



Training of future teachers for the implementation of continuity of preschool and primary Mathematical education

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ABSTRACT

The article deals with the problem of the future teacher's readiness to implement the continuity of preschool and primary mathematical education. The purpose of the study is to determine the level of training of future teachers to implement mathematical education and to summarize the data obtained during the pedagogical experiment. The standard curriculum of preschool education and training and the curriculum of the 1st grade are analyzed to determine the continuity of mathematical education. The authors developed a diagnostic program that allowed students to identify the level of readiness for the implementation of the continuity of math education. To gather objective information about the possibility of their further development, through the content of pedagogical subjects and elective course "Basics of continuity of preschool and elementary math education", as well as to identify ways to stimulate the desire of the interest of students to assimilate the necessary knowledge and skills in this field.

Keywords: continuity, mathematical education, teacher training, components

Article history

Received:
31 October 2021

Revised:
13 February 2022

Accepted:
24 April 2022

Published:
1 June 2022

Citation (APA Style): Dzhumanazarovna, S. A., Bagitovna, K. F., Bakirovna A. A., Evgenievna, A. L., Zhangazinovna, M. M. & Meirkhanovna, B. A. (2022). Training of future teachers for the implementation of continuity of preschool and primary Mathematical education. *Cakrawala Pendidikan: Jurnal Ilmiah Pendidikan*, 41(2), 531-540. <https://doi.org/10.21831/cp.v41i2.43641>

INTRODUCTION

Over the past two decades, we have been actively observing the process of globalization: modern science, the digital revolution, technological breakthroughs, and the development of human capital have necessitated the transformation of education.

The re-evaluation of the values of world civilization was led to the recognition of the need to educate the culture with global thinking at the person, who is capable of actively participating in the development not only of his country but also of the world in harmony with the world of nature, society, and his own internal world. In this regard, the orientation toward new personality qualities led to the development of two educational trends in the Republic of Kazakhstan: modernization and continuity of the education system (Syzdykbayeva et al., 2020).

Modernization issues are revealed through the holistic renewal of the content of preschool, primary and secondary education. Continuity is proclaimed as the basis for the life success of the individual, the well-being of the nation, and competitiveness.

Preschool education is the first stage of the human continuing education system, so he/she has a special role in the formation of the personality. So, it is exactly here, there are laid the foundations of personal properties, qualities, and abilities, in many ways determining the way of further formation of the child as a schoolchild, student, professional, and citizen. However, the

potential and achievements of educational institutions in this system are not fully taken into account and used to the full extent as well.

At present, the Republic of Kazakhstan introduced compulsory preschool education as one of the conditions for the implementation of continuing education of the personality. Its essence and content are interpreted as the definition of general and specific goals of education, forming the single content line ensuring the effective progressive development of the child, his/her successful transition to the next stage of education (Minister-of-Education-and-Science-of-the-Republic-of-Kazakhstan, 2018). The theoretical foundations of continuity of pre-school and primary education are revealed in the works of foreign scientists (Assel Bakirovan Akpayeva et al., 2016; Burchinal et al., 2020; Commodari, 2013; Goble et al., 2017; Golovina, 2002; Goncharova, 2004).

In the Republic of Kazakhstan, the problems of continuity of pre-school and primary education were considered by Kazakh scientists (Elkeeva, 2016). Noting the importance of the above-listed research, it should be emphasized that the issue of continuity of pre-school and primary education in science was sufficiently developed, but there are no developments that reveal the content and mechanisms of continuity of pre-school and primary mathematical education. The study of mathematics plays a system-forming role in education, developing the cognitive abilities of a person, including logical thinking, and influencing the teaching of other disciplines.

Thus, there is a contradiction between the existing theoretical basis of vocational training of teachers in the university and the absence of developments, defining the content and mechanisms of formation of skills, determining the success of the implementation of continuity of preschool and primary mathematical education. This contradiction identified the problem of research, which consists of scientific justification of formation of readiness for the implementation of continuity of preschool and primary mathematical education for the future teachers of Kazakhstan.

