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The Effect of a Designed Educational Toy on Developing the Concept of Direction: A Study on Preschool Children

Asst. Prof. Dr. Cemil YAVUZ
Eskişehir Osmangazi University, Industrial Design.
cemil.yavuz@ogu.edu.tr
https://orcid.org/0000-0002-7715-3537

Prof. Dr. Aydın ŞIK
Gazi University, Industrial Design.
aydins@gazi.edu.tr
https://orcid.org/0000-0002-8977-9094

Abstract
Allowing for sense-making of a product or situation, perception is an important factor in the act of understanding. Given that senses take a significant part in the product perception of users, a multi-dimensional axis of the interaction of the user with the respective product that appeals to multiple senses will be determinative. The use of the sound factor as a design element in this study supported the child-toy interaction with visual and auditory elements, aiming to enforce the didactic effect on the child. In order to examine the effect of the designed educational toy on the concept development of preschool children, an experimental design model with pretest and posttest control groups was used. The study sample included 148 preschool children, consisting of 79 boys and 69 girls at ages between 48-60 months; who were assigned to a total of 5 experimental and 5 control groups. Based on the statistical analysis results, it was concluded that the educational toy contributed to the improvements in the development of the direction-location-position concept in preschool children.
Keywords: Educational Toy, Design, Direction-Location Concept, Preschool Period

INTRODUCTION

Children are different from adults in terms of their behavior, emotions, thoughts, and developmental characteristics; as well as being open to change and innovation. That's why it is extremely important to provide healthy and well-equipped educational environments to them as they will encounter frequent stimuli in the early period of their lives (Koçak, 2001). If we define the time before 6-years of age as the preschool period, preschool educational institutions are of great importance for the healthy education and development of the child under the supervision of expert educators. In these institutions, children not only receive individual education but also develop socially by playing games with their friends. The kindergartens with implemented preschool curricula provide education for children in the age range from 3 to 6 years. Besides their mission to prepare children for primary school, kindergartens are very important educational institutions taking a significant part in major social functions by educating children and contributing to their development. Froebel describes the purpose of kindergartens as arising interest in learning (Yavuzer, 2005: 151). It is important to prepare preschool educational environments in such a way that those places will promote learning through play and child-centered activities. Educational environments should be planned to physically support the physical, social, emotional, language, and cognitive development of children (Wortham, 1998: 210). Preschool educational institutions are environments that offer playing opportunities to children and educate them in a planned and systematic way while developing a social environment for them as they play (Kandır, 2001). Studies show that the concept of play is important for both the cognitive and physical development of children. Playing games is more than just a recreational activity with a specific set of rules to pass time but rather a preparation practice for children to acquire all kinds of knowledge and skills that will be needed in the future. Through play activities, children build knowledge, recognize themselves, and come to know the world they live in; as well as acquiring critical thinking skills. The language of children is the play, in other words, the play is the job of children (MEB, 2014: 11). While children learn about the world through play activities and playing

with different objects, they are introduced to the chance to develop their understanding of concepts and numbers along with similar many other cognitive abilities. Play is more effective than other didactic techniques particularly because it induces children to change from a passive state to an active one. Therefore, it is a very important educational tool for children (Aytekin, 2001; Gazezoğlu, 2007). For this reason, the concept of play is important as a tool for preschool education. Toys are materials that promote mental, physical, emotional, and social development in children and they improve their imagination and creativity (Erden, 2001: 2). Regardless of the different objectives they are designed and produced to serve for, our toys accompany us throughout certain periods of our lives. They listen to us, contribute to the development of us at certain points, and sometimes impress us as loyal objects that we leave behind as we grow up.

