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Design Thinking as an Efficient Platform for Pragmatics of Educational Equipment (Case: Primary School Children)

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Abstract

This study aims to investigate the effectiveness of design thinking in enhancing primary school children's learning in the context of using educational equipment. To achieve this objective, a cross-sectional research design was utilized, which involved an examination of the theoretical underpinnings and background of the research. An online questionnaire was administered to gather the necessary information, comprising two sections: demographic information of the respondents and questions relating to children's education and the role of educational equipment. The Likert questionnaire used a 7-point scale. The sample population included primary school teachers and parents with children aged 7 to 12 years from different cities of Iran. The sampling method was voluntary, and a total of 139 respondents completed the questionnaire. Cronbach's alpha was measured at 0.865, indicating the high internal consistency of the survey. The results indicate a significant relationship between the duration of learning with the aid of educational tools and the degree of reliance on creative methods and problem-solving power. The study also found a correlation between the educational tool and the motivation to learn. In summary, this study provides evidence that design thinking is an effective approach to enhance primary school children's learning, particularly in the context of using educational equipment. The findings also highlight the importance of the type and complexity of educational tools, as well as the use of creative methods and problem-solving power, in facilitating students' motivation and willingness to use these tools.

Keywords

Creativity, Design Thinking, Learning Performance, Educational Tools, Problem-Solving.

Introduction

The training of specialized human resources is the goal of all educational systems in the world. One of the most important and impressive things is the teaching approach. By concentrating on this, the economic, social, and political development of society can be achieved (Abolhassani, 2022). Living in today's society, characterized by rapid changes and the exponential growth of information, necessitates the cultivation of correct thinking and analytical skills to adapt and align with these developments (Abedini Nazari et al., 2021). Education experts also emphasize the importance of developing thinking skills and consider fostering critical thinking as a primary goal of education (Jebeliadeh et al., 2021). Furthermore, contemporary organizations, including educational institutions, must embrace change by transitioning from traditional methods and tools to adopting new educational approaches (Jahani et al., 2020). This is because old tools may no longer be efficient in today's context (Gorev et al., 2018). The desirable models for learning in the 21st century prioritize group participation to solve real-world problems and challenges, technology-based curricula, and project-based learning focused on fostering innovation and creativity (Noel & Liub, 2017). Globally, there is a growing concern about the need for multi-purpose education in early childhood education (ECE), which requires experts in the field to explore innovative and meaningful learning approaches that align with these changes (Loyola et al., 2020).

Childhood is considered the foundation for individual and social success in adulthood, highlighting the importance of establishing creativity and abilities during this stage (Duckworth et al., 2014; Movahedi, 2019). The early years of a child's life, when their personality is forming, are crucial for laying the foundation of thinking skills (Mardazad et al., 2021). Designers of thinking skills training programs aim to shift the focus of education from memorization to developing critical thinking skills (Mahmoudi, 2020). In the current era, educational media and technology are an inseparable part of the learning process (Seyedaliyan & Salehi, 2021). Therefore, learning management should also keep pace with technological advancements and adapt accordingly (Kwangmuang et al., 2021). The usage of digital technologies in education has numerous benefits, such as increasing efficiency, promoting cooperation, reducing costs, and minimizing errors (Demartini et al., 2020).

Recent changes have led educators to emphasize the combination of technology with game-based factors to optimize children's learning and cognitive interaction (Kewalramani et al., 2020). However, beyond technical skills, students also need to develop creative problem-solving skills and be familiar with the *design thinking* educational approach (Cook & Bush, 2018). Design thinking, which has been a user-centered issue for the past few decades, involves thinking similar to a designer, wherein addressing a problem involves creative or divergent thinking that leads to creating and solving a problem (Badeleh et al., 2020). It also indicates a method of thinking that can boost creative thinking (Grammenos & Antona, 2018). Furthermore, design thinking, which is used as an analytical and creative process, originates from the concept of design (Abraham et al., 2022). Methods for flourishing creativity and innovation can be applied when attempting to understand a problem, generate ideas, and modify a plan based on evaluation and experimentation (Hatzigianni et al., 2020; Albay & Eisma, 2021).

Creative development activities raise awareness of technology, increase experience, and invite students to enhance collaboration, discussion, and ideas based on the creative process (Giannakos & Jaccheri, 2018; Safaei et al., 2021). The design thinking process, based on the Stanford University School of Design model, comprises five stages: empathize, define, ideate, prototype, and test. This process indicates how designers might empathize with the user, final product, or service to ensure that the design process is based on human needs. The basis of the design thinking process is its repetitive content, wherein steps can be repeated or returned to the previous steps until the design is fully optimized. The inherent flexibility of this approach allows interaction between different disciplines, such as science, business, and engineering, and creates an environment that facilitates rapid iteration and prototyping (Lin et al., 2020).

