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TEACHING NUMERACY AND SCIENCE IN EARLY CHILDHOOD EDUCATION

Students' names: Nazrin Huseyn, Afsana Allahverdiyeva
Contact e-mail : Nhuseyn2021@ada.edu.az,
aallahverdiyeva2020@ada.edu.az
~~aallahverdiyeva@ada.edu.az~~

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STATEMENT OF AUTHENTICITY

We have read ADA's policy on plagiarism and certify that, to the best of our knowledge, the content of this paper, entitled "Teaching Numeracy and Science in Early Childhood Education" is all our own work and does not contain any unacknowledged work.

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Signed: 

Signed: 

Date: 15.04.2023

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Approval Form

Student Name/Surname: Nazrin Huseyn

Student ID number: P0004248

Student Name/Surname: Afsana Allahverdiyeva

Student ID number:000003244

Program Name: MA in Educational Management

Academic Track Selection:

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Comments:

The Course Instructor:

The Supervisor:

SE Curator of the Graduate Programs:

Dean of SE

Abstract

Every year, thousands of children are enrolled in different preschool institutions in Azerbaijan. Preschool education has a significant impact in the development of children including their cognitive, behavioral, social-emotional and physical development. At the same time, teaching methodology of pre-school educators is important for the learning of children.

This study explores perceptions of preschool educators in teaching numeracy and science in Early Childhood Education and challenges they are facing during the teaching process. Meanwhile, support mechanisms by preschool principals are identified in this paper based on the interviews with principals of different public kindergartens. Ultimately, quantitative and qualitative data collection was conducted with preschool educators and principals of kindergartens to reveal the factors that create the challenges for teachers in teaching numeracy and science and the support provided for those teachers in order to overcome them.

The findings highlighted that teachers use various methods and tools while teaching numeracy and science in kindergartens. They teach the basic concepts of numeracy and science through entertainment, integration with other subjects, and individual approach to each child. Meanwhile, the findings revealed that preschool educators face some challenges while teaching numeracy and science in kindergartens. Inappropriate methodology, lack of resources, and insufficient knowledge on the new curriculum create drawbacks for teachers in numeracy and science classes.

Additionally, support that principal would provide are organization of regular consultations, trainings and seminars to enrich the knowledge of teachers and help them in overcoming their difficulties.

Considering the needs and challenges of pre-school teachers, a Practical Handbook is developed based on the content of the national curriculum and best practices of other countries in order to provide further support for pre-school educators in teaching early numeracy and science.

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TABLE OF CONTENTS

Chapter I: Introduction

Early Childhood Education (ECE) has a profound impact on a child's cognitive, behavioral, physical, and emotional development, which helps children to think, solve problems, communicate, and form relationships (UNICEF, 2019). As a pillar of early childhood development, ECE is aimed at provision of quality pre-primary teaching and learning services to children (UNICEF, 2019). Research on preschool education programs in several countries has indicated that children acquire enduring educational benefits from participating in preschool entities, and in fact those educational entities contribute to students' success in school and bring positive long-term social and academic benefits (Carrol, 2012).

According to OECD "Starting Strong III" report of 2012, one of the preconditions for quality pre-school education is effective design and implementation of a curriculum on ECE (OECD, 2012). A well-designed curriculum serves as a tool to define key learning areas and goals and guide pre-school educators in the realization of learning objectives (OECD, 2006). As such, literacy, numeracy, science, art and music, physical ~~and health~~ development ~~and development domains~~ are part of cognitive domains in ECE curriculum. Although ECE has a significant role in the development of children, some challenges occur for preschool educators in the implementation of ECE curriculum (OECD, 2012).

Statement of Problem

In Azerbaijan, new curriculum on preschool education was approved by the Ministry of Science and Education in April, 2022 (Ministry of Science and Education, 2022), and especially those teachers who do not have background in pedagogy and lack methodological skills in educating children face difficulties in applying the curriculum. This problem was mentioned

during the interview with one of the senior officersials from the Baku city Education Department (BED). It was revealed that pre-school teachers struggle to apply pre-school curriculum in ECE (Anon, personal communication, 03 December 2022). According to the curriculum trainer, teachers struggle to apply and understand concepts related to curriculum (Süleymanlı, 2018). For instance, they consider memorizing as a way of learning for students, refraining from teaching methods triggering creativity and critical thinking. So, onAs mentioned earlier, one of the existing problems related to the application of the new curriculum in Azerbaijan is that pre-school teachers possess vocational and graduate degrees which is not related to pedagogy, while others have only a high school diploma (Kazimoghlu, 2017). Meanwhile, there are some teachers who do not have any experience in ECE and have lack of professional skills in working with children (Quluyeva, 2021). According to Süleymanlı (2018), in Azerbaijan, parents' complaints regarding kindergartens are mostly about the admission of pre-school teachers who are unqualified in pedagogy.

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According to the data provided by the Statistical Committee of the Republic of Azerbaijan in 2022, out of 12.6583.415 pre-school teachers working in public pre-school entities only 29.832.5% completed higher education at undergraduate level (The State Statistical Committee of the Republic of Azerbaijan, 2022). Out of 29.832.5% of teachers 28.731% own bachelor's degree in pedagogy. Furthermore, 62.60% of pre-school teachers have completed vocational education in pedagogy. Nevertheless, researchers consider that for being eligible to teach in preschool entities teachers should attain at least 4 years of bachelor's degree in pedagogy or other related faculties (Mwaipopo et al., 2021; Erden, 2010; Hyson et al., 2009; OECD, n.d.). Furthermore, OECD studies conducted in Slovakia in 2012 indicated that educational background of teachers backed up by continued professional development is associated with higher quality of ECE.

In 2021, by the decree of the President of the Republic of Azerbaijan, supervision over pre-school entities was transferred back from local executive authorities to the Ministry of Science and Education (President of the Republic of Azerbaijan, 2021). Thus, for 2022-2023 school year, recruitment of pre-school teachers was carried out not by principals, but by the Human Resources Center of the Institute of Education of the Republic of Azerbaijan (hereinafter - IERA), through examination process consisting of testing and interview stages (Institute of Education of the Republic of Azerbaijan, 2022). Through test examination and interviews participants could gain 100 and 40 points respectively. So, according to the information provided by a leading official from the Center during the examination, 4549 pre-school teachers participated in the recruitment process out of which 376 successfully passed through both stages, and the majority~~97~~ has~~ve~~ been employed (Anon, personal communication, 04 March 2023). Specifically, it was revealed that recruitment process by principals in public kindergartens was not transparent which led to the admission of pre-school teachers who do not have relevant educational background and knowledge in ECE and have lack of motivation and willingness to teach in pre-school entities. Especially, during the interviews, the committee members have found that pre-school teachers lack teaching abilities and see kindergartens as a mere playing ground for children.

Goetz (2017) states that modern ECE curriculum usually consists of 5 development domains which are social, emotional, physical, cognitive, as well as literacy and language, and to be able to implement the curriculum, teachers should be aware of the content of each domain, including math and science which foster cognitive development of children (Huang & Tian, 2019). Nevertheless, according to the information provided by an official from IERA, during short interviews conducted with teachers by IERA, it was revealed that one of the areas where teachers struggle to effectively apply the new curriculum is numeracy and science related activities.

Ultimately, we were invited by IERA to explore areas of struggle among pre-school teachers in provision of early numeracy and science and the support provided to them by pre-school principals.

Purpose Statement

The purpose of this study is to find out what ~~are~~ pre-school educators' thoughts are about their experience in teaching numeracy and science related classes to children in public kindergartens of Azerbaijan, what the needs and challenges (if any) of those teachers are and how to support pre-school educators in teaching numeracy and science. The study's findings will contribute to the provision of practical handbook for principals on how to support pre-school teachers and meet their needs in teaching numeracy and science referring to the national legislation on ECE and based on interactive games and professional development models in the field of ECE.

Research Question

More specifically, the following questions will be addressed in this study.

1. What do public pre-school teachers' report about their experience in teaching numeracy and science in ECE?
2. What are the perceptions of public pre-school principals about support provided to teachers who teach numeracy and science in ECE?

Definition of the Key Terms

Early childhood education (ECE) is defined as the teaching and learning period of children aged between 1 to 6 which contributes to the development of children's cognitive, social-emotional, and creativity skills. (Law on Pre-school Education, 2017)

Numeracy in ECE is the concept related to understanding and application of math related concepts like counting, recognizing shapes, sizes, measures and problem-solving (Ahmad, 2022)

Science in ECE is the process of understanding the natural world around and exploring children's curiosity to explain and observe the correlation between different substances (Worth, 2010)

Significance of the Study

According to the report from the Center for Early Childhood Education (2015), holistic concept of Early Childhood Development consists of inter-independent dimensions which means that development of a child cannot be fragmented into education, nutrition, health, social, spiritual and emotional variables. All variables are interconnected and developing simultaneously in a child's life. The concept of holistic child development concentrates not only on academic achievement of a child, but it also covers all aspects of a child's growth. The concept focuses on the physical, social, intellectual, emotional, and mental growth of a child (Greener, 2002). Therefore, Mechler M. (2015) states that applying science and numeracy concepts in the preschool education in the learning process will also help to promote children's development in the domain of not only cognitive, but also physical, emotional, and social skills. Furthermore, understanding the development and significance of preschoolers' numeracy skills is essential for pre-school educators to encourage and support children to improve their skills in the early learning context and ensure appropriate school-entry learning (Floyd et al., 2006).

Referring to the "Law on Preschool education in the Republic of Azerbaijan" (2017), preschool education is the process of acquiring primary knowledge, skills, and habits that serve the intellectual, physical, and spiritual development of preschool-aged children. Therefore, ECE in preschool entities provides a more successful transition to primary education and better academic results in the future (Kochar, 2017; Kid City USA, 2020; NSW Government, 2022; Parikh, 2020; Vishwaroop, 2022). Furthermore, high-quality preschool education provided for

children leads to the development of human capital in the future and yields economic growth potential for countries. (Bendini & Devercelli, 2022; Nunez, 2022; OECD, 2020; UNICEF, n.d.) In this case, the preschool curriculum plays a vital role in the successful realization of ECE because it is a document that guides teachers in early teaching and learning (Bansal, 2020; Copple & Bredekamp, 2009). Therefore, effective application of numeracy and science concepts in teaching and learning process will foster successful realization of ECE in terms of children's cognitive, social, physical, and behavioral development and provide a successful transition from preschool education to primary school (Mechler, 2015).

Furthermore, it is important to consider ~~the~~ teaching methodology~~approach~~ and ~~awareness of~~ preschool teachers' ~~knowledge of pedagog~~pedagogical skills~~y~~ in ~~terms of~~ teaching mathematics (Demir, 2022). Thus, the most successful curricula are closely related to methodology of educators in implementation of pedagogical activity and practices (Gabrielle, 2019). Teachers need to know the curriculum, learning environment and opportunities so that they can provide relevant materials and activities to children and accommodate a variety of ways to convey understanding (Seetso et al., 2013). Therefore, the knowledge and skills of teachers on the curriculum, their perspectives, background, and approach all contribute to the activities of mathematics in practice and establish a foundation for children's learning experience (Piasta et al., 2014).

More specifically, according to the national curriculum on preschool education (2022), one of the indicators of cognitive development among children is the ability to demonstrate an understanding of simple mathematical concepts and calculations. To foster effective learning practices among children, preschool teachers should have a decent understanding of main mathematical and scientific concepts, the relationship between concepts, and how children of different age groups can learn these concepts (Tian & Huang, 2019).

The significance of the study is that this study will be useful for preschool teachers and principals because in this study we will explore what teachers report about their practice in teaching numeracy and science related classes in ECE, what their needs in teaching numeracy and science are, what are their challenges, how principals support pre-school teachers in their teaching and which practices can be used by principals and teachers to improve teaching numeracy and science to children. So, to analyze the practice and competency of pre-school educators in teaching numeracy and science classes in public kindergartens of Azerbaijan, we were provided an opportunity to work on the survey designed by IERA and later, to conduct interviews and make further conclusions.

Chapter II: Literature review

Considering the fact that early childhood education plays a critical role in contributing to the cognitive, personal, and moral development of the children, it hereby develops the students' problem solving, critical thinking and analysis skills (UNICEF, 2019). Thus, teachers' role is remarkable in teaching math and science to ~~the early age students~~children ~~in which~~ where teachers are the main role players in helping children to gain the aforementioned skills effectively. The aim

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of this chapter is to explore studies of researchers about international~~foreign~~ best practices in the field of early numeracy and science in ECE, challenges of preschool educators in teaching numeracy and science to kindergartners, as well as support provided to teachers ~~them~~ for effective teaching. Literature review chapter is divided into two sections. Thus, the first section will start with the best practices of different countries in teaching math and science in ECE, then we will identify the challenges of the preschool educators that they are facing during numeracy and science classes, and the last section of the chapter will be devoted to the support provided by principals and administrative staff to preschool educators in their teaching and learning process.

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Effective Teaching Practices of Early Numeracy and Science

In the 21st century, STEAM Education gained considerable significance considering the era of computational thinking and creativity (Hilppö et al., 2022) STEAM Education is embedded in the integration of science, technology, engineering, arts and mathematics, and one of the leading countries which successfully implement this system starting from ECE is Finland (Hilppö et al., 2022).

One of the core pedagogical principles of the Finnish ECE curriculum is to stimulate collaborative, imaginative and creative thinking among children and create opportunity for kindergartners to explore, experiment and produce individually and together with peers (Finnish National Agency for Education, 2016). In their study, Vartiainen & Kumpulainen (2019) conducted observations and analysis of artifacts in Finnish kindergartens to explore how children engage in early science through maker activities (hands-on activities). One of the early science classes observed by the researchers was Poetry Science in which children explore various aspects of learning such as listening, imagination, creativity, experiment, and comprehension (or meaning

making). As such, during the classes children are introduced a poem about the «Flying Fish» which results in the inability of fish to fly to a tree. After listening, kindergartners are asked to imagine and suggest through which ways fish can reach the tree, and the suggestions provided by children are parachutes, skydivers, airplanes etc. Afterwards, children start designing and making parachutes and then, experiment with them making the items fly by swinging and spinning around. Ultimately, through playful methods, children experience meaning making and learn about air resistance on their own experiment (Vartiainen & Kumpulainen, 2019).

Another successful case regarding teaching early numeracy is also observed in the Finnish ECE system. The main vision behind early numeracy in Finnish ECE is to facilitate a meaningful learning among children through «play, games, stories, songs, physical exercise and discussions along with representational material» which is not based on intense academic learning (Mononen & Aunio, 2013, p.247). As such, Björklund (2015) conducted a qualitative study with Finnish pre-school teachers to explore pedagogical approach and intentions of teachers in teaching early numeracy. Based on the results of the study, it was revealed that pre-school educators' pedagogical approach was characterized by the importance of their participation with children in their learning process, creating a playful space for learning and teaching math in an indirect way avoiding overwhelmed mathematical language. Furthermore, among the objectives of pre-school educators in teaching early math are children's developed ability to count, be prepared for the future school life, having a prosperous future and being able to apply mathematics in their daily lives. Specifically, pre-school teachers in this study think of themselves as role-models in the eyes of children and feel responsible for fostering a positive attitude towards math (Björklund, 2015).

Besides Finnish practice in the instruction of early numeracy, there are also successful cases of professional development programs observed in USA to foster effective teaching of

mathematics to kindergartners. In their study, Cross et al. (2009) described the effectiveness of Technology-enhanced, Research-based, Instruction, Assessment, and Professional Development (TRIAD) model in instructions of early mathematics in U.S. kindergartens. TRIAD model, which was designed by Julie Sarama and Douglas Clements, professors from the University of Denver based on the grants provided by Institute of Education Sciences and the National Science Foundation, stipulates for a long-term positive change in teaching numeracy; nevertheless, this change requires action not only by teachers, but also administration and parents. More specifically, TRIAD model has the following 4 key components for in-service trainings for pre-school teachers:

- Trainings should be implemented vis a vis curriculum content

- Trainings should be extensively conducted throughout the pre-school year

- Teachers are provided with coaching once a month to provide them assistance in the implementation of the curriculum

- Teachers are provided with opportunities to collaborate with colleagues, have discussions and practice their skills

Sarama et al. (2008) indicates in her research that the results of the study conducted with pre-school experimental group revealed that teachers in that group who participated in TRIAD model in-service trainings practice more numeracy in the class, attach importance to mathematics and are more confident to teach math. Most importantly, after 6 years after the TRIAD program, pre-school teachers who took part in the program expressed that their students' results in math have improved, they still use the instructional methods learnt during the trainings, their confidence in teaching math has increased and that they have discovered individual approach to numeracy (Sarama & Clements, 2021).

Challenges of Pre-school Educators in Teaching Numeracy and Science

Content knowledge (CK), pedagogical knowledge (PK) and pedagogical content knowledge (PCK)" are the focal knowledge of the teachers, the development of which directly contributes to the students' success rate (Walan & Chang Rundgren, 2014, p. 53). While CK and PCK are crucial in teaching science to the preschool students, PCK is highlighted as remarkably necessary for teaching mathematics in ECE (Tian & Huang, 2019; Walan & Chang Rundgren, 2014). According to the results of the study conducted by Walan and Chang Rundgren (2014), out of 22 pre-school teachers more than 41% indicated that they had low CK in chemistry and physics when it comes to scientific literacy. In addition, 41% had challenges in fostering creative thinking of children and analyzing occurrences. Ultimately, insufficient knowledge in science leads to avoidance by pre-school educators to include science related content and activities while teaching to kindergartners because teachers feel anxious and develop low self-esteem in teaching science (Fleer, 2009; Garbett, 2003; Roehring et. al, 2011)

A similar study was conducted by Tian and Hunag (2019) in relation to numeracy literacy of 161 pre-school teachers in Shanghai within the framework of CK, PK and PCK in math. Based on the results of the research it was revealed that most of the teachers acquire general or limited CK, PK and PCK. More specifically, pre-school teachers tended to show limited capacity in understanding early mathematical concepts, explaining children's learning traits and teaching strategies. Another researcher who decided to assess pre-school teachers' knowledge of children's mathematical development was Mery Noviyanti (2020). In her study, conducted in Indonesia with the participation of 35 kindergarten teachers, Noviyanti (2020) revealed that teachers had a limited understanding of children's developmental stages in mathematics since most of them did not comprehend the importance of children's initial knowledge and gradual progress in numeracy.