Educational toys significantly promote the development of preschool children starting from infancy. Toys and play materials that improve creativity and skills are necessary for all children of different ages and mental levels since they stimulate every aspect of the development (Tezel Şahin, 1993). Educational toys are described as "toys; that support children's cognitive, social, emotional, motor, and language development together with the development of self-care skills; holding specific purposes and rules. This type of toys are designed specifically according to the age and developmental characteristics of children; they encourage children to learn through play, and they are suitable to play with on a table, on the floor, or on a board according to their features" (Kandır & Tezel Şahin, 2011: 18). According to Lampe and Hinske (2007), the ideal learning experience consists of a combination of physical experiencing, virtual content, storytelling, and the child's imagination. Considering that the physical experience in this context is provided with games and toys, it can be argued that educational toys also play a role in concept development in children. These are the type of toys that help children learn, develop concepts, and develop a better understanding of objects and events through play. During the play with these types of toys, children acquire several kinds of behaviors such as following certain instructions appropriate to the purpose of the toy and maintaining the activity for a certain period of time. Educational toys are important in supporting the different areas of development in children at preschool ages when the development and education of the child are of major significance. Many toys and types of play can be categorized as educational. Educational materials, books, science sets, push and guess games, card games, desktop games are just a few of them. Since toys designed for cognitive development require a certain level of knowledge and motor skills, most of the toys in this category are recommended for children of 19 months and older (CPSC, 2002: 243). Considering toys as industrial products designed with certain concerns, it should be ensured at the designing phase that educational toys would meet certain qualifications to support the development of children.

According to the World Design Organization (2019), industrial design is a strategic problem-solving process that drives innovation, improves business success, and provides a better quality of life by offering innovative products, systems, services, and experiences. Industrial design bridges the gap between "what is given" and "what is possible." It is an interdisciplinary profession that utilizes creativity to bring solutions via teamwork so that improvements are enabled in a product, system, service, experience, or a job. In its English origin, the word "research" means searching deeply and intensively (Rodgers & Yee, 2015: 11). The solution sought here is reliable and new information. Regardless of the purposes of use of the word; whether it is "scientific research methods" or "research and development activities", the conduct of research requires compliance with certain systematics. Focusing on improvements in design processes and the application of knowledge in design, Owen (1998) demonstrated a process that combined inquiry and application with feedback loops, indicating that the knowledge in focus is fed throughout the design process (Figure 1).

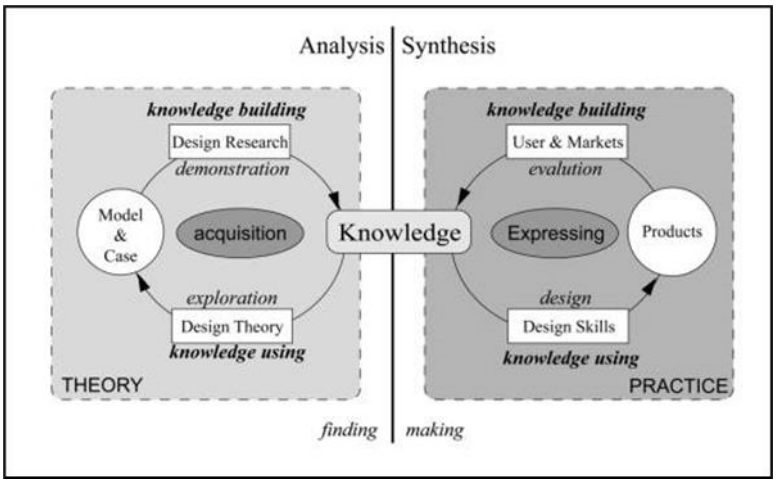

Figure 1. Cyclical Processes of Knowledge Building During Product Design Both in Theory and Practice (Owen, 1998)

Research and design are closely related but different disciplines. Although their practice and result assessment processes are different from each other, research and design are nurtured and influenced by each other, aiming to produce something new. Conducting research with prototypes; which were developed with formative designing activities for knowledge building, is a component of the research-through-design method (Figure 2). The produced prototypes allow for user-product interactions and they enable designers to observe any potential problems in advance before the product is released.

The research-through-design transforms the practice of methods and mental processes from a designing act to a research environment (Zimmerman, Stolterman & Forlizzi, 2010). Design is the process of producing simple and effective answers to complex and ambiguous problems that spread to disciplines and stakeholder groups (Kennedy Clark, 2013).

