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LONG ABSTRACT

The Impact of Early Childhood Arithmetic Thinking Training Program on Preschool Para-Educators in Israel

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Ben Yair, S., & Chiș, O. (2023). Can I Teach? Assimilation of Early Childhood Arithmetic Concepts Among Preschool Paraeducators. In I. Albulescu, & C. Stan (Eds.), Education, Reflection, Development - ERD 2022, vol 6. European Proceedings of Educational Sciences (pp. 190-202). European Publisher. https://doi.org/10.15405/epes.23056.18

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Ben Yair, S. (2021). Who will teach me math? Promoting mathematics teaching in kindergarten through of training the preschool paraeducators. The 9th International Conference of Education, Reflection, Development, June 25, 2021. Cluj-Napoca, Romania.

Ben Yair, S. (2021). Teachers' Knowledge in Developmentally Appropriate Practice of Mathematics. Calculations and Senses: in the focus of mathematical literacy and sensory accessibility Conference. December 6, 2021. Kaye Academic College of Education, Israel.

Ben Yair, S. (2022). Can I teach? I can teach! Assimilation of Early Childhood Arithmetic Concepts among Preschool Para-Educators. 10th International Conference Education, Reflection, Development. June 24, 2022. Cluj-Napoca, Romania.

Ben Yair, S. (2022). Learning-Teaching of an Adapted Mathematics. Diverse and Inclusion Conference. March 30, 2022. Kaye Academic College of Education, Israel.

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ABSTRACT

Children engage in Arithmetic throughout the day, in all kindergarten's centers. Therefore, all the kindergarten educators must have basic skills in engaging in Early Childhood Arithmetic (ECA) to provide an accurate mediation. Preschool Para Educators (PPEs) are part of the kindergarten staff. They interact with kindergarten children in all areas, including arithmetic. Unfortunately, the PPEs are not trained in early childhood mathematics. Therefore, training in ECA for PPE is required and has not been previously investigated.

This research aim was to examine the impact of an Arithmetic Teaching Training Program (ATTP) for Preschool Para-Educators (PPEs), on their Beliefs regarding Arithmetic and its Teaching in kindergarten, Professional Identity, Role Perception, and Professional Self-Efficacy. The research also explores the Education Directors' attitudes regarding implementing the program in kindergarten, and the Kindergarten Teachers' perceptions regarding PPEs' Professional Functions in kindergarten.

A mixed methods research paradigm was chosen for this research.

The research consisted of four studies: (1) A pilot study to design the research tools for the main quantitative study; (2) the Development and validation of the ATTP study with 15 Experts; (3) A quantitative study. Administering the questionnaires to 83 PPEs to examine the differences between PPEs who have participated in the ATTP compared to PPEs who have not attended, and a questionnaire to 38 Kindergarten Teachers; (4) A qualitative study. In-depth semi-structured interviews, involved observations and stimulated recall interviews with 10 PPEs, In-depth semi-structured interviews with 2 Education Directors, and open-ended question analysis of 38 Kindergarten Teachers. The triangulation of the findings reinforced the research findings concerning PPEs' attitudes regarding ECA and their professional identity.

The research conclusions indicate a need for ECA training for PPEs. The ATTP strengthened the PPEs' professional functions and influenced their Role Perception to be more pedagogical and less administrative. However, further investment in training is required to improve Confidence in professional choosing and reputation.

Keywords: Early Childhood Arithmetic, Preschool Para-Educators, Arithmetic Teaching Training Program, Beliefs regarding Arithmetic and its Teaching in Kindergarten, Professional Identity, Role Perception, Professional Self-Efficacy, Early Childhood Education.

INTRODUCTION

Research Background

This doctoral research focuses on Preschool Para-Educators (PPEs) and their ability to engage in Early Childhood Arithmetic (ECA) with children in kindergarten. Developing mathematical thinking is one of the cornerstones of learning in kindergarten (Ginsburg & Baroody, 2003). The extent of math practice and its quality in early childhood predict the child's success in continuing math studies (Clements et al., 2017; Ten Braak et al., 2022). This study focuses on Arithmetic because it is the primary branch of mathematics, and its foundation is the numbers concept (INMPC, 2010).

Children engage in arithmetic throughout the day and in all kindergarten centers. Children sometimes turn to the PPEs regarding arithmetic problems they encounter in kindergarten. They cannot distinguish who among the kindergarten staff is educated and who is not. For them, every kindergarten team member is an educator. PPEs are in daily interaction with kindergarten children and engage in ECA in kindergarten everyday life, naturally and intuitively, but without training and precise knowledge, which may lead to the assimilation of mistakes or wrong concepts among children. Therefore, all educators in kindergarten must have basic skills in dealing with ECA to provide an accurate mediation.

Despite the proven importance of early childhood mathematics education, many educators do not receive appropriate professional development in mathematics (Clements & Sarama, 2011). Therefore, training in Early Childhood Arithmetic for PPE is required and has not been previously investigated.

Gap in Knowledge

Previous studies have been conducted on PPEs' professional role perceptions in kindergarten. The importance of professional training for PPEs and its contribution has also been examined. Evidence was found in the literature of training's positive effect on the PPE's self-image and an increase in her professional level. This is of great importance when working in a kindergarten. The more professional knowledge a PPE has, the more she can help the kindergarten teacher and improve the education quality in kindergarten. Both Kindergarten Teachers and PPEs indicated this need (Goberman & Tuval, 2005; Falenchuk et al., 2017; Karademir et al., 2017; Yogev et al., 2020).

Nevertheless, training programs for PPEs deal with relevant early childhood education topics, but training programs on ECA were not found.

In the ECA aspect of this study, many studies have been conducted with Kindergarten Teachers regarding various branches of mathematics, early childhood mathematics teaching, beliefs, and perceptions.

Teacher knowledge is an essential element in teaching mathematics. A positive relationship exists between preschool teachers' knowledge and children's math learning outcomes (Lee, 2017; Li, 2020; McCray & Chen, 2012; Platas, 2014). Studies on the pedagogical content knowledge indicate that when the knowledge level was low, after receiving training, significant changes were seen in teachers' thoughts and beliefs on mathematics education and teaching (Even & Tirosh, 1995; Gökkurt & Soylu, 2016; Nicol & Crespo, 2006; Tanışlı, 2013). Teachers' Beliefs about mathematics and its teaching are subject to change for the better following training in mathematics for preschoolers (Karatas et al., 2017; Markovits & Forgasz, 2017).

The research literature justifies that PPEs need intensive training focused on math teaching for their math teaching knowledge to be more clarified and for teaching to be more knowledge informed. The training must begin in arithmetic since this is the fundamental branch of mathematics. Therefore, there is a gap in knowledge regarding Preschool Para-Educators in 3–6-year kindergartens who engage with early childhood Arithmetic (ECA).

To our knowledge, no research was found in the literature on applying early childhood arithmetic in kindergarten by Preschool Para-Educators. Similarly, no research was found on the effects of early childhood arithmetic thinking training programs on PPEs' professional functions in kindergarten.

Research Aims

This research aims to propose the implementation of Early Childhood Arithmetic (ECA) in a training program and examine its impact on PPEs' Beliefs regarding Arithmetic and its Teaching in kindergarten, Professional Identity, Role Perception, and Professional Self-Efficacy; To explore the PPEs' Education Directors attitudes regarding the program and its implementation in kindergarten; And to explore Kindergarten Teachers' perceptions of PPEs' Professional Functions in kindergarten.

Research Questions

The research questions are divided according to the four studies included in the thesis:

Study 1: What are the validity and reliability of the questionnaires which will be used in study 3?

Study 3: (1) What is the impact of the ATTP on the PPE's: Beliefs regarding ECA and its teaching in kindergarten, Professional Identity, Role Perception in kindergarten and Professional Self-Efficacy in kindergarten? (2) Which variables can significantly explain the variance of PPEs' assessment of the ATTP? (3) What are Kindergarten Teachers' perceptions regarding PPE's Professional Functions in kindergarten?

Study 4: (1) What are the PPEs' perceptions of the ATTP influence on attitudes regarding ECA, and professional functions in kindergarten? (2) How do PPEs assimilate motifs from ECA in planning lessons for kindergarten children? (3) What are the Education Directors' perceptions regarding the ATTP contribution to the PPE's ability to engage in ECA, and her professional functions in kindergarten? (4) How the Kindergarten Teachers conceive the PPE's possible contribution to promoting ECA in kindergarten?