Similar conclusion was revealed by Youmans et al. (2018) that there is a need for ECE teachers to acquire knowledge on children's mathematical development, effective teaching strategies for kindergartners, as well as innovative tools and ideas to teach numeracy classes. In addition, in their study, researchers conducted Early Mathematics Education Survey findings of which indicated that pre-school teachers encountered difficulties in teaching geometry, spatial sense, data management and instructional strategies in early mathematics. Lastly, in her study conducted in Australia, Bennison (2016) emphasized that teaching numeracy is important not only for math teachers in kindergartens, but for other ECE teachers as well because numeracy should be embedded by teachers for future academic life of students. Nevertheless, teachers are not inclined to include numerical activities in their program due to several factors such as low motivation to teach numeracy, poor subject knowledge and purely teacher-centered pedagogical approach.

Garzón and Díaz-Moreno (2019) underline the importance of teaching students the basic scientific knowledge in early ages since it plays a formulating role in the critical thinking and reasoning of the young students in an effective way. By focally taking the Spanish curriculum into account, the authors analyze the limitations and challenges that play a preventive role in the scientific learning in early education, which is especially related to teachers' professional skills, pedagogical knowledge, and most importantly confidence. Indeed, the confidence of teachers to teach science to early age students is directly or indirectly related to side factors such as active~~effective~~ participation ~~integration~~ in the classroom and learning atmosphere (Howitt, 2007). However, due to the perceptions of the preschool teachers such as feeling inadequate to teach science since the educational background of the teachers is not science related, the confidence level and self-efficacy are negatively affected, which hereby negatively impacts the teaching and learning environment (Mulholland & Wallace, 2002).

Among the impediments in teaching science in kindergartens is that science classes are not paid sufficient attention as numeracy and literacy classes. As such, according to Marshall (2012), daily, pre-school teachers in Arizona allocate most of the time for teaching numeracy and literacy to kindergartners to prepare them for future school life by fostering math, reading and writing skills. Even though Science Standards Strands were adopted in Arizona in 2010, pre-school educators could not cover those Standards because of several reasons. First, ECE curriculum did not contain prescribed science related activities and skills to be taught in kindergartens. Secondly, due to the lack of specific guidelines on effective science activities, teachers did not want to give up their time for activities without value added to children. Lastly, as it was mentioned above, ~~pre-school teachers tended to allocate more time to numeracy and literacy~~ many districts in Arizona pushed on high literacy and numeracy performance among children for their further studies at school. Similar results were revealed by Buchahan and Rios (2004) in Washington. As such, researchers expressed that as districts demanded from kindergartens to have high scores from reading and due to absence of science skills on report cards of children, it was challenging to allocate sufficient time for teaching science to children. Another challenge revealed in the study was regarding insufficient materials distributed to children which resulted in extra costs covered by pre-school educators to buy those materials.

Support Provided to Pre-school Educators in Teaching Numeracy and Science

In their studies, Walan and Chang Rundgren (2014) analyze the preschool teachers' self-efficacy in teaching children the field of science, especially by focusing on Swedish~~en~~ practice of continuous professional development programs. According to authors, teaching the preschool pupils the scientific knowledge is a multidisciplinary phenomenon, that is remarkably dependent on certain factors such as teachers' knowledge, pedagogical skills to effectively engage the

attention of minors in the science-related topics, and hereby to formulate certain science perceptions. The author suggests that the participation of the teachers in the training programs and workshops in a timely manner effectively increases their self-efficacy, and thereinto, leads to the development of their knowledge, positive attitude, and high willingness of them to effectively teach numeracy and science in early childhood education.

While analyzing the numeracy education taught by preschool teachers, importance of PCK is highlighted as "teachers' integration of subject knowledge and teaching knowledge in the process of teaching" (Tian & Huang, 2019, p. 2258). More precisely, simultaneously having efficient mathematical background along with the skills to teach the concepts and formulas to the pre-school students positively contribute to the academic performance and achievements of the students. In their studies, it is asserted that rather than developing supportive teaching method that takes personal features of children into account, the teachers indicate a higher tendency to focus on general teaching techniques, which limit the students' learning capacity. Indeed, through engagement in pre-service and in-service learning the teachers can develop their PCK, which can in turn increase the self-efficacy of the teachers to confidently teach in an integrated atmosphere, in which the development stages of the children is taken into account (Tian & Huang, 2019; McCray & Chen; 2012). In fact, according to Noviyanti (2020), due to being uninformative about the development stages, the teachers mainly fail to take cognitive factors ~~and physical factors~~ into account; however, through informative trainings and workshops which increase awareness of the interrelation between development stages and learning ability of children, teachers can increase their PCK. For example, through simulations the programs like Cognitively Guided Instructions enable ~~the teachers to teach as the student as a simulation practice, in which high empathy is managed between students and teacher, which in turn, enables the~~ teachers to ~~approach~~ have more

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empathetical attitude towards ~~ly to the~~ students' skills and perceptions (Carpenter & Fennema, 1992). Furthermore, in their study, Youmans et al. (2018) also concluded that ECE teachers lack trainings to understand mathematical development stages of children. Thus, they suggested that conducting in-service and pre-service trainings will help pre-school educators to explore early numeracy for improving their own knowledge and apply novelties in their teaching style.

Furthermore, preschool principals are one of the important players in providing quality early childhood education (Nordstrom, 2022). Therefore, school leaders are in charge of providing academic and administrative support to teachers through guidance, leadership, problem-solving, facilitation, and goal-setting (Tartari, 2021). According to Karacabey (2021), principals at the kindergartens should support teachers' professional development through group and individual development programs, organizing educational activities, and professional development for teachers. The research revealed that teacher professional development indirectly improves children' s accomplishment due to effective teaching (Duffield, 2013).

Supportive and positive attitude toward professional development will help ECE teachers to learn new teaching styles and perform innovative methods of activities with students (Ilgan, 2013). It is significant for teachers to be notified about all innovations and knowledge brought by social development, science, and technology and deliver these updates while teaching young students (Atsebeha, 2016). Furthermore, a study conducted in Albania revealed that the majority of teachers believed that supportive school principals should build trust among the teachers by treating them impartially and equally which support and help quality educational institution (Tartari, 2021). Meanwhile creating a corporation and positive climate was considered a necessity by teachers (Karacabey, 2016). For instance, giving constructive feedback, listening and

appreciating their opinions, and rewarding their performance will motivate and enhance their teaching performance (Hussain, 2006).

Garzon (2019), stated that teachers who teach science and numeracy at kindergartens should be trained about how to handle the limitations, develop the ways of teaching science by using more qualitative and innovative methodologies and collect the resource adapted to the themes and problems that interest today's community.

Lastly, according to the report from Early Learning and Child Care (2019), the quality of the childcare infrastructure and resources has been considered one of the main elements in promoting a child development and well-being. Therefore, while teaching numeracy and science, teachers should be provided enough resources and space to create these opportunities for the children (Gheit, 2016).

Conclusion

In conclusion, in this chapter, we explored successful teaching practices, as well as the challenges of pre-school educators in teaching numeracy and science and forms of support that can be provided to pre-school teachers in provision of early math and science. As such, in case of Finnish ECE, pre-school teachers engage children through maker activities in early science where they learn through imagination, experiment, listening and creativity (Vartiainen & Kumpulainen, 2019). Meanwhile, Finnish pre-school educators facilitate learning among kindergartners through playful activities avoiding exhaustive mathematics (Björklund, 2015). In addition, to provide professional development for pre-school educators, TRIAD model is applied in USA to stimulate a long-term positive change in teaching numeracy considering core elements of the curriculum (Sarama & Clements, 2021).

Furthermore, development of content knowledge (CK) and pedagogical content knowledge (PCK) is crucial for preschool educators which directly contribute to children's success. As such, studies revealed that lack of knowledge and insufficient attention towards science leads to avoidance by preschool teachers to include science related activities and content while teaching in kindergartens (Buchahan & Rios, 2004; Marshall, 2021; Walan & Rungren, 2014). Meanwhile, purely teacher-centered pedagogical approach, poor mathematical knowledge, and low enthusiasm to teach numeracy are the reasons why teachers avoid numerical activities in their classes (Tian & Hunag, 2019; Noviyanti, 2020; Youmans, 2018).

Moreover, principals of kindergartens play a vital role in supporting preschool educators in teaching numeracy and science. For instance, supportive attitude towards continuous professional development programs, effective trainings, and abundance of resources for teachers will foster more effective teaching of early numeracy and science in kindergartens (Ilgan, 2013; Tartari, 2021).

Gaps in the literature

Although there are enough data and resources provided regarding ECE, lack of practices and information is provided related to teaching numeracy and science by educators in preschool education. Almost all reviewed literature was elated to the content of foreign countries, and there is insufficient materials and resources regarding the experience related to kindergartens in Azerbaijan.

Chapter III: Research Methodology

In this research, we used mixed method approach. According to Creswell (2015), mixed method approach is used to collect both quantitative and qualitative data with an aim to integrate both and make an interpretation based on in-depth analysis of a problem. Particularly, explanatory mixed method approach was applied in the research which consists of a prior collection of quantitative data to gather information about the perception of ECE teachers of their teaching experience of numeracy and science, and then acquisition of qualitative data from ECE principals to explore the results of the quantitative data in more comprehensive manner (Merriem & Tisdel, 2016). As Schutt (2012) states in his book, quantitative data consists of a collection of measurable and attributable data, while qualitative data is a set of exploratory data informing about the experience and perceptions shared by the participant.

Research Site and Population

This research aimed to analyze countrywide reports of ECE teachers and perceptions of ECE principals in teaching early numeracy and science. So, our population was pre-school

educators and principals of public kindergartens of Baku and all regional education departments of the Republic of Azerbaijan.

Sample Size and Sampling Strategy. As Bhandari (2020) states**,** sample is a group of participants selected from the population which is less in size than the population. As it was mentioned earlier, the project was conducted in collaboration with IERA. Respondents were selected from all regions of Azerbaijan and by random sampling method. Random sampling, used in quantitative research, allows the researcher to select respondents willing and eligible to participate in the survey (Cresswell, 2014). So, our sample size consisting of 518 ECE teachers as survey respondents and 10 kindergarten principals was provided by IERA. First, 518 pre-school educators were selected randomly from all educational departments: Baku city Educational Department, Absheron-Khizi Regional Educational Department (hereinafter- RED), Mountanious Shirvan RED, Ganja-Dashkasan RED, Lankaran-Astara RED, Central Aran RED, Mil-Mughan RED, Garabagh RED, Qazakh-Tovuz RED, Guba-Khachmaz RED, Sheki-Zagatala RED, Eastern Zangazur RED, and Shirvan-Salyan RED.

When it comes to kindergarten principals, they were also selected based on random ~~convenience~~ sampling. ~~According to Merriem & Tisdell (2016), convenience sampling is applied considering "time, money, location and availability of respondents".~~ A~~So, a~~s it was challenging to conduct interviews with respondents from all educational departments due to time-management, inability to visit remote regions and availability of principals. ~~Thus, only~~ the list of only 10 kindergarten principals from Baku city Education Department and Absheron-Khizi RED was provided by IERA to conduct the interviews. Nevertheless, out of 10 principals, only 3 gave consent to participate in the interviews. On the other hand, one more kindergarten principal was

interviewed after getting an oral invitation. Ultimately, 4 pre-school principals took part in the qualitative study.

Data Collection

Data collection is the process of acquisition of information obtained from research participants which later allows to analyze the results of the acquired information and answer the posed research question (Anon, 2005). Since the nature of this research is inductive all the data was gathered first, and the conclusion was made based on the collected data results (Schutt, 2012).

Above all, our quantitative data was gathered through the distribution of surveys ECE teachers. The procedure for survey distribution was the following:

- IERA submitted a request to MOSE for acquisition of the list of pre-school education institutions in Azerbaijan and the list of pre-school teachers working there
- From 1570 ECE institutions, 120 entities were selected randomly through Excel program
- From 120 ECE entities, 550 pre-school teachers who are at the age of 21-61 and above were selected randomly
- Through Baku and regional education departments the link of the survey was distributed to the randomly selected respondents.

  Survey developed by IERA consisted of two parts: descriptive and opinion based (Appendix 1).

16 questions related to the age, gender, years of experience, educational background and the education department were asked to acquire background indicators about the respondent. The second part of the survey consisted of questions to understand to what extent pre-school teachers are acknowledged about numerical and scientific literacy, how they define these concepts, what

their view on the improvement and development of numerical and scientific literacy is, and what their suggestions to increase numerical and scientific literacy are. Particularly, dichotomous questions, Likert scale method, and open-ended questions were used as a tool to design the survey.

When it comes to the qualitative data collection, we used interviews as a tool to gather data from kindergarten principals in order to explore their perceptions of pre-school educators' knowledge and skills in teaching numeracy and science and how they support them~~. Similarly, the list of respondents was provided by MOSE based on the availability of the principals and only from BED and Absheron-Khizi RED~~. Each respondent was informed beforehand by IERA about the expected interviews, and by the time when qualitative data collection started, we contacted each principal, provided information about the study, and asked for their availability to conduct the interviews. All the interviews were conducted in online mode given the time and location limitations.

Commented [UM5]: What do you mean?

Commented [UM6R5]: How they could be considered as available if the majority refused to give interviews?

Commented [UM7]: I am not sure the sampling startegy for the principals was a convenient one

The type of the interview was semi-structured because preparation of questions in advance makes the interviewing process more concise and smoother and provides an opportunity to "straight to the point" answers (Appendix 2). As Merriem & Tisdell (2016, p.136) state in their book, "asking good questions is a key to getting meaningful data". During the interviewing process, the responses provided by the interviewees were recorded based on the consent of the respondent and transcribed accordingly.

Data Analysis

Above all, all the quantitative data gathered from 518 respondents was transferred to Excel program in Azerbaijani language. Later, the Excel spreadsheet was uploaded in STATA (Statistical software for data science) program to analyze the data. Before uploading the Excel file, all the answers were translated from Azerbaijani language into English language as the original responses

in Azerbaijani, particularly words containing letters such as "ə, ş, ç, ü, ö, ğ, I" were altered on STATA program. Particularly, STATA program was used to calculate the frequency and percentages, draw tables and charts to make the data visually available and make more thorough analysis and draw accurate conclusions.

On the other hand, while analyzing the transcribed interview responses we used relevant codings to group the interview responses under certain categories to make it easier to draw results later on.

Trustworthiness

Trustworthiness is the term used by researchers to indicate the reliability and validity of their research (Merriam & Tisdell, 2016). Validity and reliability of the qualitative research are formulated by certain criteria including credibility, transferability, dependability and confirmability (Merriam & Tisdell, 2016).

First of all, in order increase the credibility of our study, we used both quantitative and qualitative data collection method. To increase the credibility of our research, respondent validation and triangulation methods were used. Specifically, multiple data sources were gathered, including survey responses of ECE teachers and interview responses of kindergarten principals. In addition, our quantitative research site was selected on a countrywide basis, so public kindergartens from all educational departments had a chance to be part of the research. Furthermore, we used investigator triangulation meaning that both researchers from "ADA" University and researchers from IERA processed and analyzed the data. As a result of this method,

we decreased the degree of potential research bias. Finally, in order to make sure that the responses were grasped and written correctly, we double checked whether interviews were transcribed in a correct form and interpreted truthfully (Creswell, 2012).

Ethical Considerations

Ethical issues should be considered while conducting a study (Merriam & Tisdell, 2016). Accordingly, as researchers, we need to ensure that ethical rules are followed. To ensure the confidentiality of the study, we informed our participants about the objective of our study and how it would be conducted. Before interviewing the participants, we asked permission to record their voices. So, the participants were aware of the maintenance of their confidentiality and anonymity of the information they provided. As a proof of their approval, we sent consent forms to each respondent which was signed by them and sent back to us in a scanned form. When it comes to the quantitative studies, all respondents' anonymity was preserved as well which means that the respondents were not asked to indicate their name while filling out the survey. All in all, it was important for as researchers to protect from any harm the right of our respondents to privacy and display respect to personal values (Merriam & Tisdell, 2016).

Chapter IV: Findings

The purpose of this project was to examine what pre-school educators report about their experience in teaching numeracy and science in public kindergartens of Azerbaijan, as well as to explore what the standpoint of pre-school principals regarding teaching knowledge and practice of their pre-school educators in science and numeracy is and how the principals support teachers in this regard.

So, as it was mentioned in the introductory chapter, the research questions of the study were as follows:

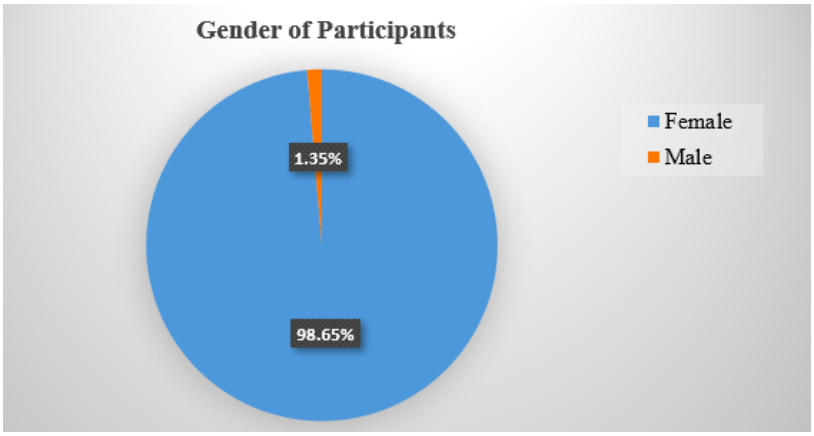
1. What do public pre-school teachers' report about teaching numeracy and science in ECE?

2. What are the perceptions of public pre-school principals about support provided to teachers who teach numeracy and science in ECE?

Results of the Quantitative Study

As a tool to gather quantitative data IERA suggested to use surveys. The survey consisted of several blocks including questions about the educational and professional background of pre-school teachers in the field of ECE and their perceptions about scientific and numerical literacy. Out of 550 pre-school teachers who were shared with the survey, 518 fulfilled it. As such, according to the results of the first question which was about the gender of pre-school educators, it was revealed that only 7 participants out of 518 were male teachers which constitutes only 1.35% of the total sample (Table 1).