METHOD

In order to solve the research tasks, we used: theoretical and empirical methods, in particular, analysis, synthesis, generalization, concretization, polling, testing, and pedagogical experiment. In order to solve the first task, we determined the essence of the concept of "continuity" and analyze whether there is continuity in the programs of preschool and primary mathematical education, as well as highlighted components that determine the readiness of the future teacher for its implementation.

Two groups participated in the research: students at the Abai Kazakh National Pedagogical University (experimental, 56 students) and the Kazakh National Women's Teacher Training University (control, 57 students). The selection included 113 students. Three (3) levels were determined for detection and identification of the level of manifestation and development of indicators of each structural component of skills: low, average, and high.

The low level is characterized by the unsustainable interest in the problems of implementing the continuity of pre-school and primary mathematical education; there is no personally significant sense of implementation; the knowledge system for implementing the continuity of pre-school and primary mathematical education was not systematized; pedagogical reflexive was not formed.

The average level has a more sustained interest in implementing the continuity of preschool and primary mathematics education; cognitive interest begins to form on the basis of knowledge about mathematical education of the specifics of preschool and primary mathematical education, knowledge is systematized; awareness of the need for continuity between educational systems has no the personal nature; pedagogical reflexive position is related to awareness of own contribution in the implementation of continuity of pre-school and primary mathematical education.

The high level is characterized by purposefulness, stability, awareness of the choice of ways and means of implementation of pre-school and primary mathematical education; the aspiration for implementation of continuity of mathematical education has personal meaning; its

provision in its own practice is based on deep pedagogical and mathematical knowledge. Pedagogical reflection is related to self-affirmation, and self-realization through the development of individual style.

The scientific concept "continuity" is represented the difficult, complex category, integrating into itself many relatively independent aspects, the main of which are philosophical, psychological, and pedagogical (Table 1).

Table 1. The essence of the concept of “continuity”

	Category	Content	Authors
Continuity	Philosophical	The objective connection between the old and the new in the development process; a moment of development; the necessary condition for any form of development, and the functional state in various directions of development.	G. Hegel E.A. Baller B.S. Baturin A.I. Zelenkov G.N. Isaenko Z.A. Mukashev et al.
	Psychological	Development condition; the relationship between stages of development; the relationship between lines of development and future activities and psychological maturity; the interrelation between new formations.	L.I. Bozhovich L.S. Vygotsky A.N. Leontiev S.L. Rubinstein et al.
	Pedagogical	Methodological principle, general pedagogical regularity, didactic condition, the way to optimize teaching methods, the means of improving the effectiveness of education and training, and the factor of improving the quality of the educative-educational process.	Sh.I. Ganelin S.M. Godnik Yu.A. Kustov V.E. Tamarin et al.

The versatile consideration of the philosophical, psychological, and pedagogical essence of continuity as the pedagogical phenomenon made it possible to highlight some commonality of approaches, which shows that continuity is the objective and necessary connection that ensures the effective conduct of the educational process.

The analysis of the historical pedagogical heritage shows that the problem of continuity of preschool and primary education and the training of teachers for its implementation was mainly addressed by scientists in the study of such problems as the integrity of the education system, the theory of education and upbringing of the personality, the development of the child in preparation for school (Klimentyeva, 2004). Next, we determine whether mathematical preschool and primary mathematical education have continuity (Table 2).

Table 2. Sections of preschool and primary Mathematical education

Elementary Mathematical ideas for preschool children	The mathematical education of the 1 st grade
"Orientation in space"	"Numbers and quantities"
"Quantity and calculation"	"Algebra elements" "Sets. Logic elements"
"Geometrical figures"	"Geometry elements"
"Mathematical modeling"	"Mathematical modeling"

The analysis of the curricula shows the significant achievement of continuity. Both programs consist of sections and subsections that contain learning objectives in the form of expected results: skill, knowledge and understanding, the description of the spatial forms and quantitative correlations of subjects in the surrounding world, aimed at developing the perception of mathematics as the way to image and understand the world. The learning objectives allow in

an organized way, consistently within each subsection, for teachers to plan their work and evaluate children's achievements, as well as inform them about the next stages of learning. There is no duplication in content, the numbering of the purpose of sections and subsections do not coincide.

The primary school mathematics curriculum is developed on the basis of D. Bruner's principle of spirality of cognitive theory, which is consisted of the consideration of material gain, with the gradual deepening, complication, and increases in the scope of knowledge and skills (Minister-of-Education-and-Science-of-the-Republic-of-Kazakhstan, 2016a).

