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Research Paper

Designing and Validating a Problem-Solving Curriculum Model for Preschool Children

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Abstract

The aim of this study was to design a problem-solving curriculum model for preschool children and validating it. In this study, a mixed exploratory approach (qualitative-quantitative) was used. In the qualitative part, the population included curriculum specialists, educational psychologists and preschool teachers, and new domestic and foreign theoretical foundations. Based on the criterion sampling method, 13 sources were studied and for the interview, the purposeful snowball sampling method was used and finally the sample size was considered to reach theoretical saturation (36 people). In the quantitative part, the statistical population included curriculum specialists, educational psychologists, and preschool educators. The sample size was determined based on Cochran's formula of 357 people and proportional block random sampling method was used. Data were collected in the qualitative part through semi-structured in-depth interviews and in the quantitative part through a researcher-made questionnaire. Qualitative findings were obtained by content analysis and Max QDA software. The findings of the qualitative section represent a comprehensive theme, organizing themes at two levels, the first of which includes the nine elements of the curriculum (aims, content, teaching method, learning activity, teaching materials, space, time, grouping, evaluation) and the second level includes the characteristics of each of these elements. Each of the second level organizing themes also has a number of

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basic themes. To validate this model, factor analysis and structural equations were used in Smart PLS3 software

***Key Words*:** Design a Model, Curriculum, Problem Solving Skills, Children, Preschool

Introduction

To enter the age of knowledge and encounter the astonishing advancements of the 21st century, children need to increasingly strengthen their research and problem-solving skills, motivation to search, and critical and creative thinking skills that enable them to make appropriate decisions and solve complex problems (Çoban Budak, 2018). Teaching the problem-solving skills ensures active participation of learners in group discussions while also encouraging them to think critically, constructively, and creatively to find solutions that eventually contribute to desirable interpersonal skills (Modarres et al., 2017). Problem-solving is a substantial mental activity and a type of learning to which the definition and conditions of learning are applied. Hence, when children can solve a problem, they were previously unable to solve, there have been changes in their abilities that have resulted in learning. Such changes in the learner's behaviour, resulting from problem-solving, are more stable than those taking place as a result of simpler learning (Seif, 2019). Problem-solving is a skill that can be learned and should be practiced (Karademir, 2019).

Children have difficulty solving problems with their peers (Treweek & Kelly-Ware, 2020). They are usually unable to solve problems in such situations, experience tension and anxiety, and resort to illogical means such as crying, aggression, isolation, fear, shyness, and embarrassment (Hawley, 2003; Walker et al., 2013). Insufficient education on problem-solving skills makes many children desperate in all aspects and stages of life, the impacts of which are evident in their adulthood, decreasing their quality of life and affecting their mental health (Kasik & Gál, 2016). Thus, the need to consider teaching problem-solving skills in childhood and the lack of a suitable curriculum model in this field reflects the importance of the current study. On the other hand, many institutions and organizations contribute to the development of children's problem-solving abilities, one of which is educational institutions, including preschool centers. Preschool children need much more professional curricula, schools, and instructors to address the current problems of childhood education (Shumway & Pace, 2017). Although various models of preschool education have been used in the national educational system so far, children still have problems with the application of what they have learned in the real world (Poordavood et al., 2020). Thus, given the evolution of the topics and concepts associated with

teaching problem-solving skills, what are the required and optimum components of the problem-solving skills curriculum to teach preschool children? This study aims to identify the components of such a curriculum using the opinions of experts in the field of curriculum planning, educational psychology, and preschool instructors. It also seeks to provide the necessary basis for teaching problem-solving skills to preschool children by the introduction and validation of a conceptual model. Given the above-mentioned, this study aimed to identify the components of the curriculum based on developing problem-solving skills followed by providing and validating an optimal model for the preschool period. Hence, the following research questions were raised:

1. What are the characteristics of the curriculum components based on developing problem-solving skills in preschool children?
2. What is the validity of the problem-solving curriculum model for preschool children from the experts' point of view?