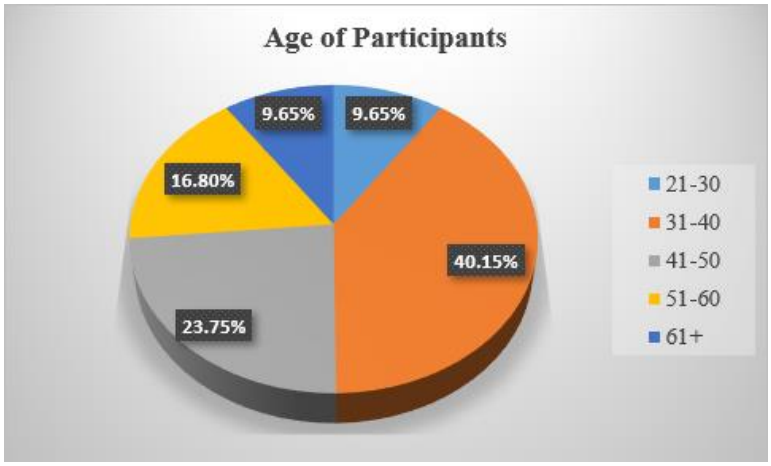
Table 1 – Gender of Participants



The next respondent profile question was about the age of participants. So, the results indicate that the majority of participants (208-40.15%) aged between 31-40, 123 (23.75%) between 41-50, 87 (16.80%) between 21-51-60, and the rest of the teachers were either the youngest, between 21-30 (50-9.65%) or the eldest, above 61 (50-9.65%) (Table 2).

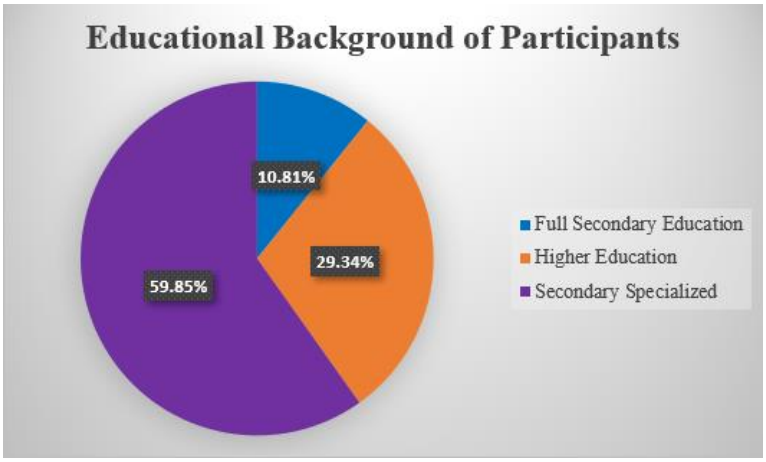
Commented [UM8]: 51?

Table 2- Age of Participants



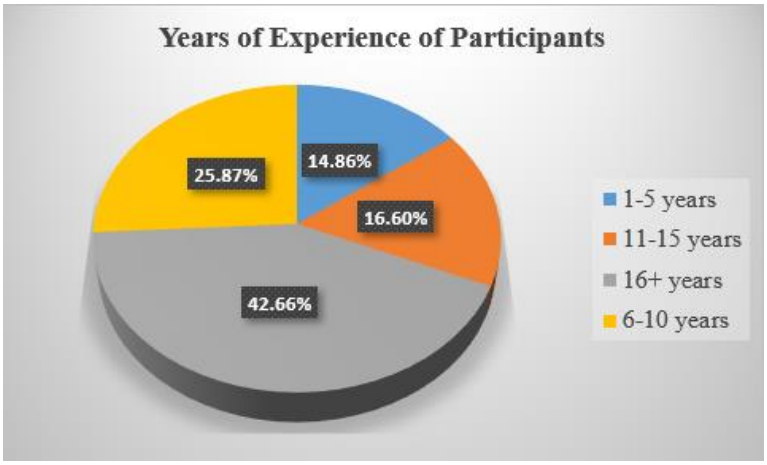
Another question about the background of pre-school teachers was related to their education. According to the results of the survey, 310 (59.85%) of the teachers completed secondary specialized education, 152 (29.34%) of them got diploma in higher education and 56 (10.81%) pre-school teachers graduated from full secondary general education (Table 3).

Table 3 – Educational Background of Participants



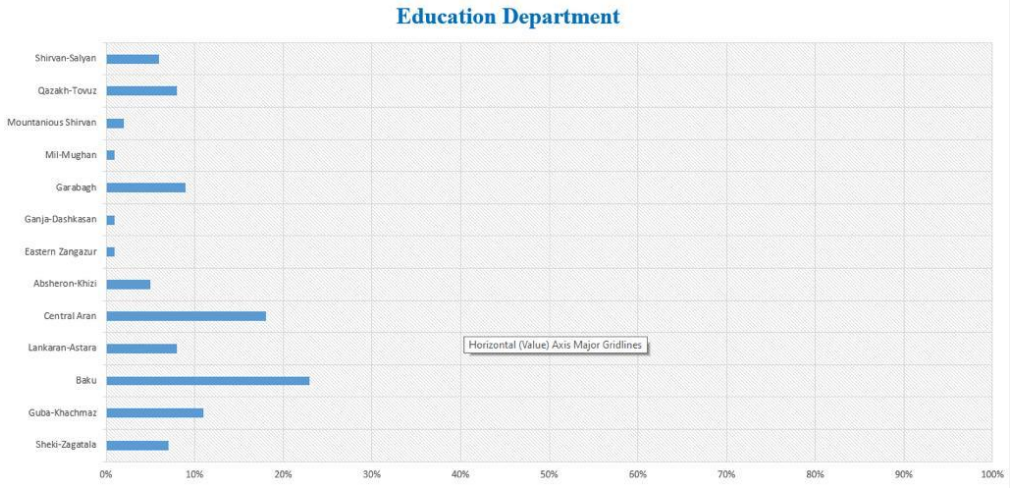
Further, another quantitative data was about the years of experience of pre-school teachers which is summarized as follows: 221 (42.66%) teachers out of 518 have more than 16 years of experience in the field of ECE, 134 (25.87%) worked in ECE sector for 6-10 years, 86 (16.60%) for 11-15 years, and finally, 77 (14.86%) worked for 5 or less than 5 years (Table 4).

Table 4 – Participants' Years of Experience in ECE



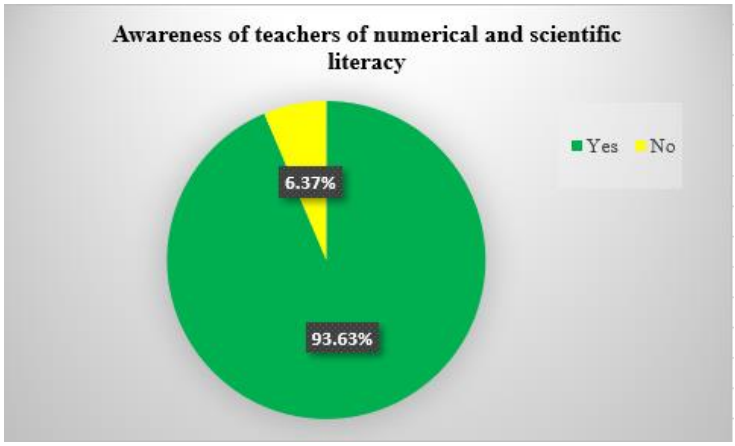
In the 5th question, pre-school teachers were asked to choose the educational department where the kindergartens they work in are registered. The results indicated that most of the respondents were registered at BED (117 - 22.59%), Central Aran RED (93 -17.95) and Guba-Khachmaz RED (57 - 11%) (Table 5).

Table 5 - Educational Department where Participants are Enrolled at



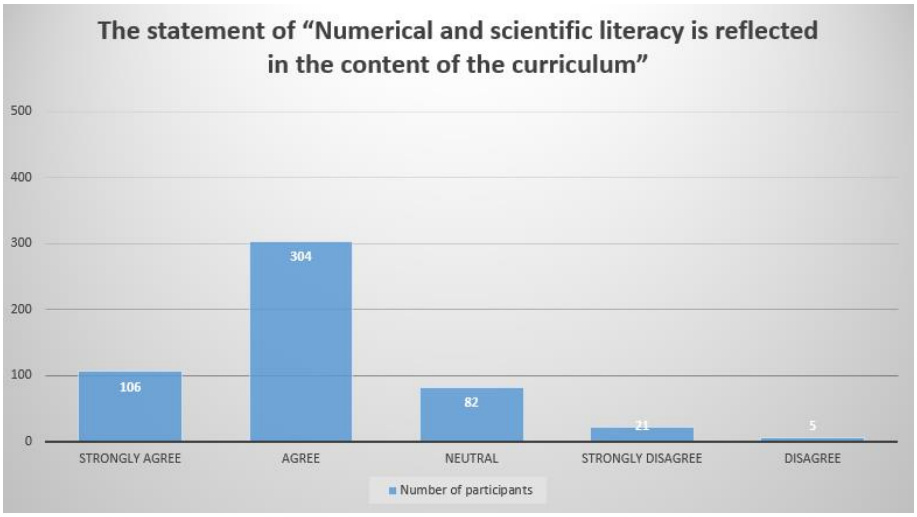
When it comes to awareness of teachers of numerical and scientific literacy, only 6.37% (33) of the respondents indicated that they are not familiar with the concepts. The rest (93.63%-485) indicated that they know what numerical and scientific literacy is (Table 6).

Table 6 – Awareness about Numeracy and Science Literacy



Another block of the survey was designed to collect data about the attitude and opinion of pre-school teachers regarding numerical and scientific literacy using Likert Scale assessment. As such, to the statement "Numerical and scientific literacy is reflected in the content of the curriculum" 106 (20.46%) replied "Strongly agree" and 304 (58.69%) replied "Agree". 82 (15.83%) stayed neutral, 21 (4.05%) disagreed and 5 (0.97%) strongly disagreed with the statement (Table 7).

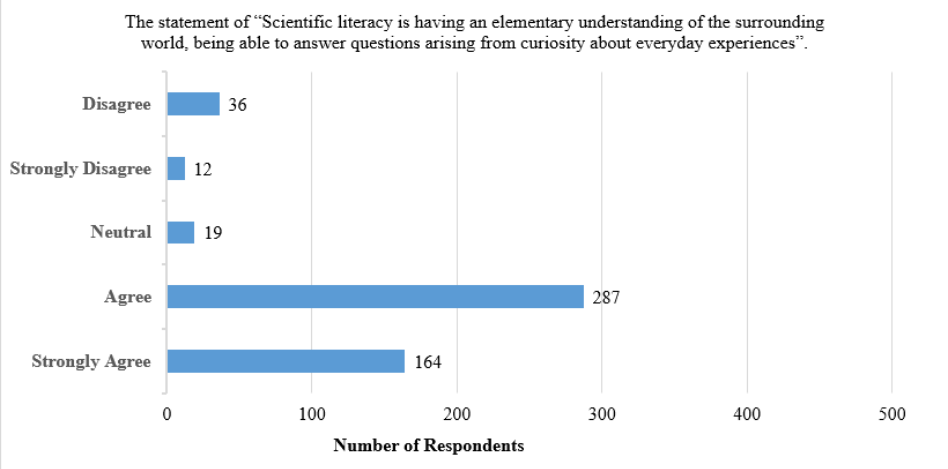
Table 7 – Awareness of the Reflection of Numerical and Scientific Literacy in ECE Curriculum



Besides, we also aimed at exploring how much pre-school teachers are aware of the definition of numerical and scientific literacy. As such, the next statement in the survey was "Scientific literacy is having an elementary understanding of the surrounding world, being able to answer questions arising from curiosity about everyday experiences". In total, 303 (87.07%) of the

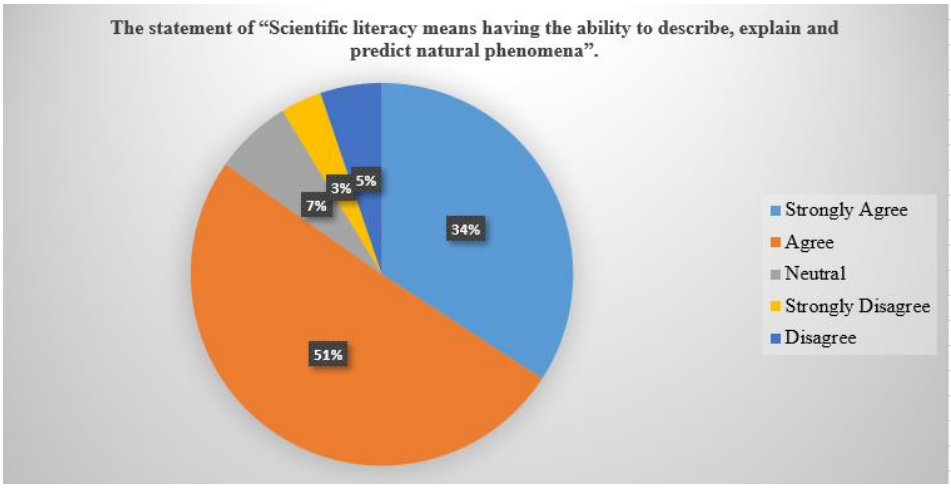
respondents agreed with this statement, 48 (9.27%%) disagreed and 19 (3.67%) stayed neutral. (Table 8).

Table 8 – Awareness of the Definition of Scientific Literacy



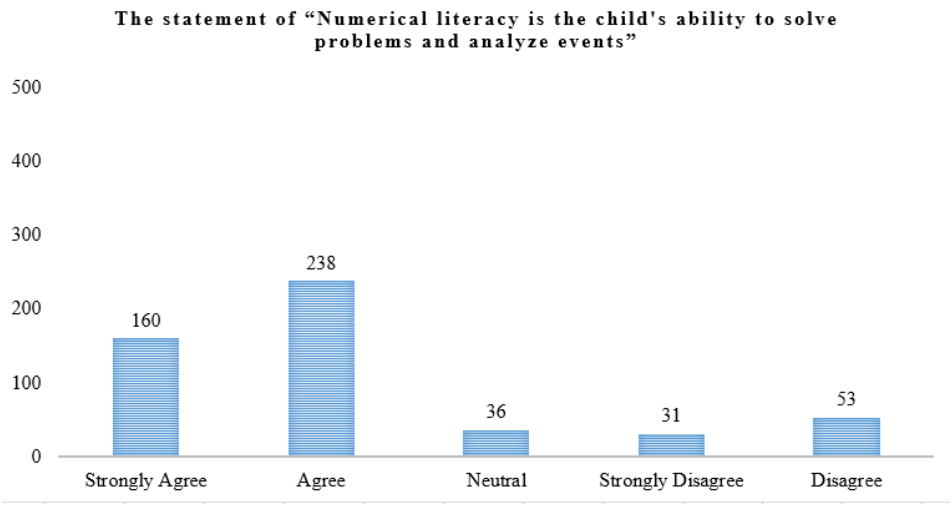
Next, scientific literacy was also defined as "the ability to describe, explain and predict natural phenomena". So, out of 518, 439 (84.75%) agreed with the statement, 34 (6.56%) did not know and very small number of the respondents 45 (8.68%) disagreed (Table 9). Ultimately, the majority of respondents agreed with both statements defining scientific literacy.

Table 9 - Awareness of the Definition of Scientific Literacy



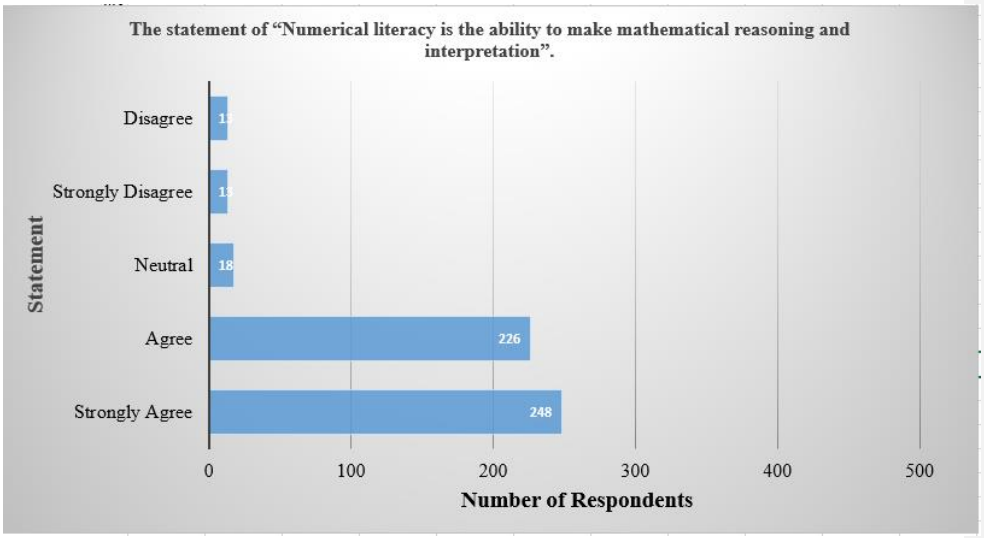
For the purposes of this study, the respondents were also asked to provide their view on the definition of numerical literacy. Ultimately, 398 (76.84%) of the respondents agreed that numerical literacy is about a child's ability to solve problems and analyze events, while 36 (6.95) did not know the answer and 84 (16.21%) disagreed (Table 10).