CHAPTER I. THEORETICAL BACKGROUND

This chapter reviews the main theories and research literature that served as the basis for this study. The chapter also presents the thesis's Conceptual Framework.

1.1 Early Childhood Education

Kindergarten is a daily formal educational setting for children and serves as a transition from home to school and precedes school. The educational approach in kindergarten is based on play, singing, practical activities such as drawing, and social interaction. Kindergartens in many countries serve as educational institutions and learning spaces for children aged to 6 years and combine various teaching methods (Zakai, 2015; Kindergarten, 2022).

Early Childhood Education in Israel

The Israeli Kindergarten is an educational institution for children aged 3-6. It has a significant developmental space that meets the needs of preschool children. Kindergarten is the beginning of public education institutions and is an integral part of it (Israeli Ministry of Education, 2010). The official kindergartens in Israel are jointly managed by the Ministry of Education and the local authorities. The Ministry of Education is responsible for implementing the Division of Pre-Primary Education policy, determining the educational program, and supervising its implementation. The local authority has two aspects: in the physical element - responsibility for the maintenance of the kindergarten building and its equipment, subject to the guidelines of the Ministry of Education; In the organizational aspect - the local authority is the employer of the kindergarten assistant (Knesset, 2017).

Contemporary Pedagogy in Early Childhood Education

The Contemporary Pedagogy in early childhood education focuses on preparing children's skills for the 21st Century. The OECD led the 2030 Education Project (OECD, 2018), defined as a person's ability and skills to act independently, show initiative and creativity, and make decisions based on his will. In kindergarten, it is learning from activities that the children initiate and promote their self-expression.

The children currently studying in kindergartens are called the Alpha generation. They are more independent, educated, and entrepreneurial because of their access to knowledge and information, people, and resources from an early age (Fell, 2018).

Following global trends and changes, the Israeli contemporary pedagogy in kindergarten is "The Future Kindergarten" model (2018), based on the ecological approach, according to which human learning and knowledge develop in social, cultural, and physical contexts and cooperation between people with different backgrounds or between people with different abilities or points of view (Bronfenbrenner, 1979). Learning in this model focuses on children's involvement in their learning processes based on topics arising from their interests (Israeli Ministry of Education, 2018; 2020).

The "Future Kindergarten" model focuses on the interaction between all the partners in the staff and the environmental and cultural context of the kindergarten. The team's work refers to the whole range of educational activities in the kindergarten: the organization, the procedures, the activity routine, the work plan, the agenda, and the design of the educational environment. The more the Preschool Para Educators are involved in the model's principles, the more they feel meaningful belonging and partnership in kindergarten and express themselves and their uniqueness. Their collaboration in the model encourages professional development, initiative, and significant doing (Israeli Ministry of Education, 2020).

Preschool Para-Educator (PPE)

The Israeli Preschool Para-Educator is a partner in the preschool team, serves as an assistant for the teacher, and plays an organizational and pedagogical role determined by the kindergarten teacher according to the Israeli Ministry of Education policy (2016). PPEs must participate in various preschool training programs. Examining the various training programs for PPEs, revealed a lack of training in the field of mathematics in general and early childhood arithmetic in particular (Israeli Ministry of Education, 2016).

1.2 The Cognitive Development Theory (Piaget, 1952)

Jean Piaget's (1952) Cognitive Development Theory explains the human cognitive development of knowledge acquisition and processing as a process consisting of universal stages with qualitative differences common to children of all cultures. Piaget was interested in how basic concepts appeared, such as the number concept, time, quantity, causality, justice, and so on. He noticed four main stages in cognitive development. Based on the previous steps, the children acquire new mental skills at

each stage. Although the sequence of stages is fixed, each child goes through the same order. The pace of development is determined by biological maturation and interaction with the environment. Starting from the reflex phase, through thinking by symbols, the concept of conservation of quantity, abstract activity with natural objects, and the last step is formal, abstract thinking.

1.3 The Social Cultural Theory (Vygotsky, 1978)

The Social Cultural Theory (Vygotsky, 1978) saw the development process influenced by a person's social environment and the maturity variables. Such a view of development invites reference to processes and not just to given capabilities. Learning and development are intertwined from the first day of the child. Education should match the level of development of the child. Cognitive function development is realized through the child's experience with cultural devices when he works with an expert in solving a particular problem in the zone of proximal development.

Two levels were determined to connect the developmental processes and the learning abilities: (1) The current development level - defines tasks the child can do independently; (2) The zone of proximal development (Z.P.D.) is the distance between problem-solving independently to problem-solving under adult guidance or in collaboration with peers whose level of ability is higher.

For the adult educator to provide appropriate scaffolding and optimally realize the child's Z.P.D., he must have Mathematical Teaching Knowledge.

1.4 Early Childhood Arithmetic

Arithmetic is a branch of mathematics. Mathematics deals with quantities, sizes, and shapes, the main concept of which is the concept of number (INMPC, 2010), the children's mathematical base knowledge is beginning to be built at an early age. Early childhood mathematics education happens through the balance between spontaneous play to adult guidance (Ginsburg et al., 2008; Uscianowski et al., 2020). The National Council of Teachers of Mathematics (NCTM) and the National Association for the Education of Young Children (NAEYC) (adopted 2002, updated in 2010) highlights that a high-quality, mathematics education for 3-to-6 years old children is a vital foundation for future mathematics learning. Early childhood mathematics education can encourage children to use math concepts in daily life and enhance their thinking

and problem-solving skills (Hassan, et al., 2019), the scope of math and its quality in preschool predict the child's success in mathematics continuing education (Clements et al., 2017).

Early Numeracy Skills

The central concept in early childhood mathematics is Numbers.

Natural numbers are abstract objects that can be counted and quantified (Piaget, 1952) and form the basis of all mathematics and the primary element in understanding the concept of numbers (Russell, 1993). The concept of numbers develops when the child becomes acquainted with and relates to natural numbers, these numbers are learned in early childhood (Russell, 1993). It usually develops spontaneously while meeting with objects perceived as quantities. The child is exposed to groups of objects concretely and verbally (Baroody & Benson, 2001).

Mathematics as a formal field, deductive, and abstract knowledge requires the child to reach abstract thinking. This is a process of representing recognized patterns using numbers and other symbols. A part of the Mathematization process is quantification (Olkun, 2022; Sfard & McClain, 2002). Representation development depends on the developmental child's maturity and the application of higher-order thinking skills (Resnick, 1983). According to the triple coding theory (Dehaene, 1992), any mathematical knowledge is coded (represented) in three different codes or modalities: symbolic, analog, and verbal. Bialystok (2000) indicates three stages that occur in the developmental process of symbolic thinking of children: (1) children recite sequences of numbers but still do not understand the relationship between the quantity and the number; (2) children recognize the symbols and know how to link them to the number's name and the appropriate quantity; (3) children understand the meaning represented by the spoken and written the numbers' signs (Olkun, 2022).

Dealing with natural numbers refers to a serial and a quantitative aspect. Oral counting is the skill of reciting numbers in the usual order and knowing the principles and patterns in the number system (Baroody et al., 2006). Counting objects is matching the names of numbers to objects and representing the quantity by the last number in the series. The young child begins to form a quantitative understanding when he realizes that the last object in the count expresses the size of the whole group (cardinality) (Paliwal & Baroody, 2020). Quantitative understanding will allow him to represent quantities in different forms, activate estimation and control processes during activity, and apply the knowledge to streamline the calculation.

Developing the concept of numbers takes place in early childhood in daily activities in which the mathematical content integrates naturally. Studies have shown a correlation between children's executive function and set counting skills (Purpura et al., 2017; Scalise & Ramani, 2021). The concept of numbers' teaching goal is to bring the learner to understand all aspects and the number's representations (Israeli National Mathematics Preschool Curriculum [INMPC], 2010).

Math Teaching Knowledge

Math Teaching Knowledge is the knowledge required for teaching mathematics (Shulman, 1986; 1987). The components of knowledge for teaching mathematics are: Common Content Knowledge (CCK), Specialized Content Knowledge (SCK), Knowledge of Curriculum (KC), Knowledge of Content and Teaching (KCT), Knowledge of Content and Students (KCS) (Ball et al., 2008). Broad mathematical and pedagogical knowledge alongside high self-efficacy enables meaningful teaching (Schreiber & Filo, 2020). There is a need to build intervention programs to promote teachers' SMK and PCK, with a view to their self-efficacy and empowerment (Schreiber & Filo, 2020).