Theoretical Foundations and Review of Literature

Preschool education is a process through which children learn to preserve the values and cultural identity of society while also achieving physical, social, emotional, linguistic, and mental development. Education is achieved at the desired level through the implementation of a good practical curriculum (Kazu & Iş, 2018). Fogarty (1997) defines the problem-solving curriculum as a curriculum model designed around real-life problems, which are usually unstructured, goal-free, and vague. This approach leads to the active engagement of students in problem-solving. The students' confrontation with real-world problems develops problem-solving strategies, basic knowledge, and disciplinary skills (Malopinsky et al., 2000). This learning method has been extensively used in various fields of education to promote critical thinking and problem-solving in real learning situations (Yew & Goh, 2016). This educational approach provides students with the opportunity to participate in problem-solving, subsequently create a mental model for learning, and develop self-directed learning habits through practice and reflection (Schmidt & Moust, 2000). Preschool is the best time to teach basic skills such as problem-solving because children are best prepared to learn during this period (Resing et al., 2016).

According to Olivares et al. (2020), the components of a problem-solving curriculum include the objective, role of teachers, the teaching process, content, evaluation, and classroom management. Based on research by Delfan Azari et al. (2020), the components of a problem-solving curriculum include objectives, content, teaching-learning strategies, materials and resources, learning activities, evaluation

methods, grouping, time, and space. As stated by Ebrahimpour Koumleh et al. (2018), desirable components and characteristics of a problem-solving curriculum consist of objectives, content, teaching materials and resources, teaching-learning strategies, learning activities, learning environment, learner role, teacher role, and evaluation. Zhang (2019) examined the effect of ambiguous situations on creative problem-solving and showed that the stories made by students in ambiguous situations were significantly more creative than those in unambiguous situations. Barnes et al. (2018) showed in a study that social problem-solving skills could help children achieve social success in school and life. Kaya et al. (2017) showed in their study that preschool education games affected the problem-solving skills of preschool children. Guido (2016) listed the advantages of learning problem-solving skills as the enhancement of long-term knowledge retention, the ability to use different types of learning, constant student engagement in the learning process, development of transferrable skills, and improvement of teamwork skills.

Research Methodology

In terms of purpose, the current study is applied research, conducted using an exploratory sequential mixed (qualitative-quantitative) approach. Interviews are among the most commonly used methods of qualitative research in this process, known as interview research methods (Fooladi, 2014). Purposeful snowball sampling was carried out in the qualitative part of the research to conduct in-depth semi-structured interviews with curriculum specialists, educational psychologists, and preschool teachers. Interviewees had different characteristics based on gender, education (master's and Ph.D.), work experience (at least 5 years), and various related experiences such as attending workshops and conferences, giving lectures, teaching, writing papers, or compiling books in the field of the present research (at least one of the mentioned cases). Interviews were performed separately for each group until reaching theoretical saturation by 14 curriculum specialists, 10 educational psychologists, and 12 preschool teachers. Finally, the sample size of the interviewees was considered to be 36 after theoretical saturation. The deep semi-structured interviews included 10 open-ended questions. Changes were made to the interview questions according to the specialized literature of the field and the knowledge of the interviewees to make the comprehension of the questions easier for each group and obtain more accurate answers. Some professors in the field of curriculum planning and educational psychology received interview questions and approved them after several correction stages. To observe the ethical principles in the research, the interviewees were initially assured about their information confidentiality, under which data

were analyzed using codes rather than participant names. Some interviewees agreed to record their voices, while some others preferred to respond at a slower pace and provide the researcher with more time to record the responses more accurately. There was also a group of interviewees who could not attend in person and were consequently interviewed by telephone. Each interview lasted approximately half an hour to an hour, during which the researcher directed the interview process with relevant questions to prevent any deviations in the responses and obtain more accurate answers related to the research questions. Besides, criterion sampling was utilized for research theoretical foundations and review of the literature, based on which 13 sources were selected and studied out of the relevant internal and external sources, including books, printed and electronic papers, theses, and dissertations related to at most 5 years ago. Note-taking was used to collect data for the theoretical foundations of the study. Data were analyzed using content analysis in the qualitative part. Hence, the interviews and texts were first transcribed, followed by a three-step coding to extract the concepts, themes, and initial codes from which the final codes were obtained. Theme analysis was performed through coding with MaxQDA software 2018 to extract the basic, organizing, and global themes and subsequently design the relevant model.