The materials of the simplest ideas are contained in the first section "Numbers and quantities", such as counting in the direct and reverse order within 10 in the pre-school class, from 10/11 to 20 in the first class. In the first class, it is studied the operation of addition is the combining sets that have no common elements, and subtracting is removing part of the set. The objects are compared by different characteristics of length/mass/volume (capacity) / time using the conditional measure, by a sequence of different events/figures/time (day, week, month, year). There are studied the temporary representations: today, yesterday, tomorrow, the day after tomorrow; parts of the days; as well as time in hours is determined by clock dial in 12-hour format / the distinguishing units of time: minute, hour, day, week, month, year. The main aims and tasks of training in mathematical education in this section are not broken.

In the section "Algebra elements" there is no study of elements of algebra, but in the subsection "Equality and inequality. Equations" in order to recognize equality, inequality, equation / to distinguish the right and wrong equality, to solve equations by means of selection and on the basis of connection of addition and subtraction, the principle of continuity is not violated for the purpose of pre-school training to compare numbers / to establish equality and inequality of objects in groups, adding or removing objects, to generalize numerical values on the basis of calculation and comparison of groups.

In the section "Sets. Logic elements" children of the pre-school class learn to combine the objects into the set by a certain property, call elements of the set. In the first class, combining two sets and removing the portion of the set is illustrated, children learn to classify sets based on the characteristics of their elements (color, shape, size, material, object action), to compare sets of objects using pairings / determine equal sets, empty sets, and determine correct and incorrect statements. In the subsection "Sequence" there is no violation in the pre-school class, children solve simple actions to name the missed number in the sequence of numbers from 1 to 10, analyze the regularity and find the violation with the help of the teacher. In the first class, they form the sequence of numbers up to 10 / up to 20 / tens up to 100 and vice-versa /; determine the regularity in the sequence of drawings, figures, symbols, and numbers within the 100; determine the sequence of actions and states in nature /; form the sequence of numbers, figures, toys, multicolored beads; find a violation of the regularity in kindergarten.

In the section "Geometry elements", continuity is not broken in the use of spatial notions, this is noticeable in the pre-school class for the purpose of orienting on the sheet of paper, children describe the location of geometric figures on cards, respectively, in the first class they depict on the plane straight line, curve, broken closed and open lines / simplest plane figures (triangle, quadrilateral) on dot paper. Along with it, there is considered a location in space: at the left, on the right, above, below, in front (before), from behind, (after), close, between, or nearby; younger schoolchildren determine the main relations between geometrical figures (more-less, higher-lower, wider-narrower, thicker-thinner), the direction of objects of the world around (front-back, left-right, top-bottom, between, near, on, over, under, inside, outside, in the middle).

In the section "Mathematical modeling", sequence and continuity are not broken. Use and understanding of the language of the sign "+" as the sign uniting objects, "-" as the sign of removal from a group of objects at pre-school continues with the analysis and the solution of tasks on increase, reduction of number by several units, differential comparison, drawing up and the solution of the return tasks with the use of signs "+", "-", "≠", "=", ">", "<" in the first-class (Minister-of-Education-and-Science-of-the-Republic-of-Kazakhstan, 2016b).

It follows from the above that the analysis of the current curriculum in grade 1 and the model curriculum of the pre-school organization allows teachers to develop uniform goals in the

development and upbringing of children of senior pre-school age, as well as to minimize the differences between pre-school and school education systems through the principle of spirality at the projecting of the content of the subject, however, it is necessary to make changes in the sections and in order to maintain the principle of spirality in the relationship between pre-school and primary education. This applies to both the numbering of sections and the formulation of purposes. The introduction of compulsory pre-school education was a good help in the implementation of continuity and the creation of adaptation conditions of education in the study of the first section of the current program.

Next, we will determine whether the future teacher is ready for the implementation of the continuity of preschool and primary mathematical education. For this purpose, it should be considered the structure of readiness of the future teacher for implementation of the continuity of preschool and primary mathematical education, including motivational, cognitive, activity, and reflexive components (A. B. Akpayeva & Lebedeva, 2017; Kucher & Pustovalova, 2014) (Table 3).