Teacher's Self-Efficacy to Teach Mathematics

Teachers' self-efficacy in mathematics is defined as the individual's sense of security about his ability to solve various mathematical problems. Self-efficacy in mathematics is related to knowledge and refers to the teacher's extensive work in the classroom (Hackett & Betz, 1989; Lerman, 2009; Torner, 2002). The higher the teacher's self-efficacy, the more satisfaction they will feel in their work, prepare personalized curricula for students, and collaborate with parents and peers (Brouwers & Tomic, 2000; Sarıçam & Sakız, 2014). Kindergarten Teachers' Self-efficacy in teaching mathematics is also related to the training they receive. A study that examined kindergarteners' self-efficacy level in teaching mathematics found a connection between their self-efficacy and the training they received (Schillinger, 2021).

1.5 The Self-Determination Theory (Deci & Ryan, 2000)

The Self-Determination Theory (SDT) is a motivational theory developed by Deci and Ryan (Deci & Ryan, 2000; 2002; 2012; Ryan & Deci, 2017), emphasizing the importance of the environment in addressing basic psychological needs for promoting motivational-emotional processes. According to this theory, three basic psychological

needs are required for healthy development: Relatedness, Competency, and Autonomy. These needs are innate and universal and contribute to optimal growth, intrinsic motivation, autonomy, investment, and optimal functioning, social and emotional adaptation. This concept relates to identity-design processes (Kaplan & Madjar, 2017). Supporting the needs of teachers during professional training may create and promote positive values toward the profession (Beauchamp & Thomas, 2009; Ryan & Deci, 2017).

Developing Teachers' Professional Identity

"Professional Identity" refers to the individual's professional choice, attitudes regarding their chosen profession, the activation of professional decision-making processes, the sense of belonging to the work, and how society views the occupation (Fisherman, 2018). "Professional identity in teaching" is the teachers' sense of belonging and identification with the profession (Tickle, 1999) .

The Professional Identity perception affects the sense of self-efficacy, judgment, professional decisions (Beijaard et al., 2000), and continuing professional development. Responding to the PPEs' psychological needs during professional training may contribute to the processes of building their professional identity, as shown in studies on the course of professional learning in teacher training (Beauchamp & Thomas, 2009; Deci & Ryan, 2000; 2008; Dobrow & Higgins, 2005; Fisherman, 2004; Ryan & Deci, 2017).

1.6 The Social Learning Theory (Bandura, 1986)

The Social Learning Theory (SLT) (Bandura, 1977; 1986) is a theory that explains human behavior as being influenced by environmental and cognitive factors. The social approach explores the learning of different behaviors from a social context (through observation and interaction with others). The theory grew out of the behaviorism approach, which emphasizes the role of experience in shaping and changing behavior. Much of the learning takes place through observation of others and imitation. Through imitation, we often repeat behaviors seen among others, especially when we realize they have positive results, and stop behaviors that lead to negative consequences. Bandura (1986) argues that thanks to reciprocity with the environment, a person can learn by watching others, proving that he can control his behavior.

Professional Self-Efficacy

Self-Efficacy is derived from the SLT (Bandura, 1977) and refers to an individual's belief in his ability to perform a task and the extent to which he believes his actions will lead to the desired results. Teacher's self-efficacy is the beliefs that teachers have about their ability to perform different teaching tasks, and to teach a particular subject (Ferreira, 2013). The higher and self-efficacy, the greater the effort, and perseverance (Pajares, 1996).

Combining between the two theories: The Cognitive Development Theory (Piaget, 1952) and The Social Cultural Theory (Vygotsky, 1978), is essential for understanding the development of arithmetic thinking in early childhood, to refer to the children natural thinking role. On the other hand, the two theories are essential to provide appropriate arithmetic tasks for their age and abilities, an encouraging and supportive learning environment, with teachers who activate the children's arithmetic thought.

Combining between the two theories: The Self-Determination Theory (Deci & Ryan, 2000). The Social Learning Theory (Bandura, 1986), can be helpful in education, particularly in teaching arithmetic in kindergarten. The use of psychological theories leads to the improvement of teaching ability and the promotion of positive learning, contributing to the development of the Preschool Para-Educators professional identity, that will allow them to help children in their learning processes. The theories offer different methods for mobilizing and encouraging enthusiasm and positive behavior in the learning environment.

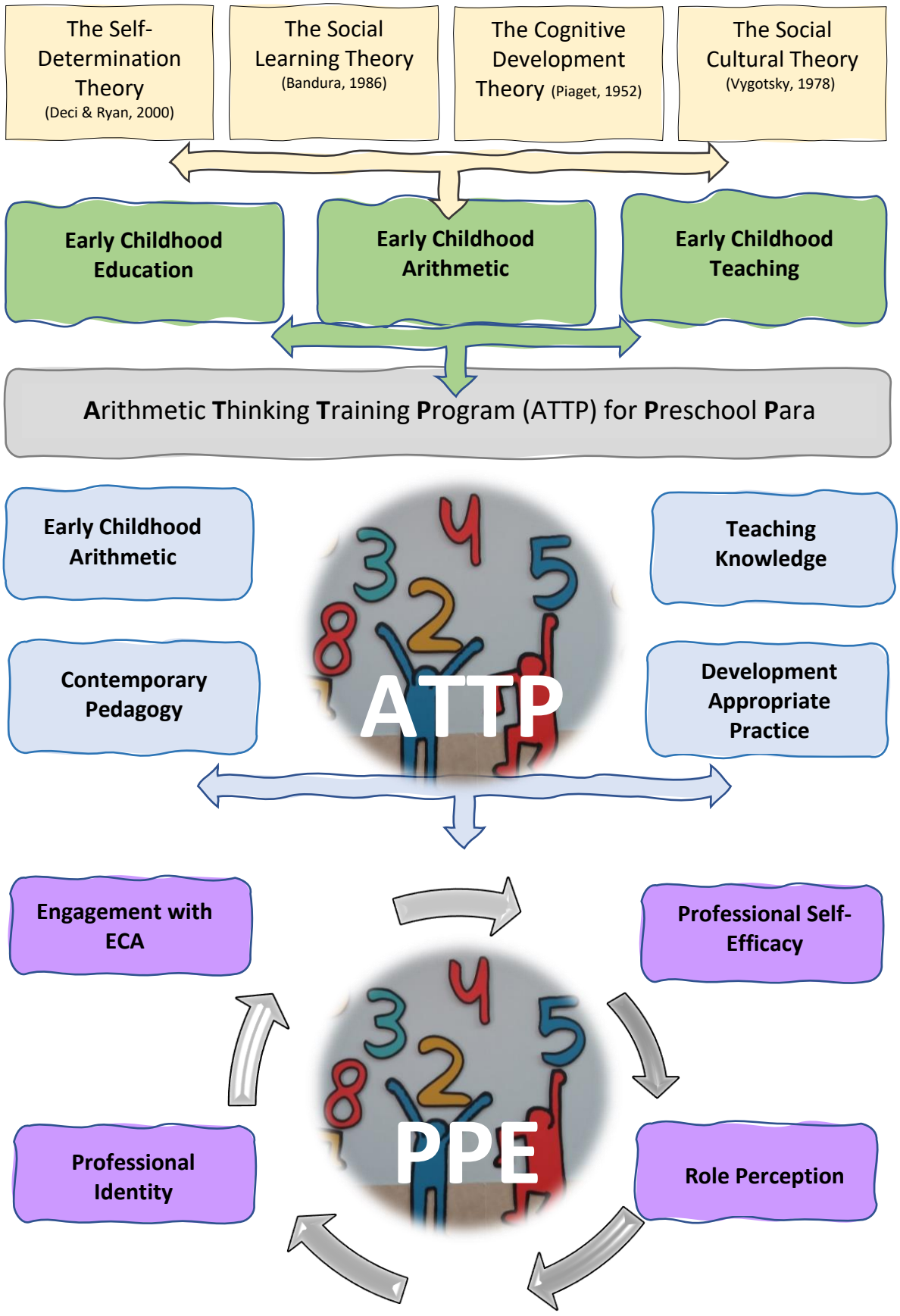
1.7 Conceptual Framework

The conceptual framework visually summarizes the theoretical basis for this research . The conceptual framework of this research pertains to three interrelated areas: Early Childhood Education, Arithmetic, and Teaching. The ATTP is based on grand theories, and the main topics are derived from those theories. The two psychological theories are related to developing the PPE's professional identity, while the cognitive theories are related to the PPEs' ECA and teaching skills development.

