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DUAL FORM OF OBTAINING EDUCATION IN THE MATHEMATICS TEACHERS TRAINING SYSTEM: EMPLOYERS' POSITION

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Abstract. In the article, we analyze the survey results on employers' (administrators of schools and vocational colleges) interest, readiness and opportunity for cooperation in training math teachers in a dual form of education. The opinion of employers regarding the advantages, disadvantages and obstacles in the implementation of such a study mode was studied. Several specific issues that need to be resolved in order to effectively implement a dual mode of study in math teacher training have been identified. The obtained results could be used by universities that provide training in pedagogical specialties, experts in the field of education, state authorities and local government organizations that take care of education issues, as well as other specialists interested in the spread of the dual form of obtaining education in Ukraine and abroad.

Keywords: dual study; math teacher training; quality of math teacher education

1. Introduction

The problem of ensuring the quality in education has always been relevant both in Ukraine[1] (Kremin et al. 2021), (Kalashnikova et al. 2015), (Viktorov 2006)) and abroad ((Kelly 2004), (Muller 2000). It applies to all levels of education (from primary to higher education), as well as all modes of study (full-time, evening, extramural, dual). This article focuses on the peculiarities of providing quality educational services for master students in thematic area: 0114 Teacher training with subject specialization in mathematics (ISCED-F) who choose a dual form of obtaining higher education.

The dual form of obtaining higher education is a method of obtaining it by full-time students, which involves training at the workplace at enterprises, institutions and organizations to acquire a certain qualification in the amount of 25% to 60% of the educational program, based on the contract. On-the-job training involves fulfilling job duties in accordance with the employment contract[2].

The motherland of dual study is deservedly considered to be Germany, which standardized the training of specialists in vocational education institutions in close cooperation with enterprises as early as the 60s of the 20th century. At the same

time, the training model "apprentice – assistant – master" was created by the first craft guilds in the trade development cities in Germany as early as the twelfth century, compulsory vocational education for workers was introduced in 1869, and in 1897 the Law on the Protection of Craftsmen provided for the first time and regulated principle of dual vocational training. The Law on Vocational Training of 1967 standardized the norms, which previously differed depending on the region, and also provided the participation and close cooperation of social partners in all matters of vocational training. This approach was later adopted in Europe, South Korea, China, and Canada. Today, 50% of the population in Germany, Austria, and Switzerland study in the dual mode. In South Korea and China, 33% of the students are engaged in dual education (Drozach 2008).

In Ukraine, today there is an increased interest in implementing dual study. The first steps in the implementation of dual education in Ukraine were initiated in 2013 with the joint project "Implementation of elements of the dual education system in higher education institutions of Ukraine to increase the competitiveness of graduates on the labour market" of the representative office of the Friedrich Ebert Foundation in Ukraine, the Marketing Association and Sumy State University. In 2014, with the support of MES of Ukraine, 14 pilot micro-projects implementing dual study programs in higher education institutions were initiated, and the Roadmap for the implementation of dual education in Ukraine was developed[3]. Based on the results of the four-year project and German experience of dual education, the Concept of training specialists in the dual form of obtaining education was developed and approved by the Cabinet of Ministers of Ukraine in 2018[4]. The work group included the representatives of higher education institutions, scientific institutions, and the Federation of Employers of Ukraine.

In October 2019, a pilot project on training in a dual mode of study designed for 2019-2023 launched in professional pre-higher and higher education institutions[5]. Since 2019, 27 higher education institutions, 17 pre-tertiary vocational education institutions, and 198 partner enterprises have become participants in the project.

As part of the project, the Regulation on the Dual Form in Vocational (Vocational and Technical) Education was developed and approved[5; 6]. The Draft Regulation on the Dual Form of Education in institutions of higher and pre-tertiary vocational education was also developed; currently, it is under public discussion for the third time[7].