Table 3. Content of components of readiness of the future teacher for implementation of the continuity of preschool and primary mathematical education

Name of the component	Characteristic	Method of diagnostics
Motivational	The orientation of the future teacher towards the comprehensive development of the child and, above all, mathematical preparation for school; sustained motive and cognitive interest in the problems of continuity, learning the foundations of continuity of pre-school and primary mathematical education.	Questionnaire (determining the attitude of future teachers to the problem of continuity of pre-school and primary mathematical education, Kurlat A.).
Cognitive	Knowledge of theoretical-methodological foundations of continuity of pre-school and primary mathematical education; legal-regulatory documentation (MC (Model curriculum), SC (school curriculum), IEP (individual education plan), etc.); mechanisms of management of educative-educational (training and educative) processes of studying of mathematics on the basis of the principle of continuity.	Conversation (questionnaire, which reveals that students have common ideas about the essence of continuity of mathematical education, directions of its implementation, software equipment, Goncharova I.).
Activity	Skills and abilities in the projecting, designing and organization, control, and estimation of continuity of preschool and primary mathematical education.	Testing (method of self-evaluation of analytical, prognostic, projective, control-evaluative, organizational, and communicative skills, Kurlat A.
Reflexive	Analysis and self-evaluation by the future teacher of the phenomena of own consciousness and activity towards solving the problems of continuity of pre-school and primary mathematical education.	Testing (method of self-evaluation of reflexive skills, Syzdykbayeva A.).

The motivational component is highlighted as the leading in psychological-pedagogical research on the problems of professional training of the future teacher. A.M. Romanov notes that motivation ensures the formation of criterion-normative value orientations of students, high efficiency of education, and personal and professional development. A. Rodionov believes that motivation can be considered the fundamental condition for the realization of the activities of training. The results of research, conducted by E.P. Ilyin, V.A. Yakunina, N.N. Meshkov, prove that the factor of motivation for a successful study is stronger than the intelligence factor. M.A. Prikhodko notes that by means of educational motivation it is possible to reach the required level of the formed knowledge, abilities, or skills, and to form professional knowledge, abilities, and skills (Abylkassymova et al., 2006).

Within the framework of our study, motivation is the set of all factors, determining inducement, interest in continuity problems, and learning the foundations of continuity of pre-school and primary mathematical education. The readiness of the future teacher for implementation of continuity of pre-school and primary mathematical education provides for mastering the basics of knowledge not only of mathematical content but also from various pedagogical fields in specially created conditions of the organized and managed process.

Theoretical analysis of functions, content, and structure of teacher's activity, the study of normative and educational-methodical support of professional-pedagogical education allowed to highlight the volume and content of knowledge which the future teacher should possess for successful realization of continuity of pre-school and primary mathematical education: to know the essence, content, technologies of realization of continuity of mathematical education in a pre-school organization and primary school; normative-legal support of this process (curricula in kindergarten and the first grade of primary school in mathematics); age characteristics of the study of mathematical education; specificity and content of preparation of the child for school, diagnostics of the level of preparation of the child for school; innovative approaches of the continuity of preschool and primary mathematical education. In our research, we focused on the activity component, which we will focus on it in more detail.

The activity component is considered as the set of consistently developing actions, based on knowledge, aimed at solving pedagogical problems, which, in general, are limited to skills to think and act professionally, to analyze facts and phenomena of pedagogical reality. The indicators of activity component formation are awareness, stability, and accuracy of transferring the learned knowledge of mathematical content into pedagogical actions. This includes several groups of analytical, prognostic, projective, control-evaluative, organizational, and communicative skills.

Analytical skills determine to a large extent the success of the implementation of continuity of preschool and primary mathematical education and allow to highlight aspects and directions of implementation of mathematical education, to correctly set tasks of continuity, to approach to the solution of problems of continuity from different positions; to consider the causes and consequences of its unresolved problems, to carry out the diagnostics of readiness of children for school education (Lojdová, 2019).