Participation in ATTP, in turn, affects the PPEs' development in the following areas: competence to engage with ECA in kindergarten, Professional Identity, Role Perception, and Professional Self-Efficacy in kindergarten. The components are related to each other and influence each other. Development in one area affects development in another and vice versa, as can be seen in Figure 1.

Figure 1.

Conceptual Framework of the Research.



CHAPTER II. RESEARCH DESIGN and METHODOLOGY

This chapter will describe the doctoral research studies, the research participants, tools, and ethical considerations.

2.1 Overview of the research design and methodology

Table 1. Overview of the research design and methodology

Studies	Aims	Participants	Research Hypothesis	Tools	Data Analysis
Study 1. Development and Validation of a Package of Questionnaires	Development and Validation of a Package of Questionnaires allowing the assessment of the PPEs' Beliefs regarding Arithmetic and its Teaching in kindergarten, Professional Identity, Role Perception, Professional Self-Efficacy, and the Kindergarten Teachers' perceptions towards PPE's Professional Functions, which will be used in study 3, and assessment of the training program by the satisfaction of the participants.	17 PPEs	----------	1. Beliefs regarding Arithmetic and its Teaching Questionnaire, based on Markovits (2011). 2. Professional Identity Questionnaire, based on Fisherman and Weiss (2011). 3. PPE's Role Perception Questionnaire, based on Israeli Ministry of Education (2016). 4. Self- Efficacy Questionnaire, based on Segal (2018). 5. Training Program Assessment Questionnaire, based on Guberman, & Tuval (2005).	Validation and reliability testing (α Cronbach and item analyses)
		10 Kindergarten Teachers		Kindergarten Teachers' Perceptions regarding the PPE's Professional Functions Questionnaire, based on Guberman, & Tuval (2005).	

Studies	Aims	Participants	Research Hypothesis	Tools	Data Analysis
Study 2. Development, Experts' Validation, and Implementation of ATTP for PPEs	To examine the development, design, experts' validation, and implementation of the Arithmetic Teaching Training Program (ATTP), for Preschool Para Educators (PPEs).	----------	----------	Experts' Content Validation	Content of Experts' Validation
Studies	**Aims**	**Participants**	**Research Hypothesis**	**Tools**	**Data Analysis**
Study 3. Quantitative study: The impact of the ATTP on PPEs' Beliefs regarding Arithmetic and its Teaching in kindergarten, Professional Identity, Role Perception, and Professional Self-Efficacy	1. To examine the impact of the ATTP on PPEs' Beliefs regarding Arithmetic and its Teaching in kindergarten, Professional Identity, Role Perception in kindergarten, Professional Self-Efficacy in kindergarten, and assessment of the training program by the satisfaction of the participants.	Experiment group: 41 PPEs. Control group: 42 PPEs.	1.a. The PPEs' level of Beliefs regarding Arithmetic and its Teaching will be the similar before the training program in the Experimental and Control groups, but higher in the Experimental group after the training program. 1.b. The PPEs' level of Professional Identity will be the similar before the training program in the Experimental and Control groups, but higher in the Experimental group after the training program. 1.c. The PPEs' level of Role Perception will be the similar before the training program in the Experimental and Control groups, but higher in the Experimental group after the training program. 1.d. The PPEs' level of Professional Self-Efficacy will be the similar before the training program in the Experimental and Control groups,	Online questionnaires: 1. PPE's Beliefs regarding Arithmetic and its Teaching Questionnaire 2. PPE's Professional Identity Questionnaire 3. PPE's Role Perception Questionnaire 4. PPE's Professional Self-Efficacy Questionnaire 5. Training program assessment Questionnaire	The PPEs' demographic data were tested with statistical tests to verify that there are no demographic differences between the experimental group and the control group. 7 independent pre/post-t-tests were performed to check differences between the groups in all the variables of the study (beliefs in mathematics, professional identity, role perception, professional self-efficacy,) to check whether are no initial differences.

			but higher in the Experimental group after the training program. 2. To explore which variables can explain the PPEs' satisfaction from the ATTP.		7 ANOVA tests were performed in both groups, to check differences between the experimental and control groups in beliefs in Arithmetic professional identity, role perception, professional self-efficacy.
	2. To examine the Kindergarten Teacher's perceptions of PPE's Professional Functions in kindergarten.	38 Kindergarten Teachers.	3. The Kindergarten Teachers' perceptions regarding the PPE's Professional Functions will be below average.	Questionnaire for Kindergarten Teacher's attitudes about PPE's Role Perception	
Studies	**Aims**	**Participants**	**Research Hypothesis**	**Tools**	**Data Analysis**
Study 4. Qualitative study: Exploring Individual perceptions of the ATTP implementation	1. To explore the PPEs' perceptions regarding the influence of the ATTP on attitudes regarding ECA, and professional functions in kindergarten. 2. To examine how PPEs assimilate motifs from ECA in planning lessons for kindergarten children.	10 PPEs	----------	1. Semi-Structured Interviews 2. Involved Observations during simulation activities. 3. Stimulated Recall Interviews after simulation activities.	A systematic content analysis was conducted on the interview transcriptions, the simulation activities, observations, and the open-ended question, by identifying themes and categorizing them into groups.
	3. To explore the Education Directors' perceptions regarding the ATTP contribution to the PPE's ability to engage in ECA, and her professional functions in kindergarten.	2 Education Directors	----------	4. Semi-Structured Interviews.	
	4. To explore the Kindergarten Teachers' perceptions regarding the PPEs' possible contribution to promoting ECA in kindergarten.	38 Kindergarten Teachers.	----------	5. Open-Ended question in the Kindergarten Teacher's Questionnaire.	

2.2 Researcher's Role

Study 1

- The research participants in the pilot study were chosen for convenience reasons .
- The participants included Kindergarten Teachers and PPEs, known to the researcher from past years when the researcher worked as a kindergarten teacher. Therefore, the researcher personally addressed each participant and asked for their help filling out the questionnaires. Participation in the pilot study was the goodwill of voluntary participation .
- The questionnaires were administered online and were sent as a link to the phone .
- The pilot study participants answered the questionnaires online without the researcher's presence. If necessary, a technical explanation of how to fill out the questionnaires was given in a phone call.

Study 2

- The researcher is both the author of the intervention program and the lecturer. 15 experts validated the program.

Study 3

- Research tools: The researcher in this study designed the research tools and created validity for them with other experts.
- Research participants: The researcher has no previous acquaintance with the research participants.
- Conducting the research: The researcher administered online, anonymous questionnaires for the experimental and control groups.
- Data analysis: The researcher analyzed the quantitative data received. The data analysis was transferred to two external experts.

Study 4

- The researcher in this study was also the lecturer at the ATTP .
- The researcher had no previous acquaintance with the participants .
- The researcher and the participants created a relationship of trust and appreciation during the ATTP .
- The researcher is also the interviewer in the semi-structured interviews.

2.3 Ethical Considerations of the Research

- The authors of the original questionnaires gave written consent to the use of the questionnaires for this research and the approval to adapt them for this research.
- All participants received an explanation of the research's purpose and the related procedures.
- Participation was anonymous. To maintain the anonymity of the participants, codes were used during the data analysis and not the participants' full names.
- Participation is based on a will and consent. Despite the consent, it is possible to withdraw and not send the questionnaires.
- Participants signed an informed consent form stating their rights were protected throughout the research.
- The PPEs were assured that no information about their work in the kindergarten would be collected from the Kindergarten Teachers. This allows them to feel free and safe and not subject to criticism and judgment from the kindergarten teacher.
- The Kindergarten Teachers' population was asked to fill out a general function questionnaire of PPEs, without specific reference to the PPE who works in their kindergarten. Thus, the rights and protection of the PPE were preserved.
- The interviewees could make their voices heard without judgment or criticism.

CHAPTER III: FINDINGS

This chapter will describe the findings from the analyses done in each research study.