Pedagogical universities were not involved in the MES of Ukraine experiment in 2019. The possible reason could be in taking as pattern the German model having no practice of training teachers in dual study mode. However, it is worth noting that the authors' position regarding the perspective of teacher training in a dual mode of study is shared by our colleagues from the University of Bielefeld (Germany). At the same time, the Concept of the Development of Pedagogical Education[5] provides the possibility of training teachers in the dual form of obtaining education.

In our opinion, training teachers in a dual mode of study is optimally justified and beneficial. Traditional teacher training (including both theoretical and practical components) requires 2 – 3 years for a young teacher (university graduate) to adapt to the conditions of real practical activity. Lots depend on the first working place, and the teaching and student staff. A young teacher needs help and support when entering the profession. The last depends on the interest of secondary education institution administrators in providing assistance and their understanding of its necessity.

Close cooperation in training teachers in the dual mode of study between the university and the school will engage the school in developing the teacher training program content (as well as the LLL program), will give the school a teacher trained according to its requirements, familiar with school peculiarities, school staff and working environment and does not need to adapt. Mentoring will maintain the continuity of generations. Educational programs developers at Universities will receive up-to-date information about employers' requirements for teachers and better understand the needs and conditions of modern schools, which will make it possible to promptly update the content and methods (technologies) of teacher training.

At the same time, it is not a secret that many Ukrainian schools, especially in big cities, need teachers in mathematics, physics and computer science. Every year in July and August, many school administrators address the administration of the Faculty of Mathematics, Informatics and Physics of the National Pedagogical Dragomanov University with the request to inform students and graduates about the available vacancies, ask to refer students to internships, etc. Therefore, many graduate students combine their studies with work as school teachers. Over the last 30 years, there have been periods when up to 80% of graduating students have worked in schools. According to the statistics of the dean's office, in 2021, 16 out of 29 master's students were working as mathematics teachers at schools. Among 45 final-year bachelor students, 10 combined studying with work at school.

In 2021, aiming to create favorable studying conditions for students who combine their studying with work as a school teacher and, at the same time, to increase the effectiveness of practical training, the Faculty of Mathematics, Informatics and Physics of the National Pedagogical Dragomanov University initiated the research on implementing dual mode of study in mathematics teacher education.

The project involves the implementation of a set of measures to modernize the structure, content, technologies, and methods of teacher education, in particular, the development and implementation of models of mutually beneficial relations between institutions of higher education, schools and students, aimed at ensuring the quality of training of teachers for independent professional

activity, their social and professional adaptation to the conditions of real professional activity (Pratsiovytyi et al. 2022).

2. Implementation

As it is known, in order to implement dual mode of study, a higher education institution must develop a curriculum that takes into account the features of dual education, the schedule of the educational process, and methodical support of educational components. The most common models for study load distribution in conditions of dual study in Ukraine are:

– an integrated model (or a split-week model), according to which the academic week is divided into two parts: several days of study take place at a higher educational institution, and the remaining days are at the workplace;
– a split-day model, according to which the academic day is divided into two parts: several hours of study take place at a higher educational institution, and the remaining hours are at the workplace;
– a block model, according to which the entire study period is divided into blocks (blocks of study at a higher educational institution and blocks of study at the workplace), each block lasts from 2 weeks to a semester and the blocks alternate.

A combination of models and different options for time allocation is possible. At the same time, these models are indicative. Employers may need specialists in the educational program in a specific period, season, or month. The educational program developers should not consider a dual mode of study as a marketing ploy. Such a study mode must be determined by a practical need, and employers must be interested – these are the requirements for a quality study. Therefore, higher education institutions must independently make decisions on the model, adapting it to the employer's needs.

When choosing a model for study load distribution, one should take into account the specifics of the specialty (educational program), the specifics of the profession, and the needs and opportunities of employers. It is necessary to ensure the fulfillment of the requirements of the educational program, and the achievement of program learning outcomes. It is unacceptable to replace dual education with intensive practice or, on the contrary, to overload the student by introducing practical training in addition to work at school.