Prognostic skills are related to the management of mathematical education of children and imply orientation to the clear idea in the consciousness of the future teacher of the purpose of his activities in the form of the foreseeable result. The purpose of the implementation of continuity of preschool and primary mathematical education is to establish the single line of development of the child's personality at the stages of childhood and ensuring the smooth transition from preschool organization to school, where the end result is the readiness of the child for school education and easy adaptation to new conditions (Burchinal et al., 2020).

Projective skills are the ability to identify and accurately formulate specific tasks and content of mathematical education; project the child's personal development and predict the results of preparation for school education; choose reasonably the means, methods, and forms of work with children on the formation of mathematical ideas; provide for possible obstacles and omissions in the process of the implementation of continuity of the pre-school organization and primary school (Neghavati, 2016).

Control-evaluative skills are manifested at the correction stage of work during control-evaluative activities aimed at itself. These abilities are necessary for future teachers for carrying out different ways of control: control on the basis of correlation of the received results with the set samples; control on the basis of the expected results of the actions carried out only mentally; control on the basis of analysis of the ready results of actually performed actions (Christoforidou et al., 2014).

Organizational skills mean the degree of readiness acquired on the basis of knowledge and experience and the personal solution of any practical problem in the training of mathematics, which purposefully affects the subjects in changing conditions. The structure of organizational skills consists of mobilization skills to make decisions and find the most effective means of

pedagogical interaction in the course of teaching mathematical knowledge; demonstrate the ability to transfer previously acquired knowledge to new conditions (Elfeky et al., 2020).

The group of communicative skills, necessary for the successful realization of continuity of pre-school and primary mathematical education, includes: the ability to model communication with children, parents, and colleagues; establish the dialogic type of relationship, and emotional contact with the interviewer; to possess verbal and non-verbal means of communication; to create the favorable psychological climate of communication in the group, contributing to the creative expression of the child in the conditions of mathematical education (Catalano & Catalano, 2015).

The separate component is the reflexive component. Reflexion is interpreted as the specific form of theoretical activity aimed at understanding and analyzing of own actions. Reflexive skills allow to determine the correctness of the set goal and transformation of it into specific tasks, to relate tasks with the content of activity and efficiency of methods, techniques, means, and forms of work. Scientific-methodological abilities as a self-analysis of the carried-out steps, evaluation of the obtained results, and correlation of them with the set goal, in our opinion, are the necessary and mandatory elements of training of the future teacher for work on implementation of continuity of pre-school and primary mathematical education (Mumford & Dikilitaş, 2020).

The formation of each structural unit of the component of reflexive skills necessary for the future teacher to carry out the continuity of pre-school and primary mathematical education is advisable based on mechanisms of formation of a reflexive culture of the future teacher, which require reference to the internal potential of the subject. In this regard, the position of B.G. Ananyev's "On the resources of human development itself", its possibilities of self-development, self-study, and self-improvement appeared fundamental for this research (Ananiev, 2001).

The proposed arrangement of professional skills for implementation of continuity of preschool and primary mathematical education does not claim to be complete, as the phenomenon of most skills includes their variability, cultural conditionality, and dependence on the personal potential of the future teacher.

FINDING AND DISCUSSION

Finding

The following results were obtained at the ascertaining stage of the research (Table 4).

Table 4. Summary data of the ascertaining experiment

#	Groups	The level of readiness for the implementation of continuity of pre-school and primary mathematical education					
		low		average		high	
		number of participants	%	number of participants	%	number of participants	%
1	Experimental	21	37	26	46	9	17
2	Control	22	38	25	44	10	18

The results of the ascertaining stage of the research revealed and proved the need to improve the training of students for ensuring the continuity of preschool and primary mathematical education, justified the purposefulness of the formation of certain skills, and allowed to determine the main components of skills and conditions of their formation.

Among them, we can highlight the enrichment of content of disciplines of the pedagogical cycle of general professional and subject training; inclusion in the pedagogical process of the elective course "Foundations of continuity of pre-school and primary mathematical education"; introduction of the model of formation at students the skills for implementation of continuity of pre-school and primary mathematical education, the program of the interaction of subjects of the pedagogical process, during its implementation, as well as the creation of necessary organizational-pedagogical conditions for holistic formation of skills of components. Re-diagnostics of formed skills were performed again after conducting the forming experiment (Table 5).