3.1 Findings of Study 1

The research question was: *What are the validity and reliability of the questionnaires which will be used in study 3?*

The Tool Package Development pilot study included 6 Questionnaires and a demographic Questionnaire. The questionnaires were used in the pilot study for validation. These questionnaires were adapted for the main quantitative study (study 3). After the pilot study, some adjustments were made following Statistical and Logical considerations:

Tool No 1. *Beliefs regarding Arithmetic and its teaching Questionnaire*. Deletion of open-ended questions and replacing them with questions on a Likert scale; questions with several sections from the original questionnaire were split into individual questions; creating a homogeneous Likert scale; undergoing a scale reversal. The overall reliability of the scale was Cronbach's Alpha .790.

Tool No 2. *Professional Identity Questionnaire*. Some questions have undergone scale inversion. The overall reliability of the scale was Cronbach's Alpha .913.

Tool No 3. *Role Perception Questionnaire.* This questionnaire is based on the Israeli outline for the professional development of PPE, which defines her responsibilities in kindergarten. The scale contains seven items, on a 4-point Likert scale. The overall reliability of the scale was Cronbach's Alpha .875.

Tool No 4. *Professional Self-Efficacy Questionnaire*. Questions were adapted from general self-efficacy to professional self-efficacy at work. The overall reliability of the scale was Cronbach's Alpha .984.

Tool No 5. *Questionnaire to assess the training program by the PPEs*. Questions were adapted to the contents of the training program: arithmetic in early childhood, the contemporary pedagogy in kindergarten, the 'Future Kindergarten Model,' and the empowerment of PPE.

Tool No 6. *Questionnaire for the Kindergarten Teachers of Assessment of the PPEs' Role Perception.* Some questions were eliminated because they were irrelevant to the study's aims. The overall reliability of the scale was Cronbach's Alpha .914.

3.2 Findings of Study 2

The researcher in doctoral research designed the ATTP. The researcher is an early childhood mathematics expert at the Ministry of Education in Israel. Content validation was performed for the ATTP with 15 experts from the relevant field of research. The experts reviewed the ATTP by the content of early childhood Arithmetic, contemporary pedagogies in 21st-century kindergarten, and the requirements of the Ministry of Education. The syllabus was adapted according to all the experts' comments.

3.3 Findings of Study 3

Study 3 was quantitative research.

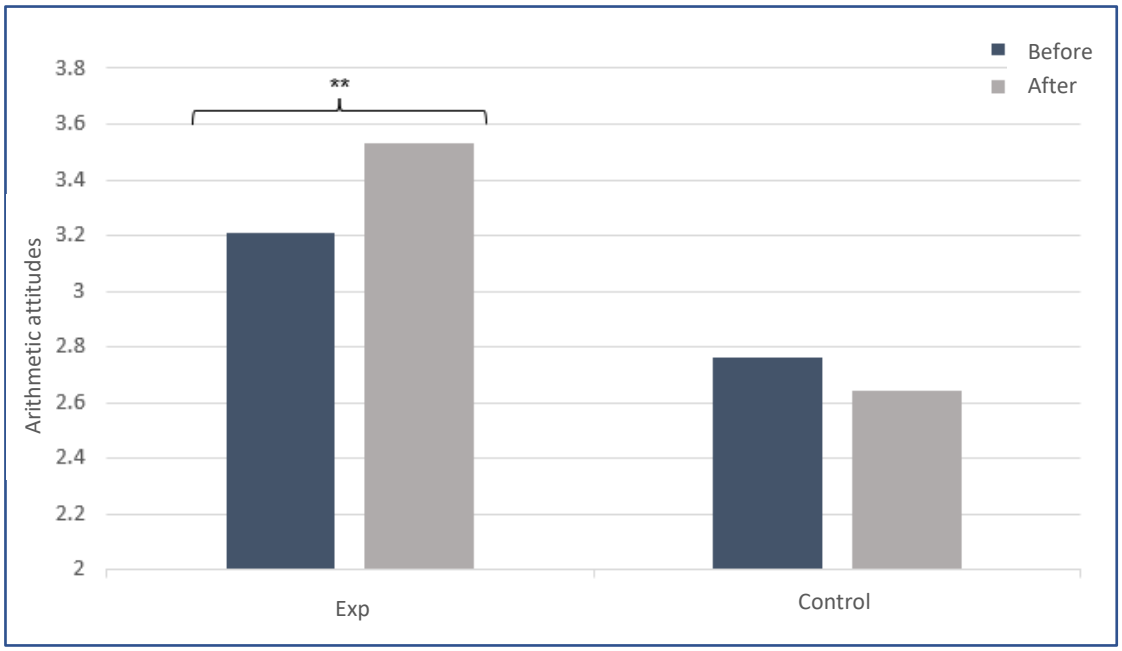
1. Findings related to the First Research Question: *What is the impact of the ATTP on the PPE's: Beliefs regarding Early Childhood Arithmetic and its teaching in kindergarten, Professional Identity, Role Perception in kindergarten and Professional Self-Efficacy in kindergarten?*

A. The First Hypothesis was: *No difference will be found between the experimental group and the control group in measures of Beliefs regarding Arithmetic and its Teaching before the training program. However, it will be higher in the Experimental group after the training program.*

The main effect showed that the level of Beliefs in Arithmetic was higher among the experimental group, beyond the measurement time and the controlled variables. Moreover, the significance of the interaction effect is consistent with the hypotheses of the present study. Follow-up analyses of the Bonferroni type showed that while in the experimental group, there was a significant improvement in Arithmetic beliefs ($p<.001$) - so it can be said that there was a significant increase in Arithmetic Beliefs, in the control group, no significant difference was found ($p= .06$) - indicating that there was no change in Arithmetic Beliefs of the PPEs in this group (Figure 2).

Figure 2.

The Interaction Effect for Predicting Arithmetic Beliefs as a Function of Time and Group.



The First Hypothesis, regarding Beliefs regarding Arithmetic and its Teaching, was confirmed.

B. The Second Hypothesis was: *No difference will be found between the experimental group and the control group in measures of Professional Identity before the training program. However, it will be higher in the Experimental group after the training program.*

In *Professional Identity*, a significant improvement following participation in ATTP was found in two of the four indicators: Self Efficacy to be a PPE and Sense of Mission. There was no substantial improvement in Confidence in professional choosing and Reputation measures. A possible explanation for this finding can be attributed to the knowledge acquired by the PPEs during the training program, as can be seen in Table 2. The reasoning for this can be found in the Dunning-Kruger Effect (Kruger & Dunning, 1999). This means that the PPEs overestimated their Confidence in professional choices and Reputation before participating in the training program. It is

possible that participation in the training program reflected the PPEs' lack of knowledge and false self-confidence before the training program. Now, they understand how much knowledge is required to engage in education, which led to the undermining of Confidence in professional choosing and the understanding of how much more is needed to improve the Reputation of the PPEs.

Table 2.

Averages and Standard Deviations of Professional Identity in Two Study Groups.

		Experimental group N=41		Control group N=42	
		M	SD	M	SD
Confidence in profession choosing	Before intervention	3.55	0.44	3.35	0.60
	After intervention	3.40	0.63	3.30	0.68
Self-Efficacy to be a PPE	Before intervention	3.85	0.31	3.72	0.43
	After intervention	4.02	0.29	3.78	0.35
Mission	Before intervention	3.61	0.34	3.47	0.55
	After intervention	3.84	0.61	3.32	0.74
Reputation	Before intervention	3.35	0.37	3.28	0.38
	After intervention	3.09	0.63	3.15	0.61