Given the small number of full-time students gaining their master's degree in "0114 Teacher training with subject specialization in mathematics" in recent years, the downward trend of this number (see Table 1), and the small academic group of undergraduates, we realized the unprofitability of training students in a dual mode of study within a separate curriculum. Therefore, we decided to adapt the full-time curriculum to the needs and requirements of a dual mode of study.

Table 1. The number of 1-st year master students in "0114 Teacher training with subject specialization in mathematics" at the Dragomanov National Pedagogical University (2017 – 2021)

	2017	2018	2019	2020	2021
Teaching oriented educational program	10	10	9	6	4

Taking into account the specifics of the subject teacher profession (continuous educational process, vacation period in general secondary education institutions for one week in the autumn and spring, and two weeks in the winter period – in different educational institutions, the vacation periods may not coincide), a combination of a split-week and a split-day models was chosen. This model involves theoretical study at the university for 2-3 days per week in the afternoon and practical study at the workplace at the time free from classes (other days or in the first half of the day at student's choice).

In spring 2021, an educational program was revised and updated. The structure of practical training was changed, and the new curriculum was developed. The new schedule of the educational process is presented in Table 2.

Table 2

	Period	Higher Education Institution (University)	General Secondary Education Institution
First semester	September, 1 – December, 24	Theoretical Study, 2-3 days per week in the afternoon	Practical Study at the workplace, at the time, free from classes (other days or in the first half of the day at student's choice)
		Master Thesis	
	December, 25 – January, 11	Vacations	
	January, 12 – January, 25	Exams	
	January, 26 – February, 8	Vacations	
Second semester	February, 9 – June, 7	Theoretical Study, 2 days per week in the afternoon	Practical Study at the workplace, at the time, free from classes (other days or in the first half of the day at student's choice)
		Master Thesis	
	June, 8 – June, 28	Exams	
	June, 29 – August, 31	Vacations	
Third semester	September, 1 – November, 23	Theoretical Study, 2 – 3 days per week in the afternoon	Practical Study at the workplace, at the time, free from classes (other days or in the first half of the day at student's choice)
		Master Thesis	
	November, 24 – December, 7	Exams	
	December, 8 – December, 24	Qualification Exams (including Master Thesis defense)	

For comparison, Table 3 presents the schedule of the educational process in full-time mode of study (traditional model of mathematics teacher training).

Table 3

	Period	Higher Education Institution (University)	General Secondary Education Institution
First semester	September, 1 – November, 16	Theoretical Study	-
	November, 17 – December, 25	-	Practical Study
	December, 25 – January, 11	Vacations	-
	January, 12 – January, 25	Exams	
	January, 26 – February, 8	Vacations	
Second semester	February, 9 – June, 7	Theoretical Study	-
		Research Practical Study	-
		Master Thesis	-
	June, 8 – June, 28	Exams	
	June, 29 – August, 31	Vacations	
Third semester	September, 1 – November, 23	Theoretical Study	-
			Practical Study
		Master Thesis	-
	November, 24 – December, 7	Exams	
	December, 8 – December, 24	Qualification Exams (including Master Thesis defense)	

Forms of teaching at the university and at the general secondary education institution are shown in Figure 1. For comparison, Figure 2 presents the forms of teaching in full-time mode of study (the traditional model of mathematics teacher training).

