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TRANSFORMATION OF MATHEMATICS EDUCATION CURRICULUM IN PRE-SCHOOL IN LATVIA

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ABSTRACT

The acquisition of mathematics begins with the birth of a child within the cultural environment or socio-economic environment of the child. The child learns mathematics by investigating and exploring the environment in which they are located. The article describes and analyses theoretical materials and documents about applying the new education curriculum for the acquisition of mathematics in the competence-based approach in pre-schools in Latvia. From the school year 2017/2018, competence-based learning is gradually being introduced in Latvia. The research focuses on the analysis of preschool education guidelines (2018) developed by the National Centre for Education in the framework of the project "Competence-Based Approach to Curriculum," preschool curriculum (2019) and the document "Education for modern literacy: description of the teaching/learning content and approach" (Skola 2030) giving particular attention to mathematics to be acquired in pre-school. Such criteria as the aim, content, teaching strategies and assessment were chosen in the research aspect of applying the new education curriculum for the acquisition of mathematics in preschool. Main findings reveal the improvement of the aim, teaching and learning as well as teaching strategies of mathematics education in the acquisition of mathematics in preschool.

Keywords: *aim, content, curriculum, education, mathematics, pre-school.*

Introduction

Preschool education is an integral step of education which covers the time from the child's birth till the primary school, forms the children's future and to a great extent supplements their social, emotional, mental and physical development. The aim of this stage of education is to promote the children's social, emotional, cognitive and psycho-motor development in a planned and programmed manner after the family (Bronfenbrenner & Morris, 2006; Kostelnik et al., 2014). The preschool education stage which ensures a stimulating environment, which is rich in possibilities for

children aged 0 to 6 years, which is also known as the most critical period in the person's life, provides children with considerable opportunities that they are not able to obtain later in their lives (Yalçın & Erden, 2021). Researchers and policy makers agree that the early years are crucially important for children's development, and high quality preschool education helps to define children's positive trends in school and life (Wakabayashi et al., 2020; Damon & Lerner, 2006).

The acquisition of mathematics starts in the very early years and determines the mathematical academic achievements in the elementary grades (Purpura & Reid, 2016; Sarama & Clements, 2004; Geist, 2009). Children build important basis of mathematics knowledge and mathematical understanding interacting with important caregivers (Pakarinen et al., 2017; Ramani et al., 2015; Trawick-Smith et al., 2016; Zippert et al., 2020), especially, if adults ensure children with special pedagogical opportunities to acquire mathematics concepts and skills of mathematics (Notari-Syverson & Sadler, 2008; Copley, 2010; Anthony& Walshaw, 2009). Therefore, one of the important sources opportunities where the teacher gains support for promoting the planning and organization of the preschool child's acquisition of mathematical skills is the curriculum.

Decision making on what and how to teach forms the core of teaching mathematics. At the general level, the resource of making these decisions is the curriculum, which incorporates the aims, goals, and intentions of education (Valverde et al., 2002; Van den Akker, 2003; Van Zanten & Heuvel-Panhuizen, 2021). However, the curriculum in different countries can chang over time. Decisions on the anticipated outcomes largely depend on what is considered good education (Leung et al., 2006; Schmidt et al., 1997; Van Zanten & Heuvel-Panhuizen, 2021). Thus, new opinions on mathematics education can appear as well as the approach to teaching mathematics can change (Furinghetti & Karp, 2018; Karp & Schubring, 2014; Stanic & Kilpatrick, 2003; Van Zanten & Heuvel-Panhuizen, 2021). Scientifically validated curricula, which demonstrate positive child outcomes, are the heart of high-quality preschools. Hence, as new curricula are being developed and introduced into the field, more scrutiny is placed on their evidence. For example, National Center on Quality Teaching and Learning rates curricula on thirteen "components of effective curricula," which include curriculum effects on children's outcomes, comprehensiveness and depth in learning domains, individualized instruction, ongoing assessment, and professional learning (National Center on Quality Teaching and Learning [NCQTL], 2015; Wakabayashi et al., 2020).