In recent years, there have been efforts to improve the quality of interaction between teachers and students in the classroom, with a focus on enhancing communication as a cognitive and cultural tool for learning and problem-solving. One approach has been the integration of digital technology and collective thinking in the classroom. However, the successful implementation of such activities, such as digital fabrication and design thinking, requires more than just technical skills on the part of the teachers (Andersen & Pitkänen, 2019). It also involves considering how children can be involved in participatory design, which can take various forms depending on the specific context of the task (Landoni et al., 2018).

The use of advanced technologies has become a practical way to enhance the quality of education in recent years, owing to their fast-paced development (Hao & Xiao, 2017; Machado et al., 2020). Particularly during times of crisis, such as the Covid-19 pandemic, educational institutions need to develop strategies, standards, and quality assurance mechanisms for digital education (MacDonald et al., 2021). In this context, our forthcoming research aims to investigate how design thinking can improve primary school students' productivity by utilizing educational equipment in a more accurate and effective manner. The objective of this study is to gain a deeper understanding of the best practices of design thinking by creating a system model of education or a quality control system for other educational systems that leverage modern technologies.

Literature Review

In a study conducted in Denmark, researchers aimed to investigate the impact of design thinking on the utilization of digital manufacturing technology in education. The study involved 69 fifth to ninth-grade students from two selected schools. The researchers observed the activities of groups consisting of two to four students for two months and a total of 45 hours in the *Familiarization with Digital Design and Production* classroom, during which they noticed five major challenges for students in understanding the digital manufacturing process. To address these challenges, the researchers held a six-week training workshop on design thinking and digital manufacturing, where students were introduced to the design process. Following the workshop, a design challenge with the theme of *designing a public garden for the young generation* was presented to the students, and the response process and results were analyzed. The study's findings suggest that design thinking can serve as an integrated part of primary and secondary education programs that involve digital construction. Design thinking was found to support children's ability to solve unknown problems, as observed in the students' responses to the design challenge (Smith et al., 2015).

Amid the Covid-19 pandemic and the subsequent school closures, the need for online curriculums for students in preschool through second grade became increasingly urgent. To address this issue, researchers conducted a study aimed at creating a process and model for expanding the online learning environment for these students asynchronously. The project team employed an iterative process to solve previously unknown problems and presented a design thinking model through the development process of a topic-based virtual curriculum that covered early literacy, writing, reading comprehension, science, and math. The modified model included six stages: discovery, interpretation, ideation, testing, implementation, and evolution. The curriculum was implemented during a six-week summer 2020 period and was used by more than 5,800 preschools through second-grade students. Following the success of the program, the online platform is currently available for students to use (Severino et al., 2021).

In 2020, Attard and Holmes conducted a qualitative multiple case study to examine the impact of digital technology on the learning of pre-primary to twelfth-year students in eight Australian schools. The study revealed that technology-based exercises, along with engaging teaching methods, can enhance students' participation and interaction (Attard & Holmes, 2020). Another study focused on enhancing communication through spoken language in problem-solving activities using digital technologies as a mediator to improve the quality of classroom interaction between teachers and students.

The researchers used tested and developed methods and found that the use of digital technologies improved cooperation, reasoning, and academic progress, despite being used for specific purposes during classroom activities (Mercer et al., 2019).

In the field of digital technology and education, several studies have been conducted to investigate the impact of digital technology on learning and teaching processes. In one study, Rahiem (2021) investigated the use of digital media in storytelling by digital media teachers, children's responses to stories, and the use of digital technology in storytelling, arts, and science programs. The study provided valuable insights into how digital technology is used in these programs.

In Italy, Rossano et al. (2020) evaluated the effectiveness of the Geo+ program in teaching geometry to elementary school students. The study was conducted using an experimental study on the prototype and an evaluation study on the new version of Geo. The participants found the program interesting and effective in their learning process. In another case study, Arbieto-Batallanos, et al. (2019) used a design thinking approach to develop a mobile phone application for teaching kinematics, a branch of physics. The study involved 70 students in three groups, and the use of design thinking with user involvement helped innovation and quick response to needs through redesign.