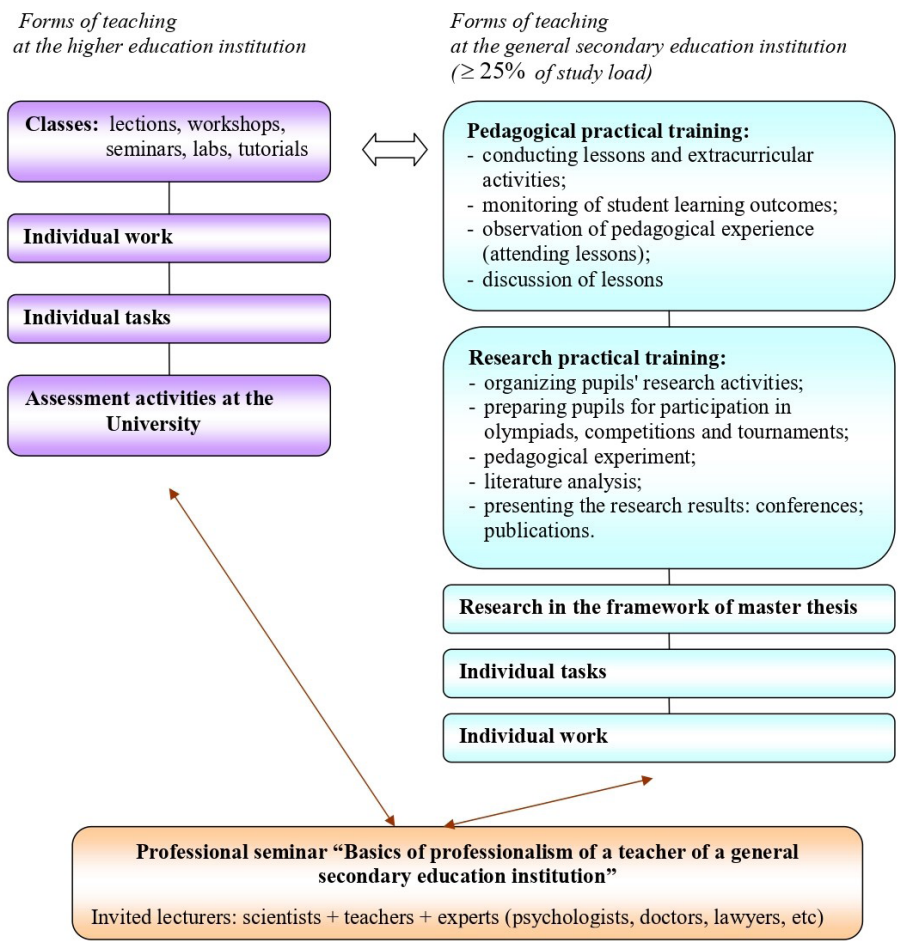
The peculiarities of the study load distribution model (2021) presented in Table 2 and Figure 1 are the following.

The pedagogical practical training is continuous. Practical training permeates all semesters, takes place every week, its tasks are organically connected with theoretical learning. In classes on the methodology of teaching mathematics, situations from the teacher's professional activity are simulated, and students can try themselves in different roles: teacher, student, and class leader. Practical training tasks require a synthesis of psychological-pedagogical, methodical and subject knowledge and skills. On the other hand, the accumulated practical skills contribute to the understanding of theoretical knowledge. The suggested approach provides the principles of integrity, continuity, gradualness and systematicity, the interrelationship

of theory and practice, the connection of practice with life. At the same time, the content of practical training was updated and expanded, and learning outcomes to be implemented at the workplace were defined.

Research practical training remains one of the important components of practical training. It is a cross-cutting line of the study process. Its tasks take into account the school features (a student workplace). During the research practice, students acquire knowledge, skills and abilities to organize pupils' research activities, conduct a pedagogical experiment and process its results.

Model of the study load distribution in mathematics teacher education delivered in a dual mode at master level



