the high level of qualifications of teachers, especially teachers of mathematics and physics, as well as the use of modern educational technologies. This is facilitated by two inseparable aspects: the fundamental nature of education and its practical component. Of great importance is the term distribution of academic disciplines and various types of internships.

In modern conditions, when Russia is part of the single European educational space, it is necessary to implement new approaches to the assessment of quality of educational outcomes. Within the discipline, the curriculum focuses on Russian and international learning outcomes. In practical classes, students perform tasks that prepare them for teacher's control and evaluation activities: projects on "Evaluation of educational achievements"; identification of features of the internal system for assessing quality of education in a particular educational organization. They perform the first task on the basis of their pedagogical experience; when completing the second task, they take into account the work experience of their teaching staff.

One of the components of the practical training is expert activity in education. The following didactic units can be distinguished in the content of the academic discipline: principles of expert activities; requirements for experts; indicators and evaluation criteria; examination procedures; examination results; management decisions based on examination results. All these didactic units are considered on the example of procedures for state accreditation of educational activities in various educational organizations, professional and public accreditation of educational programs, the work of experts within championships held according to WorldSkills standards, professional competitions, etc.

The objects of expert activities are educational programs in general or their components, as well as various educational projects. The source of information about the objects of examination is data from the official websites of educational organizations, which are responsible for the openness and reliability of the information provided. Comprehending the basics of expert activity, students act as "secret" experts in educational projects such as regional and all-Russian professional competitions ("Teacher of the Year", "Educator of the Year", etc.); regional and university championships held according to WorldSkills standards, etc. Students get acquainted with provisions on competitions and evaluation criteria. Each "expert" presents results of his work, followed by discussion, especially in those situations when several experts" have one subject of expertise. Knowledge, skills and experience gained will find application in practical activities.

The training of master's degree students in physics and mathematics should take into account modern trends in the overall digitalization of all spheres of life. Currently, the development of digital education is one of the main directions of the state policy of the Russian Federation. Therefore, pedagogical education should develop communication skills, creativity, tolerance, critical thinking, and teach students to apply information, communication and digital technologies. The teacher should be able to work with a new "digital generation" of learners. Moreover, there is a "digital divide" in the degree of

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readiness of teachers to work in a digital environment; the same divide is observed between teachers and students (Andryukhina et al., 2010).

The way out of this situation is the development of academic disciplines aimed at developing the ability to work in a digital educational environment and using mathematical packages. The objectives of such disciplines are as follows: the ability to use information (including online) technologies in individual and group design and research activities; training in the field of information technology application in pedagogical research, education and self-education; the ability to develop and introduce pedagogical information resources into professional activities, including in the process of teaching people with disabilities. The practical classes should consider features of the educational process using e-learning, the issues of video lectures and webinars in synchronous and asynchronous modes, video events and the use of gadgets.

Secondly, the study of software systems for the development of electronic educational resources and the design of lessons based on online learning technology is relevant. Here, much attention is paid to the monitoring of quality of e-learning and methodological systems. The practice-oriented approach involves the parallel implementation and testing of electronic resources in educational organizations, where master's degree students carry out their professional activities. This allows you to implement an individual trajectory of training for a master's degree student. Thus, upon completion of training, the student is ready to carry out e-learning activities. During the coronavirus pandemic, when all educational organizations implemented distance and e-learning forms of education, master's degree students felt more comfortable than other teachers, they quickly and easily adapted to the new conditions.

The basic principles of the integrative approach are implemented in the process of preparing and conducting various types of practical activities. Correct design (on the part of the university) and successful implementation (on the part of educational organizations) of all types of internships allow students to successfully enter the profession of a teacher of mathematics or physics, adapt to new working conditions and gain professional experience (Shukshina et al., 2016).