A curriculum for a particular learning domain is not only a set of activities, in which a child can be engaged. The curriculum is developed taking into consideration the child's abilities, natural interests and needs. Information

reflected in the curriculum help the teacher to understand what the child is able to do at the respective stage and how to plan the pedagogical process, how to organize the learning experience so that the child understands the information which he/she has obtained and helps him/her understand how to apply this information in everyday life. The Education Law (1999) in Latvia states that the Cabinet of Ministers (CM) defines the guidelines for national preschool education, which include sample curricula that comply with the requirements of these guidelines (18[1] 01.06.1999). Since 2016, the National Centre for Education (NCE) has been implementing the ESF project "Competence-Based Approach to Teaching/Learning Content" (Skola2030) which aims at developing, piloting and sequential introduction of such content of general education and approach to teaching from preschool years to secondary school in Latvia that would result in learners acquiring knowledge, skills and attitudes necessary for life nowadays. One of the first binding education documents, which was approved by the CM on November 2018, is the guidelines for preschool education. Latvia started implementing the education process in accordance with the approved guidelines in all preschools as of academic year 2019/2020.

Methodology

The aim of the study is to analyse and assess what changes have taken place after the education content reform in the mathematics curriculum in preschool. Documents complying with the following criteria were selected for the document analysis: documents approved by the CM, intended for the stage of preschool education, incorporate necessary conditions for the acquisition of mathematics domain in preschool, define the implementation of preschool pedagogical process in Latvia, are issued in the period from 2010 till 2020. The analysis of curricula of teaching/learning mathematics in Latvia for preschool covers the analysis of documents:

- Preschool education guidelines (Regulations on national preschool education guidelines, 2018) developed by the National Centre for Education in the project "Competence-Based Approach to Curriculum";
- Preschool education curriculum (2019);
- Preschool education curriculum (Content curriculum of preschool education, 2012);
- Document "Education for modern literacy: description of the teaching/learning content and approach" (Skola 2030, 2017).

The analysis of documents was based on the set research criteria and indicators: the teaching/learning aim of mathematics, the teaching/learning content of mathematics.

Results

The reforms started in the education system of Latvia in 2016 envisage reconsidering not only the content of teaching/learning domains of all stages of education but also how to teach so that the child acquires key competences. Changes are observed also in mathematics content and its acquisition. Comparing the preschool curriculum developed by the National Centre for Education in 2019 with the previous curriculum developed in 2012, there are noticeable differences that need to be considered as regards the formulation of the set aims of teaching and learning (see Table 1).

Table 1. The aim of mathematics education domain in preschool

Curricula of the teaching/learning content of preschool education (2012)	**The curriculum preschool education (2019)**
To promote children's **comprehensive and harmonious development,** taking into consideration the regularities of their development and needs in the acquisition of all the knowledge and skills necessary for life, based on the formation of positive attitude and learning by doing. To form **mathematical notions** in diverse activities and to promote the understanding of the **basic regularities of mathematics.**	To form the **basic literacy in teaching/learning domains** – languages, social and civic, understanding of culture and self-expression, sciences, **mathematics,** technologies, health and physical activity.

It is obvious that the aim of mathematics acquisition in the curriculum of preschool education developed in 2012 specifically emphasises the child's comprehensive and harmonious development as well as it indicates the formation of mathematical notions in diverse activities (Preschool education curriculum 2012, 15). In fact, Component #4 of the Preschool Curriculum Consumer Report (National Center on Quality Teaching and Learning [NCQTL], 2015) recommends a comprehensive whole-child approach (Wakabayashi et al., 2020**)**. The formulation of the aim has some reference to the dominant role and position of the teacher or adult who plans and implements the acquisition of mathematics in preschool, and the emphasis is put on the acquisition of the content of mathematics. It is only the Regulations of guidelines of national preschool education, developed in 2012, that speak about the necessity to promote and develop the preschool child's cognitive activity, inquisitiveness, the understanding about the sequence of logical actions, the skills to substantiate their opinion, to observe and ask questions, which is an integral part of mathematics (Regulations on national…, 2012).

In recent years, content-specific curricula or targeted curricula, which focus on specific content areas or skills, such as literacy or mathematics, have shown evidence of enhancing children's learning (Jenkin & Duncan, 2017; Weiland et al., 2018; Wakabayashi et al., 2020; Wortham, 2002). It is possible to identify it also in the aim formulated in the curriculum of preschool education, developed in 2019, which points to the necessity to form the basic literacy in several teaching/learning domains, including mathematics. The aim of the acquisition or literacy at the end of preschool education has been defined for every teaching/learning domain. The literacy incorporates both knowledge, understanding and basic skills, transversal skills, and value-based habits (Preschool education curriculum, 2019). Thus, the new formulation of the mathematics domain envisages the acquisition of learning outcomes of the mathematics domain in compliance with the big ideas.