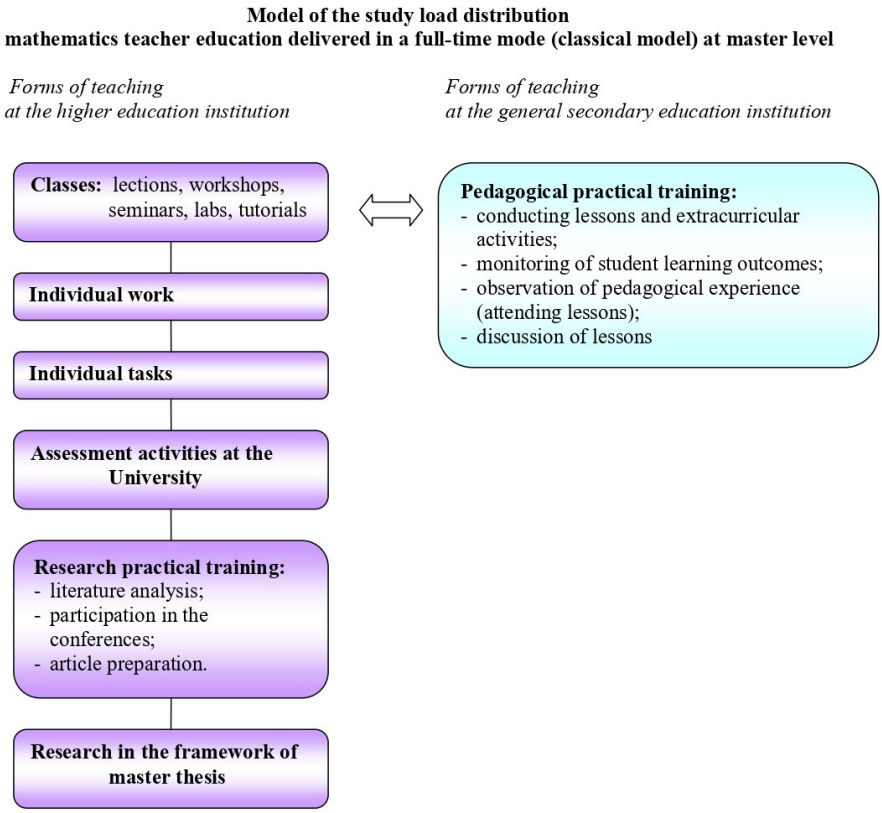


Figure 2

Within the framework of each discipline, individual tasks to be carried out at the workplace are provided. Thus, theoretical knowledge becomes in demand.

The topic of master thesis, the tasks of master's research are agreed with the school administration, the results of the conducted pedagogical experiment are discussed and taken into account in the further work of the school.

The teacher (student's mentor) provides feedback on the student's ability to organize the learning process. The school administration prepares a conclusion based on the results of an experiment conducted by student in the framework of master's research.

Special attention is to be paid to the professional seminar "Basics of professionalism of a teacher of a general secondary education institution" (Trebenko & Shkolnyi 2021). Its purpose is providing methodical assistance and psychological support to master students who combine their study at the university

with a work as a mathematics teacher. This seminar is designed to accelerate the process of professional adaptation of young teachers, to promote their professional development; to provide qualified, effective and timely assistance in the organization of the educational process. The professional seminar is held once every two weeks. Within it, there is an opportunity to discuss the problems and difficulties that students have faced in various situations at the workplace (at the lesson, in communication with pupils, parents, teaching staff, in preparation for lessons, etc.) and to find effective solutions. The content of the discipline has a mandatory and variable component. The variable component is formed on the basis of students' questions in response to challenges arising at the workplace. Specialists in the fields of pedagogy, psychology, medical basics, political science, jurisprudence, etc., experienced mathematics teachers are involved in the work of the seminar. For more details about the professional seminar, see (Shkolnyi 2021).

The model of the study load distribution suggested in 2021 allows organizing mathematics teachers training of education both traditionally and in a dual mode of study using one curriculum. Transfer to study in a dual mode is possible both from the beginning of the 1-st semester and at any time when the student wishes and the partner general secondary education institution gives written approval.

To find out whether the employers have interest, desire, readiness and opportunities for cooperation in the framework of mathematics teacher training in the dual form of education, National Pedagogical Dragomanov University surveyed administrators of Kyiv and Kyiv region schools and vocational colleges that are or were partners of the University. The opinion of employers regarding the advantages, disadvantages and obstacles in the implementation of such a study mode was studied. Several specific issues that need to be resolved in order to effectively implement a dual mode of study in mathematics teacher education have been identified. This article describes the results obtained.