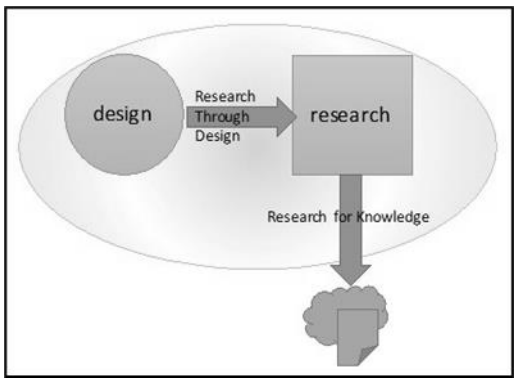

Figure 2. Designerly Way of Doing Research (Stappers and Giaccardi, 2019)

According to Kolko (2009), designing is defined as the process of "organizing complexity or finding clarity in chaos." By focusing on problems related to design and the needs of humans and technological advances, and by empathizing with users and stakeholders; the designing process addresses different perspectives with a holistic approach to create aesthetic works that can be rich in meaning (Maher R., Maher M., Mann & McAlpine, 2018). An approach through the framework of design-oriented thinking will provide a solution-oriented strategy for the resolution of problems.

Assumptions

The assumptions of the study are as follows:

1) In the study, in some schools, teachers were assigned as practitioners instead of the researcher. Since the things to be done were conveyed to the teachers who will do the

application in detail by the researcher, the process was carried out at the same level in all groups.
2) There was no interaction in the experimental and control groups during the process.

Limitations

The limitations of the study are as follows:
1) Since the study was carried out with kindergartens in two different cities, support was received from teachers when the researcher could not be involved one-on-one during the implementation phase.
2) The sample of the study; In the first semester of the 2018-2019 academic year, it consists of children between 48-60 months who attend 3 kindergartens in Ankara and 2 kindergartens in Bursa. The final stage of the study, the test phase, is limited to a total of one hundred forty-eight children, including seventy-nine boys and sixty-nine girls.
3) While creating the experimental and control groups, the students were not randomly assigned to the groups, experimental and control groups were formed by random assignment over the existing classes.
4) Since there is no test that is exactly suitable for the purpose of the study and only measures the concept development of location in direction-space, the data obtained are in Ömer Koçak's (2016) doctoral dissertation titled "The Effect of Three Dimensional Cartoons on the Concept Development of Preschool Children in Space". The developed concept is limited to the development test.
5) The possibility that the concepts of above-below, inside-outside, front-behind and right-left, which are aimed to be taught within the scope of the study, have been learned before by children by age group constitute the limitations of this study.

Research Questions and the Importance of Research

On the axis of assumptions and limitations, the research questions of the study are as follows:
1) What factors should be taken into consideration when designing educational toys?
2) By focusing on research by design with interdisciplinary knowledge, how do design and research practices integrate and nurture each other?
3) Does adding the sound factor to the toy during the design phase support the targeted learning in the educational toy?
4) Is there a significant difference in the concept education levels of the children in the experimental and control groups about the location in direction-space during the test phase of the study?
5) When the pre-test scores of the experimental and control groups that were pre-tested in the test phase of the study are kept under control, is there a significant difference in the post-test scores?

Toys, which are tools for games and an integral part of children's games, can be effective at different levels in children's acquisition and development of different skills, based on their characteristics. As each age group has its own characteristics in children whose abilities change in later ages, the appropriate toy will also change, so their toy preferences will be shaped accordingly. Since all stages of this development have a separate importance in themselves, every period should be followed carefully in child education.
While 20-25 dollars of toy expenditure per child is made in our country, this figure is 300 dollars per child in the USA, 350 dollars in Europe and 35 dollars in the world average. The EU has 28%, the USA 24% and China 8% of the total toy sales worldwide. While 53% of the total toy sales in the EU are outdoor toys, Puzzle and card games and preschool toys have a 13% share in total sales (Demirci, 2016).

According to the new strategy developed by the Ministry of Industry and Technology to develop the domestic toy industry, it is planned to establish a toy specialization zone in Düzce and create domestic toy brands. Thus, it is aimed to end the domination of imported toys in the market and gain socioeconomic gains (Kılıçaslan, 2017). It is thought that the

data obtained in this study will also constitute a source for the possible toy specialization area that is planned to be established.

