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STAGES OF TRAINING FUTURE MATHEMATICS TEACHERS IN THE FIELD OF PEDAGOGICAL IMPROVISATION

Pedagogical improvisation helps a teacher to respond to new unexpected situations in a quick, flexible and adequate way. The aim of the research is to test the effectiveness of theoretically developed stages of training future mathematics teachers in the field of pedagogical improvisation (motivational-target, content-procedural, evaluative-reflexive). The following criteria for future Mathematics teachers' pedagogical interaction skills were distinguished: motivational, substantive, procedural-behavioral, reflexive, on the basis of which the examination of the investigated phenomenon was carried out. At the initial stage of the pedagogical experiment, the students were interviewed, and the results showed a low level of their pedagogical improvisation skills according to all indicators. Subsequently, each group was subdivided into experimental and control subgroups. In the experimental subgroup, the suggested stages were implemented, while in the control group lessons were conducted in a traditional way. The results of the pedagogical experiment confirmed the effectiveness of the suggested stages in the work on the formation of Mathematics students' improvisation skills.

Keywords: *training, readiness, future teachers of mathematics, educational process, higher educational institutions, pedagogical improvisation.*

Introduction

The general tendencies of democratization and humanization of the new Ukrainian school require an increase in the level of professional training of future Mathematics teachers (Zhernovnykova, 2017). It is known that teaching is focused on solving a system of tasks, including unplanned ones, whose solution is ensured by the constant creative search of a Mathematics teacher, his or her readiness to make extraordinary decisions, that is, to improvise (Zhernovnykova, 2017). Pedagogical improvisation is a quick, flexible and adequate response to newly created situations or those that spontaneously, suddenly arose, and require an instant reaction (Bashkir, 2007). As psychologists note, improvisation is filled with sensual-rational representations, fantasy, intuition of the subject (Nemov, 1995; Stolyarenko, 2004). A person capable of improvisation has the ability for profound comprehension of reality and making optimal decisions.

Pedagogical improvisation has its own peculiarities due to the specifics of the work of a teacher (Hedden, 2017) and is intended for positive perception by students, that is, it is characterized by necessarily a pedagogically significant final result; combines formalized, regulated activity with the creative one and acts as an indicator of the quality of interaction; has a public character; requires teacher's mastery of verbal and non-verbal means of communication that provide a vivid expressiveness of thoughts, logics of expression, and the effectiveness of persuasion. An educational effect of pedagogical improvisation is achieved also due to the general culture, pedagogical mind, imagination, inspiration, intuition, taking into account the peculiarities of the experience of a teacher-improviser (Wright, 2010).

Pedagogical improvisation fulfills the following functions: organizational (activation of knowledge acquired by students), stimulating (inducing students to improvise, searching for bright, original ways of its realization), communicative (using communicative means for creating favorable communication) and regulatory (focusing pedagogical interaction on a positive result), which in unity contribute to its effectiveness (Bashkir, 2006).

The study of scientific literature and our own experience gives grounds to assert that the training of future Mathematics teachers in the field of pedagogical improvisation results in the acquisition of a corresponding ability, which we define as a stable personality formation containing integrated values, knowledge and skills necessary for the implementation of pedagogical improvisation in the teaching of Mathematics students. According to the actions that a future Mathematics teacher performs when dealing with unforeseen pedagogical situations, we distinguish the components of students' pedagogical improv-

isation ability (motivational, substantive, procedural-behavioral, reflexive), on the basis of which the evaluation of the investigated phenomenon is carried out.

Taking into account the components of the future Mathematics teachers' pedagogical improvisation ability and the logics of the process of professional training of students, the following phases of their training were substantiated theoretically: motivational-target, content-procedural, evaluative-reflexive.

The motivation-target stage of the training is aimed at stimulating the development of positive motivation in students for pedagogical improvisation, ensuring awareness of the features of future work, which requires a steady need for achieving a high level of professionalism, creativity, activity and initiative as the basis for pedagogical improvisation; selection and development of the strategy of forming students' improvisation ability in the process of professional training.