The quantitative part of the research was allocated to the validation of the proposed curriculum model. Hence, some criteria were considered to limit the large statistical population. Accordingly, only curriculum specialists who were permanent members of the Iranian Curriculum Studies Association for one year (n=200) were taken into account from the population of curriculum specialists in Tehran. Besides, only regular and official members of the Iran Educational Psychology Association (n=238) and preschool teachers in the academic year 2019-2020 (n=2022, according to the statistics department of the Directorate General for Education) were selected from the statistical population. Cochran's formula was used to determine the sample size, which was estimated to be 333 in the quantitative part of the study. The sampling method was stratified random sampling, based on which the questionnaires were distributed among three groups of experts, including curriculum specialists, educational psychologists, and preschool teachers proportional to the statistical population. To ensure access to a sufficient number of questionnaires, more questionnaires (n=370) were distributed, of which 357 were completed and returned to the researcher. Therefore, statistical analysis was performed on this number of questionnaires, of which 293, 35, and 29 belonged to preschool teachers, educational psychologists, and curriculum specialists, respectively. Table 1

presents the demographics of the participants. The study used a researcher-made questionnaire whose items were designed based on the model obtained from the qualitative part. The opinions of experts and professors were used to ensure the face validity of this 115-item questionnaire which was on a 6-point scale from completely agree to completely disagree. Content validity ratio (CVR) was used to ensure that the questionnaire statements were best designed to measure variables. Accordingly, 10 professors and specialists were provided with the questionnaire to express their opinions concerning each of the 115 statements as "necessary", "useful but not necessary", and "not necessary", after which the responses were calculated based on the CVR formula. According to the Lawshe Table, the results showed values of 0.62 for the opinions of 60 experts concerning the 115 statements, confirming the content validity of the questionnaire. To evaluate the reliability of the questionnaire, a sample of 30 people was used, resulting in a Cronbach's alpha coefficient of 0.89 for the whole questionnaire and indicating the acceptable reliability of the questionnaire. Different tests were implemented using SPSS25 and Smart PLS3 software, along with factor analysis and structural equation modeling to evaluate the fit of the research model.

Table 1. Participants' demographics in the quantitative part of the research

Variable	Indicators	Frequency	Frequency %
Gender	Male	46	12.90
	Female	311	87.10
Education	BSc.	210	58.82
	MSc.	116	32.50
	Ph.D.	31	8.68
Work experience	<5 years	116	32.49
	5-10 years	141	39.50
	>10 years	100	28.01
Occupation	Preschool teacher	293	82.07
	Educational psychologist	35	9.81
	Curriculum specialist	29	8.12

Findings

The findings of the qualitative part indicated a global theme (problem-solving curriculum in preschool) and organizing themes at two levels, the first of which included nine components of the curriculum. The second level represented the characteristics of each of these components, including objectives (cognitive, attitude, and performance), content (organization and presentation methods), teaching methods (traditional, attention to learners' age, teacher characteristics, and active methods), learning activity (individual and collective),

educational materials (resource characteristics and type), space (physical characteristics, facilities), time (length, child's readiness, age), grouping (responsibility, respect for others, moral characteristics, group homogeneity, problem nature, group heterogeneity, number of group members, gender, age, individual differences), and evaluation (program evaluation, evaluation based on individual differences, process evaluation, quantitative evaluation, and descriptive evaluation). It is noteworthy that each theme at the second level had several basic themes which were not mentioned here for brevity. Tables 2 to 4 present the results of the investigations.