Comparing the curriculum of 2012 with the curriculum of 2019, there are no considerable differences in the teaching/learning content. The greatest differences are observed in connecting the content units of the mathematics domain with the big idea, which also outlines the process of mathematics, revealing that mathematics is applied in everyday life and how it integrates in other teaching/learning domains (see Table 2).

Table 2. The teaching/learning content in preschool

Curricula of the teaching/learning content of preschool education (2012)	**The curriculum preschool education (2019)**
The content of the teaching/learning content domain or integrated subjects: the Latvian language; sciences; **mathematics**; social sciences and ethics; music; physical education and health; visual art; home economics and technologies	The compulsory teaching/learning content is formulated as the **basic literacies** in the languages, social and civic, understanding of culture and self-expression in art, sciences, **mathematics,** technologies, health and physical activities teaching/learning domains

It is evident that the teaching/learning content in the document developed in 2012 is formed by the content of the teaching/learning content domain or integrated subjects where the most important components are described for each teaching/learning content domain. For instance, science (the development of the language and orienteering in the surroundings, sensory development, actions with objects, getting acquainted with a nature); mathematics (sensory development, construction, formation of mathematical notions, mathematics); social sciences and ethics (the development of a language and orienteering in the surroundings, development of social skills, actions with objects, getting acquainted with the nature and processes of public life). The indicated components of the teaching/learning content

allow noticing and implementing the integration of the STEM content and less possibilities for integrating the greatest part of the teaching/learning content, transdisciplinarity (2012). STEM combined with art can make significant contributions to humanity, and humanity being a part of its environment, not a means of establishing superiority. While doing this, it can be ensured that children understand the world by gaining experiences through theoretical knowledge and real situations. From this point of view, by integrating STEM with learning by doing, which is a must for early childhood, children can be supported to experience a reality, question it, and establish relationships between situations and production-oriented activities. This is discovering a nature and the world in innovative ways, solving problems while exploring and producing while solving problems (Affifi, 2019; Yalçın & Erden, 2021: Taylor & Harris, 2014).

In turn, the compulsory content of preschool education in the transformed curriculum is formed by values and virtues, general or transversal skills, knowledge, understanding and basic skills in teaching/learning domains. The compulsory teaching/learning content is focused on the most important aspects for the child in the acquisition of this content "so that it results in the formation of literacy (competence) as a complex outcome of the child's learning during a longer period of time" (Preschool education curriculum 2019, 7). Transversal skills (critical thinking and problem solving, innovation and entrepreneurship, self-guided learning, collaboration, civic participation and digital skills) are the basis of the compulsory content of preschool education which define the learning outcomes for the child. The mathematics teaching/learning domain is the most closely connected with such transversal skills as critical thinking and problem solving. The learning outcomes of these transversal skills envisage that the child will be able to apply the algorithms of everyday activities in familiar situations, will formulate simple connections and the sequence of actions, will establish causes and consequences of familiar situations and events, will evaluate the reliability of information, will make decisions, will make choices and will assess the work done (Preschool education curriculum, 2019).

There is an assumption underlying early childhood mathematics curricular standards that informal mathematical knowledge is multi-dimensional. The National Research Council's (2009) report on mathematics learning in early childhood recommends three key strands of mathematics teaching/learning content in early childhood classrooms – number and operations, geometry, and measurement. The National Council of Teachers of Mathematics (National Council of Teachers of Mathematics [NCTM], 2006) also recommends these same three strands of early mathematical content in their Pre-kindergarten Curriculum Focal Points for instruction as part of a coherent mathematics curriculum from pre-kindergarten to

eighth grade (Milburna et al., 2019). These priorities in the mathematics teaching/learning content can be found also in the documents published in 2012 and 2019 (see Table 3).

Table 3. The content of mathematics education in preschool

Curricula of the teaching/learning content of preschool education (2012)	The curriculum preschool education (2019)
Number and counting (numbers from 1–5, composition of numbers, simple text tasks, comparison of sets of objects)	The language of mathematics. Quantity and numbers (quantity, number, digits, the composition of the number)
Size (notions, comparison, measuring with the conditional measure)	Connection between sizes (connections between objects, sets of objects, the measuring skill)
Geometrical figures (circle, triangle, quadrangle)	Exploration of features, placement and characteristics of shapes (different forms, placement of the object in space, plane)
Orienteering in time and space (direction, place, time)	

The preschool education curriculum of 2019 places equal emphasis on both the content of mathematics (number and counting, geometry, measurement of sizes, quantities, data analysis) and the process (problem solving, reasoning, communication, connections, and representation). For the first grader to became a flexible thinker who knows all the mathematics, understands of what has been learnt, is able to apply mathematical ideas and skills in everyday life. The acquisition of content is not enough because the process is also important (Brewer, 2007; Bullard, 2017, Robertson, 2017; Epstein, 2014; Cotton, 2019; National Council of Teachers of Mathematics, 2006).