The content-procedural stage of training involves mastering necessary knowledge about the essence of improvisation, its specificity, structure, types, functions, features, the interrelation of improvisation and creativity, as well as its role in ensuring comfortable interaction of participants in the educational process and pedagogical improvisation skills (abilities related to the assessment of a situation (to concentrate and distribute attention, to activate acquired knowledge and to search for original decisions in unforeseen situations and ways of their realization, adequately evaluate pedagogical problems, to respond quickly and urgently to students' questions and acts, etc.), skills that enhance the effectiveness of pedagogical improvisation (to think extraordinary, to predict situations that may lead to improvisation, to evaluate students, engage them in improvisation, to cause necessary reactions, communicative skills (verbal and nonverbal));

The evaluative-reflexive stage of training was aimed at the evaluation and correction of the content, forms and methods of training future Mathematics teachers in the field of pedagogical improvisation; studying the effectiveness of the implementation of certain stages.

Aim and Tasks

The paper aims to verify the effectiveness of the theoretically grounded stages of training future Mathematics teachers in the field of pedagogical improvisation.

The following tasks are set:

1) to review literature on the issue, to find out the meaning of the pedagogical improvisation concept, the training of future Mathematics teachers in the field of pedagogical improvisation concept, and to identify the components of the maturity of future specialists' improvisation ability;

2) to assess the levels of the maturity of future Mathematics teachers in terms of pedagogical improvisation;

3) theoretically substantiate stages of training future Mathematics teachers for pedagogical improvisation and experimentally verify the effectiveness of their implementation.

Research Methods

To assess the maturity of the respondents' pedagogical improvisation ability, we used the criteria and indicators selected on the basis of psycho-pedagogical literature review: motivational, content, procedural-behavioral, reflexive.

The motivational criterion is considered to be the leading one, because improvisation ability itself depends on motivation. The system of motives performs a regulatory function in the process of professional training and promotes the formation of future Mathematics teachers' pedagogical improvisation skills. The motivational criterion is assessed according to the following indicators: awareness of the role of pedagogical improvisation in future work; positive attitude to mastering pedagogical improvisation skills; the domination of positive cognitive motives, the desire to achieve mastery in the process of mastering improvisational skills.

"Communicative and Organizational Skills Inventory" (by L. Stolyarenko) and "Pedagogical situations" (by R. Nemov), and "What is your creative potential? Questionnaire" (O. Bodalev) were used to examine the indicators of the motivational criterion.

The content criterion was examined through the "knowledge of the essence of pedagogical improvisation" indicator, ways of mastering pedagogical improvisation and self-study. To assess it, such exercises-tasks as "Transformation", "Reinterpretation", etc. were used.

The procedural-behavioral criterion for the formation of future Mathematics teachers' activity in the field of pedagogical improvisation was examined through the following indicators: constant application of knowledge in relation to the phenomenon under study in practice; instantaneous search for solutions to the proposed problem; public realization of pedagogical improvisation.

The reflexive criterion was examined by constant correction of future Mathematics teachers' actions by their own in the field of pedagogical improvisation, rethinking and predicting the results of further interaction.

168 respondents - students of the Faculty of Physics and Mathematics of 1st-4th years of study of H.S. Skovoroda Kharkiv National Pedagogical University participated in the survey.

The respondents were suggested to fill in a questionnaire containing 38 questions of open and closed types. It consisted of 3 units: the first one was intended to reveal knowledge about pedagogical improvisation, its functions, features; the second one was focused on assessing practical skills of pedagogical improvisation; the third one – on assessing the maturity levels of pedagogical improvisation ability (in accordance with the stages of training in the field of pedagogical improvisation).

In addition to the questionnaire, other methods of psychological and pedagogical diagnostics were used at this stage of the pedagogical experiment.

To assess the respondents' creative thinking, we used the following methods: "Word Meaning", "Exception of Concept". In order to determine the type of thinking, we

used a test that involved the task to make individual psychological characteristics of personality traits related to the peculiarities of their work. The level of original thinking of students was determined using a test with a picture (Nemov, 1995).

A technique "Identifying communication and organizational abilities of future Mathematics teachers" (Nemov, 1995) was aimed at examining communication and organizational skills (the ability to accurately and quickly make business and friendly contacts with people, participate in teamwork, the ability to influence people, take initiative, etc.). A "Teaching Situations" method (Kutsevol, 2017) helped to assess the level of decision-making skills in the process of improvisation. A questionnaire "What is your creative potential?" (Bashkir, 2007) helped to evaluate the respondents' creative skills.

In order to assess the maturity of pedagogical improvisation skills, we attended 68 lessons of student-interns who had pedagogical internship at Kharkiv Pedagogical Lyceum № 4 of the Kharkiv City Council of Kharkiv region, the Kharkiv Gymnasium № 116 of the Kharkiv City Council, and the Kharkiv Gymnasium № 169 of the Kharkiv City Council.