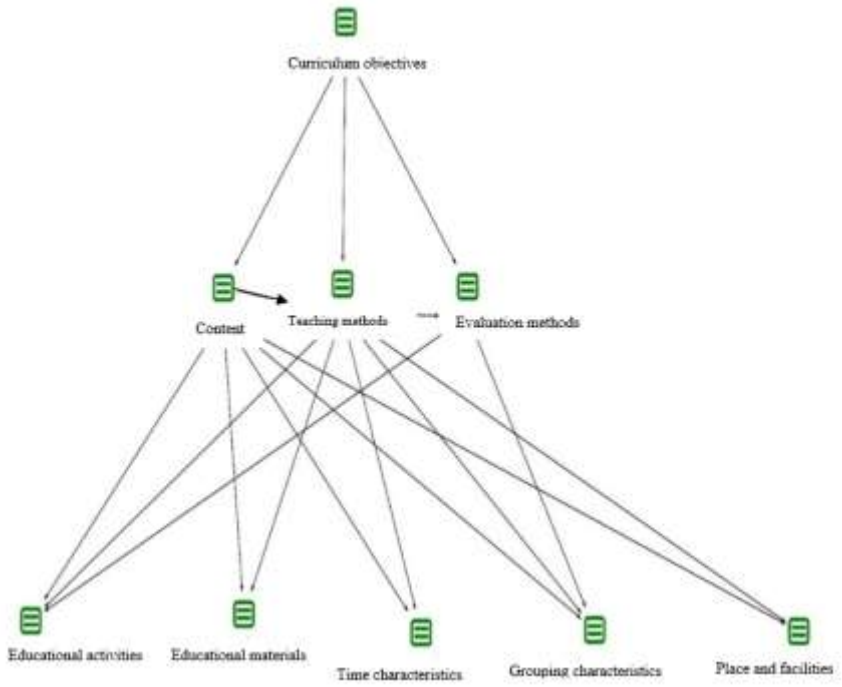

Fig. 1. The basic model of problem-solving curriculum for preschool children (MAXQDA output)

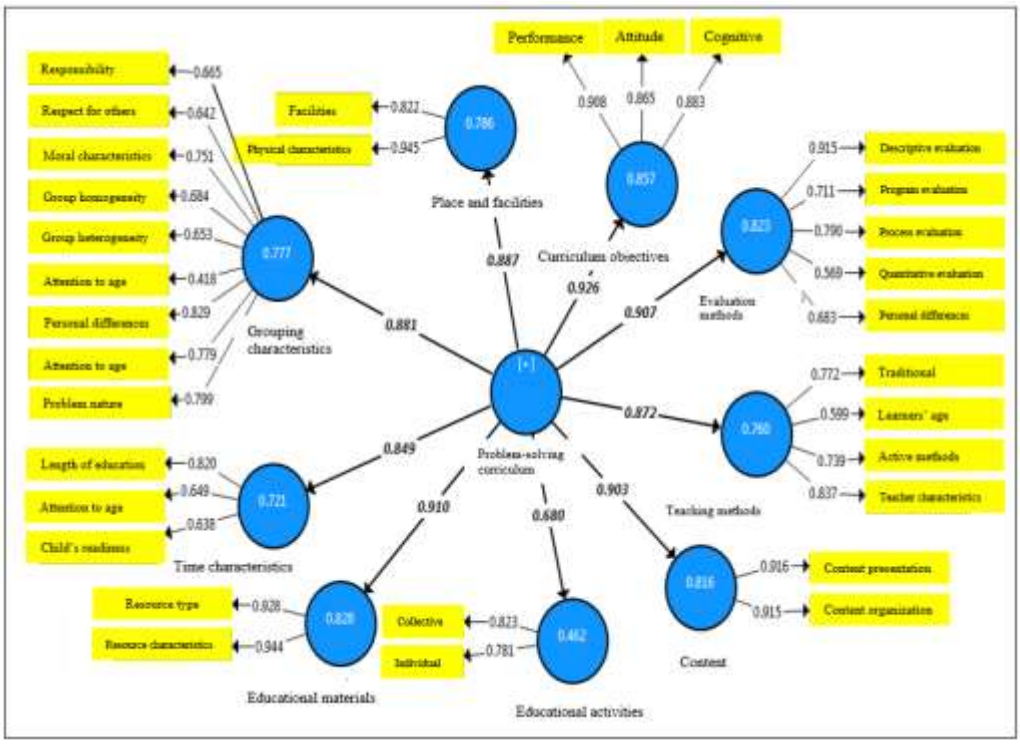

Fig. 2. Factor analysis model for the indicators of problem-solving curriculum model for preschool children

Table 2. Factor analysis model for the indicators of problem-solving curriculum model for preschool children