The learning outcomes of the child in the mathematics teaching/learning domain in the curriculum of 2019 are grouped into three content units and are connected with the respective big ideas. The basis of literacies is the big ideas or the most essential key notions of the mathematics teaching/learning content domain which the child has to comprehend in order to form a common understanding about the surrounding world and oneself in it. The language of mathematics is used for communication and scientific description of concepts, ideas, problem solutions. Numbers are used for solving concrete, practical tasks because each operation with numbers has a particular meaning, and for their execution there are concrete rules/algorithms (2019). During the preschool period children develop definite basic skills connected with the acquisition of numbers. Four skills have been identified as important indicators of a child's early mathematical learning and development: mapping between number symbols and quantities, order

processing, cardinal principle knowledge and digit recognition (Cahoon et al., 2021).

Connections between quantities are described by algebraic models and functions. Using these models for problem solving, they are transformed ensuring equivalence. Data about objects, situations, events, processes can be mathematically processed and analysed to make well-grounded decisions. To solve a problem in a way characteristic to mathematics means to identify structures, systems, connections, to form generalisations and to prove them (2019). Preschool children also demonstrate knowledge of informal measurement, including the direct comparison of objects on physical dimensions (e. g., length) and the use of non-standard units to measure objects. Conceptual skills that underlie or are associated with children's knowledge of non-standard units of measurement include partitioning (i. e., mentally separating an object into same sized units), unit iteration (i. e., mentally recognizing the length of a small item fitting within the length of a longer one), and conservation (i. e., understanding that if an object is moved or rotated it is still the same length). Informal measurement abilities have also been the focus of curricula activities developed for preschool math interventions (Clements & Stephan, 2004; Klein & Starkey, 2004; Sophian, 2004). For example, curricula activities may help children learn to directly compare the relative length of two objects (e. g., which pencil is longer?) or to use a non-standard unit of measurement (e. g., which string is about the same length as these cubes?) (Milburna et al., 2019).

The learning content has been specified in the acquisition of geometrical figures supplementing it with the process of exploring the figures. The exploration of the features of shapes, their placement and characteristic dimensions allow solving concrete and also practical problems, formulating general conclusions about objects, space and shape (2019). In addition to numbers and operations, young children develop knowledge of geometry, such as recognizing and analysing two and three-dimensional shapes and reasoning about spatial orientation, during the preschool years (Clements et al., 2004) identified a developmental progression for geometric understanding from pre-kindergarten to second grade. It begins with knowledge about physical shapes, then mental imagery about shapes and constructs, and finally entails explicit geometric knowledge. Furthermore, these early geometric abilities have been associated with more general mathematics achievement in school (for a review, see National Research Council, 2009). As such, geometric abilities that emerge in preschool are important precursors of children's later mathematical learning (Milburna et al., 2019).

It is necessary, however, to remember that early math skills are acquired when children spend more time in content-specific instruction

(Burchinal et al., 2016), especially if skills are acquired gradually and diverse possibilities are provided for acquiring each skill before moving to teaching the next skills (Bierman et al., 2008; Clements & Sarama, 2007; Powell et al., 2010; Burchinal et al., 2021).

Conclusions

The new mathematics curriculum incorporates the planning of a mathematics teaching/learning content and a learning outcomes. The innovation in the new mathematics curriculum is defining the transversal skills.

The content of mathematics education has not changed in the mathematics curriculum. Mathematics literacy is based on the BIG IDEAS/the basic concepts of learning content that children need to understand in order to develop a common understanding of the surrounding world and themselves in it.

The teaching/learning process of mathematics education includes teacher and child's responsibilities in the learning process in the mathematics curriculum. The child acquires the mathematics content through an integrated learning process in play activities/play lessons.

The possibilities to improve the child's personality are connected to the content of education. The content of mathematics education consists of values and virtues, as well as transversal skills. Evaluation emphasis shifts from evaluation of results to evaluation to improve learning.

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