If we divide toys in the world toy industry into two as traditional toys and electronic toys in general, there are also examples where concrete toys are integrated with the digital world. Within the scope of the study, the toy developed for preschool children is also designed to be played in interaction with the internet. Considering that sound is important in teaching, the design is dealt with not only visual and tactile but also auditory with the sound toy. With this study, which supports the view that games that appeal to more than one sense will provide permanent learning, it is predicted that the designed toy will contribute to the literature in terms of measuring the effect of learning. The study is important in terms of showing how toys can be integrated into the educational process and support their learning in terms of not only seeing toys as entertainment tools but also contributing to the cognitive development of children. Making educational research from a designer perspective, showing the positive results that will arise when different disciplines work together, and the effort to create awareness in the toy industry are the factors that make the work important.

METHOD

In this section; the research design, the research model, the study groups, the research process, the methods used to interpret and analyze the obtained data, and the data analysis techniques are explained.

In this research, the educational toy called "KATMAN" (meaning "layer") was designed and a prototype was produced after consulting with academicians, teachers, child psychology experts, and designers (Figure 3). Since the play with this toy will be an interactive one, a specific web page was designed and made online for this purpose (www.katmanoyunu.com).

Considering that sound has an effect and contribution to learning, sound was included in the toy as a design element. At the point of adding sound to the toy, a panda-shaped Muicho brand bluetooth speaker was used. Because of it was integrated into the game fiction with the name Panda Pufi, it was not out of context. After the texts to be used in the plays were determined, the voiceovers were performed in a studio environment by a professional voice-over specialist who has voiceovers on TRT Kid channel. Games designed for the development of location concept in direction-space are played interactively with the web page prepared for the toy. The reason why sound is not directly integrated into the toy is to prevent possible false learning in the child by including the parent or teacher in the process of playing the toy. In this way, in the games belonging to the toy, the parent or the teacher playing the game will control the playing steps, so it is ensured that the rules are fulfilled.

Figure 3. Designed Educational Toy Named "KATMAN"

In order to explain the use of the sound factor in the toy, it would be appropriate to write about the playing steps of the first game of the toy named KATMAN, which consists of a total of four game setups. This first game consists of three parts, and it is based on the principle of placing 12 stamps with different visuals on the relevant spaces on the wooden table according to the voice commands given. The 12 stamps belonging to this game are randomly placed in the linear spaces on the platform together with the educator or practitioner. Before starting the game, the bluetooth speaker (Panda Pufi) is activated by the educator or practitioner and paired with the phone/tablet and the internet address www.katmanoyunu.com opens. The first part in the Layer Game-1 tab at the address is clicked and the page related to the first part of the game opens. Following the instructions on the relevant web page, the "Game Start" sound is played first and the game is started. Afterwards, the defined sounds are played to the child in order, and the child is asked to place the relevant stamp in the relevant space on the game board in accordance with the voice command. After each command is executed correctly by the child, the next voice command is passed. The sounds with the commands are played one by one and the child is asked to put a stamp in the relevant space. If the stamp is placed incorrectly, the "Repeat" sound is played from the speaker and the child is asked to repeat the action. The action is repeated until the child gives the correct answer. If the stamp is placed in the right place, the sound of "Well done" can be played from the speaker, and the next voice command can be passed. After completing all the steps, the "Congratulations" tab is clicked and this part of the game is over. The gameplay of the other games belonging to the toy and the related sounds of each game can be accessed at www.katmanoyunu.com.

The pretest and posttest control group model, which is one of the real experimental designs, was used in the test stage where the effects of the educational toy designed for the development of direction concept were measured to evaluate whether it supports the targeted concept development. The pretest and posttest control group design is a complex pattern; in which participant assessments were performed before and after the test by dependent variable measurements and by the comparison of the data between the experimental and control groups consisting of a certain number of participants (Büyüköztürk, 2011: 19). This study was finalized with the last phase; namely the test phase of the research analyzing the collected research data. Experimental studies attempt to determine whether a specified procedure has an effect on the outcome; where one group is intervened with and the other one isn't during the procedure and where the scores obtained in both groups are analyzed at the end (Creswell, 2014: 13).

In the model with the pretest and posttest control group, there are two groups called experimental and control groups formed by random assignment of participants (Büyüköztürk, 2011: 20). This study was carried out on 10 groups in 5 different

kindergartens. Classes comprising mostly 4-year-old children were randomly selected from different kindergartens. Then, one class was randomized as the experiment group and the other was randomized as the control group in each respective kindergarten.