3. Research methodology

The research was conducted in three stages. At the preparatory stage (June and July 2021), the research group developed the content of the questionnaire and conducted expert surveys. Based on the results of expert surveys, questions were clarified and supplemented. During the data collection stage of the survey (from November 1 to 30, 2021), the Employment Department of the Educational and Methodological Center of the National Pedagogical Dragomanov University sent e-mails to schools and vocational colleges with a request to fill out the questionnaire. For the reliability of the results, the chosen schools had real partner cooperation with the National Pedagogical Dragomanov University.

All these schools have appropriate sufficient resources (material, technical, informational, personnel). The survey was conducted using the Google forms service. Finally, at the data analysis and report preparation stage (from December 1 to 29, 2021), the results of the survey were summarized.

The total number of respondents who participated in the survey was 28, including 24 schools and 4 colleges. The majority of respondents (23 – 71.4%) represented an educational institution that is currently cooperating with the National Pedagogical Dragomanov University in the framework of teacher training: permanent cooperation had 16 (57.1%), periodic cooperation – 7 (25%); cooperated earlier, but currently temporarily do not cooperate – 4 (14.3%), never cooperated before, but plan to do – 1 (3.6%).

Cooperation of the University with educational institutions was carried out in the following forms: organization and conducting of educational pedagogical practices – 25 (89.3%), participation of the institution's employees in qualification examination commissions – 2 (7.1%), employing students – 8 (28.6%). It is worth noting that 95.5% of educational institutions whose representatives took part in the survey have employed National Pedagogical Dragomanov University last-five-year-graduates, which to a certain extent made it possible to obtain information about the quality of teacher training, and outline ways to improve it.

Two thematic blocks of questions were offered to the respondents. The first block aimed to reveal the readiness of University graduates in pedagogical specialties for working in their profession, while the second one addressed on cooperation between education institutions and the University in teacher training in a dual mode of study.

4. Survey results

It is worth emphasizing that all respondents noted the need for a certain period of adaptation and further training of graduates: according to 17 (60.7%) respondents, graduates of pedagogical specialties are almost ready to work in their profession and only need adaptation; 11 (39.3%) respondents indicated that graduates are mostly ready and only need some adaptive training. No respondents chose options "Partly ready, need long training course" and "Not ready", as well as the option "Completely ready, need no training and no adaptation".

According to 12 (42.9%) respondents, more attention in mathematics teacher training is to be paid to the formation of the ability to plan the educational process. A quarter of the respondents consider methodical, inclusive and evaluation competencies to be improved. Detailed information is presented in Figure 3.