Table 10 - Awareness of the Definition of Numerical Literacy



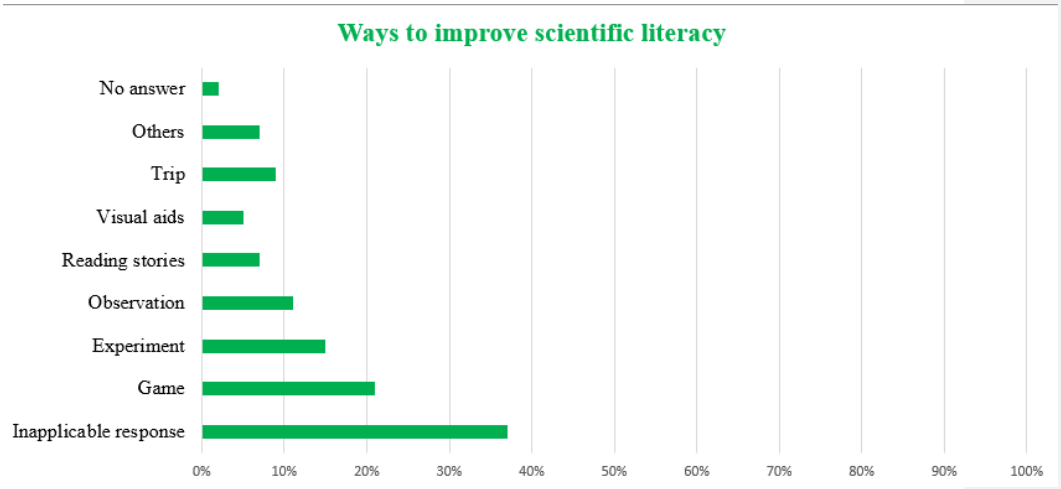
Another definition of numerical literacy was presented as "the ability to make mathematical reasoning and interpretation". In general, 474 (91.51%) of pre-school teachers agreed with the statement, while 18 (3.47%) did not know the definition and 26 (5.02%) did not share the same view (Table 11).

Table 11 - Awareness of the Definition of Numerical Literacy



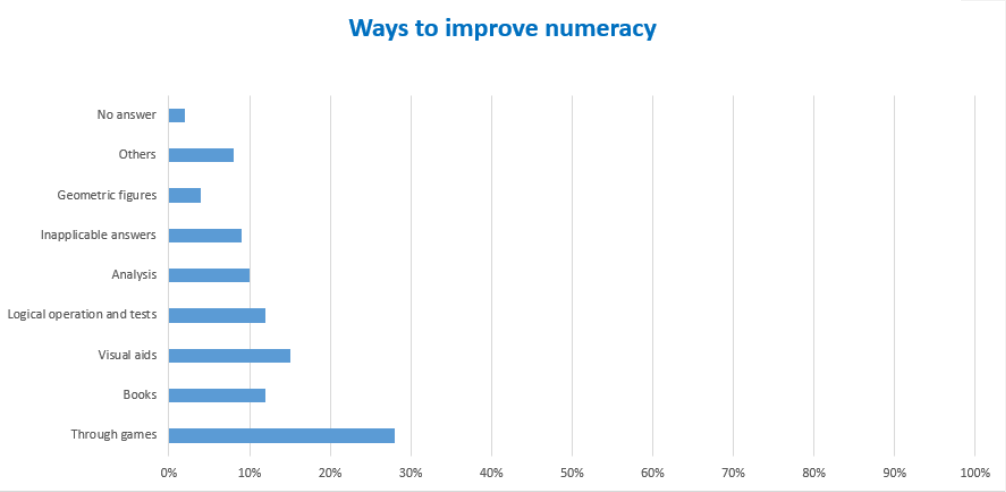
Besides, there were multiple choice and open-ended questions in the survey. So, one of the open-ended questions was **"**Which methods do you use to improve scientific literacy?". The responses to this question were as follows: games are used by 110 (21%) pre-school teachers as a tool to develop scientific literacy, while conducting experiments is preferred by 78 (15%) respondents; in addition, observations are proposed by 59 (11%) teachers, 34 (7%) of pre-school educators choose to read stories, 28 (5%) use visual aids as a tool, and 48 (9%) prefer going on trips with children. Among the methods, there are also "oral teaching, discussions, Q&A sessions, use of online resources" etc. which constitute 7% (37) of the responses. On the other hand, 190 (37%) of the respondents misunderstood the question and proposed methods to increase teachers' scientific numeracy although the survey was piloted before. The unapplicable responses were about reading books, participating in trainings, using social media, exchange of experience etc. (Table 12).

Table 12 – Ways to Improve Scientific Literacy



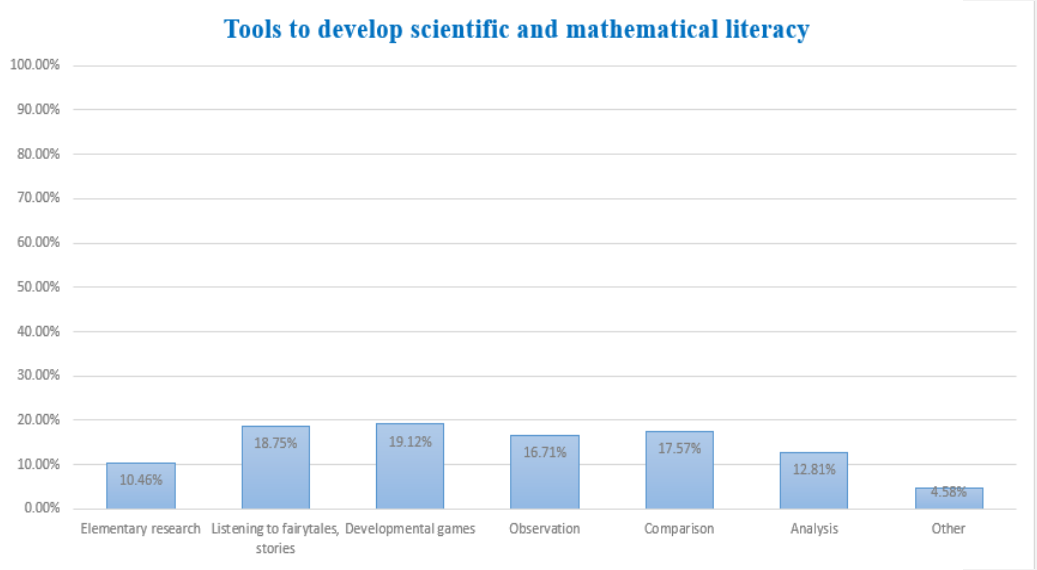
Furthermore, the survey also included an open-ended question asking for methods to increase numerical literacy. The responses to this question were the following: 145 (28%) of the respondents increase numerical literacy through games, 62 (12%) through using books and 76 (15%) via visual aids. In addition, 61 (12%) of the participants use logical operations and tests, 22 (4%) - geometric figures and 53 (10%) conduct analysis with children. Among the responses, there are 41 (8%) more methods written once such as conducting competition among children, counting with sticks, conducting elementary research, using crosswords, puzzles and making comparison. Finally, 12 (2%) of the participants did not respond to the question, while 46 (9%) again misinterpreted the question and wrote about methods to increase numerical literacy of teachers through books, trainings, discussions etc. (Table 13) .

Table 13 – Ways to Improve Numerical Literacy



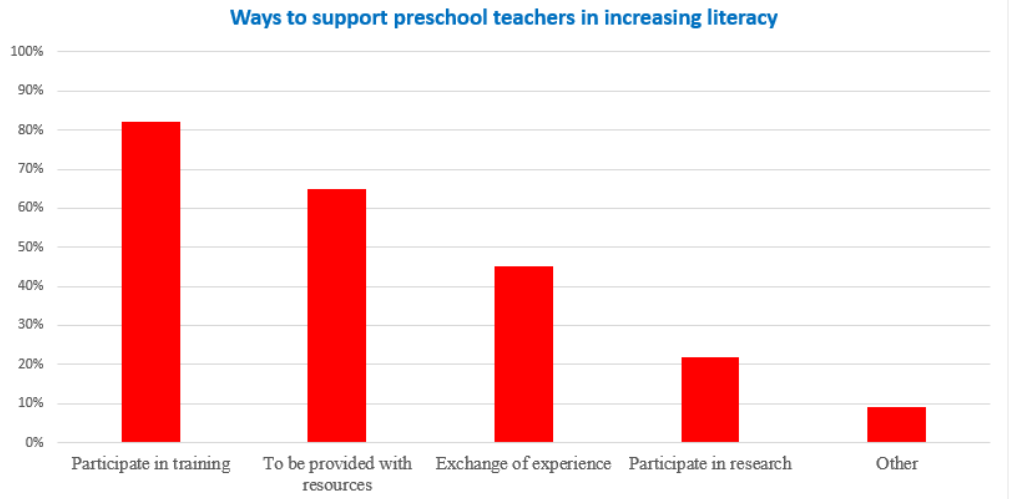
A multiple-choice question was about the tools used by pre-school teachers to develop scientific and numerical literacy. To reply to this question, the participants could choose more than one answer. The results of this question were as follows: 99 (19.12%) respondents chose developmental games as tools to increase scientific and numerical literacy, while 97 (18.75%) selected listening to fairytales and stories. In addition, 91 (17.57%) use the method of comparison, 87 (16.71%) - observations, 66 (12.81%) - analysis, and 55 (10.46%) - elementary research. Lastly, 23 (4.58%) of the participants use other means not specified in the survey (Table 14).

Table 14 – Tools Teachers Use to Develop Scientific and Numerical Literacy



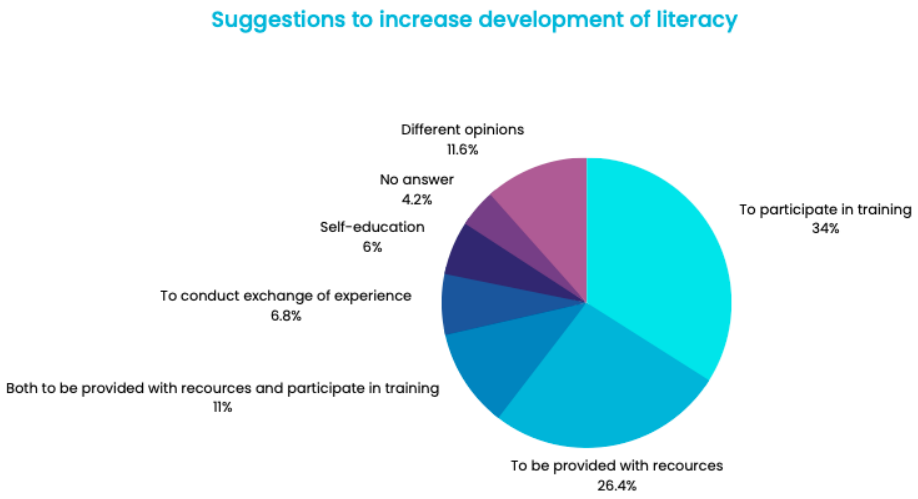
The other multiple-choice question was "Through which means should pre-school teachers be supported to increase numerical and scientific literacy?". The results of this question were the following: participating in trainings was proposed 429 (82%) times, while provision with resources was suggested 336 (65%) times; also, 232 (45%) participants offered to have exchange of experience, while 114 (22%) suggested to participate in research. Lastly, 44 (9%) of the respondents selected "Other" option (Table 15).

Table 15 – Supporting Pre-school Teachers in Increasing Numerical and Scientific Literacy



Finally, the last open-ended question was about the suggestions to support development of scientific and numerical literacy. 176 (34%) participants responded that if they participate in regular training, it will be better, while 137 (26.4%) suggested to be provided resources. 57 (11%) respondents claim that they want to be provided with both resources and participate in trainings, while 35 (6.8%) respondents answered that it is better to have an exchange of experience with others. 31 (6%) respondents answered that a teacher should work on themselves regularly. On the other hand, 22 (4.2%) respondents did not answer the survey question, whereas 61 (11.6%) respondents have other answers such as working hard, watching programs, going on excursions, increasing computer skills etc. (Table 16).

Table 16_– Teachers' Suggestions to Develop Numerical and Scientific Literacy



Results of the Interviews with Kindergarten Principals

To explore the teaching experience of preschool educators in numeracy and science in ECE, we have interviewed 4 principals from different public kindergartens functioning under BED and Absheron-Khizi RED. The main purpose of this qualitative study was to analyze the methodology of preschool educators in teaching numeracy and science, the challenges they encounter during the teaching process and support they receive from the principals. So, the same 7 questions were addressed to all principals, and as a result of in-depth interviews with the participants, we managed to acquire valuable information.

To begin with, short information about the experience of pre-school principals in ECE was identified as below (Table 17):

Table 17 -Participant information

Participant information

Respondent No.	Experience in ECE	Experience as a principal
Respondent 1	21 years	9 years
Respondent 2	35 years	29 years
Respondent 3	22 years	11 years
Respondent 4	36 years	28 years

Taking into account the research questions and the purpose of our study, we organized the findings from the interview into three themes: (1) teaching methodology of preschool educators in numeracy and science, (2) the challenges teachers faced during the teaching process, (3) support that they received from the administrative staff to overcome their obstacles.

Theme 1. Teaching Methodology of Preschool Educators in Early Numeracy and Science

One of the interview questions in our study was addressed to identify which methods preschool educators use in teaching numeracy and science. So, the responses to this question were separated into 3 parts which are entertainment, integration with other subjects and individual approach (Table 18).

Table 18- Teaching Methodology

Teaching methodology of preschool educators	Result
1.1 Entertainment (through games, role playing, visual aids)	• Better engagement • Increased motivation to learn • Skill development
1.2 Integration with other subjects	• Learning through multiple ways • Deeper understanding
1.3 Individual approach	• Teaching based on needs

Subthemes 1.1 Entertainment (through games, role playing, visual aids). Respondent 1 supports the idea that children learn better through playing games. There are different age groups of children in kindergartens and for each age group the teaching methodology is different.

Respondent 1 highlights:

Düşünürəm ki, bütün bunların fonunda bizim metodikanın ən vacib, ən əyləncəli hissəsi uşaqlara oyun formasında öyrədilməsidir. 1-6 yaş civarında uşaqlara tədris etdiyimiz üçün bu yaşda oyunla öyrənən uşaqların öyrəndiyi bilik və bacarıq ümumiyyətlə uşaqların yaddaşından çıxmır. Ən əsas öyrənmə metodu məktəbəqədər yaş dövründə oyundur. Oyunlar da müxtəlif cürdür. Uşaqların inkişaf səviyyəsindən, qavramasından, xarakterindən asılı olaraq tərbiyəçi müəllim ona fərdi yanaşmanı bilməlidir.

[I think that the most important and funniest part of our methodology is to teach though the games. Since we are teaching children between the age of 1-6 years, children never forget the knowledge and skills learnt through games. Games are the most important method in Early Childhood Education. The games are different. Based on children's level of development, comprehension, and character, the educator should know how to approach them individually].

Meanwhile, the Respondent 2 also highlighted the importance of games in teaching numeracy and science in children's learning process.

She said:

Məsələn bizdə öyrədici oyunlar var, hansı ki, rəqəmlər verilir və uşaqlar həmin rəqəmi tanıyıb onun üzərini işarələməlidirlər. Bu onların daha tez və əyləncəli formada öyrənməsinə kömək edir. Bizim bağçada tez-tez uşaqlar arasında yarışlarda təşkil olunur. Həmin yarışlarda məsələn kim ən tez toplayar, kim ən çox saya bilər və s. kimi əyləncəli metodlardan istifadə edirik.

[For example, we have instructional games where numbers are given, and children have to recognize that number and mark it. This helps them to learn faster and in a fun way. Competitions are often organized among children in our kindergarten. In those competitions, we use entertaining methods such as who can make the fastest summation, who can count the most and so on].

Meanwhile, according to view of the Respondent 4, majority of the children do not like the numeracy and therefore, they always try to organize their lessons in a way that will grasp the attention of children considering that teaching though the games is one of the effective ways. According to her, this way motivates children to learn mathematical skills.

Also, Respondent 4 pointed out that they teach numeracy and science to children by role playing and showing various videos.

She said:

Uşaq üçün nəzərdə tutulan riyaziyyat dərin riyaziyyat deyil, formaların üzərində gündəlik işləyirik, hər şeyi oyunla edə bilməzsən, bəzi şeylər tapşırıq kimi verilir, anlatmalısan ki, yekunlaşdırıb qrup halında həyətə düşəcəyik. Forma və metodlar fərqlidir. Məsələn, televizor və ya proyektor vasitəsilə uşaqlara videolar göstəririk. Riyaziyyata və rəqəmlərin öyrədilməsinə aid video və audio materiallar çoxdur.

[Mathematics intended for children is not deep mathematics, we work on the forms daily, you can't do everything through games, some things are given as tasks, you have to explain that we will finalize and go to the yard in a group. The forms and methods are different. For example, we show videos to children through television or projector. There are many video and audio materials related to learning mathematics and numbers].

Subtheme 1.2 Integration with Other Subjects. Respondent 1 highlighted that all the subjects should be integrated with each other in preschool education, and it is significant for a child's learning:

Ümumiyyətlə, mən belə başa düşürəm ki, bağçanın uşağın həyatında ən önəmli rolu odur ki, uşağa bacarıqlar bütöv halında təqdim olunur. Hər bir fənn, hər bir bilik bir-birinə inteqrə olunmuş formada verilir. Hər bir metod tərbiyəçi müəllimin biliyinə və bacarığına bağlıdır.

[In general, I understand that the most important role of the kindergarten in a child's life is that skills are presented to the child as a whole. Each subject and each piece of knowledge are given in

an integrated form. For example, we have built the stairs in the kindergarten in the form of small steps for their safety. We teach children to count by climbing the stairs and saying 1 2 1 2. Here, we integrated physical culture through sports, but what we learnt there? We learnt to count. Or we teach them to count by clapping 1 or 2 hands. This learning method depends on the knowledge and skills of the teacher].

Respondent 4 also added that they teach numeracy and science to children through integration with other subjects. She added that we have handicraft classes where the children learn to sew different models by the help of scissors and cloth. In that class, they learnt how to measure width and length of different figures.

According to the thoughts of respondent 3, when the subjects are integrated with each other, the children can learn easily, and they will remember it for a long time. She said:

Məsələn, biz bədii ədəbiyyatda dörd ördəyin nağılını keçirik. Bu nağılı danışarkən tərbiyəçi müəllim burada dörd ördəyin olduğunu vurğulayır və uşaqlar başlayır saymağa 1, 2, 3, 4. Burada bədii təffəkürlə riyazı anlayış inteqrə olmuş olur.

[For instance, we teach the story of four ducks. When teacher tells this story, he or she highlights the existence of four ducks and the children starts to count 1, 2, 3, 4. We integrated artistic thinking into numeracy].

Respondent 2:

Bizdə yeni kurrikulumla əlaqəli olaraq bütun dərslər demək olarki, bir-biri ilə əlaqəlidir, istər rəsm dərsi olsun, istər ətraf mühit və ya riyazi fənn olsun. Məsələn, mövzu payızdır və biz payıza aid mahnılar, nağıllar, meyvələr və bayramlar haqqında uşaqlara öyrədirik.