Components	Items (Indicators)	Factor Loading	Path Coefficient
Curriculum Objectives	Cognitive	0.883	0.926
	Attitudes	0.865	
	Performance	0.908	
Content	Content organization	0.915	0.903
	Content presentation methods	0.916	
Teaching Methods	Traditional	0.772	0.872
	Attention to learners' age	0.599	
	Teacher characteristics	0.739	
	Active methods	0.837	
Evaluation Methods	Evaluation based on individual differences	0.683	0.907
	Process evaluation	0.790	
	Program evaluation	0.711	
	Quantitative evaluation	0.569	
	Descriptive evaluation	0.915	
Place and Facilities	Physical characteristics	0.945	0.887
	Facilities	0.822	
	Attention to the	0.665	

	responsibility		
Grouping Characteristics	Respect for others	0.642	0.881
	Attention to moral characteristics	0.751	
	Attention to group homogeneity	0.684	
	Attention to the problem nature	0.799	
	Group heterogeneity	0.653	
	Attention to gender	0.418	
	Attention to age	0.779	
	Attention to personal differences	0.829	
Time Characteristics	Length of education	0.820	0.849
	Attention to the child's readiness	0.638	
	Attention to age	0.649	
Educational Materials	Resource characteristics	0.944	0.910
	Resource types	0.928	
Educational Activities	Collective	0.823	0.680
	Individual	0.781	

Factor loadings of 0.3, between 0.3 and 0.6, and greater than 0.6 show weak, acceptable, and strong relationships, respectively. According to Table 2, factor loadings of all components were >0.6, except for attention to the learners' age (0.599), quantitative evaluation (0.569), and attention to gender (0.418), confirming the goodness of the model.

Table 3. Significance of factor loadings and path coefficients of the components of problem-solving curriculum model for preschool children

No.	Component	Factor Loading	Path Coefficient	Significance
1	Curriculum Objectives	0.857	0.926	
2	Content	0.816	0.903	
3	Teaching Methods	0.760	0.872	
4	Evaluation Methods	0.823	0.907	
5	Place and Facilities	0.786	0.887	
6	Grouping Characteristics	0.777	0.881	Significant
7	Time Characteristics	0.721	0.849	
8	Educational Materials	0.828	0.910	
9	Educational Activities	0.462	0.680	

Given that the factor loading of none of the components was 0.3 or less in Table 3, none of the components were removed from the analysis path. Thus, 9 components and their indicators

were accepted as the components of the problem-solving curriculum model for preschool children. Finally, Figure 3 shows the problem-solving curriculum model for preschool children.

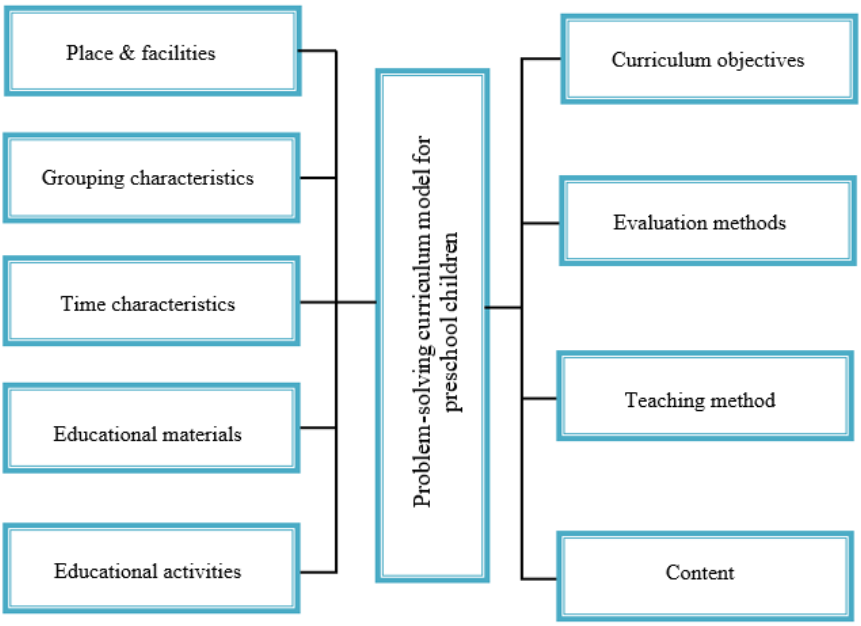

Fig. 3. Problem-solving curriculum model for preschool children

R^2 and Q^2 criteria were used to investigate the validity of the problem-solving curriculum model for preschool children and confirm its adequacy (Table 4).