At present, in the Russian system of higher education, there is a discrepancy between the needs of the educational organization. To eliminate this discrepancy, it is necessary to pay attention to the fundamental education of students and revise the content and procedural aspects of internships. One of the factors in ensuring the quality of training in the context of the competence-activity approach is individualization of development of the educational program and design of the content of educational and industrial internships, taking into account the nature of their professional activities and the level of the educational organization (Darling-Hammond, 2010; Kruger et al., 2009).

When developing an internship program, priority is given to the type of internship; continuity in the organization and content of internships; uniformity of requirements for internship programs, taking into account individual areas of research work; dense (networked) interaction with educational organizations (management, leading specialists, teachers, etc.). At the same time, internship assignments take into account such features of educational organization as the level of education, the potential of teaching and student teams, directions of research activities and topics of final qualifying works.

Educational internships are aimed at analyzing educational (classroom and extracurricular) activities of the educational organization, highlighting goals, content and procedural components. Students analyze documents and work with managers and teachers. These internships lay the foundation

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for fieldwork and future research. They are based on rigid algorithmic programs. Industrial internships are directly related to the psychological, pedagogical, methodological and design spheres of professional activity. The content of internships is connected with the main stages of pedagogical experiments during the preparation of final qualifying works.

Students develop competencies related to psychological and pedagogical, methodological, design, research, management and support areas. The latter is becoming more and more relevant, since an increase in the number of students with disabilities is obvious. The problems of scientific research are isolated in real conditions of educational organizations, are solved within the master's degree studies and rethought, which changes the learning process and "reset" all participants in this process.

The results of internships depend on activities of various subjects. Comprehensive management of the entire process of practical training, from the selection of content to the formation of a systemic worldview of a teacher, is entrusted to the managers of the university and places of internship. When designing programs for pedagogical internships, wishes of managers and requirements of the National Doctrine of Education in the Russian Federation are taken into account.

The areas of responsibility of the departments are as follows: 1) the fundamental component of pedagogical education, including disciplines of the subject training and methodological modules aimed at mastering modern educational technologies and identifying problems facing the modern educational system; 2) training of master's degree students in educational organizations. The department responsible for the organization of internships, has to ensure the continuity of internships based on the principle of continuity and compliance with professional standards of the teacher. Heads of master's programs and internships coordinate the content and procedural aspects of the training.

The content of internships is aimed at passing through all phases of professional development of a teacher, understanding the nature of research work and including students in activities of the educational organization and research institutes. The selection of the content of practice-oriented education is aimed at developing all groups of competencies: universal (related to the general development of thinking), general professional (pedagogical) and professional (revealing the nature of future specific professional activities).

Internship programs are provided with assessment tools that help to identify the level of formation of the declared competencies. The FES includes an internship map, relations with previously studied disciplines, indicators of competence formation, approximate flow charts of lessons, diagrams of various types of lesson analysis, work program models for elective courses and educational projects, analytical tables for specific stages of scientific and experimental work. Of particular interest is the map for assessing innovative activities of educational organizations and the bank of situational tasks.

Tasks performed by students are preliminarily considered in practical classes. For example, in the process of mastering the methodological foundations of educational programs for physical and mathematical education, master's degree students independently develop local didactic systems for teaching mathematics or physics, elective courses, design lessons (training sessions). It is necessary to take into account the level of the educational organization. The projects are discussed during practical classes using the technology of educational dialogues, which allow for various approaches when solving the problem. As a result, students make required adjustments to their own developments. It is valuable to

be able to check the result obtained. During the internship, the effectiveness of the chosen option for the project development is assessed.

7. Conclusion

The process of integration in the training of a master's degree student is carried out at the main stages of professional development: entry into the profession, adaptation, self-realization and self-improvement. This complex process is aimed at solving the problem of training a modern competent teacher and allows you to see it in a new way, taking into account changing conditions. The experience in the implementation of the integrative approach to teaching physics and mathematics allows us to assert that special training conditions are effective and increase their level of professionalism.

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