[In accordance with the new curriculum, almost all lessons are related to each other, whether it's art, environment or math. For example, the topic is autumn, and we teach the children songs, fairy tales, fruits and holidays related to autumn]

Subtheme 1.3 Individual Approach. According to the opinions of four principals of kindergartens, teacher should approach each child individually. They should know the needs and psychology of each child and teach that child in his or her favorite way.

Respondent 1 said:

Ümumiyyətlə, tərbiyəçi müəllim hər bir uşağa fərdi yanaşmalıdır. Hər bir elmi, biliyi və bacarığı uşağa differensiyallaşdırılmış formada keçməlidir. Yəni baxmalıdır Leyla, Lalə, Əli necə öyrənməyi sevir və burada da tərbiyəçi müəllimin uşağı tanıması ən vacib faktordur. Əgər uşağı tanıyırsa, ona fərdi yanaşacaq və bu biliyi ona onun sevdiyi formada təqdim edəcək.

[In general, a preschool educator should approach each child individually. Each science, knowledge and skill should be transferred to the child in a differentiated form. In other words, he/she should see how Leyla, Lala, Ali like to learn, and the most important factor here is that the teacher should know the child. If the teacher knows the child, he/she will approach him/her individually and present this knowledge to him/her in a form that he/she likes].

Furthermore, Respondent 4 stated that you must stimulate the children to learn the subject. She added that when you approach individually and learn their learning needs, children will show high motivation and performance to that subject.

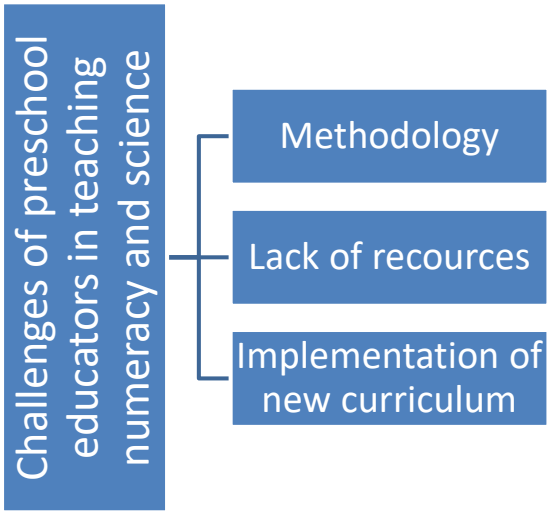
Respondent 4 highlighted:

Uşaqda fənlərə maraq oyatmaq lazımdır. Elə çatdırmalısan ki, maraq və motivasiya yaratmalısan ki, o səni dinləsin. Məktəbəqədər işçilər aktrisa olmalıdır. Siz uşaqların psixologiyasını tapmalısınız, incə yerin tutmalısınız.

[It is necessary to trigger children's interest in the subject. You have to deliver, trigger interest and motivation in such a way that a child listens to you. Staff of Early Childhood Education should be like actresses. They have to understand children's psychology, find their weakspot.]

Theme 2. Challenges of Preschool Educators in Teaching Numeracy and Science. While interviewing four principals of preschool institutions, we tried to find out the challenges of preschool educators in teaching numeracy and science. The most notable answers from the interviewees were related to teaching methodology of preschool educators, to the lack of resources and ~~nd~~experience with the ~~its i~~mplementation of the new curriculum (Table 19).

Table 19 – Challenges Faced by Pre-school Teachers



Subtheme 2.1. Methodology. According to the responses of pre-school principals, teachers do not have any significant challenges in teaching science and numeracy because in preschool education children learn the basic concepts and therefore, teachers do not need deep knowledge on numeracy and science. However, the most significant factor is the teaching methodology of the preschool educators.

Respondent 1 highlighted the idea that:

Elementar riyazi təsəvvürləri bir tərbiyəçinin bilməsi üçün dərin elmi savada ehtiyyac yoxdur. Əgər onun qabiliyyəti və düzgün metodologiyası varsa, o bu fənni uşaqlara rahat və başa düşülən formada ötürə bilər.

[An educator does not need deep scientific knowledge to know elementary mathematical concepts, if she/he has the ability and the right methodology, she/he can convey this subject to children in a convenient and understandable form].

In addition, Respondent 4 expressed that teacher-centered approach of educators will not be effective for a child's learning. The classes should be organized in a way that both educators and children contribute to teaching and learning process.

She said:

Əgər müəllim düzgün forma və metod istifadə edirsə, uşaq həmin dərsə daha çox maraq göstərəcək. Məsələn, əgər müəllim uşağa 1+1 soruşursa, bu uşağa maraqsız gələcək. Düzgün metod seçsə çətinlik olmayacaq, yox əgər masa arxasında oturub, uşaqlara suallar versə çətinliyi olacaq.

[If a teacher uses the right method and form, a child will demonstrate more interest towards that class. For example, if a teacher simply asks what is 1+1, that will be boring for a child. If she chooses the right methodology, she will not have any difficulty, but if she just sits at the desk and asks from students, she will have difficulty in teaching them].

Furthermore, Respondent 3 emphasized that a teacher should be trained to overcome the challenges in their methodology because in preschool education it is important to have the right methodology.

She replied:

Mən belə başa düşürəm ki, müəllimlərin ən böyük çətinlikləri metodika ilə bağlıdır, səriştəsizliklə bağlıdır. Bunun üçündə biz bütün tribunalardan deyirik məktəbəqədər təhsillə bağlı təlimlər çoxalmalıdır, təcrübə mübadiləsi çoxalmalıdır, akademik təhsil verən müəssisələr bununla çox ciddi məşğul olmalıdırlar.

[I believe that the biggest difficulties of teachers are related to methodology and incompetence. Therefore, we say from all the platforms that trainings related to preschool education should be increased, exchange of experience should increase, academic education institutions should deal with this very seriously].

Subtheme 2.2 Lack of Resources. Meanwhile, the participants emphasized another challenge of preschool educators which is related to the lack of resources in teaching numeracy and science. They expressed that due to the implementation of the new curriculum, they have difficulty in providing those new resources to teachers. According to the perception of Respondent 2, they collaboratively work with other preschool institutions in exchange of resources.

She said:

Çətinliklər bilirsiz necədi? Biz dövlət müəssisəsiyik və dövlət tərəfindən bizə vəsaitlər verilməlidir. Hər bir məşğələnin, hər bir təlim prosesinin rahat keçirilməsi üçün əyani vəsaitlər və kitablar önəmlidir. Riyaziyyatla bağlı hər yaş qrupunun özünün ölçüsü var. Körpələr qrupu üçün bütün oyuncaqlar, vəsaitlər böyük olmalıdır, böyük qruplar üçün isə kiçik olmalıdır. Amma bizə o vəsaitlər verilmir. İnanırıq ki, veriləcək bu yaxın zamanlarda.Vəsaitlə bağlı müəllimlər çox çətinlik yaşayır.

[You know what the difficulties are? We are the public institution, and the state should provide us with resources. Visual aids and books are important for the smooth conduct of each exercise and teaching process. Every age group has its own measurement of mathematics. All the toys, resources for the baby group should be large, and for the older groups, they should be small. But we are not given those resources. We believe that it will be provided in the near future. Teachers face a big problem with the lack of resources].

Furthermore, Respondent 1 also pointed out regarding the lack of resources in preschool institutions.

She highlighted:

Bəzən müəllimin düzgün metodologiyası olsa belə əyani vəsaiti yoxdur. Əyani vəsaitin yoxdursa bu konkret çətinlikdir çünki uşağa nə verirsənsə maraqlı verməlisən.

[Sometimes, even though a teacher has the right methodology, she does not have visual aid. If you don't have visual resources, this is a real difficulty, because whatever you give to the child, you have to give it in an interesting way].

Subtheme 2.3. Implementation of the New Curriculum. Respondent 1 emphasized that due to the implementation of new curriculum, teachers face challenges to teach children. They have difficulties with how to work with the curriculum.

She said:

Bilirsiniz ki, biz əvvələr İcra Hakimiyyətlərinin səlahiyyətində olmuşuq. Daha sonra Elm və Təhsil Nazirliyinin səlahiyyətinə keçdik və yeni kurrikulum qəbul edildi. Müəllimlər yeni kurrikulumla bağlı çətinliklər yaşayırlar. Bəzən onlar yeni kurrikulumdan necə istifadə etməyin yollarını bilmirlər.

[As you know, we used to be under the authority of the Executive Powers. Later, we fell under the authority of the Ministry of Science and Education and a new curriculum was adopted. Teachers are experiencing difficulties with the new curriculum. Sometimes they don't know how to use the new curriculum].

Theme 3. Support Provided to Preschool Educators by Principals of Kindergartens. After revealing the challenges of preschool educators in teaching numeracy and science, the next question was related to the support provided to them from the administration. The principals highlighted multiple ways of support mechanisms to help teachers to overcome their challenges (Table 20).

Table 20 – Support Provided by Pre-school Principals to Teachers

Subtheme 3.1 Consultations. During the interviews, it was revealed that pre-school teachers first of all consultate with metodists and pre-school principals when they face difficulties.

Respondent 1 emphasized:

Ümumiyyətlə, nəyin ki, elmi riyazi biliklərin aşılanmasında çətinlik çəkən müəllimlərin, bütün sahələrdə çətinlik çəkən müəllimləri müdir və ya metodist müşahidə etməlidir. Hər hansı tərbiyəçinin harda çətinliyi yaranır? Təlim nəticələrində harda bizi qane eləmiyən faktlar var və bu faktların səbəbləri araşdırmalıdır. Bundan sonra biz həmin müəllimlə konsultasiya edirik və onun çətinliyini aradan qaldırmağa çalışırıq.

[In general, not only teachers who have difficulty in teaching scientific and mathematical knowledge, but also teachers who have difficulties in all areas should be observed by the principal or methodologist. Where does any educator face difficulty? What are the facts that do not satisfy

us in the training results, and the reasons behind these facts should be investigated. Afterwards, we consult with that teacher and try to overcome his/her difficulty].

In addition, Respondent 3 pointed out:

Bizim çox təcrübəli baş metodistimiz var və hal-hazırda xanımın 64 yaşı var. Demək olar ki, 22 yaşından bağça sferasında işləyir.Müəllimlərin hər hansı bir çətinliyi olarsa, o xanıma yaxınlaşıb məlumat alıb ondan öyrənirlər.

[We have a very experienced senior methodist and she is currently 64 years old. She has been working in the kindergarten since she was almost 22 years old. If teachers have any difficulties, they approach her and learn from her].

Subtheme 3.2 Trainings. According to thougths of Respondent 3, teachers are involved in various training programs by The Minisrty of Science and Education and through this trainings, teachers deepen their knowledge and practices in different areas.

She said:

Biz artıq Elm və Təhsil Nazirliyinin tabeliyinə keçdikdən sonra müxtəlif təlimlərə cəlb olunmuşuq. Həmin təlimlər müəllimlərin professional inkişafında əhəmiyyətli rol oynayır. Məsələn, bu yaxınlarda bizim yeni bir təlimimiz baş tutacaq.

[We have already been involved in various trainings after falling under the authority of the Ministry of Science and Education. Those trainings play an important role in the professional development of teachers. For instance, our new training will take place soon].

Moreover, Respondent 3 expressed that if teachers encounter challenges on implementing the right methodology in relation to children's learning, trainings will help them to overcome this challenge.

She emphasized:

Müəllimlər müxtəlif təlimlərə cəlb olunur və bu təlimlərdə onlar düzgün metodologiya ilə işləməyi və uşaqlara dərsi necə keyfiyyətli və effektiv öyrətməyin yollarını öyrənirlər.

[Teachers are involved in various trainings, and in these trainings, they learn how to work with the right methodology and how to teach children qualitatively and effectively].

Subtheme 3.3 Seminars and workshops. Respondent 4 thinks that organizing seminars and workshops for teachers will also support them in overcoming their challenges.

She pointed out:

Bizdə tez tez bağçanın daxilində seminar və praktikumlar keçirilir, və müəllimlərin hansı mövzuda çətinliyi varsa metodist mənə gəlib deyir. Həmin çətinliyi seminarlar vasitəsi ilə həll etməyə çalışırıq. Müxtəlif mövzülarda seminarlar olur. Məsələn, Uşağın bağçaya qəbulu, valideynlə müəllim arasında münasibət, ərköyün uşağa yanaşma tərzi, əyləncəli məşğələ dəqiqələləri və s.

[We often have seminars and workshops in the kindergarten, and if the teachers have any difficulties, the methodist comes and tells me. We are trying to solve this problem through different seminars. There are seminars on various topics. For example, the admission of a child to kindergarten, relationships between a parent and a teacher, approach towards a spoiled child, organization of entertaining lessons, and so on].

Subtheme 3.4 Exchange of experience. Based on the opinions of principals, exchange of experience has an important role in the development of a teacher, and therefore, teachers should collaboratively work with each other when they have any challenge in the teaching process.

Respondent 1 emphasized:

Çalışıram ki, fikir mübadiləsi aparım və onlara daha çox hami müəllimlər, yəni daha çox təcrübəli müəllimlər təyin edirik, və həmin müəllimlər öz fikrini diktə etmir, elə eləməlidir ki həmin hami müəllim qarşısındaki tərbiyəçi müəllim onun işinə baxaraq, özü üçün ciddi fikirlər götürə bilsin və onun iş təcrübəsindən yararlana bilsin. Burada təcrübə mübadiləsi çox ciddi önəm daşıyır istər bağça daxili, istərsə də bağça xarici digər bağçalara getməklə təcrübə qazana bilərlər.

[I try to exchange ideas and assign them more experienced teachers, and those teachers do not dictate their own opinion, so a teacher will take serious takeaways from the mentor's experience and practices. Exchange of experience is very important here, either inside the kindergarten or outside the kindergarten, they can gain experience by going to other kindergartens].

Meanwhile, Respondent 2 supported the idea of the Respondent 1 and pointed out that teachers should exchange their experience and practices.

She revealed:

Bizdə daha təcrübəli müəllimlər gənc müəllimlərə dəstək olur. Məsələn, onlar öz təcrübələrini bölüşərək müəllimlərə uşaqlarla düzgün işləməyin metodlarını öyrədirlər.

[We have more experienced teachers supporting young teachers. For example, they share their experiences and teach educators the right methods of working with children].

Chapter V: Discussion

In this study, we explored the experience and challenges of pre-school educators in teaching early numeracy and science, and what kind of support they receive to overcome those challenges. So, in this part of the paper, we discussed main takeaways from quantitative and qualitative studies of the research and make comparative analysis between two data sets to add valuable insight to our final conclusion about the study.

Above all, the study's findings of 2023 about educational background of pre-school teachers are in conformity with the data provided by the Statistical Committee of the Republic of Azerbaijan in 2022 that the majority of pre-school educators in public pre-school entities of the Republic of Azerbaijan completed vocational education. As such, based on the information provided by the Statistical Committee, in 2022 out of 12.658~~13.415~~ pre-school teachers 65.1~~0~~% owned degree in vocational education; meanwhile, according to the results of our survey, out of

518 teachers 59,85% completed secondary specialized education. Nevertheless, many researchers in the field of ECE suppose that having higher education degree in pedagogy or other faculties related to ECE is correlated with the provision of higher quality pre-school education (Mwaipopo et al., 2021; Erden, 2010; Hyson et al., 2009; OECD, 2012; OECD, n.d.).

When it comes to the comparative analysis between two data sets, we have observed that both pre-school teachers and principals find games as the most effective way of teaching kindergartners early numeracy and science. During the interview, it was revealed that pre-school educators avoid teaching hard mathematical concepts to children in an academic manner. Instead, they play games, set stages, play songs and do other interactive activities. This practice was also supported in the literature by Björklund (2015) and Mononen & Aunio (2013) that ~~in Finland,~~ ECE should be ~~is~~ exercised through playing and other entertaining means of education, but not through intense academic learning.

Besides, pre-school principals indicated in their responses that early numeracy and science should ~~not~~ be taught ~~as separate classes to children, but~~ in a holistic way. It is essential to note that holistic teaching of early numeracy and science together with other domains such as arts, technology or engineering classes is also one of the core principles of STEAM Education which is successfully implemented in Finnish pre-school system (Hilppö et al., 2022).

Commented [UM9]: It is not taught as separate classes because ECE does not have lesson system

Lastly, another consistency in data sets is that both preschool teachers and principals think that one of the challenges faced by pre-school teachers is the lack of needed resources. This was also observed by Gheit (2016) and in the report of Early Learning and Child Care (2019), that the quality of pre-school infrastructure and resources predefines well-being of children and effective ECE to a great extent. Besides, among other challenges was teaching methodology which is not

engaging for children and difficulties faced by pre-school teachers in the implementation of the new curriculum.

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Chapter VI: Conclusion

In conclusion, this study was aimed to analyze the perception of the preschool educators about their teaching experience on numeracy and science in public kindergartens. More precisely, the research is studied to find out the possible challenges and needs faced by teachers during the teaching process and how principals support them to overcome these challenges. The significance of this study was in the preparation of a Kindergarten Handbook for preschool educators and principals in order to assist them in teaching numeracy and science and improve their competency in the field of ECE.

The analysis has indicated that methodology of pre-school educators is important during teaching numeracy and science to children. Children learn better when they are teaching through different activities such as playing games, experimenting, role playing and singing. Furthermore,

the study revealed that teachers have faced various challenges during the teaching process including implementation of new curriculum, lack of resources and trainings.

On the other hand, principals use multiple ways of support mechanism to overcome the challenges of preschool educators. As such, according to the results of the study, principals provide different kinds of support mechanism such as consultation, seminars, trainings, and exchange of experience to assist teachers to overcome their challenges.

Finally, based on the findings, Kindergarten Handbook was developed to assist pre-school educators in teaching numeracy and science in accordance with the national curriculum. In this Handbook, a wide range of activities such as 3D Model of Literacy, color-mixture palette, sun-colored paper, art, poem activities and other exercise are presented to foster holistic and engaging learning of numeracy and science. Meanwhile, professional learning community and TRIAD models are included in the Handbook prepared to provide support to pre-school educators to increase their knowledge and experience in teaching numeracy and science.