Avcu and Er (2020) conducted a case study on gifted students who improved their design thinking skills and learned course content using different tools such as Scratch, Arduino IDE, and Lego Mindstorms EV3 in the prototyping stage of DT processes.

Lastly, Sprenger and Schwaninger (2021) investigated the tendency of students to use digital education technologies in a study conducted with 94 general psychology students at the University of Applied Sciences and Arts in Northwestern Switzerland. The study evaluated students' use and evaluation of Classroom Chat, Classroom Response System, electronic lectures (e-lectures), and mobile virtual reality (VR). The results showed that students were willing to use digital technologies for education. Overall, these studies provide insights into the use and effectiveness of digital technology in various educational contexts, including storytelling, geometry, kinematics, and psychology education.

Materials and Methods

This study is descriptive-analytical research aimed at evaluating the effectiveness of design thinking in increasing the learning level of elementary school children. To collect necessary information, a questionnaire was distributed online, which consisted of two parts. The first part included demographic information related to the respondents, while the second part included questions on a Likert 7 scale regarding children's education and the role of educational equipment. The questionnaire was completed voluntarily by elementary school teachers and parents of children aged 7 to 12 years. The questionnaire was designed to measure various factors, such as the type of educational tool (modern or traditional), the pleasantness of technology, the attractiveness of educational tools, the duration of learning, the place of learning, the use of familiar elements in educational technology, the complexity of educational equipment, the level of teachers' mastery over the equipment used in education, technology-oriented tools, educational entertainment, improving the knowledge and skills of teachers in using educational tools. The level of persuasiveness, effectiveness, and motivation of primary school children to learn was measured using a Likert 7 scale. The validity of the questionnaire was determined using the face validity method. The research variables and the formulation of questions and options were evaluated by experts, and several revisions were made before conducting the study. The reliability coefficient of the test based on Cronbach's alpha was 0.865, indicating a high validity. Statistical analysis was performed using the analysis of variance method.

Table 1: *Demographic Information.*

Variable	Grouping	*Teachers*		*Parents*		*Total*	
		Frequency	**(%)**	**Frequency**	**(%)**	**Frequency**	**(%)**
Gender	Female	52	45.6	62	54.4	114	100
	Male	15	60	10	40.0	25	100
	Total	67	48.2	72	51.8	139	100
Marital Status	Married	46	3	72	61	118	100
	Single	21	100	0	0	21	100
	Total	67	48.2	72	51.8	139	100
Age Range	20 - 25	4	100	0	0	4	100
	25 - 30	10	66.7	5	33.3	15	100
	30 - 35	11	47.8	12	52.2	23	100
	35 - 40	20	38.5	32	61.5	52	100
	40 - 45	7	41.2	10	58.8	17	100
	45 - 50	9	50	9	50	18	100
	50 - 55	5	62.5	3	37.5	8	100
	Total	66	48.2	71	51.8	137	100
Work Experience	1 - 5	15	38.5	24	61.5	39	100
	5 - 10	23	60.5	15	39.5	38	100
	10 - 15	11	42.3	15	57.7	26	100
	15 - 20	5	35.7	9	64.3	14	100
	20 - 25	2	28.6	5	71.4	7	100
	25 - 30	9	90	1	10	10	100
	More than 30	2	40	3	60	5	100
	Total	67	48.2	72	51.8	139	100
Education	Less than a diploma	0	0	4	100	4	100
	Diploma & post-diploma	8	28.6	20	71.4	28	100
	Bachelors	32	56.1	25	43.9	57	100
	Masters	23	59	16	41	39	100
	Doctorate	4	36.4	7	63.6	11	100
	Total	67	48.2	72	51.8	139	100

Result and Discussion

The study comprised 139 participants, including 72 parents and 67 coaches, who voluntarily participated in the research questionnaire. A gender breakdown of the participants revealed that 52 of the 72 parents were women, while 15 were men. In the case of coaches, 62 of the 67 participants were women and 10 were men, resulting in an overall proportion of 82% female participants. The distribution of participants is depicted in Figure 1, which presents a frequency analysis of the sample.