At the beginning of the experiment, a concept development test was applied to experimental and control groups as the pretest measurements in the research. Afterwards, the children in the experimental group played with the toy named "KATMAN" (independent variable), which was designed and composed of 4 different play settings, for eight weeks at certain periods (Figure 4). In this process, the control group continued with the existing education program without undergoing any interventions.

Figure 4. Playing Stages With the Toy Named "KATMAN"

After the eight-week period of playing with the toy, the concept development test was applied to both groups once more as the posttest measurement. At the end of the experiment, the experiment and control groups were compared to detect differences in the pretest and posttest results.

The universe of this research consists of children in the age group of 48-60 months, who showed normal development and continued their education in private and public kindergartens in Ankara and Bursa in the first semester of the 2018-2019 academic year. Because it was thought that they would be able to express themselves clearly, the research targeted 4-5-year-old children in the so-called "stage of excellence" characterized by the absence of concrete thinking patterns. According to Üstün and Akman (2003), knowledge in the memory needs to be organized in order to learn about concepts. As children tend to conceptually activate new cognitive abilities upon acquiring them, the ability of conceptual thinking begins to improve from the age of four. For this reason, the study was mainly conducted on 4-year-old children as the conceptual infrastructure had not completely been shaped yet in this age.

The sample of the research consists of children in the 48-60-month-age group attending one private and two public kindergartens in Gölbaşı, Keçiören, and Haymana districts of Ankara province and one private and one public kindergarten in İnegöl district of Bursa province. Having one experimental group and one control group in each kindergarten; five experimental groups and five control groups making a total of 10 separate groups were created with the random assignment method. A total of 148 children comprising 79 boys and 69 girls participated in the study. The demographic data of kindergartens and children participating in the study are presented in Table 1. It is thought that there is no ethical problem in the study, since there is no sharing about the personal information of the students in the relevant tables. However, before starting the study, approval of the Ethics

Committee was sought to determine that there was no harm in the application of the study. The permission document given by Gazi University Ethics Committee is presented in Appendix 1.

Table 1. Demographic Data of Kindergartens and Children Participating in the Research

	City	Experimental Group (N)	Gender	N	Control Group (N)	Gender	N
1	Ankara/ Gölbaşı (Public)	23	Boy Girl	6 17	21	Boy Girl	8 13
2	Ankara/Keçiören (Private)	15	Boy Girl	10 5	15	Boy Girl	9 6
3	Ankara/Hayman a (Public)	11	Boy Girl	7 4	11	Boy Girl	6 5
4	Bursa/ İnegöl (Private)	12	Boy Girl	7 5	12	Boy Girl	9 3
5	Bursa/İnegöl (Public)	12	Boy Girl	7 5	16	Boy Girl	10 6
	TOTAL	73	Boy Girl	37 36	75	Boy Girl	42 33
	GRAND TOTAL					148 (79 Boys, 69 Girls)	

Data Collection Tools

The concept development test developed by Ömer Koçak in his doctoral dissertation was used in order to measure the conceptual learning levels of children in the pretest and posttest procedures (Koçak, 2016). The literature review did not reveal any comprehensive concept development tests for the measurement of the levels of concept learning; which are aimed to be taught within the scope of the research. The concept development test used by Koçak (2016) in his doctoral dissertation was further developed for this research in consultation with a preschool specialist and an art teacher. While the original test included questions about the concepts of "Under-On, In Front of-Behind, In-Out"; six more questions were added for the concepts of "Right-Left" since the aim of this study was to acquire the concepts of right and left. These six questions were added to the test developed for this research without disturbing the original graphic structure. Thereby, the total number of questions in the test used in this research increased to 24. In order to use the concept development test in this research, Ömer Koçak was contacted for permission and necessary permissions and approvals were obtained from him.

Validity and Reliability of the Concept Development Test

In order to check whether the measurements performed with the concept development test would be reliable in this research, the KR-20 coefficient was assessed. The reliability coefficient was calculated as 0.72 with the KR-20 method (Koçak, 2016). According to the reliability intervals; the coefficients of less than 0.50 in the tests mean that the reliability is low, the coefficients between 0.50 and 0.80 mean moderate-level reliability, and coefficients of more than 0.80 mean that the reliability is high (Tan, 2009).