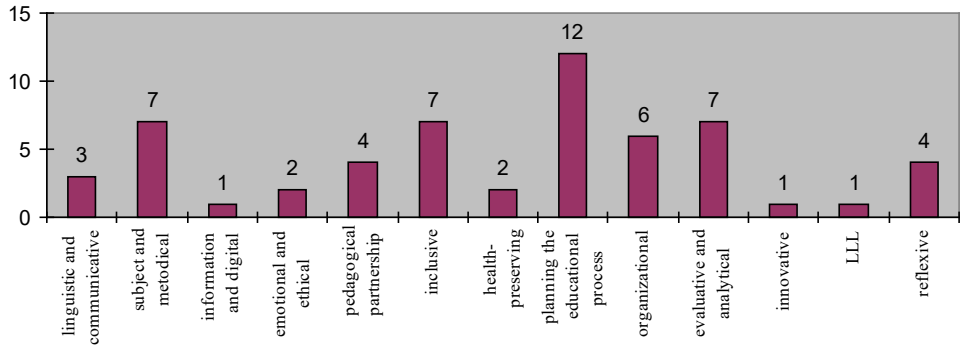


Figure 3. Competencies that require more attention by training teachers

The opinions of employers regarding the ratio of theoretical and practical components of mathematics teacher program differed: 12 (42.9%) believe that the theoretical and practical components should have the same amount (1/2 – theory, 1/2 – practice), 7 (25.0%)) are convinced that theoretical training should comprise up to 3/5 of the educational program, and the same number of respondents believe that, on the contrary, 3/5 of the credits should be allocated to practical training, 4 (14.3%) believe, that 1/5 of the amount of the educational program is sufficient for the theoretical training of math teacher. As we can see, all respondents are convinced that at least 40% of the study workload should be allocated to practical training.

In the context of the research, we were interested whether respondents are familiar with the concept of the dual form of obtaining an education. It was established that 9 (32.1%) generally know about the dual form of education, 7 (25.0%) are well aware, and 6 (21.4%) have a certain idea. However, 5 (17.9%) know almost nothing about this form of obtaining education and 1 (3.6%) knows nothing.

24 (85.7%) respondents are ready to cooperate with the University in mathematics teachers training in the dual mode of study. At the same time, 8 (28.6%) are ready to start such training right now, 7 (25%) – in some time, 3 (10.7%) – starting from the next academic year, 6 (21.4%) need more details about this form of education.

According to the respondents who are familiar with the dual form of education concept, the following advantages are expected in teacher training in the dual mode of study:

- acquisition of practical experience and skills;
- acceleration of adaptation of a young teacher;
- upon completion of training, the school will receive a teacher who does not need adaptation;

- implementation of the competence approach;
- opportunity to acquire real practical skills of communication with children;
- students immediately see which methodology of teaching mathematics theory issues they should pay attention to;
- faster adaptation to the school conditions.

This question was open-ended, 8 respondents put no answer or answered that they did not know or did not see the benefits.

At the same time, respondents noted the following obstacles to implementing dual education in mathematics teacher training:

- lack of vacancies;
- lack of clear instructions or algorithms for implementing work-based learning;
- imperfect regulatory framework;
- certain beliefs of university teachers;
- lack of personnel who could provide mentoring;
- difficulty in establishing cooperation with employers;
- reluctance of students themselves, lack of motivation to work at school, low level of career guidance;
- insufficient payment for mentoring;
- impossibility of adjusting student schedule at the university to school one and school needs;
- reluctance of school administrators to employ students at present;
- quarantine restrictions.

This question was also open-ended, only three respondents answered that they saw no obstacles.

Positive for cooperation is the fact that all partner schools and vocational colleges, whose representatives participated in the survey, have got a mentoring and support system to help young teachers enter the profession. In 20 (71.4%) institutions, a mentor is assigned to each young teacher; in 3 (10.7%) ones, there is a young teachers' school, 5 (17.9%) ones assign the head of the methodological association (cathedra, cycle commission) to be responsible for adaptation. 24 (85.7%) respondents are ready to provide mentoring for young mathematical teachers studying in dual mode. A detailed analysis of answers shows that respondents who do not know about the dual form of education are not ready to provide such assistance.

Thus, the results of the survey indicate that partner institutions were interested in cooperation on mathematics teacher training in a dual mode of study; they satisfy the requirements for staff and understand potential advantages and obstacles. At the same time, only 6 (21.4%) partner institutions had full-time mathematics teacher vacancy (or would have it in the nearest future), 4 (14.3%) had a part-time vacancy, and 18 (64.3%) had no vacancies for mathematics teachers.

5. Conclusions and recommendations

The results of the survey of administrators of schools and vocational colleges being partners of the National Pedagogical Dragomanov University with long-term and fruitful cooperation in various forms (organization and conducting of educational pedagogical practices, participation of the institution's employees in qualification examination commissions, employing students) revealed their interest in cooperation in the framework of mathematics teacher training in dual mode of study, the availability of staff meeting the requirements for mentoring. In some schools and vocational colleges, a mentor is appointed to young teachers, while some have got a school for young teachers. The cooperation experience is convincing in the sufficiency of other resources (material and technical, information support). The respondents understand the potential advantages of this form of cooperation and realize that they will receive a teacher already adapted to the institution's needs.