Table 4. R^2 and Q^2 values for research variables

No.	Variable	R2	Result of R2	Q2	Result of Q2
1	Curriculum Objectives	0.857	Strong	0.591	Strong
2	Content	0.816	Strong	0.510	Strong
3	Teaching Methods	0.760	Strong	0.426	Strong
4	Evaluation Methods	0.823	Strong	0.449	Strong
5	Place and Facilities	0.786	Strong	0.445	Strong
6	Grouping Characteristics	0.777	Strong	0.415	Strong
7	Time Characteristics	0.721	Strong	0.416	Strong
8	Educational Materials	0.828	Strong	0.516	Strong
9	Educational Activities	0.462	Moderate	0.277	Moderate

R^2 is related to the latent endogenous (dependent) variables of the model, which indicates the effect of an exogenous variable on an endogenous variable considering three values of 0.19, 0.33, and 0.67 for weak, moderate, and strong relationships.

Q^2 determines the predictive power of the model, in which the

values of 0.02, 0.15, and 0.35 for an endogenous construct indicate the weak, moderate, and strong predictive power for the related exogenous constructs. According to Table 4, R^2 confirms the fitness of the model, while Q^2 also shows the appropriate predictive power of the problem-solving curriculum model for preschool children, supporting the fitness of the structural model.

The value of goodness of fit (GOF) was 0.625 for the research model, which is greater than the standard of 0.36 ad confirms the appropriate power of the problem-solving curriculum model for preschool children.

The findings of the qualitative part indicated that the problem-solving curriculum for preschool children has nine components, including objectives (cognitive, attitude, and performance), content (organization and presentation methods), teaching methods (traditional, attention to learners' age, teacher characteristics, and active methods), learning activity (individual and collective), educational materials (resource characteristics and type), space (physical characteristics, facilities), time (length, child's readiness, age), grouping (responsibility, respect for others, moral characteristics, group homogeneity, problem nature, group heterogeneity, number of group members, gender, age, individual differences), and evaluation (program evaluation, evaluation based on individual differences, process evaluation, quantitative evaluation, and descriptive evaluation).

Discussion and Conclusion

In this study, objectives were identified in three areas of cognitive, attitudes, and performance. The curriculum for children should teach them thinking skills (creativity, critical thinking, problem-solving) and research (reasoning, explaining, classification, observation, etc.) instead of simply delivering scientific information and facts (Ghasemtabar, 2016). Content should have features such as activity-oriented, logical, and explicit. In-depth, student-centered, and problem-oriented features have to be taken into account in content selection. The content organization has to promote deep understanding, learner motivation, and knowledge building in the learner. It is also important to consider the characteristics of the learners and focus on up-to-date issues when selecting and organizing content. Content delivery methods should include the use of images such as paintings, photographs, and posters, content presentation through shows such as role-playing, films, and animation, audio, including music, poetry, and storytelling, sports and individual or collective games, and finally written and printed tools such as books or magazines. This finding is consistent with research conducted by Ebrahimpour Koumleh et al. (2018), Salsabili (2006), and Weiland et al. (2018). Teaching methods were divided into two categories of traditional

and active. Active methods should be interactive (group or collective problem-solving, participatory learning, brainstorming, and debate), practical (role-playing, attention to process instead of product, information collection in different ways, and fitness with children's intellectual structure), and exploratory (doing the project and facing challenging situations). This finding agrees with the results obtained by Sabzeh (2018), Delfan Azari et al. (2018), Karademir (2019), and Kaya et al. (2019).