Validity is the degree of precision in measuring the targeted feature excluding potential confounders. In other words, the validity of the measured results is the degree to which the intended measurement is obtained (Büyüköztürk et al., 2011: 118). Studies about education employ measurement tools for many purposes, such as assessing the effectiveness of teaching and determining deficiencies in learning; anticipating that these tools would be sufficient enough to question the behaviors that are intended to be measured. Information about the measures taken by Koçak (2016) for the validity and

reliability of the concept development test; which was used in the test phase of the study, is listed in Table 2.

Table 2. Validity and Reliability Measures Taken for Data Collection Tool

Data Collection Tool	Validity Measures	Reliability Measures
Concept Development Test	- The test was developed in consultation with the experts in the field. - The construct validity was checked by a specialist in preschool education and a specialist in Computer Education and Instructional Technology. - An art teacher provided consultation for the design of the questions. - Care was exercised to ensure that the test questions were relevant for the learning aimed to be measured.	- The KR-20 value was calculated. - The number of questions in the test was kept high.

Data Analysis

The aim of the study was to measure the contributions to learning; which would be provided by the toy designed to support the acquisition of the direction-location concept. In order to measure these effects, the pretest posttest control group model was used in the testing phase of the research. The one-way analysis of variance (ANOVA) was used for comparing the posttest achievement scores in all groups. The analysis of covariance (ANCOVA) was used for comparing the posttest scores of the experimental and control groups; which underwent the pretest assessments.

RESULTS

In this section, the results obtained during the test phase are presented. The data obtained from the research and the results of the statistical analysis are presented in the tables. Data categorization and the names of the groups in the research sample are presented in Table 3.

Table 3. The Names Given to the Groups; Which Make Up the Research Sample

Group Name	Description
EGPU	Experimental group selected from public schools
EGPR	Experimental group selected from private schools
CGPU	Control group selected from public schools
CGPR	Control group selected from private schools

Descriptive statistics of age and gender variables related to the groups are given in Table 4.

Table 4. Age and Gender Variables of the Study Groups

EGPU		EGPR		CGPU		CGPR	
Age Average	Gender	Age Average	Gender	Age Average	Gender	Age Average	Gender
4,20	M:20 F:26	4	M:17 F:10	4,16	M:24 F:24	4,05	M:18 F:9

One-way analysis of variance (One-Way ANOVA)

The one-way analysis of variance (One-Way ANOVA) was selected to check whether there was a statistically significant difference between the averages of the posttest results of the experimental and control groups by the school types so that the effects of the designed games and toys on the acquisition of the direction-location concept would be examined in the participating preschool children. When there is one dependent and one independent variable, the one-way ANOVA is used for testing the significance of group differences (Kerr, Hall & Kozub, 2002: 92). The main assumptions used in the one-way ANOVA are that the grouped data conform to a normal distribution and that the group variances are homogeneous. The posttest averages and the standard deviations in the groups are presented in Table 5.

Table 5. Posttest Averages and Standard Deviation in the Groups

EGPU	EGPR	CGPU	CGPR
20.97 ± 2.43	21.54 ± 2.42	19.19 ± 1.96	19.10 ± 3.62

After checking the assumptions, the one-way ANOVA was performed to compare the averages of posttest values between the groups. The analysis results are presented in Table 6.

Table 6. ANOVA Results of the Posttest Scores of the Experimental and Control Groups

Source	Sum of Squares	SD	Average of Squares	F	p-value
Inter-Group	132.653	3	44.218	6.821	.000
Intra-Group	764.920	118	6.482		
Total	897.574	121			

When Table 6 is examined; it is seen that there is a statistically significant difference between the posttest averages of EGPU, EGPR, CGPU, and CGPR groups since the p-value of the "F-test" is <0.05. In case of difference between groups as a result of variance analysis, one of the tests applied to find the source of the difference is the LSD (Least Significant Difference) test (Landau & Everitt, 2003). The LSD paired comparison test was performed to determine which group was the source of the difference in the ANOVA results of the posttest scores. The results of the LSD test are presented in Table 7.