Limitations of the Study

Some limitations were observed while conducting the study. As such, while analyzing the survey responses, we noticed that open-ended questions regarding the methods used to increase scientific and numerical literacy were misinterpreted by the participants. As a result, 236 responses in total were inapplicable in the quantitative part of the research. In addition, while analyzing the quantitative data, we observed that although some respondents indicated that they were unaware of numerical and scientific literacy, they displayed level of agreement or disagreement with the statements related to numerical and scientific literacy instead of being neutral which demonstrates inconsistency in the responses. Similarly, while some participants indicated that they are aware of

the concept of numerical and scientific literacy, they responded that they do not know the definitions of these terms which were displayed in the survey.

Another inconsistency was that the tools proposed by pre-school teachers to increase scientific and numerical literacy mostly overlap with the options provided in the previous questions of the survey which indicates that either pre-school teachers in this study did not reflect their own experience in open-ended questions by simply copying the responses or they lack such experience.

Lastly, among 10 pre-school principals that we planned to interview based on the list provided by IERA, only 3 agreed to participate which limited the scope of the qualitative data.

Chapter VIII: End Product

As clearly highlighted and discussed in the previous chapters, the aim of the study is to get familiar with the science and numeracy education in public kindergartens of Azerbaijan by taking the challenges into consideration that are faced by the pre-school teachers, and hereby provide the practical guidance that can potentially contribute to the pre-school math and science education in accordance with the current curriculum. Ultimately, in this chapter, we have designed Kindergarten Handbook with reference to the findings of the paper, certain policy measures are defined as the potential contributors to the development of the early childhood education in Azerbaijan based on three different aspects as offered by Lawrence: “policy resources, promising practices, professional development and teacher preparation” (2017, p.2).

KINDERGARTEN HANDBOOK

FOR EARLY NUMERACY AND SCIENCE

2023

Nazrin Huseyn

Afsana Allahverdiyeva

Table of contents

The Handbook intends to provide practical information on pre-school games which can be practiced by pre-school educators, present models of professional development for pre-school principals and suggestions on increasing competencies of pre-school educators and acquaint the reader with the main legislative acts of the Republic of Azerbaijan in the field of Early Childhood Education. The Handbook is planning to deliver to preschool educators different versions of games and exercises for teaching numeracy and science. Meanwhile, the Handbook will be useful for principals by applying professional development models as a support mechanism for preschool educators.

The first part of the Handbook provides preschool educators with practical information on early numeracy and science classes since the focus of this Handbook is to help teachers to get acquainted

with peculiarities of the cognitive development of children which formed based on practice of tasks requiring logical and critical thinking. Different activities and exercises are indicated in the Handbook intended to improve children's cognitive and language development. The main purpose of those activities and exercises is to help children to learn basic mathematical and scientific concepts in a simple and funny way.

The second part of the Handbook is dedicated to professional development models and suggestions for pre-school principals to provide opportunity for teachers to increase their competency. In order to provide an effective teaching environment for kindergartners to learn math and science, it is essential to pay special attention to the professional development of teachers. Professional development enables pre-school teachers to analyze children's progress, by having individualized approach to each student choosing the best teaching technique (Clements & Sarama, 2005). Ultimately, the Handbook provides two models of professional development for preschool educators which are TRIAD and PLC's model (Dimino, 2015).

Finally, the last part of the Handbook covers the list of main legislative acts of the Republic of Azerbaijan in the field of early childhood education, including the Law on Pre-school Education, State Standards on Early Childhood Education, Pre-school Curriculum and others.

Games and Exercises for Teaching Early Numeracy and Science

Considering the fact that the early age students are in the process of cognitive development with the high sense of imagination, teaching them science through the practices and games that will directly satisfy their imagination can lead to higher perception of basic concepts of numeracy and science. Hereinto, the science and mathematical education in early age should be taught in an integrated and holistic manner within the framework of STEAM education, through the means of art, games, engineering activities, role-playing and as such. The following some examples of the science-learning games are mentioned that can lead to the development of critical and analytical skills of the students.

"Makerspaces in Early Years"

The aim of this project which is implemented in Finland is to trigger the students' critical skills, reasoning, and ability to analyze by engaging them in the playful environment in which they enjoy, learn, repeat, and hereby remember what they have learnt from the joyful learning experience (Vartiainen & Kumpulainen, 2020). In correspondence to the preschool curriculum of Azerbaijan (2020) and law on preschool education (2017), early age students should be engaged in the playful activities, which enable them to analyze, compare and contrast, and evaluate the events or exercises.

"Color Mixture Palette"

The game aims at enabling students to observe the possible color tones they can get by only using the main colors in the color palette that is given to them. In this regard, students not only spend joyful time where they collaborate and have fun, but also, they learn that the different proportions of each color always change the final color, which enables them to pay attention to details and be more critical (Marshall, 2012).

Engineering and Architecture Activities

By providing students with certain shaped-figures, including circle, triangle, rectangle, and colons, the children are asked to design the little toy-buildings, which teaches them about gravity and the

required ascending order of the shape from big to small shapes respectively from the bottom to up (McClure, 2017).

"Sun-Colored Paper"

The experiment is based on the observation of the color-changing process of sun-sensitive paper by putting an object on the paper and hereby exposing it to the sunlight. As a result, sunlight-exposed sections turn lighter while the covered part of paper remains in relatively same color. The experiment enables students to get familiar with the scientific explanations of the weather condition and the Sun through developing their observation skills (Marshall, 2012).

(The photo is retrieved from "Run Wild My Child")

(The photo is retrieved from “Run Wild My Child”)

Art and Poem Activities

Instead of asking the students to provide solutions for the problems offered to them, description of the problem through poems and leaving a room for the students ’individual interpretation about the end result can be attention grabbing and engaging in addition to promoting critical and analytical skills. Moreover, students can make evaluation of each activity or express their opinion with drawing, origami, or similar artistic techniques, which highly contribute to the creativity of children, their ability to assess and evaluate, along with self-expression. The origami activities, on the other hand, are asserted to be a part of mathematics, the practice of which improves numeracy learning (Cipra, 2001). Thus, by folding the paper with different degree angles, students get

different shape of birds, animals, and as such, and hereby visually getting familiar with the role of proportions, numbers, and angles.

Didactic Games and Puzzles

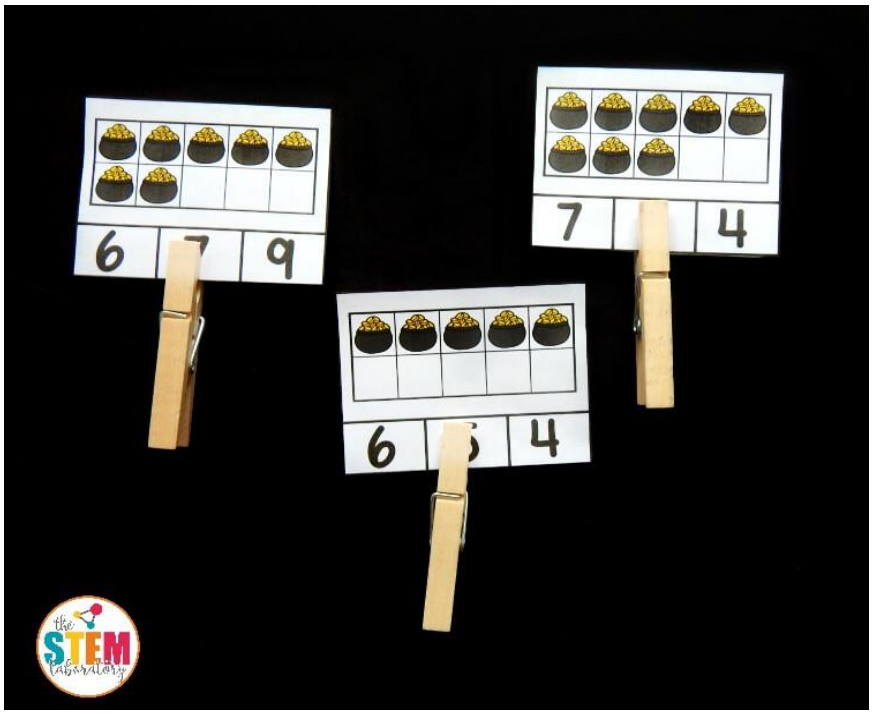
Those games trigger the critical and analytical thinking of the kids along with directing them towards solution-oriented stance. By practice, the early age students start to logically connect the shapes and their right space in the ground, which lays the foundation for basic geometrical knowledge. The preschool curriculum of Azerbaijan (2022) highlights the importance of such games to be practiced in a regular and repeated manner for the fast learning. ~~ing of students.~~

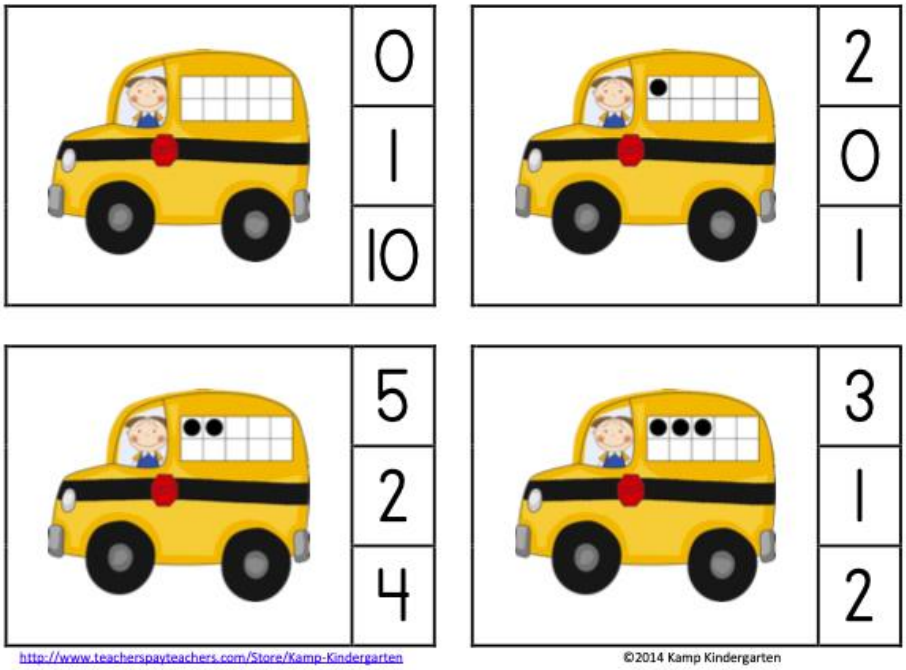
Tracks with stones

These types of activities activate both intellectual and sensitive development among children. As such, children load the track which is drawn on a printed paper with stones which they can prepare from play doughs. This exercise will help children to learn counting and fine motor skills. In addition, the teacher can also ask about the color of the truck. This game is designed for the age of between 5-6 years old.

"Pots of Golds"

In this exercise, children are distributed cards with different number of pots with gold and clothespins. Children try to find how many golden pots are on the card by trying not to count them but guess visually. When there are more than 10 pots, children can count after 10th pot. There are various forms of this activity like counting the number of dots in a bus, apples on a tree, farm and

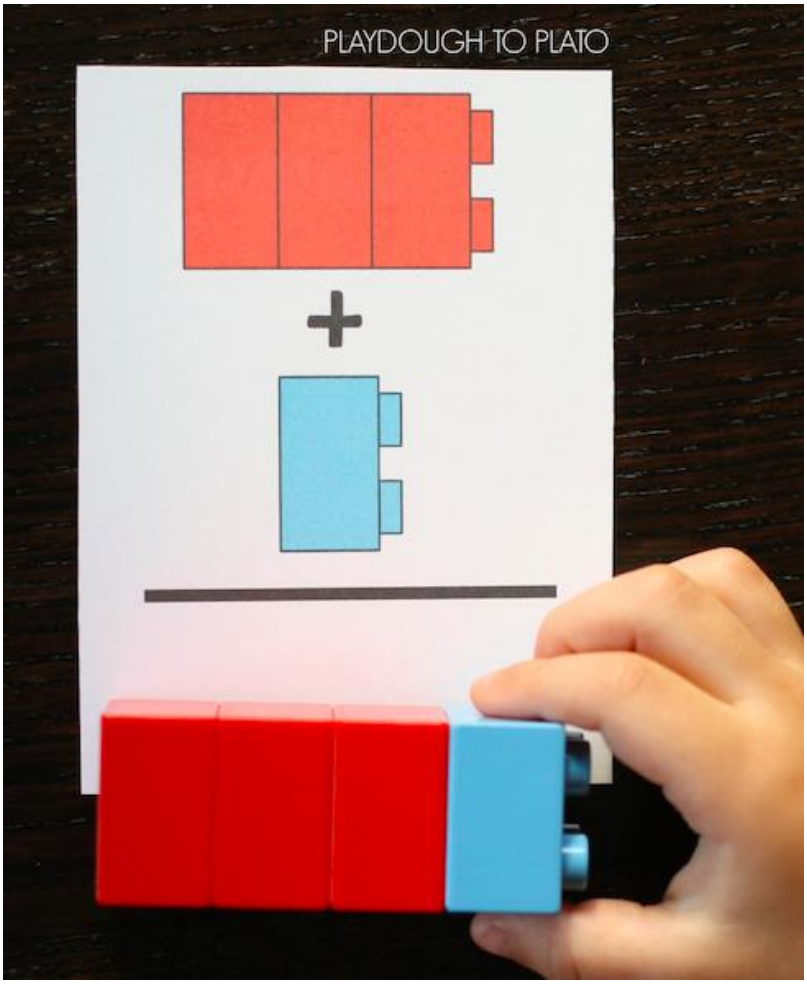




ocean animals and many others. These kinds of exercises include elements of math and science through teaching counting and cardinality (defining the number of elements in one spot), as well as living and non-living objects, their conditions of existence.

«Addition Lego Cards»

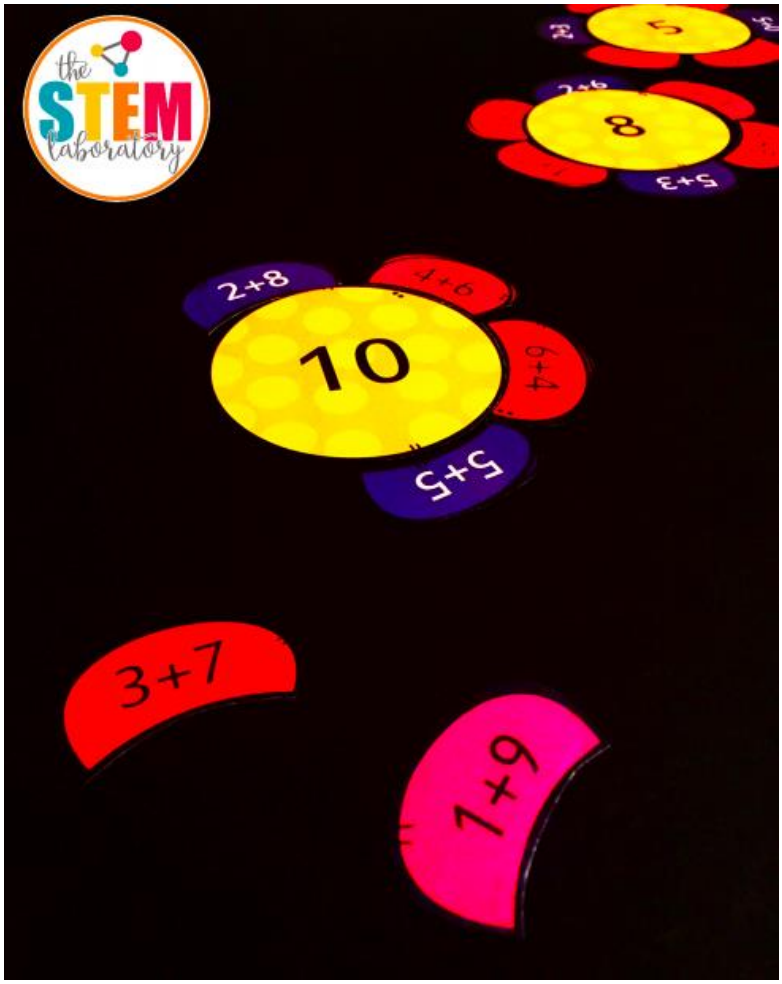
In this game, kindergartners learn to sum through adding together LEGO blocks. This exercise is an interesting way of teaching math to children. In addition, LEGO is beneficial for toddlers to develop their problem solving and spatial skills (Shelli, 2023). Specifically, it improves concentration and eye/hand coordination.



«Addition Flower Puzzles»

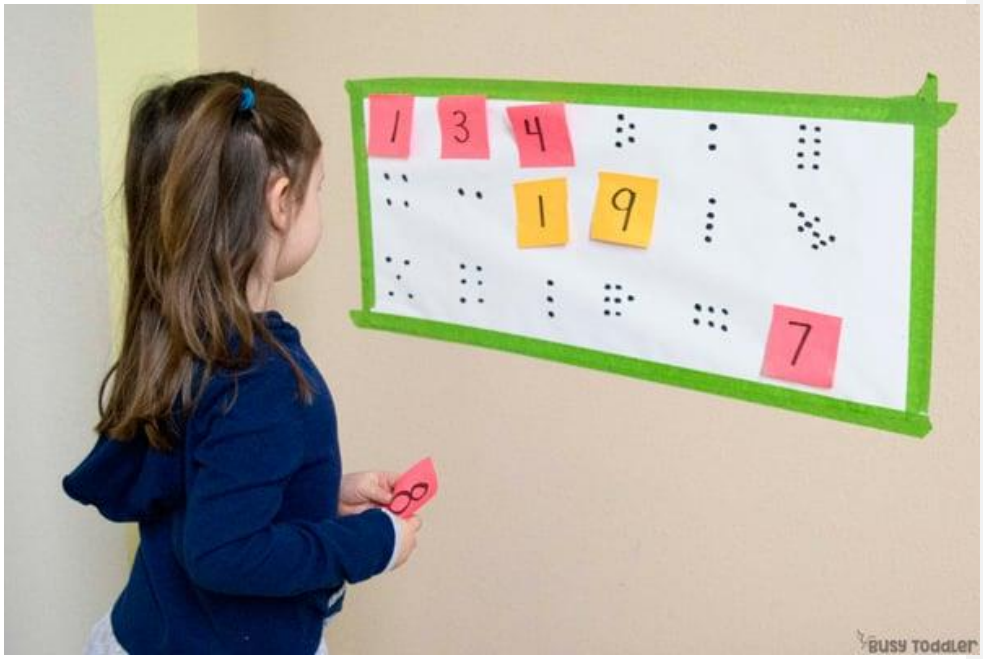
In this exercise, the teacher distributes the piece of center of flowers with a number from 5 to 10 and petals which numerical equations that match the number on the center of the flower. The teacher explains to children that they should match the pieces of flower to the center. It is essential

that in this kind of exercise teacher observes children working in groups without interrupting their work to give a chance to practice problem solving and team collaboration together.