At the control stage of the research there is the positive dynamics of the shift of the formed quality in EG, namely: the low level of readiness for implementation of continuity of pre-school and primary mathematical education decreased by 23%, the average improved by 10%, the high increased by 13%.

Table 5. Summary data of the control stage of the research

#	Groups	The level of readiness for the implementation of continuity of pre-school and primary mathematical education					
		low		average		high	
		number of participants	%	number of participants	%	number of participants	%
1	Experimental	8	14	31	56	17	30
2	Control	21	37	26	46	10	17

Discussion

In our view, the professional skills on the implementation of continuity of preschool and primary mathematical education are presented as the new formation, comprising several interrelated components of skills, namely: motivational, enabling students to understand the importance and necessity of the implementation of the continuity of pre-school and primary mathematical education, and forming the need for obtaining the certain volume of knowledge in this direction of activity; cognitive, which allows to supplement and expand the knowledge of students on the studied problem; activity, designed to form the ability of students to predict, design, plan, implement, monitor activities to ensure continuity and reflexive, forming skills of students to analyze and evaluate the activities and results of ensuring continuity of pre-school and primary mathematical education from scientific and methodological positions.

The primary school mathematics curriculum is developed on the basis of D. Bruner’s principle of spirality of cognitive theory, which is consisted of the consideration of material again, with the gradual deepening, complication, and increase in the scope of knowledge and skills (Mathematics., 2016).

The materials of the simplest ideas are contained in the first section "Numbers and quantities", such as counting in the direct and reverse order within 10 in the pre-school class, from 10/11 to 20 in the first class. In the first class, it is studied the operation of addition is the combining sets that have no common elements, and subtracting is removing part of the set. The objects are compared by different characteristics of length/mass/volume (capacity) / time using the conditional measure, by a sequence of different events/figures/time (day, week, month, year). There are studied the temporary representations: today, yesterday, tomorrow, the day after tomorrow; parts of the days; as well as time in hours is determined by clock dial in 12 hour format / the distinguishing units of time: minute, hour, day, week, month, year. The main aims and tasks of training in mathematical education in this section are not broken.

The proposed arrangement of professional skills for implementation of continuity of pre-school and primary mathematical education does not claim to be complete, as the phenomenon of most skills includes their variability, cultural conditionality, dependence on the personal potential of the future teacher.

The conducted research does not claim to be the exhaustive solution to the problem of formation at future teachers of professional skills for implementation of continuity of pre-school and primary mathematical education and presents only one of the options of the approach to its solution. The accumulated theoretical and practical material requires development and clarification. The certain interest is the search for alternative methods and technologies of formation at university students of the professional skills for implementation of continuity of pre-school and primary mathematical education

CONCLUSION

In our view, the professional skills on the implementation of continuity of preschool and primary mathematical education are presented as the new formation, comprising several interrelated components of skills, namely: motivational, enabling students to understand the importance and necessity of the implementation of the continuity of pre-school and primary mathematical education, and forming the need for obtaining the certain volume of knowledge in this direction of activity; cognitive, which allows to supplement and expand the knowledge of students on the studied problem; activity, designed to form the ability of students to predict, design, plan, implement, monitor activities to ensure continuity and reflexive, forming skills of students to analyze and evaluate the activities and results of ensuring continuity of pre-school and primary mathematical education from scientific and methodological positions.

The content of each component of professional skills for implementation of continuity of pre-school and primary mathematical education is reflected in the complex of motivational-personal relations, the system of scientific and special knowledge, the complex of active skills, and the block of reflexive skills of the future teacher, and the main source of their formation is the pedagogical process of the university, namely the process of learning disciplines of the pedagogical cycle.

The conducted research does not claim to be the exhaustive solution to the problem of formation of future teachers of professional skills for implementation of continuity of preschool and primary mathematical education and presents only one of the options of the approach to its solution. The accumulated theoretical and practical material requires development and clarification. A certain interest is the search for alternative methods and technologies of formation at university students of the professional skills for implementation of continuity of preschool and primary mathematical education others.

ACKNOWLEDGEMENT

The authors thank the anonymous reviewers for their invaluable comments. We also thank the Abai Kazakh National Pedagogical University and the Kazakh National Women's Teacher Training University for the opportunity to test the results of the research.

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