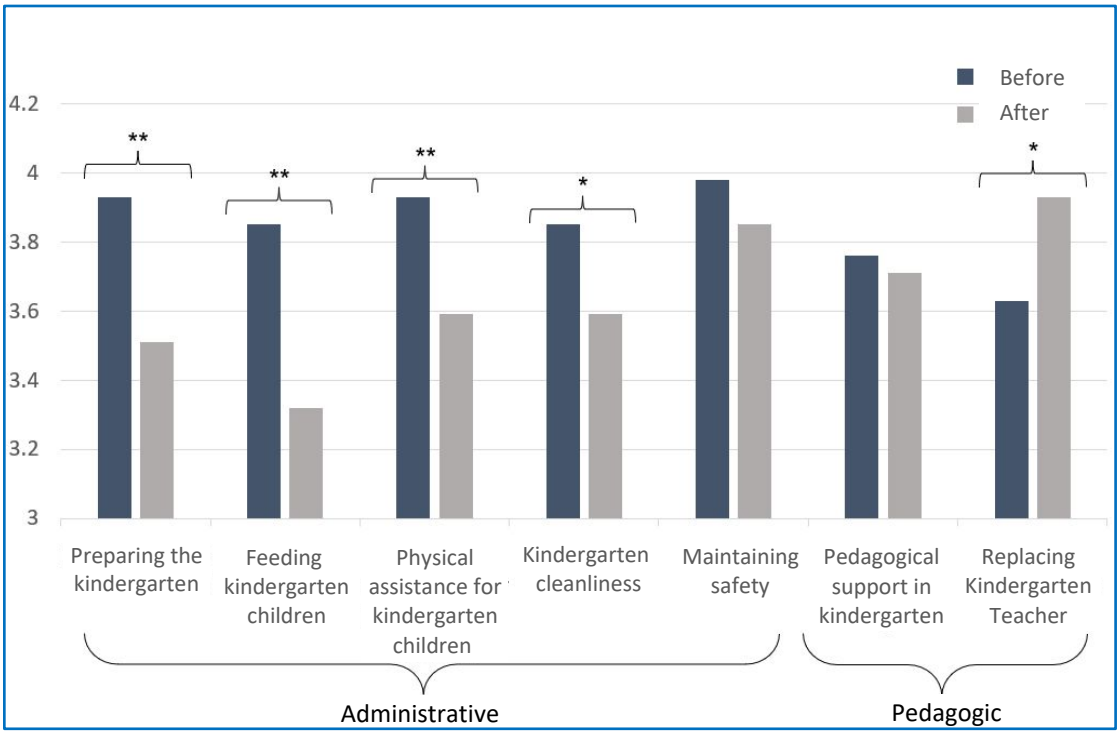
The Second Hypothesis, regarding Professional Identity, was partly confirmed.

C. The Third Hypothesis was *No difference will be found between the experimental group and the control group in measures of Role Perception before the training program. However, it will be higher in the Experimental group after the training program.*

Findings from PPEs' Role Perception indicate a significant decrease in the administrative indices after the training program. In contrast, the PPEs valued their role as substitutes for the kindergarten teacher in pedagogical matters to a greater extent, which indicates that the training program did indeed help the PPEs appreciate their pedagogical role to a greater extent. It is important to note that the indicator of Pedagogical Support in Kindergarten did not rise after participating in the ATTP. A possible explanation is that "pedagogy" is not a common term in the PPEs' language, so they probably did not understand it. While "Replacing Kindergarten Teacher" is a popular term. As can be seen in Figure 3.

Figure 3.

Differences in PPEs' Role Perceptions in the Experimental Group, Before and After the Intervention.



The Third Hypothesis, regarding Role Perception, was confirmed.

D. The Forth Hypothesis was *No difference will be found between the experimental group and the control group in measures of Professional Self-Efficacy before the training program. However, it will be higher in the Experimental group after the training program.*

Research findings indicate that the PPEs' *Professional Self-Efficacy* in kindergarten is significantly higher among the experimental group after the ATTP than the control group.

The Forth Hypothesis, regarding Professional Self-Efficacy, was confirmed.

2. Findings related to the Second Research Question: *Which variables can significantly explain the variance of PPEs' assessment of the ATTP?*

The Hypothesis was: *Beliefs regarding Arithmetic and its Teaching, Professional Identity, Role Perception, and Professional Self-Efficacy will significantly predict the PPEs' experimental group assessment of the ATTP*.

This Hypothesis was tested with a Multiple Linear Regression Model. Experimental group improvements in Beliefs regarding Arithmetic and its Teaching, Professional Identity, Role Perception, and Professional Self-Efficacy were the predictors of the model, predicting course satisfaction.

The Hypothesis, regarding Assessment of the ATTP, was confirmed.

3. Findings related to the Third Research Question: *What are Kindergarten Teachers' perceptions regarding PPE's Professional Functions in kindergarten?*

The Hypothesis was: *The Kindergarten Teachers' perceptions regarding the PPE's Professional Functions will be below average.*

Research findings indicate that the average score of the *Kindergarten Teachers' assessment of the functioning of PPEs* was relatively low and close to the middle of the

scale. Kindergarten Teachers believe that the central role of PPE is in the organizational aspect. In contrast, the indicators related to pedagogical aspects are less part of the role of the PPE. On the other hand, all the Kindergarten Teachers indicated that they needed help from the PPE in teaching arithmetic in kindergarten.

The Hypothesis, regarding the Kindergarten Teachers' perceptions of the PPE's Professional Functions, was confirmed.

3.4 Findings of Study 4

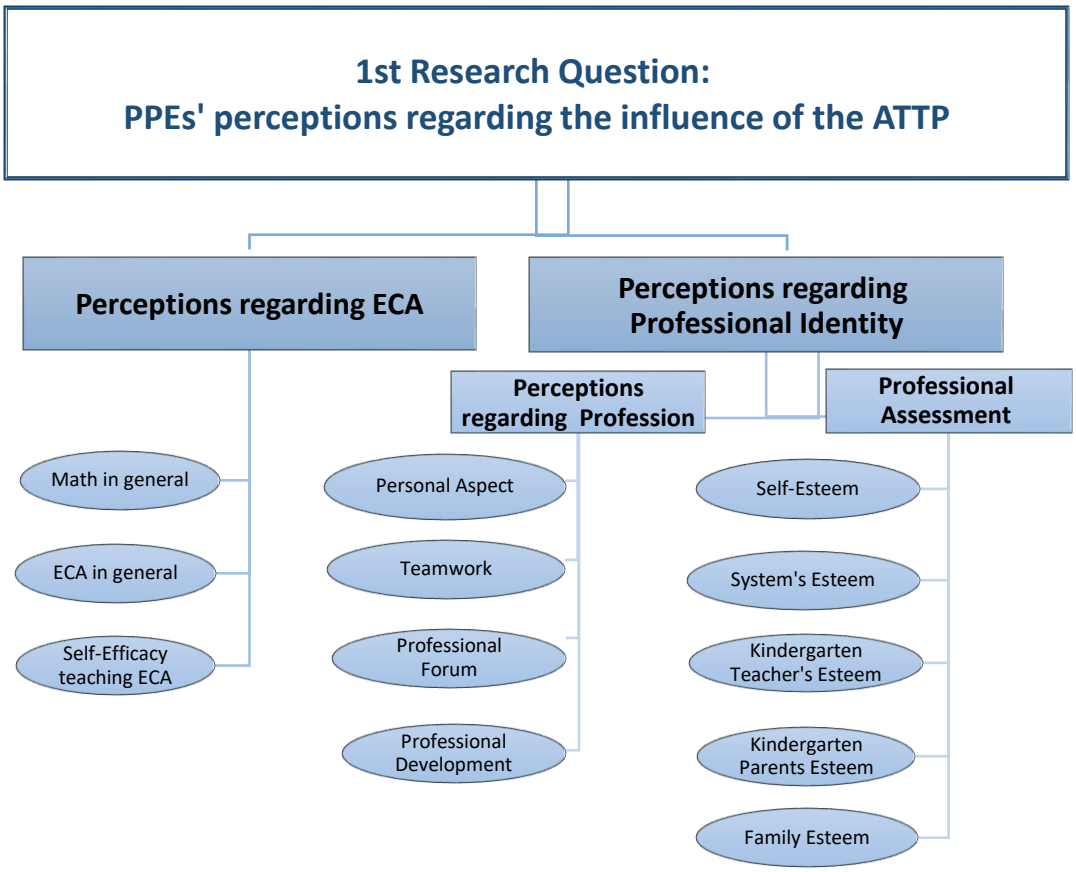
Study 4 was qualitative research.

1. Findings related to the First Research Question: *What are the PPEs' perceptions of the ATTP influence on attitudes regarding Early Childhood Arithmetic, and professional functions in kindergarten?*

The interviews analysis with the PPEs presents a picture of a general transformation in attitudes towards arithmetic and ECA. Some talked about a barrier towards arithmetic and mathematics, which caused them to ignore the subject in their work in kindergarten. According to them, the ATTP awakened their eyes to the fact that arithmetic is integrated into everyday life naturally. Another emerging category presented a change in their perception of the need to study ECA to engage in it in kindergarten. According to them, ECA seems simplistic, and only after participating in ATTP, they understand its complexity and the need to learn to engage in it optimally and accurately in kindergarten. Another theme that emerged is their professional role perception in kindergarten, as more pedagogical after participating in the ATTP. If in the past their role was mainly administrators - maintenance and cleaning the kindergarten, now they feel that they are more professionally valued, belong to the system, and have increased motivation at work.