Table 7. LSD Test Results

		Differences between Averages	**Standard Error**	**p-value**
EGPU	EGPR	-0.565	0.648	0.385
	CGPU	1.785*	0.588	0.003
	CGPR	1.878*	0.692	0.008
		Differences between Averages	**Standard Error**	**p-value**
EGPR	EGPU	0.565	0.648	0.385
	CGPU	2.349*	0.652	0.000
	CGPR	2.443*	0.747	0.001
		Differences between Averages	**Standard Error**	**p-value**
CGPU	EGPU	-1.785*	0.588	0.003

EGPR	2.349*	0.652	0.000
CGPR	0.094	0.696	0.893

According to Table 7, the posttest scores of the EGPU group are significantly different from the posttest scores of the CGPU (p=0.003) and CGPR (p=0.008) groups. The posttest scores of the EGPU and EGPR (p=0.385) groups are not significantly different. These results mean that the applied technique worked and that the school type did not cause a significant difference in the posttest scores of the experimental groups (p=0.385).

The posttest scores of the EGPR group were significantly different from the posttest scores of the CGPU (p=0.000) and CGPR (p=0.001) groups. These results demonstrate that the applied technique worked and that the number of the correct answers in the posttest results was statistically significantly different among the EGPR, CGPU, and CGPR groups.

The posttest scores of the CGPU group were significantly different from those of the EGPU (p=0.003) and EGPR (p=0.000) groups. Again, as in the experimental group, it can be argued that school types (whether public or private) did not affect the posttest scores of the control groups (p=0893).

The comparison of the concept development levels in the experimental and control groups; which underwent the pretest procedures

This section presents the results of the data analysis showing whether there are significant differences between the posttest scores in the pretested experimental and control groups when their pretest scores are kept under control. ANCOVA was used for data analysis. In experimental studies, the experimental control method is applied to obtain unbiased estimates of the experimental effects by reducing the variability that may occur due to experimental errors. Experimental control is made possible by the following ways; including the random assignment of units to groups, the homogeneous grouping of subjects, and checking the data with statistical analyses.

Analysis of Covariance (ANCOVA)

Firstly, the posttest data were corrected according to the average of the pretest achievement scores obtained before the application. The mean achievement scores are presented in Table 8.

Table 8. Posttest Scores and the Posttest Scores Corrected According to the Pretest Data

Group	N	$\bar{X}$	SD	Corrected Average	Standard Error
Experimental	61	21.295	2.3618	21.305	0.262
Control	56	19.089	2.6096	19.079	0.273

The review of Table 9 helps interpret whether there is a significant difference between the experimental group and the control group, or in other words, whether the difference between them is statistically significant.

Table 9. Comparison of the Level of Concept Development Between the Experimental and Control Groups by Performing the Covariance Analysis

Source	Sum of Squares	SD	Average Squares	F	p-value
Corrected Model	374.082[a]	2	187.041	44.681	.000
Intersection	764.764	1	764.764	182.691	.000

Pretest	232.025	1	232.025	55.427	.000
Group	144.673	1	144.673	34.560	.000
Error	477.217	114	4.186		
Total	48778.000	117			
Corrected Total	851.299	116			

According to Table 9, it can be argued that there is a significant difference between the experimental group and the control group because the p-values for both the pretest values and the groups are less than 0.05, which is the α-significance level. It is concluded that the developed educational toy contributes to the improvement of children's acquisition levels of the direction-location concept.

DISCUSSION AND CONCLUSION

In this study, a new educational toy design was developed by considering concept learning in preschool education with a design-oriented thinking system. At the same time, it has been a study that deals with theory and practice together, where theoretical knowledge is the basis for practical application, and new theoretical knowledge is produced by analyzing the results of practical application. In this section, the results obtained at the end of the research process are presented with some recommendations.

Considering that teachers take part in the decision-making process of selecting toys to be used in kindergartens and reviewing the roles of teachers and parents as the people choosing toys from the shelves, their opinions and tastes should be taken into consideration in deciding the design. However, in the observations at the kindergartens before designing educational toy, it was seen that the concept education was mainly given through play activities and there was not much material for this.