Research Results

The results of the observation showed that the teachers almost did not have transformation skills, which envisaged the transition from the lesson plan to improvisation, they were afraid to discuss those issues which, in their opinion, did not relate to the topics of lessons, but could relieve psychological tension and facilitate the perception of learning material.

The results of the summative assessment revealed the levels (high, average and, low) of the respondents' pedagogical improvisation ability (see Table 1) and the necessity of carrying out special and purposeful work on the development and implementation of training in the field of pedagogical improvisation.

Table 1.

Levels of the Respondents' Pedagogical Improvisation Ability

levels / years of study	I	II	III	IV	V
high	3%	5.5%	8.5%	11%	13.5%
average	11%	13%	18%	21%	22.5%
low	86%	81.5%	73.5%	68%	64%

The analysis of the survey results showed that most students did not realize the essence of pedagogical improvisation, the peculiarities of its introduction into the educational process and, accordingly, had a low level of pedagogical improvisation skills. Therefore, the implementation of theoretically grounded stages of training future teachers of Mathematics for pedagogical improvisation was provided. In the experimental group EG (86 respondents) training was carried out through the implementation of the suggested stages, in contrast to the control group CG (82 persons), who were taught according to the traditional system.

The process of forming the respondents' pedagogical improvisation ability was examined by means of:

• implementation of theoretically grounded stages of training, proving their effectiveness in the process of professional training;

• introduction of changes into the curriculum in Pedagogy, Methods of Teaching Mathematics, Technologies of Teaching Mathematics, based on the individual creative approach, which provided students with creative tasks and improvised situations; playing business games; discussion of pedagogical situations; performance of exercises for the development of mathematical skills of pedagogical improvisation.

The motivational-target stage of the training was realized by stimulating the development of the students' positive motivation to acquire improvisational skills through awareness of their future duties at work, which required a steady need to acquire a high level of professionalism, creativity, activity, initiative. The work on enhancing motivation for pedagogical improvisation provided for the following tasks: to reveal the role and significance of pedagogical improvisation in the work of a teacher; apply various stimuli to maintain a positive attitude towards the pedagogical improvisation.

The development of positive motivation in the respondents for mastering improvisation skills was achieved as a result of the disclosure of the significance of improvisation as a factor in maintaining a favorable atmosphere at a lesson in Algebra and Geometry and in the student team; stimulating students' needs for improvisation and use it in the educational process.

The process of the formation of students' pedagogical improvisation ability at the content-procedural stage of training provided for the acquaintance of future teachers with the theoretical material regarding it.

Educational activity that can be defined as the purposeful interaction of the teacher and students, which results in the formation of the future Mathematics teachers' scientific knowledge regarding improvisation and the skills of its practical implementation, plays a leading role in forming the students' pedagogical improvisation ability.

In the process of studying, the students mastered:

• knowledge that characterized the essence of pedagogical improvisation, its specifics, structure, types, functions, features, the relationship of mathematics with creativity, as well as its role in ensuring comfortable interaction of participants in the educational process;

• knowledge of ways, methods and ways of cognition;

• knowledge concerning evaluation procedures.

The process of mastering the knowledge and skills of pedagogical improvisation was carried out in the following ways:

• distinction or recognition of the subject (the identification of improvisation among other teaching and educational functions of the teacher);

• memorization and reproduction of theoretical material on improvisation;

• application of knowledge in practice;

• use of acquired knowledge and skills in new situations.

The difficulties that arose in the process of organizing communication as a leading component of pedagogical improvisation were overcome when performing an "Individual training" exercise, listening to TV and radio reports and messages, developing improvisations on a given topic.

The implementation of exercises on the development of such qualities of a teacher as fantasy ("knowing the conditions of modern studying Mathematics", "Transfer of emotions", "Alive picture", "Uninhabited island"), imagination ("Description of compositions", "Matrix of the future story", "History of photography", "The abstract drawing", "Recognize me", compilation of poems, etc.), creativity, intuition, responsiveness, was an important task of the content-procedural stage.

The formation of the respondents' pedagogical improvisation ability was due to the organization of the subject-subjective relationship between a teacher and students, the introduction of changes in the methodology of conducting the training, the inclusion of students in self-study focused on preparing improvisations at home, their involvement in the work as assistant consultants.