Figure 4.

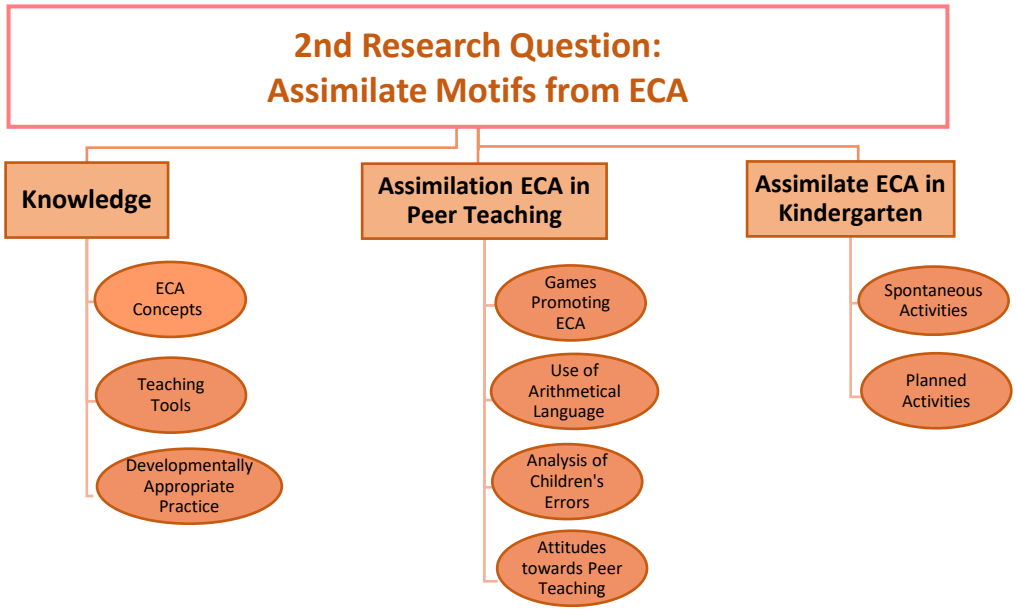
Categorization of the Findings from the Interviews with the PPEs regarding the Influence of the ATTP.



2. Findings related to the Second Research Question: *How do PPEs assimilate motifs from Early Childhood Arithmetic in planning lessons for kindergarten children?* In the interviews, the PPEs said that their participation in ATTP increased their knowledge of ECA concepts, teaching tools, and how to adapt ECA activities for children. They apply the ECA teaching in planned and initiated activities, ensuring that the activities are adapted to children's abilities and with awareness of the ECA teaching stages. Furthermore, in spontaneous activities where arithmetic exists naturally, the PPEs mediate if necessary. The video clips of the simulation lessons revealed the application of arithmetic activities. All the activities were in significant contexts for the subject studied in kindergarten. The PPEs applied precise arithmetical language and referred to mistakes in counting objects. According to them, the experience in simulation lessons where they practiced arithmetic activities strengthened their confidence and self-efficacy in applying ECA.

Figure 5.

Categorization of the findings from the observations on the PPEs' simulation activities, and Stimulated Recall Interviews after it.



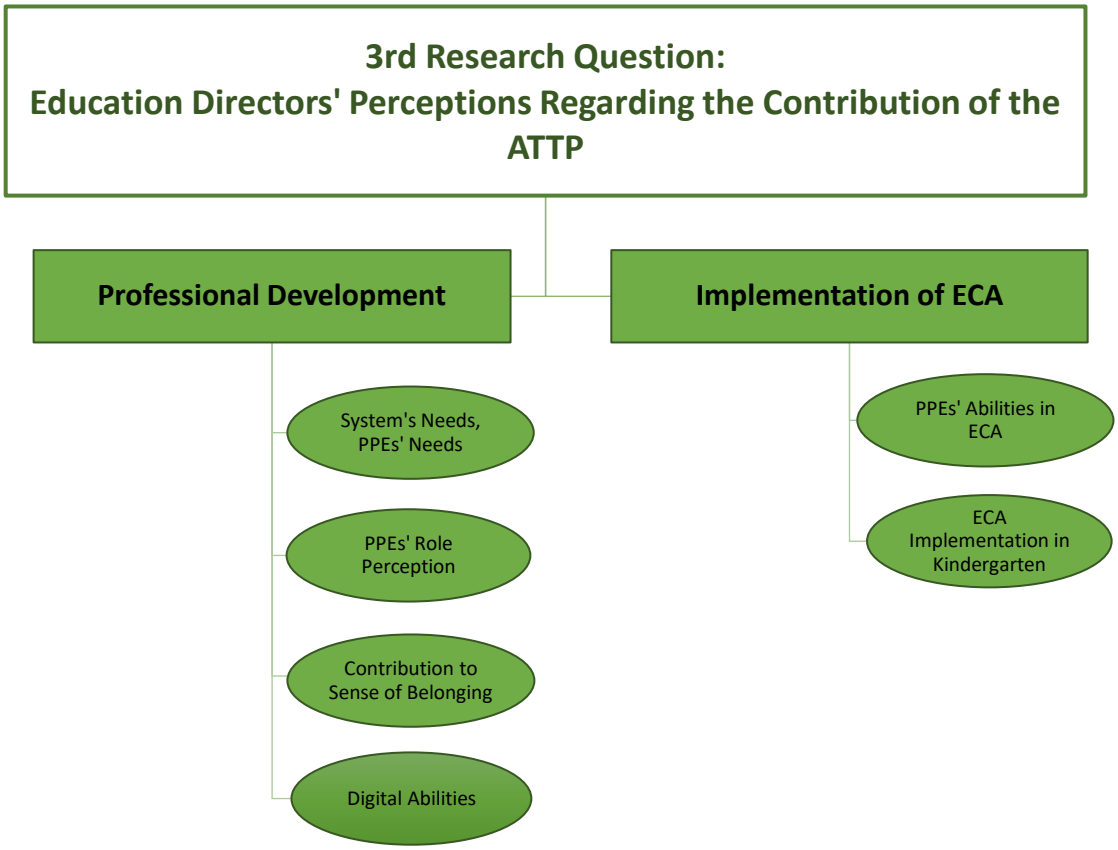
3. Findings related to the Third Research Question: *What are the Education Directors' perceptions regarding the ATTP contribution to the PPE's ability to engage in Early Childhood Arithmetic, and her professional functions in kindergarten?*

The content analysis of the interviews with the Education Directors, evident implementation of ECA following the ATTP. They indicate an improvement in the PPEs' ability to engage in ECA in kindergarten, based on professional knowledge and understanding and not only in an intuitive way. This is reflected in promoting ECA in kindergarten centers, arithmetical discourse with children, and correct mediation in situations where arithmetic exists. It was also found that the Education Directors consider the PPEs' professional development very important. First, the position of the PPEs has changed for the better by everyone who interacts with it, as more professional and pedagogical. Second, since the PPEs constantly interact with kindergarten children, they must be professional to promote their development. It also provides significant help to kindergarten teachers. They also stated that the PPE's professional reputation is not high, and recruiting workers for this field is difficult. They believe professional training like the ATTP will increase the PPE's professional reputation and attract more

women to this work. The last category referred to the ATTP's contribution to the PPE's sense of belonging in kindergarten, the team's work, and the PPEs' social formation.

Figure 6.

Categorization of Findings from the Interviews with the Education Directors.



4. Findings related to the Forth Research Question: *How the Kindergarten Teachers conceive the PPE's possible contribution to promoting Early Childhood Arithmetic in kindergarten?*

To answer this research question, the Kindergarten Teachers received one Open-ended question in the Kindergarten Teacher's Questionnaire. The Kindergarten Teachers wrote about their need for PPE, which is a part of the kindergarten team, which can promote children in arithmetic in kindergarten. This need arises from the fact that Kindergarten Teachers cannot cope alone with all the teaching tasks in kindergarten. Therefore, the PPE can help her to promote arithmetic in kindergarten.

CHAPTER IV. GENERAL CONCLUSIONS, LIMITATIONS, and IMPLICATIONS

4.1 Main Conclusions of the Doctoral Research

1. A package of questionnaires was designed due to a lack of suitable research tools for the PPEs in Israel in the context of early childhood arithmetic. The package of questionnaires was found to be valid and comprehensive, which could be further used to explore the PPEs' attitudes toward professional functions in implementing teaching early childhood arithmetic in kindergarten, in Israel, and other cultures throughout the world.