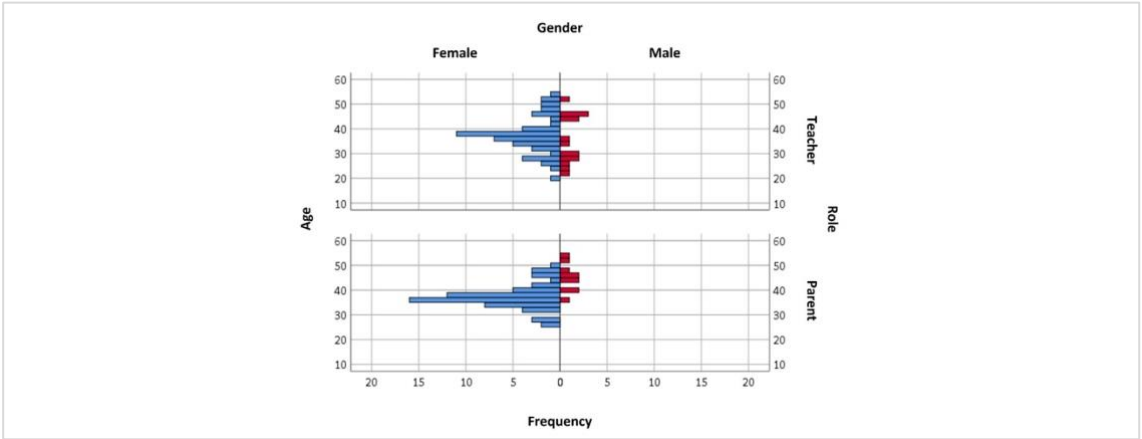

Figure 1: *Frequency of participants.*

Figures 2 and 3 indicate, respectively, the number and ages of children of parents and teachers.

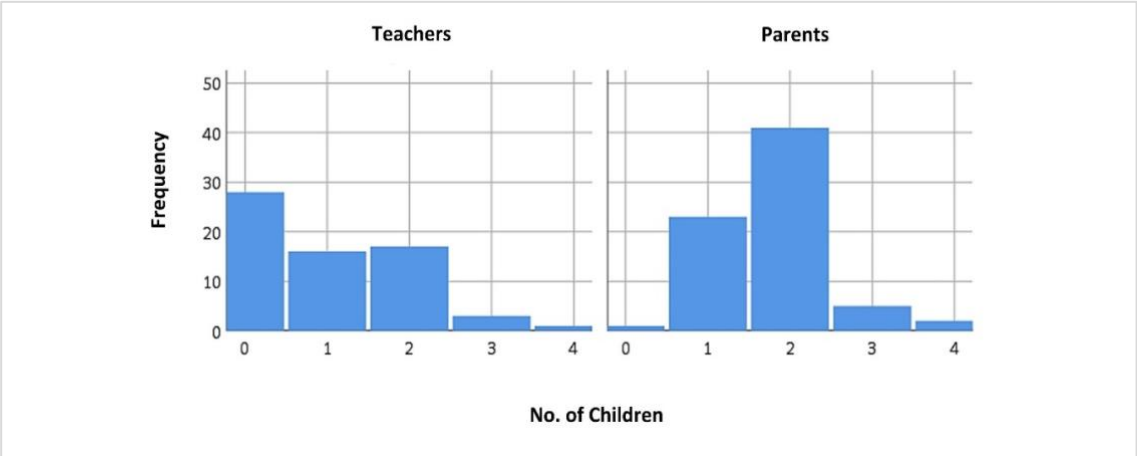

Figure 2: *Number of children.*

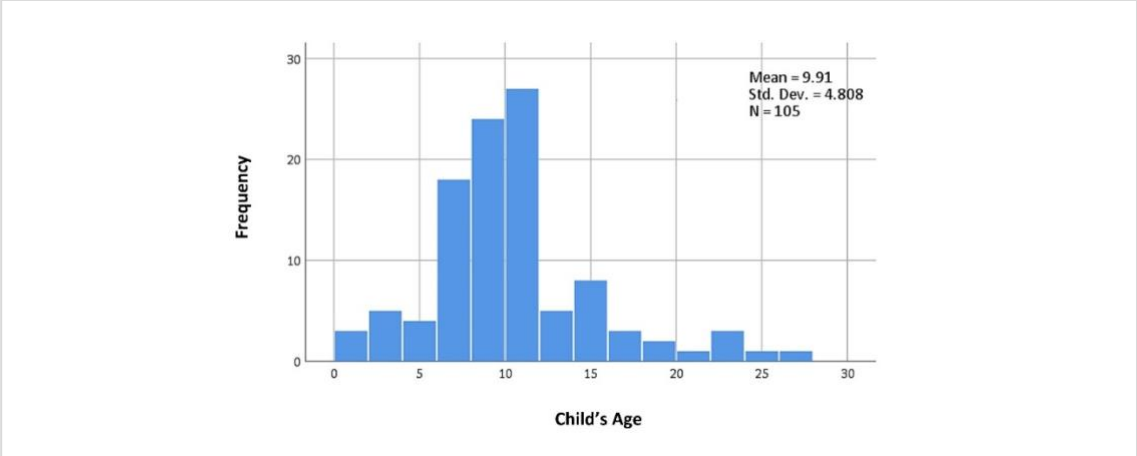

Figure 3: *Children's Age.*

The majority of the respondents in this study hailed from Tehran province, accounting for 53.3% of the sample. Other significant regions of representation included Alborz (16.5%) and Razavi Khorasan (7.2%) provinces. The remaining participants were from other provinces throughout the country.