«Post-It Number Match»

This mathematical game creates an opportunity for children to learn counting through moving (Susie, 2020). For this exercise, teachers will need a poster, stickers, a marker and a tape. The teacher should paint dots on the white poster attached to a wall and write down the numbers on stickers which later a child will find in the classroom and stick to the poster. The same exercise can be used for matching shapes and equations.

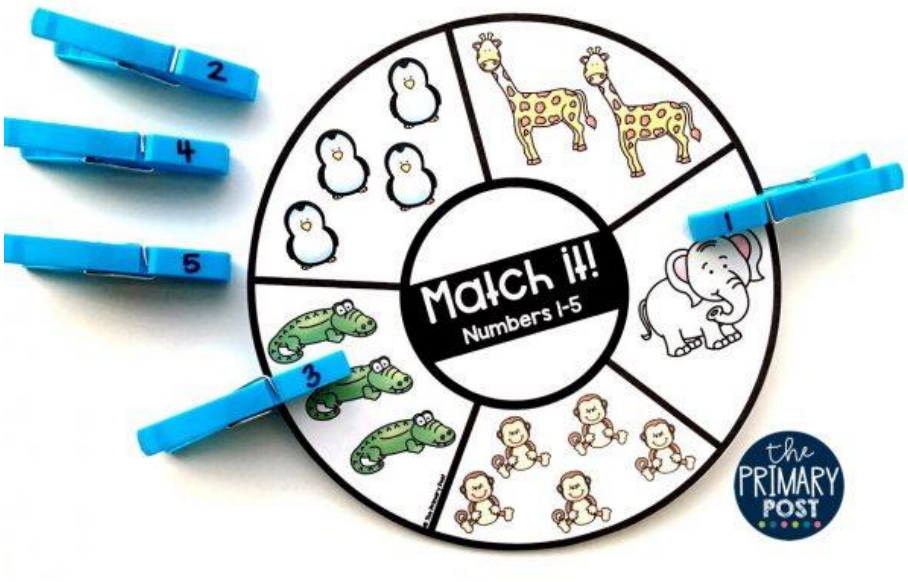


«Rainbow Teen Number Match»

This activity was designed for children between the age of 4-6 years to match the ten-frame pot of gold with the number written on the cloud. The two-digit teen numbers were purposefully written in the center so that the ten's digit was on the left half and the one's digit was on the right. Splitting each number this way helped children check their answers instead of having to rely solely on reading those tricky teen names.

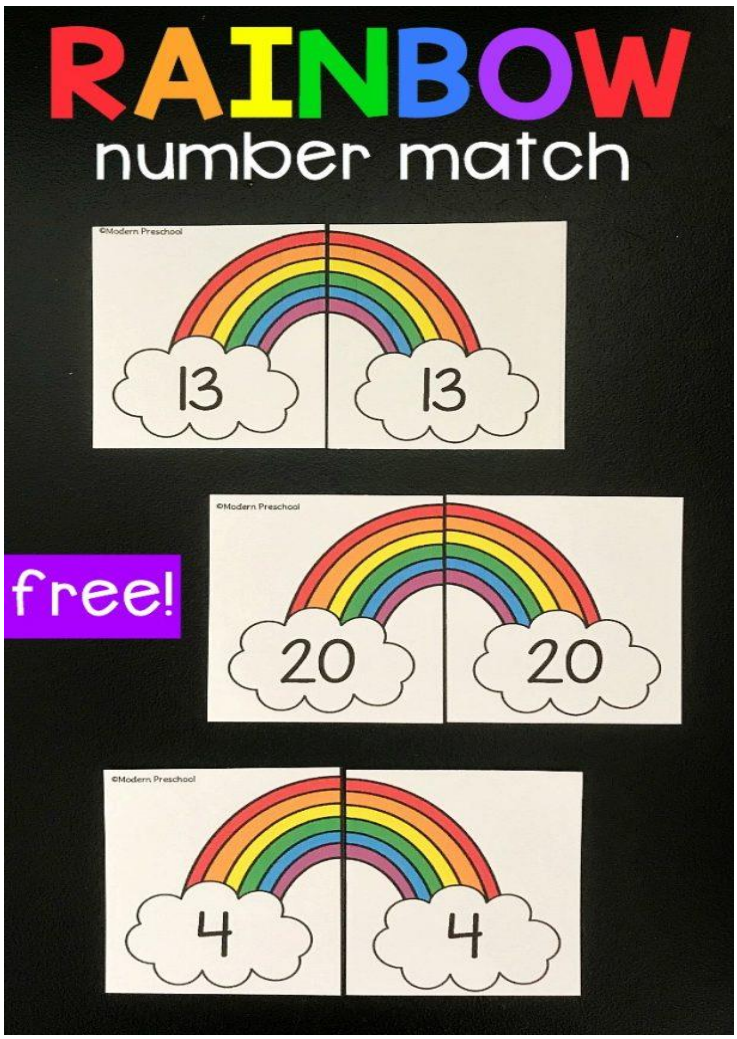
«Match it. Numbers 1-10»

In this activity teachers will prepare a circle including numbers 1-5 and 6-10. Children are asked to count the animals and match the correct pin with a number. This activity will help students to learn the names of animals, counting and matching correctly and improve their fine motor skills.



«Rainbow Number Match»

This printable rainbow number match activity for preschoolers includes 20 rainbow puzzles. Each rainbow puzzle has the same number printed on both sides of the rainbow. The numbers included in the puzzles are 1-20. To prepare the activity, print the set from the file included in the links part. Choose whether to print all 20 rainbows, just 1-10, or 11-20. Cut the rainbow puzzles apart on the gray dotted lines. Then cut the rainbows in half down the black line. If you are laminating the set, prefer to laminate and then cut down the black lines to separate the rainbows.

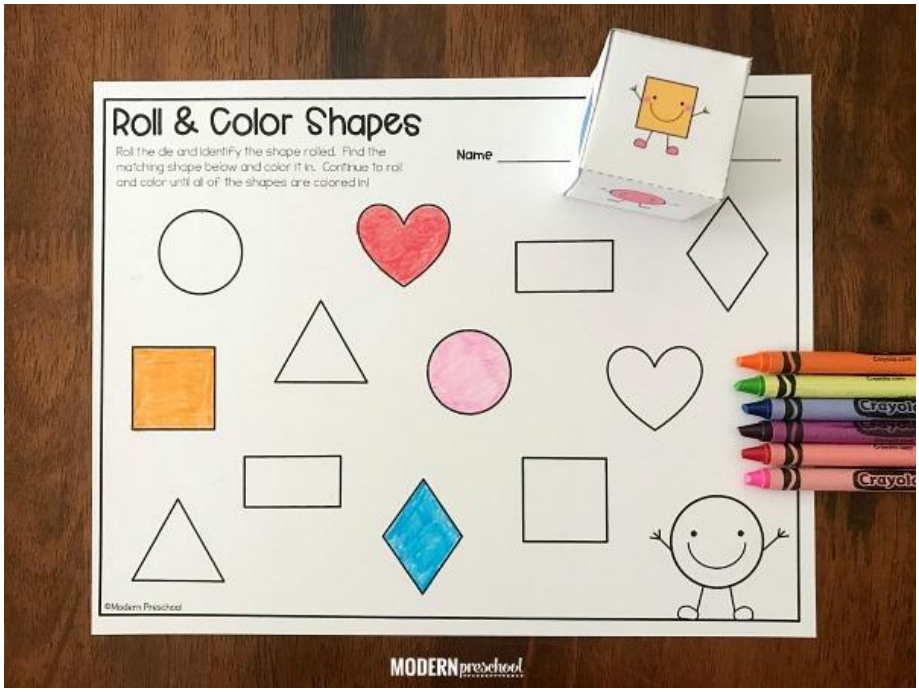


«Gingerbread Fine Motor Number Cards»

In this activity each card has a numeral and a cute gingerbread friend on it. Print the set of number cards and cut them apart on the gray dotted lines. Laminate the set when using them in your classroom. Place the gingerbread fine motor number cards in a basket or tray. Add buttons, beads, or pom poms to the set. And for even more fine motor practice, add kid-friendly squeezers, and children will be ready to play, count, and learn.

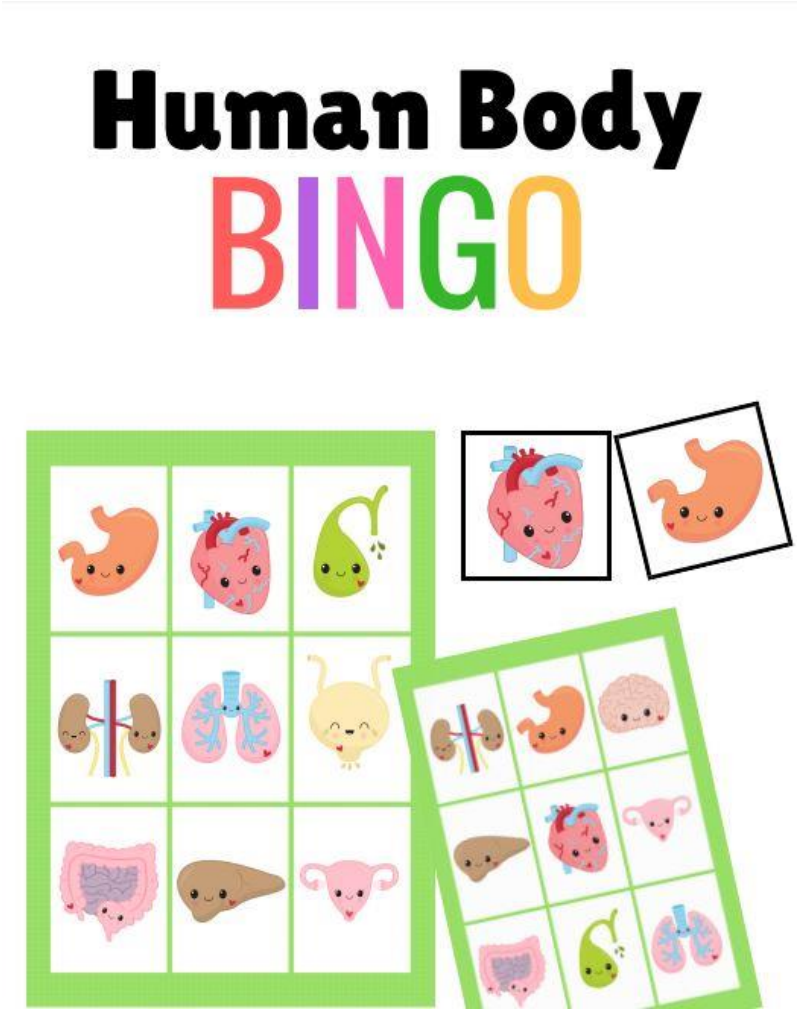
«Shape Roll & Color»

In this activity, children will learn shapes and colors by rolling the paper. The printable shape roll & color learning center includes 2 printable dice. Each die has 6 shapes on it. It also includes a recording sheet with 12 shapes. To prepare the dice simply cut each die out around the solid black line. Do not cut on the dotted lines. After the die is cut out, fold along all the tabs on dotted lines, and along the dotted lines in between all of the sides. Add glue to each tab. Fold the die together while holding the glued tabs against the inner side of the die. The glue will dry quickly, and children will be ready to roll. After rolling children will paint the shape on the paper which turned up on the roll.



«Body Part Bingo»

"Human Body Bingo" cards help kids learn about human anatomy. They are made with cute-animated drawings of body parts like brain, heart, stomach, and lungs. Gather playing pieces (and find an announcer) before starting the game. In this activity, teacher will ask each child to tell the name of human body which help them to learn about human anatomy.



Recycling activity

In this activity, preschool educator will ask each child to bring waste materials from their home to the kindergarten in order to convert them into new materials and objects. For example, bringing some materials such as boxes, plastic bottles, paper, and cardboard and converting them into new

objects including carton bird feeder, junk mail pinwheel, water bottle octopus and so on. This activity will help the children to develop their fine motor skills, increase their creativity, and practice with problem solving.

«Planting and Gardening»

In this activity, children engage in planting seeds and taking care of plants. By cleaning the site of the plant, regularly watering the plant, and properly providing with sunlight, children can learn about the life cycle of plants, observe changes over time and understand the importance of nurturing living things.

«Sink or Float»

In this exercise, a teacher will write “sink” and “float” on a piece of paper and make two columns. She will ask preschoolers to collect different objects from around the house, such as rubber ties, paper, pens, spoons, pins and so on. The teacher will also explain the meaning of both the words “sink” and “float” to the children. After that the teacher will fill a pan with water and asks kids to

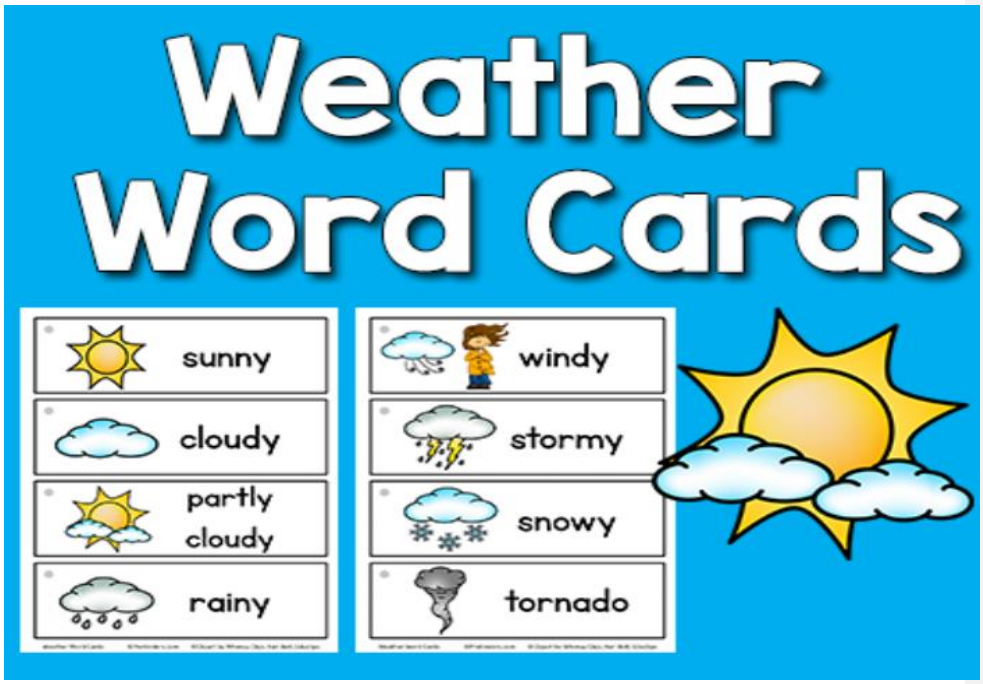
put the objects in the water one by one. She/he will observe together with children which one floats, and which ones sinks and write them down on paper.

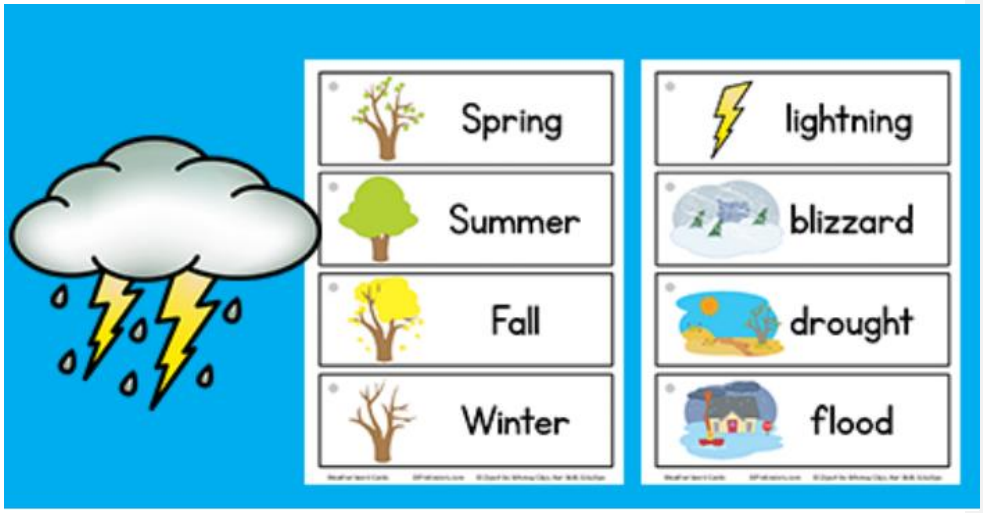
«Magnet Play»

In this activity, a teacher will ask children to collect some items from around the house and gather them around a magnet. After that she will let children see which ones are pulled in by the magnet and which ones are not. This activity will help children to understand the meaning of magnet and what kind of materials are pulled by magnet.

“Weather Vocabulary”

In this activity, the teacher will show preschoolers words to describe all kinds of weather with free printable cards. The words like sunny, cloudy, and stormy, as well as blizzard, flood, hurricane, the four seasons, and others can be used for many activities, such as helping kindergartners fill in their weather journals.


Weather
Word Cards
sunny
cloudy
partly
cloudy
rainy
windy
stormy
snowy
tornado



Professional development models for early childhood educators

This part of the Handbook is dedicated to Professional development models for early childhood educators and two models - “TRIAD” and “PLC” will be introduced to teachers and principals to help them to improve their professional competency.

TRIAD model

We aim to approach TRIAD model as a paradigm to be practiced for professional development of pre-school teachers of Azerbaijan, which promotes the “healthy” child-teacher interaction and communication in the school environment which simultaneously focuses on effective learning of the children along with the professional development of the teachers (Sarama & Clements, 2019). The focal aim of TRAID (Technology-enhanced, Research-based, Instruction, Assessment and Professional Development) projects is to define the learning trajectories for each stage of cognitive

development of students, constant learning and development of teachers, equal chance for children and instructors to participate in the tasks that contribute to development, to keep in the right track of the national curriculum, and to make regular assessment and evaluation through which the shortages and achievements can be observed.