Learning activities are divided into two categories of individual and collective. Since the problem-based curriculum provides an activity-oriented environment in which children shape their knowledge through participation in a variety of activities, these activities should be designed according to some principles that guide the learner, and encourage thinking, reflection, active learning, and problem-solving as reflected by the constructivist theory. Such principles focus on the development of high-level skills, stimulation of children's curiosity, connecting learning activities with the purpose of the curriculum, facilitating learning styles, linking learning activities, encouraging the learners to participate in group activities, providing activities based on real events, and presenting important and strange tasks and issues in problem-solving. This finding is consistent with research conducted by Salsabili (2006), Kaya et al. (2017), and Ngang et al. (2014). Educational materials and resources include two sub-components of resource characteristics and types, indicating the necessity to have diverse educational tools to facilitate the teaching-learning process. It is also important to have materials and resources compatible with problem-solving skills to ensure they are usable, attractive, and safe for preschool children. The results of research by Naidu (2005) support this finding.

Taking into account the spatial-physical and psychological-emotional characteristics in preschool classrooms and environments can be effective in the development of problem-solving skills in preschool children. Various facilities such as tables and benches for group work, an appropriate place for photos and posters, shelves to store children's handicrafts properly, and an atmosphere of trust and mutual respect can create a suitable learning environment for the development of problem-solving skills. Thornton and Brunton argued that children's learning environment should facilitate their creativity, selection, research, thinking, and interaction with their project while also providing them with privacy (Thornton & Brunton, translated by Mohammadi, 2017). As also confirmed by Ebadi et al, (2020), time is one of the important features. The main characteristics of grouping included attention to responsibility, respect for others, moral characteristics, group homogeneity, the nature of the problem, group heterogeneity, number of group members, gender,

age, and individual differences. These findings agree with research conducted by Ebadi et al. (2020), and Sun et al. (2020). The fitness of evaluation strategies with the objectives of the curriculum, their process-based and persistent nature, the use of diverse strategies, and the authenticity and reality-based nature of the strategies can help achieve the curriculum objectives. Strategies such as using checklists, grading and anecdotal scales, self-assessment, peer assessment, workbooks, diaries, and parental evaluation are examples of assessment methods through which learning is improved, and the objectives of the problem-solving curriculum are achieved. The results obtained by Weiland et al. (2018) and Mclachlan et al. (2018) support this finding.

Validation of the problem-solving curriculum model for preschool children showed its validity based on the mentioned nine components. This finding is consistent with the results of research by Delfan Azari et al. (2018) and Ebrahimpour Koumleh et al. (2018). Problem-solving skills are regarded as a universal preparation for preschool children and require an effective curriculum (Rohaty et al., 2017). William and Aislie (2014) found that teaching problem-solving skills to preschool children could enhance their abilities to solve problems, while a social problem-solving curriculum would expand their abilities to solve social problems (Van Loan et al., 2018). Hence, children trained in problem-solving skills perform better in solving problems (Resing et al., 2016). To explain this finding, it can be said that problem-solving is one of the main skills that must be learned throughout the educational process. The problem-solving curriculum for preschool children focuses on appropriate objectives, suitable content to teach problem-solving skills, efficient methods to teach and learn problem-solving skills, educational activities for meaningful problem-solving learning by preschool children, the use of required educational materials and facilities, appropriate place and time characteristics for correct learning of problem-solving skills, grouping, and optimal evaluation methods. This enables preschool children to learn meaningful and deep problem-solving skills and apply them in all academic and real-life conditions. According to the above-mentioned, the validity of the problem-solving curriculum model for preschool children was confirmed.

The present study only considered resources available in Persian and English languages for the review of the literature and theoretical foundations of the research, which limited the theoretical scope of the study. The spatial aspect of the study was another limitation, as it merely focused on the preschool period and curriculum specialists, educational psychologists, and preschool teachers in Tehran. Therefore, the results obtained in this study are limited in terms of generalizability to other academic periods and different cities.

This model can be the basis for teaching problem-solving skills to preschool children, while curriculum specialists and preschool teachers can use it to design appropriate teaching methods for problem-solving skills. Hence, children can be equipped with an effective tool to improve their level of life skills, particularly problem-solving skills in their daily and real lives. This model can be also useful in making preschool teachers familiar with teaching methods of the 21st century in preschools while facilitating their professional development. Thus, considering the role of preschool teachers in the development of children's problem-solving skills, governmental and non-governmental organizations, agencies, and educational centers are recommended to consider how to prepare preschool teachers to teach these skills to children.

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