However, the majority of partner schools and vocational colleges currently do not have an organizational opportunity to implement the dual study in mathematics teacher training: the teacher vacancy is available only in a third of the partner employers, and others do not see it in the nearest future. It means that new educational institutions with which the University has not previously cooperated will be involved in training in a dual mode of study. Does a secondary educational institution that wants to hire a student as a teacher have enough resources to provide quality training at the workplace in accordance with the educational program? Probably not. Hence, it is necessary to determine specific requirements for institutions aiming for cooperation in the dual mode of study. These are the criteria for selecting mentors, requirements for workplaces (material, technical and informational support) and job duties.

At the same time, we understand that the request of educational institutions for graduates is periodic. If a graduate remains working in a school for a long time (it is one of the goals to implement the dual form of education), then this request is mainly specific. (This year math teacher is needed, while next year Ukrainian language teacher is required.) This means that the cooperation within the framework of the dual form of education between the University and the educational institution will also be periodic, hence mentor training is needed almost every time (another subject requires a new mentor). Thus, it is necessary to carefully analyze:

– when the selection of partner institutions for dual education should be organized,
– when and how cooperation agreements should be concluded,
– when and in what way mentors should be trained.

We realize that it is students having found a job at school themselves who will often be initiators of transferring to dual study. Hence, clear instructions for this case should be developed.

It is necessary to elaborate an algorithm on transfer taking place in the middle of the year and to decide in what way to train the mentor (since the developed course requires a group of trainees). Since such a transfer is possible in the middle of the year only if the part of practical training for the study period that a student has mastered is not less than that provided by the study plan for the dual mode of study, then this case should be taken into account in the structure of study plan.

The survey results showed that the partner schools and colleges need clear recommendations and instructions regarding the implementation of the dual study. Clear criteria for evaluating the quality of training at the workplace (including indicators of mentor effectiveness) and procedures for monitoring the quality of organizing training at the workplace should be also developed (in particular, through surveys of students, practice managers, etc.).

Among the obstacles to the dual study implementation, respondents noted the students' reluctance and lack of motivation to work at school. In our opinion, it is not relevant for dual study since students choose this mode of study voluntarily, seeking to acquire practical skills at the workplace. We realize that, most likely, there will be a small number of dual study students in teacher education even when the dual form of education becomes widespread. This makes it necessary to coordinate the schedule of the study process and the schedule of classes at the University with the specifics of the subject teacher's work.

Respondents noted objective reasons that block the dual study implementation. At the time of the survey, there was a peak period of the COVID-19 spread and quarantine restrictions in Ukraine (as well as in the world), which to some extent caused the reluctance of educational institution managers to hire students.

It should be noted that at present in Ukraine these issues are even more acute: martial law was imposed, many children have gone abroad, and some schools provide distance, blended learning or learning in sessions. Hence, the need for teachers, in general, has slightly decreased or, due to the instability of the situation, the school administrators solve the problems on their own by means of additional workload on teachers. On the other hand, school administrators refuse to undertake additional obligations when there is no state support (including a decent additional payment for mentoring from the government), as well as there are no corresponding norms in labour legislation.

We understand that the rather small number of respondents, a limited number of partners of the National Pedagogical Dragomanov University and territorial restrictions do not allow us to assert the representativeness of the obtained results. However, these results, the generalizations and conclusions based on their analysis can be used as a basis for further research. The analysis of the employers' answers made it possible to identify a number of specific problems that need to be resolved, obstacles that employers see, and issues that concern them.

The obtained results could be used by higher education institutions providing training in pedagogical specialties, experts in the field of education, state authorities and local government institutions responsible for education policy, and other specialists interested in the spread of the dual form of obtaining education in Ukraine and abroad.

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