Considering that sound is effective in language development, the primary purpose of the study is to design an educational toy that supports concept learning related to the word and to use sound as a design element in toys. In this context, the selection of the product planned to be developed for the problem and the need as a toy and the inclusion of the auditory element in the product made this purpose meaningful.

"KATMAN" is a designed educational toy within the scope of this research. It allows for playing structured and semi-structured games initiated by the teacher or parent and the game is continued with the active participation of children. Teachers or parents are also involved in the game by interacting with the web page developed specifically for this toy. Since they will direct the play, they will be able to make the necessary corrections timely by following the answers of the children. The sound component was not included in the play directly but rather introduced under the control of parents or teachers because it was aimed to eliminate the possibility that the child could be misled by the sound while playing alone.

The measurement of the improvement in the acquisition of the direction-location concept in the testing phase of the research demonstrated that the children in the groups playing with the educational "KATMAN" toy for 2 months were more successful compared to the children; who continued their normal education. This result shows that correctly designed educational toys can positively affect the concept development in preschool children.

In line with the findings and results obtained at each stage of the research, several suggestions were made to designers, toy manufacturers, teachers, educational institutions,

and to researchers; who would conduct further research. Considering that preschool teachers try developing educational materials themselves when they cannot find adequate educational toys in the market; educational toy designers' consultation with teachers may contribute to producing cost-effective and efficient solutions by exchanging information and benefiting from their knowledge and expertise.

Direct one-to-one teaching and teaching with the interaction of children with other children or adults are important for children's cognitive development (Senemoğlu, 2010: 57). In particular; educational toys not designed to be given to children to keep them entertained and busy but rather designed to include parents and teachers in the play as in this study can be considered supporting factors for learning. Play designs for toys are considered favorable; if they are appropriate for the development level of the child, if they attract the child's interest, and if the sound component is used for a predetermined purpose.

Since body development occurs through physical development and cognitive development occurs through learning, it is important to exercise care in producing educational toys; which would contribute to children's learning. With the introduction of digital technologies and the internet to our lives, the production of interactive toys that combine online games with a concrete toy structure can offer new market opportunities for domestically produced toys and games.

An important factor that affects learning is motivation; comprising several pre-operational processes including attention, caring, needing, and willingness. (Seven & Engin, 2008). Therefore, it is important to teach the curricula in kindergartens by arising interest in the child and motivating the child to learn. According to Gagne (1985), the ultimate aim of educational programs should be to teach students to solve problems. Since design is also a problem solution, it would be beneficial to provide children with equipment that they will learn by designing rather than presenting ready-made things. Based on the conclusion that the educational toy designed within the scope of this research supports concept-learning, it is recommended that preschool educational institutions enrich their training curricula by using educational toys; which would stimulate children's senses for different developmental areas.

Children can play different roles in design research processes; in which new technologies and products are developed. In this study, children took part in the product development process as information providers. A further study on an educational toy design may firstly include children as design partners taking active parts in the design phase and the effect of the resulting product on learning can be measured afterward.

Cultural differences in early childhood, the environment in which children are raised, the family environments, and the games they play affect children's conceptual development. The last phase of this study, the test phase, was carried out in two different cities, namely Ankara and Bursa. In order to measure regional differences, studies can be conducted in different regions and the results from different regions can be compared.

In the testing phase of the study, the effect of the toy designed on children studying in kindergartens was measured. With the designed product, children in the 4-5 age group who do not attend kindergarten can be compared between the results by making the same application under the supervision of their parents. At the same time, the results can be tested by carrying out similar processes with children of different age groups.

Looking at the results of the concept development test conducted at the last stage of the study, it was seen that the concepts of above-below, front-behind, inside-outside are generally known in children, and the most mistakes were made in right-left concepts. In future studies, different studies can be conducted by focusing on teaching left and right sides within the concepts of direction-position in space.

This study aimed to investigate the effects of this research-specific designed educational toy on children's acquisition of concepts based on the pre-study inquiry results. In future studies, this educational toy can be used for investigating its effects in different developmental areas in children. In this study, a toy design proposal has been developed that appeals to three different senses (touch, sight, hearing). In different studies, the effect of the activation of different senses on children can be measured by adding features such as smell and taste to the toy.

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