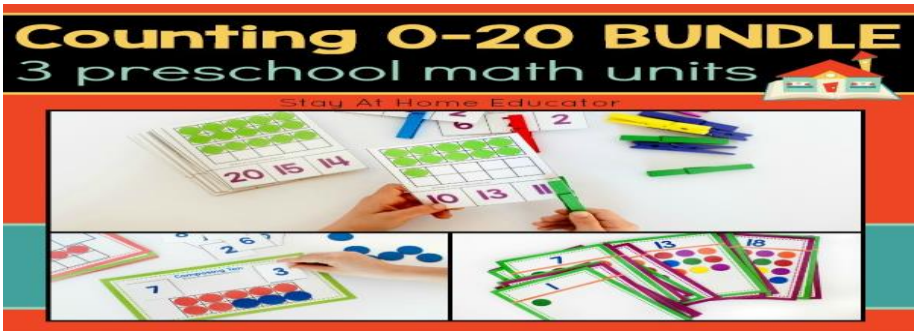
TRIAD model's Considerations for Professional Development and Teacher Training:

- State-level or institutional-level financial funding of the educative trainings, conferences, workshops, and seminars for the teachers, which constantly engage them in discussions about early childhood education especially for science and math learning.

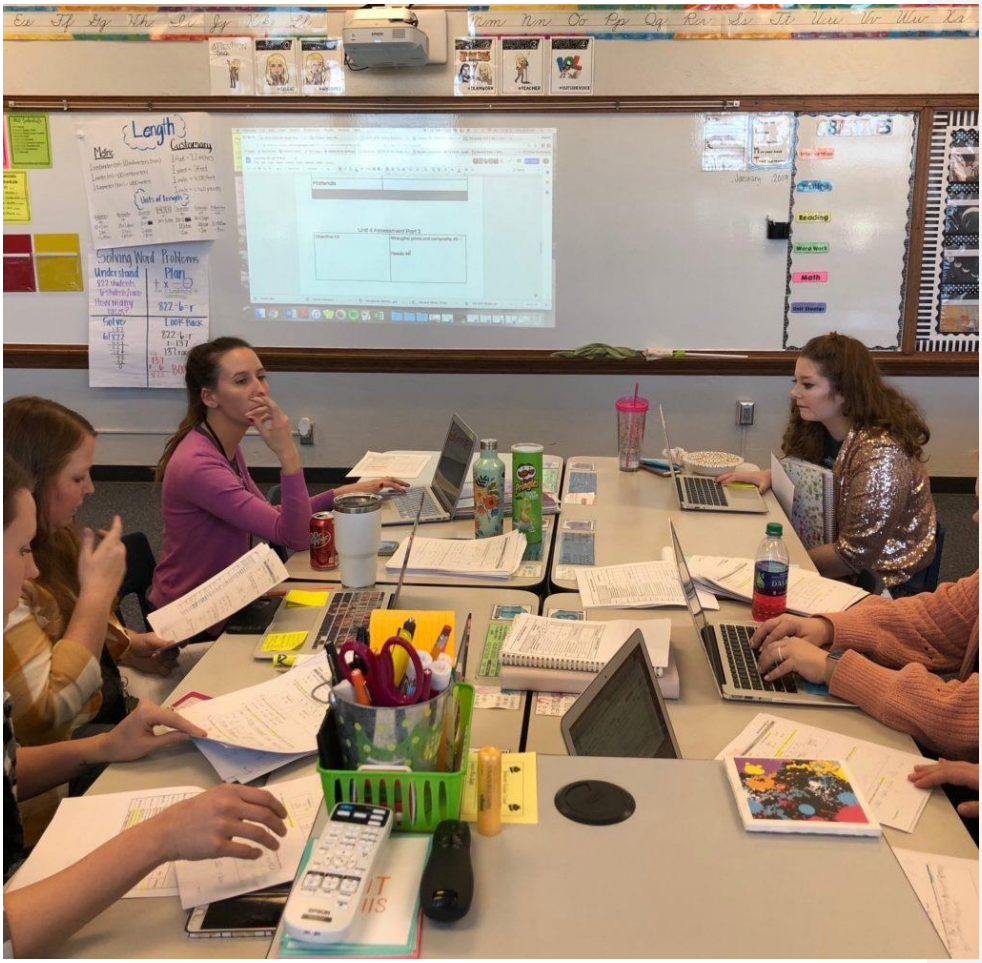
- Creating the digital platforms or providing free access for teachers to enroll in the existing digital platforms that contain several courses about ECE, in order to stimulate continuous learning and pedagogical skills of the teachers.

- To encourage teachers to establish a motivational class-spirit, in which the students are engaged in learning progress through playful activities, games, and conversations, which are explained in the promising practices chapter.

- Building blocks based on the existing curriculum, through which teachers manage to cover all subjects by dividing the topics for weekly activities.



- Constant monitoring, assessment, and evaluation made in a weekly manner that describe the learning outcomes, pre-determined learning goals, and potential policies that should be implied if the goals are not met, and regular weekly or monthly meetings of the school staff, including teachers and psychologists, along with the parents or caretakers of the students.



Professional Learning Community

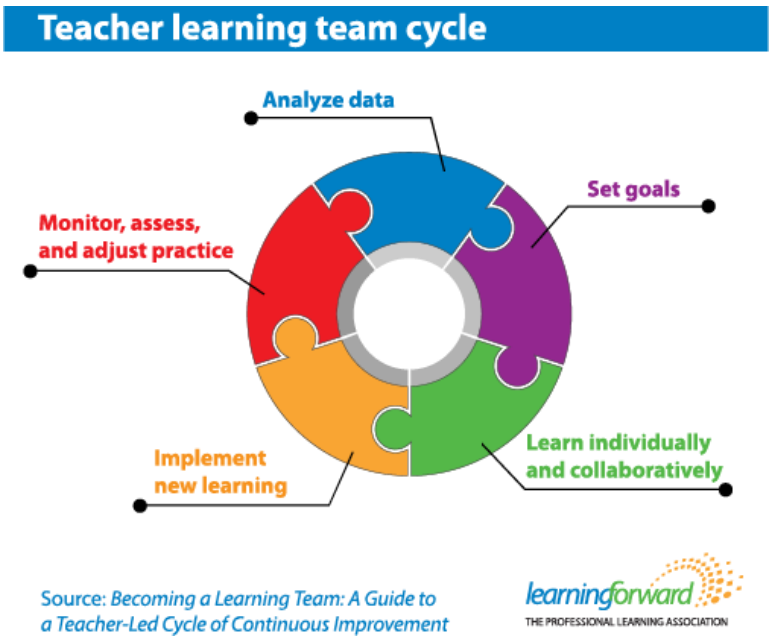
We also propose PLC's model of professional development of preschool teachers in Azerbaijan where a group of teachers with common interests can work together with for increasing their knowledge and expanding their vision. In general, a professional learning community involves a team of educators that have a meeting regularly on new topics, share their ideas and concerns and

propose solutions to the problems together (Dimino, 2015). In the model of PLC's community, members often share the aim of fostering students' achievement by developing their own teaching methodology and practices. This collaborative interest brings continuous learning and coherence to their professional development. Furthermore, this model will help novice teachers to learn from experienced teachers. Meanwhile, teachers have an opportunity to be in touch with instructional coaches and mentor teachers who support and guide pre-school educators during the period dedicated to professional development. There are five stages in PLC model which demonstrate an inquiry-action cycle that motivates teams to debrief, define, explore, experiment, reflect and plan (Dimino, 2015).

5 stages in Professional Learning Community

Debrief: in PLC sessions, head methodist will ask team members to share their instructional activities and strategies which they practiced in the classroom and explain how students understand the topic and respond to the questions in written, as well as oral way. Afterwards, she/he will ask teachers to share how they adapt or change their activity to improve student learning.

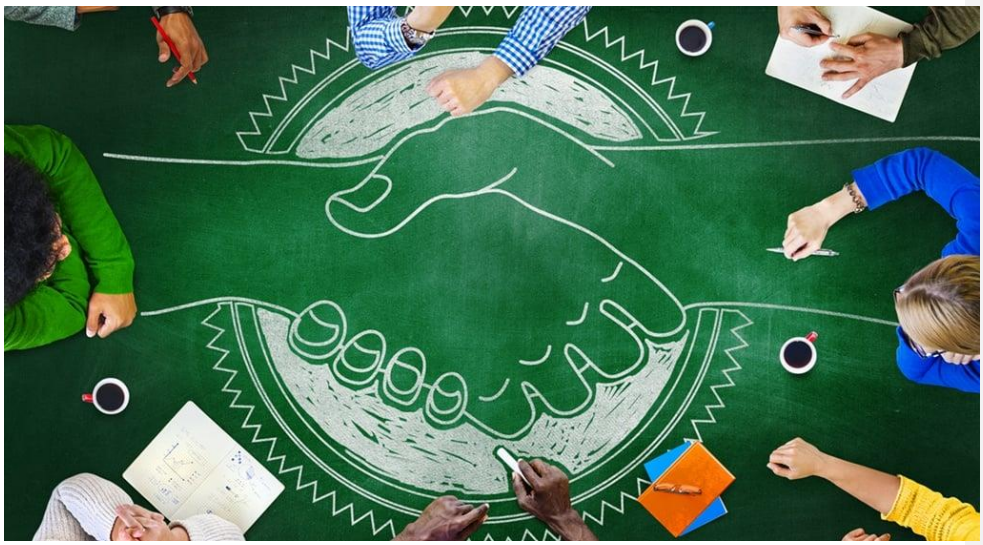
Define Session Goals: Teachers will identify the specific goals and focus of the session. They will share their values and vision with other teachers.



Explore New Practices and Compare Them with Current Practices: during this stage, each teacher is asked to share their prior knowledge and practices related to the topic of the session. After covering new learning methodologies, they will compare new experience with their current knowledge.

Experiment with Newly Learned Strategies: collaborate with teachers to practice applying strategies and activities that were addressed in the practice guide.

Reflect and Plan: instructional coach will guide teachers to reflect on how new experience and learning relates to their previous practices and knowledge. After that, pre-school educators will plan how newly learnt strategies and activities will be applied in members' classrooms prior to the next PLC session. It is recommended that each teacher comes prepared at the beginning of the next session to express their experiences and thoughts about the implemented strategies.



Legislation of the Republic of Azerbaijan in the Field of Early Childhood Education

The following links are provided to get acquitained with the main legislative acts of the Republic of Azerbaijan in the field of ECE:

- Law of the Republic of Azerbaijan on Pre-school Education (2017)

  https://e-qanun.az/framework/35791

- Rules on Organizing Pre-school Preparation (2010)

  https://e-qanun.az/framework/12492

- State Standard on Pre-school Education in the Republic of Azerbaijan (2019)

  https://e-qanun.az/framework/43192

- Pre-school Education Programme (Curriculum) (2022)

  https://edu.gov.az/uploads/mektebeqeder/sened/mektebeqeder_tehsil_proqrami-kurikulum.pdf

- Charter of Pre-School Education (2012)

  https://e-qanun.az/framework/24394

- Regulation on Pre-School Pedagogical Councils of

  https://e-qanun.az/framework/24093

Printable versions of game cards:

Truck mats:

https://www.prekinders.com/wp-content/uploads/2015/11/load-trucks-play-dough-mats.pdf

Clip cards:

https://thestemlaboratory.com/wp-content/uploads/2017/01/pot-of-gold-count-and-clip-cards.pdf

https://www.teacherspayteachers.com/Product/School-Bus-Count-and-Clip-Cards-Sets-to-10-1331469

https://www.teacherspayteachers.com/Product/Apple-Clothespin-Count-Clip-Cards-Freebie-1316026

https://www.teacherspayteachers.com/Product/Farm-Animal-Count-and-Clip-Cards-1-12-717647

https://www.makinglearningfun.com/themepages/GingerbreadCountandClipCards.htm

https://www.themeasuredmom.com/25-sets-of-free-count-and-clip-cards/

LEGO addition cards:

https://www.playdoughtoplato.com/wp-content/uploads/2015/05/ADDITION-LEGO-CARDS.pdf

Adding flower petals cards:

https://thestemlaboratory.com/wp-content/uploads/2021/01/Addition-Flower-Puzzles.pdf

«Rainbow Teen Number Match» cards:

https://thestemlaboratory.com/teen-number-rainbow-match/

«Match it. Numbers 1-10» cards:

http://theprimarypost.com/2018/05/color-word-match-it-freebie.html

«Rainbow Number Match» cards: https://modernpreschool.com/rainbow-number-match/

«Gingerbread Fine Motor Number Cards»:

https://modernpreschool.com/gingerbread-fine-motor-number-tracing-cards/

«Shape Roll & Color» cards:

https://modernpreschool.com/shape-roll-color-math-activity/

«Body Part Bingo»: https://www.twinkl.com/resource/t-t-21099-body-bingo

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Appendix 1

Survey questions for pre-school teachers (Translated from Azerbaijani into English)

1. Please indicate your gender

- Male
- Female

2. Please indicate your age

- 21-30
- 31-40
- 41-50
- 51-60
- Above 61

3. Please indicate your education background

- Full secondary education
- Secondary specialized education
- Higher education

4. Please indicate your working experience

- 1-5 years
- 6-10 years
- 11-15 years
- More than 16 years

5. Please indicate the educational department which supervises the kindergarten where you work

- Baku city Educational Department
- Absheron-Khizi Regional Educational Department
- Mountanious Shirvan Regional Educational Department
- Ganja-Dashkasan Regional Educational Department
- Lankaran-Astara Regional Educational Department
- Central Aran Regional Educational Department
- Mil-Mughan Regional Educational Department
- Garabagh Regional Educational Department
- Qazakh-Tovuz Regional Educational Department
- Guba-Khachmaz Regional Educational Department
- Sheki-Zagatala Regional Educational Department
- Eastern Zangazur Regional Educational Department
- Shirvan-Salyan Regional Educational Department

6. Are you informed about numerical and scientific literacy?

- Yes
- No

7. Please indicate your view about the following statements

	Strongly agree	Agree	I do not know/Neutral	Disagree	Strongly disagree
Scientific literacy is having an elementary understanding of the surrounding world, being able to answer questions arising from curiosity about everyday experiences					
Scientific literacy means having the ability to describe, explain and predict natural phenomena					
Numerical literacy is the child's ability to solve problems and analyze events					

Numerical literacy is about mathematical reasoning and interpretation skills					

8. Which methods do you use to improve scientific literacy? (open-ended question)
9. Which methods do you use to improve numerical literacy? (open-ended question)
10. How much do you agree with the following statement “Numerical and scientific literacy is reflected in the curriculum content”?

- Strongly agree
- Agree
- I do not know/Neutral
- Disagree
- Strongly disagree

11. Which tools do you use to increase numerical and scientific literacy in ECE institutions? You can choose more than 1 option.

- Elementary research
- Stories, listening to fairytales
- Developmental games
- Observation
- Comparison
- Analysis
- Other

12. Through which means should pre-school teachers be supported to increase numerical and scientific literacy?

- To participate in trainings

- To be provided with resources
- To participate in research
- Exchange of experience
- Other

13. What are your suggestions to support development of numerical and scientific literacy? (Open-ended question)

Appendix 2

Interview questions for pre-school principals (Translated from Azerbaijani into English)

- For how many years have you been working in ECE sector in general?
- For how many years have you been working as a ECE principal?
- What is your view about the importance of numeracy and science classes for children?
- What is your perception of teaching preparedness of your ECE educators in the field of numeracy and science?
- Could you describe some activities applied by pre-school teachers in your kindergarten during numeracy and science classes?
- How do you support pre-school teachers to increase their knowledge and practice in numeracy and science?
- How do you know if a teacher struggles to teach numeracy and science? (If such a case ever happens).
- How do you support pre-school educators in teaching numeracy and science?
- What is done to increase effectiveness of numeracy and science classes for children?

Appendix 3

MÜSAHİBƏYƏ RAZILIQ FORMASI

Tədqiqatçıların adları: Nəzrin Hüseyn və Əfsanə Allahverdiyeva

Tədqiqatın adı: Məktəbəqədər təhsil müəssisələrində elmi və riyazi biliklərin öyrədilməsi
Tədqiqatın məqsədi: Bu tədqiqatın məqsədi məktəbəqədər təhsil müəssisələrində elmi və riyazi biliklərin uşaqlara öyrədilməsi ilə bağlıdır. Məktəbəqədər təhsil müəssisələrində müəllimlərin riyazi və elmi bilikləri öyrədən zaman qarşılaşdığı çətinlikləri aşkara çıxarmaq və bu çətinliklərin məktəb müdirləri tərəfindən necə dəstək olunaraq həll edilməsini tədqiq etməkdir. Tədqiqatın nəticələri məktəbəqədər təhsil müəssisələrində elmi və riyazi bilikləri tədris edən müəllimlərə dəstək məqsədi ilə tövsiyələrin hazırlanmasına töhfə verəcəkdir.

- Mən təsdiqləyirəm ki, bu tədqiqatda könüllü olaraq iştirak edirəm.
- Mən başa düşürəm ki, məni narahat edən hər hansı müsahibə sualına cavab verməmək hüququm var.
- Mən başa düşürəm ki, müsahibənin səs yazısı aparılacaq, səs yazısı ancaq məlumatların təhlili üçün istifadə olunacaq və bütün şəxsi məlumatlar silinəcək. Mən başa düşürəm ki, səs yazısı üçüncü tərəflə paylaşılmayacaq.
- Mən təsdiq edirəm ki, müsahibə təqribən 30-35 dəqiqə çəkəcək.
- Mən təsdiq edirəm ki, mənim şəxsi kimliyim anonym saxlanılacaq.
- Mən başa düşürəm ki, bu müsahibədən toplanılmış məlumatlar üçüncü tərəflə paylaşılmayacaq.
- Mən bu sənədi oxudum və anladım.

İştiakınız üçün təşəkkür edirik!

Bu sənədi imzalamaqla mən müsahibədə iştirak etməyə razılıq verirəm.

İştirakçının adı	Tarix	İmza

Tədqiqatçının adı	Tarix	İmza