Statistical analysis revealed a significant correlation between learning time and student motivation in learning, as evidenced by a significant correlation coefficient (P=0.000). The findings suggest that an increase in learning time is positively associated with heightened student motivation in learning. Additionally, the study found that the speed of learning through the use of technology was also a significant factor in student motivation (P=0.000). Conversely, no significant relationship was established between teachers' mastery over the use of educational equipment and students' motivation to learn.

The results of this study further indicate that the type of educational tool used, whether it is touch-based or auditory-based (such as smartphones and headphones), significantly impacts the level of students' motivation in learning and the effectiveness of the tool for educational purposes (P=0.000).

The results of this study demonstrate a significant relationship between the type of educational tool utilized and the transfer of knowledge, as indicated by a significant correlation coefficient (P<0.05). However, the study did not find a significant relationship between the increase in educational productivity resulting from the use of visual equipment and the persuasiveness of the learning level due to the attractiveness of the educational tools (P>0.05).

Design thinking, as a platform for using creativity-oriented educational equipment that emphasizes problem-solving, has the potential to further increase educational productivity. This highlights the growing dependence of education on educational tools, particularly in the realm of design thinking.

Furthermore, the results indicate that the use of complex educational tools can significantly increase both learning motivation and educational productivity (P=0.000). The findings suggest that there is a significant relationship between increased learning motivation and increased educational productivity when utilizing educational tools.

The results of the study revealed that there was no significant relationship between the interest in using technology-oriented educational entertainment tools and the effectiveness of educational tools based on creativity and problem-solving ability (P>0.05). Additionally, the results did not indicate a significant relationship between the increase in learning motivation resulting from the use of educational tools and the motivation of the learning level brought about by the attractiveness of the tools (P>0.05).

However, the results did reveal a significant relationship between educational tools that emphasize creativity and problem-solving ability and the attractiveness of the educational tools, which has the potential to increase interest in learning (P=0.000). These findings suggest that utilizing educational tools that are designed to foster creativity and problem-solving skills can lead to heightened student interest in learning.

Conclusion

The results suggest that the presence of educational tools that are based on problem-solving and foster creativity can enhance the allure of education for children and increase their educational productivity. The use of design thinking and creative tools in education has a palpable effect on increasing student engagement in the learning process. An analysis of the research questions revealed that both the simplicity and complexity of educational equipment can have a positive impact on educational productivity. This implies that the use of educational tools can improve educational productivity regardless of its level of complexity or simplicity. Therefore, the type of educational tool used can play a critical role in enhancing student motivation and facilitating better learning outcomes. This highlights the importance of carefully considering the type of educational tools that are utilized in the classroom and their impact on student motivation and learning outcomes.

The results of this study indicate a significant relationship between the amount of time spent learning and student motivation. This highlights the potential of designing educational tools and incorporating design thinking in the educational system to facilitate effective learning. By increasing the level of interaction between the student and the educational tool, and guiding the students through a controlled and structured process, the extended learning time can be leveraged to increase student motivation and engagement. This underlines the importance of considering the design and use of educational tools in the context of design thinking to achieve more effective and meaningful learning outcomes.

The significance of increasing learning time is reinforced by the correlation between student motivation, interaction with educational tools, and the principles of design thinking, which emphasize the creation of a creative educational platform. Furthermore, the findings of a significant relationship between the type of educational tool and knowledge transfer highlight the crucial role of aligning educational tool selection with the target educational topics and standards. The modernization of the educational system and the adoption of new educational tools should be guided by accurate knowledge and understanding of the subjects to ensure optimal effectiveness. Considering the gathered data and outcomes, the role of design thinking in learning performance is crucial; in this regard, educational tools and equipment in the context of design thinking might be known as an effective complex service for achieving an efficient education system for pupils. Undoubtedly the role of designers is considered in educational equipment design, making a connection between educational centers and designers, whether services or product authorities, will end in better educational outcomes.

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