At the evaluative-reflexive stage, the students were taught to evaluate the correctness of the decisions made, identify errors and analyze their causes, carry out correction of actions, find out the expediency of pedagogical improvisation, and its pedagogical consequences through methods of self-assessment. The foregoing provided for the formation of future teachers' skills to evaluate their own actions, to predict possible consequences of pedagogical improvisation, to deliberately criticize mistakes and to adjust their own activities.

When organizing self-study activities, special attention was paid to such basic aspects as: taking into account individual interests, peculiarities, needs of future Mathematics teachers, their demand for special scientific and methodical literature; rational distribution of working and free time; continuity, systematic work on self-improvement in the field of improvisation; the need to avoid occasional and superficial character in the formation of pedagogical improvisation ability.

Analytical-reflexive methods (analysis, self-analysis, evaluation, self-assessment, comprehension, comparison, generalization, reflection), methods of influence on the formation of personality (suggestion, persuasion, encouragement, induction) were the technological tools of this stage of the training.

At the final stage of the experiment, an analysis of its results was carried out: verification of the effectiveness of the implementation of the suggested stages of the training of future Mathematics teachers in the field of pedagogical improvisation.

In order to evaluate the theoretical knowledge of pedagogical improvisation, we used tests where the correct answer should be chosen from several suggested variants (TMaker computer test program), control papers requiring independent answers, where students should fill in omissions in paragraphs or sentences.

The conducted work contributed to the formation of self-control ability in different situations, the ability to evaluate one's own actions. Thus, in most students, the desire to improve themselves in the field of communication, to manage their behavior, activities, feelings, emotions, etc. could be observed. The respondents understood that self-education, self-management are creative processes, which require the overcoming of contradictions, the formulation of their own new goals, the search for new expedient and effective solutions, and the improvement of means of achieving goals. The students also observed the desire to change some of their stereotypes, consolidate the acquired knowledge and skills.

It was found that the level of the maturity of the respondents' pedagogical improvisation ability grew with an increase in the level of their ideas of the profession, which envisaged knowledge of those requirements and the conditions of work.

Depending on the manifestation of the indicators, the respondents' pedagogical improvisation ability was differentiated according to the levels presented in Table 2.

Table 2.

Maturity Levels of Future Mathematics Teachers' Pedagogical Improvisation Ability (in %)

Levels	**Criteria**	**Indicators**	Groups			
			EG (86 respondents)		CG (82 respondents)	
			Summative assessment	Reassessment етап	Summative assessment	Reassessment етап
1	2	3	4	5	6	7
High	Motivational	• Understanding the role of pedagogical improvisation in future work; • Positive attitude to mastering pedagogical improvisation skills; • Domination of positive cognitive motives, desire to gain mastery in pedagogical improvisation	36	82	35	80
	Content	Knowing the essence of pedagogical improvisation, ways of its mastering and self-education	32	89	28	47
	Procedural-behavioral	• Constant use of knowledge of pedagogical improvisation in practice; • Urgency of finding variants of solving problems; • Public realization of pedagogical improvisation	34	84	31	72
	Reflexive	Constant correction of one's own actions, rethinking and predicting the results of further interaction	40	81	39	77
Average	Motivational	• Superficial understanding of the role of pedagogical improvisation in further work; • Neutral attitude to mastering pedagogical improvisation skills; • Domination of motives over a desire to gain mastery in the process of working on pedagogical improvisation skills	45	18	46	19
	Con-tent	Superficial knowledge of the essence of pedagogical improvisation, ways of mastering pedagogical improvisation and self-education	51	21	49	33
	Procedural-behavioral	• Situational application of knowledge about pedagogical improvisation; • Occasional search for solutions of the proposed problem; • Insecurity during public realization of pedagogical improvisation	48	16	46	28
	Reflex-ive	Students partially correct their actions, and predict further activity.				
Low		The indicators are not manifested in full, the students ignore the issue of pedagogical improvisation.	17	-	16	-

Table 2 shows that the work on the formation of future Mathematics teachers' pedagogical improvisation ability was carried out effectively. The data of statistical processing and generalization of received information show that the formation of their pedagogical improvisation skills depends not only on the intensity of the work carried out by the teachers, but also on the active inclusion of students in the process of training, their involvement in cooperation, activating their independent search and self-study activities.