2. The researcher developed an Early Childhood Arithmetic Thinking Training Program for PPEs in Israel for this study. The validation findings show that the training program is suitable for the PPEs, provides training in early childhood arithmetic and contemporary pedagogies for kindergarten, and promotes motivation in professional functions at their work in kindergarten.

3. The impact of the ATTP on the PPE's Beliefs regarding Arithmetic and its Teaching in Kindergarten is noticeable in improved knowledge, positive perception, and implementation of arithmetic in kindergarten, with an awareness that arithmetic is naturally integrated into daily life. Participation in Simulation Lessons revealed the PPEs' abilities to plan appropriate activities that encourage ECA, create appropriate games for children in a meaningful context, and implement this appropriately in teaching, strengthening the PPEs' self-efficacy to engage in ECA. Integration of simulation-based learning in the ATTP was found to be an effective tool that allows practice and gaining teaching experience even before the implementation in the field - in kindergarten. Furthermore, it helps identify challenges, perceptions, and successes and improves practice in ECA teaching.

4. The impact of the ATTP on the PPE's Professional Identity is noticeable in improving the indicators of Self-Efficacy and Sense of Mission but not in the indicators of Confidence in Choosing the Profession and the Profession's Reputation. The reason may be that participation in the training program reflected to the PPEs that in-depth professional learning and development is necessary to work optimally in ECA and education in general. It is possible that this insight led to an appeal in Confidence in professional choosing and the understanding of how much further professionalization is required to improve the PPEs' reputation.

5. The impact of the ATTP on the PPE's Role Perception in kindergarten is noticeable in a high valuation of the PPEs' pedagogical role in kindergarten, a positive attitude towards their profession, and their commitment to promoting children's education. Following the ATTP, a significant conclusion emerges that the PPE assumes her role as an educator who participates in the educational process in the kindergarten and is not only responsible for the maintenance and cleaning of the kindergarten.
6. The impact of the ATTP on the PPE's Professional Self-Efficacy is noticeable and is reflected in the PPEs' daily functioning in kindergarten.
7. The Kindergarten Teachers' perceptions indicate that Kindergarten Teachers need help teaching arithmetic in kindergarten, and they see the PPE as someone who can do this. Furthermore, they believe there is a need for appropriate training for PPEs to help them in the pedagogical role, not just the administrative one.
8. The Education Directors' perceptions regarding the ATTP's contribution indicate a change in the PPEs' status from a role that mainly dealt with the cleaning and maintenance of the kindergarten, to a pedagogical function in promoting and educating children. The PPEs' role perception change affects the environment's appreciation and contributes to the sense of belonging and the team's work in the kindergarten. These are important for designing the PPEs' professional identity.

4.2 Research Limitations

Limitations related to the Research Participants

- The study was conducted in only one area, in southern Israel. However, this regional council is in a wide spread of settlements with diverse characteristics, indicating that the demographic characteristics of the Preschool Para-Educators participants varied. Therefore, this research population can be considered an adequate representative of this study.
- The number of participants in the quantitative study was relatively low (41 PPEs in the Experiment group, 42 PPEs in the Control group, and 38 Kindergarten Teachers) since only one regional council in southern Israel agreed to hold the training program. A more significant number of study participants might have presented more robust results. However, the PPEs population can be considered an adequate representative of the Israeli PPEs, who work in kindergartens with children of different ages in diverse settlements (city, village, kibbutz, town).

Limitations related to the Research Tools

The semi-structured interviews used in Study 4 carry a possible limitation of social desirability, in which the participants give answers to satisfy the researcher. To overcome this limitation, several steps were taken: (1) The interviews were semi-structured, with questions prepared in advance, in different variations with a request for expansion. All of these require the interviewee to be consistent in his answers. (2) A triangulation of quantitative and qualitative research tools (questionnaires and interviews) and a triangulation of different qualitative research tools (semi-structured interviews, filming of simulation lessons, and open-ended question analysis) were conducted with diverse participants (PPEs, Education Directors, and Kindergarten Teachers). All these yielded various findings that allowed the researcher to cross-reference them to strengthen the study's reliability and validity by verifying its results.

Limitations related to the Researcher

The researcher was the lecturer who taught in the training program and even passed the questionnaires to the participants, conducted the semi-structured interviews, and filmed the simulation lessons. Therefore, to avoid biasing, the researcher made several moves: (1) The researcher has no previous acquaintance with the study participants. (2) The questionnaires were transmitted digitally on the Internet without face-to-face interaction between the researcher and the participants and anonymously. (3) A variety of research tools were used to test the effect of the ATTP. (4) The findings were analyzed with other researchers. Therefore, the researcher's involvement was reduced.

4.3 Theoretical, Methodological, and Practical Implications

Theoretical Implications

- The research literature reflects a gap in knowledge on the topic of PPEs' training in ECA. This population has not yet been studied in this context.
- As part of the research, a training program was developed based on the following theories: the Cognitive Development Theory (Piaget, 1952) includes the studies of the development of mathematical thinking; the Social Cultural Theory (Vygotsky, 1978) consists of the component of the child's educational environment; the Self-Determination Theory (Deci & Ryan, 2000; Ryan & Deci, 2017) deals with the inner desire to achieve goals and form a positive

identity; and the Social Learning Theory (Bandura, 1986) emphasizing the function of the environmental system on human behavior and learning. Combining the theories is essential for understanding ECA development, improving teaching ability, and promoting positive education. This contributes to the PPEs' professional identity development, allowing them to help children learn.

- From the literature review conducted for the purpose of this study, it emerges that previous studies have examined the Preschool Para-Educators' role perception after participating in a training program. Still, the training programs do not include Early Childhood Arithmetic or mathematics training topics. Therefore, the current study contributes to knowledge by investigating the impact of participating in an Early Childhood Arithmetic training program designed explicitly for Preschool Para-Educators working in kindergartens.

Methodological Implications

- The current thesis used previous research tools, and a new tool was developed to assess the PPEs' Role Perception. The tools were adapted to the current study, experts' validation was conducted, and reliability was calculated. These tools make it possible to examine the effect of a training program in a field that has not been studied so far with a population of Preschool Para-Educators and in the context of Early Childhood Arithmetic, thus making a methodological contribution to examining the effect. The validated questionnaires can help researchers and therapists in other countries and cultures use the information they provide.
- Unique research tools were used to collect qualitative data: Involved observations during simulation activities and Stimulated recall interviews after simulation activities. Under the influence of the training program, the PPEs prepared activities on ECA. This simulation activity allowed the participants to bring up real situations from kindergarten life in the field of ECA. The research findings indicate that these tools help identify challenges, perceptions, and successes, provide practical teaching experience before the implementation in kindergarten, and strengthen the PPEs' Self-Efficacy in ECA instruction. Therefore, these tools can be applied in the training of other participants or different areas of teaching.

Practical Implications

- The Arithmetic Thinking Training Program proposed in this study is an original model applied specifically for Preschool Para-Educators. It seems that this program can also be adapted to other countries and cultures to strengthen the PPEs' role in kindergartens and give them tools to help kindergarteners in pedagogy in general and to teach arithmetic in particular. Its principles can be integrated into other courses for diverse participants. The program may contribute to building similar training programs with a practical orientation for implementation in Israel and worldwide.
- The training program contributed to improving the professional identity among the PPEs in the indicators of Self Efficacy to be a PPE and Sense of Mission, but not on the Confidence in choosing the profession and the Reputation. Therefore, additional planning of courses that will contribute to improving these aspects to promote the PPEs' professional identity should be considered. Continuous and consistent training can have implications for improving Confidence in professional choosing and PPE's profession Reputation.
- After participating in the training program, the PPEs improved their role perception in kindergarten to a more pedagogical, and Professional Self-Efficacy. These findings may have implications for the PPEs' better daily functioning in the kindergarten system, the quality of teaching in kindergarten, and the advancement of kindergarten children.
- The research findings may have practical implications for teamwork in kindergartens. When the Ministry of Education and the Kindergarten Authority's supervision orders professional training for teams, they should pay attention to cultivating positive attitudes toward teamwork in kindergartens and strengthen the team's cooperation to obtain better effectiveness in the kindergartens and for the children's benefit.
- Decision-makers and policymakers in early childhood education can continue to develop this training program to help promote the development of early childhood children in other areas.

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