In addition, the study conducted made it possible to teach the future Mathematics teachers to see a problem in a pedagogical situation and consider it as a pedagogical task (83% vs. 44%), to assess pedagogical problems ur-

gently, to respond quickly to questions or deeds of students (91% vs. 34), combine necessary pedagogical influences according to the purpose and the expected results (87% vs. 43%), to predict and analyze possible effects of occupational impact (76% vs. 24%), major skills (88% versus 32), the ability to transform (76% vs. 12%), ability to attract a child to improvise (92% vs. 29%).

In order to confirm that the results of the pedagogical experiment are not accidental but provided by the targeted action of teachers, their statistical verification has been carried out. The fact that, according to all indicators, the components of the respondents' pedagogical improvisation ability in the control group, where the mean value is significantly different from that in the experimental group (t-number (7.86)> t-tabl (1.96); P> 0.05), gives grounds to assert that there are significant changes as a result of the formative stage of the pedagogical experiment. And, therefore, the theoretically grounded stages of training future Mathematics teachers in the field of pedagogical improvisation are effective and can be proposed for widespread use.

Conclusions

Thus, after conducting a pedagogical experiment, we can state that the gradual training of future Mathematics teachers in the field of pedagogical improvisation provided the development of their positive motivation to pedagogical improvisation and their awareness of the features of future work, which requires a steady need to achieve a high level of professionalism, creativity, activity, initiative as the basis for pedagogical improvisation; developing a strategy for forming pedagogical improvisation ability; the selection of necessary knowledge (the essence of improvisation, its specifics, structure, types, functions, features, the relationship of improvisation with creativity, as well as its role in ensuring comfortable interaction of participants in the educational process) and skills related to the assessment of the situation and increase the efficiency of the phenomenon under study; analysis, correction of content, forms and methods of training future Mathematics teachers in the field of pedagogical improvisation.

The implementation of the staged training in the field of pedagogical improvisation proved its effectiveness. Specifying the work in the experimental group allowed students to form a positive motivation for pedagogical improvisation, deep knowledge of the phenomenon under study, the ability of pedagogical improvisation, a constant desire for self-improvement.

The conducted research does not cover all aspects of the issue. A promising area of research covers the study of peculiarities of future teacher training in the field of pedagogical improvisation, taking into account the specifics of their specialty, etc.

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ЕТАПИ ПІДГОТОВКИ МАЙБУТНІХ УЧИТЕЛІВ МАТЕМАТИКИ ДО ПЕДАГОГІЧНОЇ ІМПРОВІЗАЦІЇ

У статті розглянуто підходи сучасних науковців до визначення сутності процесу підготовки майбутніх учителів математики до педагогічної імпровізації. Згідно з дослідницьким задумом, формування готовності майбутніх учителів математики до педагогічної імпровізації сприятиме тому, що в майбутній професійній діяльності студенти швидко, гнучко й адекватно реагуватимуть на щойно створені ситуації або ті, що виникли стихійно й раптово. Мета статті полягає в перевірці ефективності теоретично розроблених етапів підготовки майбутніх учителів математики до педагогічної імпровізації (мотиваційно-цільовий, змістово-процесуальний, оціно-рефлексивний). Методи дослідження: теоретичні – аналіз, синтез, порівняння, класифікація науково-методичної літератури з метою визначення ключових понять дослідження; емпіричні – фрагменти педагогічного експерименту; анкетування студентів, майбутніх учителів математики. Проаналізовано наукові позиції щодо визначення критеріїв формування готовності майбутніх учителів математики до педагогічної взаємодії: мотиваційний, змістовий, процесуально-поведінковий, рефлексивний, на основі яких здійснюється оцінка досліджуваного феномена. На початковому етапі педагогічного експерименту було проведено анкетування та бесіди зі студентами, результати яких зафіксували низький рівень оволодіння ними вміннями педагогічної імпровізації за всіма показниками. Після цього кожну групу було розподілено на експериментальну та контрольну підгрупи. В експериментальній підгрупі реалізовано етапи підготовки майбутніх учителів математики до педагогічної імпровізації, а в контрольній – заняття проведено традиційно. Результати педагогічного експерименту засвідчують, що в цілому у всіх групах покращилися показники, що сприяли формуванню готовності майбутніх учителів математики до педагогічної імпровізації, найвищі були зафіксовані в експериментальній групі.

Ключові слова: підготовка, готовність, майбутні вчителі математики, навчально-виховний процес, заклад вищої освіти, педагогічна імпровізація.

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