

Effect of Physical Elements in Educational Spaces on Children's Creativity Promotion Using Graphic Analysis of Painting*

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ABSTRACT

Quality of education and educational spaces is important in the modern world. Due to their physical and mental conditions, children are highly influenced by the surrounding spaces. The educational spaces of children play a significant role in forming their attitudes toward education and learning. The primary purpose of this study is to investigate the effect of physical elements and factors on the growth and promotion of children's creativity. This study also aims to prioritize the considered components assuming that physical elements of architecture can promote children's creativity. The research method of this study was qualitative and quantitative, conducted in survey method, and paintings were analyzed through MAXQDA 2020 software. Paintings were selected and analyzed based on random sampling among paintings drawn by 7-12 years old children and students. It is worth noting that happy colors, large windows, shelves and special tables, and circular classroom arrangements are seen in most. Analysis of the paintings and what is in mind of children helps to create a desired space to satisfy their needs, who are the primary audiences of the space. Furthermore, children's paintings are the best sources providing access to their intellectual layers. Hence, the results of this study indicate that furniture (first rank), openings and color of physical elements (second rank), green space, and space clarity (resulted from the connection between inside and outside of the class by using physical factors of walls and body of class) at third and fourth ranks, respectively are the components affecting the promotion of children's creativity. The reason for such influence is that educational spaces and classrooms used with such features influence the promotion of creativity in the mind of children, so attendance in desired space makes the mind of children ready to accept new issues and viewpoints, which is a definition of creativity.

Keywords: Educational Spaces of Children, Children's Painting, Physical Elements of Architecture, Quality of Space.

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1. INTRODUCTION

Children are influenced by their surrounding environment. This influence lasts from childhood to adulthood. In terms of psychology, especially child psychology, many topics point to the importance of the space in which individuals grow up. The education space and architectural body of this space have a vital role. Hence, increased quality and optimality of space can be a factor for creativity growth. On the other hand, mind functions improve when self-confidence, security, peace, and comfort are improved, leading to better individual and collective creativity based on the available research. According to the present research process, the following question can be answered: How physical factors and elements of architecture can promote creativity in children? How do the physical elements of architecture affect the promotion of children's creativity? Students' viewpoint is highly substantial because they are the primary audiences of classrooms in terms of considered aspects. Accordingly, the priority and importance of considered physical factors are extracted based on the graphical analysis of students' paintings. In other words, it is assumed that physical elements of architecture can be used to promote children's creativity. In this process, this study investigates the effect of independent variables (physical factors and elements of architecture) on the dependent variable (children's creativity). This study aims to examine the effect of physical elements and factors of architecture on promoting the creativity of children and prioritize the considered components using qualitative and quantitative methods through a survey study.

2. RESEARCH BACKGROUND

Child psychology and the design of architectural bodies for children are fundamental issues. The nature of the environment and human interaction are different in every environment (Lang 2004, 34-57). In his book "hidden dimension," Edward Hall expresses some points about space perception under the influence of five senses: touch, smell, hearing, taste, and sight (Hall 2006, 26-58). The messages that children receive from the surrounding world play a significant role in their futures (Asensio 2001, 51). In the opinion of David Orr, the education and training (pedagogy) system is to foster the character of humans. In the current world, the psychological dimension of children is crucial for architectural design in spaces for children (Nair and Fielding 2012, 3and15). Children's readiness, growth, and creativity are substantial factors in creating self-confidence and responsibility (Makarenko 2002, 152-153). Play and playgrounds are important and necessary for children's mental health in terms of psychology. Some options, such as equipment and furniture used in these spaces, influence the physical and mental

abilities of children (Parsons 2016, 58). In the current world, kindergartens are designed and built to provide a space for "Play," "motion," and "opportunity for creative actions" (Galindo 2011, 156).

Now in the world, especially in developed countries, children are allowed to choose the arrangement and colors of their educational spaces. This measure makes the space more desired for children and promotes their creativity. When children are promoted in this field, they become responsible citizens that can have loud voices influencing the strategies that shape cities and their environments in the future (URL2 2003). The room where a child is present is similar to a small-scale society in which children have contributions and roles, so its quality is essential (Lorenzo 1999, 125). Anatomical data and human body sizes help to perceive the human scale in each space (Panro 1998, 47). If sufficient attention is paid to features of educational spaces from preschool to university, a comprehensive view will be created for such specifications (Barret 2001, 64). Many centers for children's care and entertainment are emerging in recent years, so a more comprehensive design can be achieved by identifying these centers (Kotnik 2015, 24). Positive results will be obtained if comments and opinions of children are considered in the design and each architectural element is examined from the viewpoints of the child (audience) and designer (Kroner 1994, 108). Officials must teach children suitable lifestyles to help individuals achieve holistic cognitive growth, to achieve their goals in a pedagogy context, and to create biological and psychological balance in future generations of the country. Individuals will achieve perfection if individual differences and various cultures, tastes, and mindsets are considered. This growth is achieved in family and educational space (Darhamjani 2020, 19). Physical environments play a significant role in people's lives. Many abnormalities are rooted in cultural and historical aspects and educational and environmental quality. School is one of these critical environments that can be considered a larger home. Hence, schools must be designed regarding the needs of children from the age range of 7-12. Architects must know the users' expectations and try to meet their physical and psychological needs. An architect or designer must know how children behave or react to various environmental factors when designing childish spaces, such as kindergarten and school (Hasankhani and Nezhaddarzi 2020, 36-41). Many children do not have exemplary achievements in school despite their high intelligence because their expectations are not satisfied based on their hobbies and moods in school. These problems may last from kindergarten to the end of university. Therefore, children will have low performance if they are not in the right learning environment (Bisnow 2021, 32).

Individuals, family, school, peers, and society

influence children. Girls are more oriented towards interpersonal relationships and more sensitive to the surrounding environment within the growth and socialization process (Svensson 2003, 324). The ability to be creative is associated with some variables such as thinking patterns, flexibility, bearing ambiguity or being unpredictable, and enjoying unknown affairs. On the other hand, the quality of the environment highly influences behavior, self-confidence, environmental perception, and attending in a matter focused on the group and team creativity. Three reasons motivate individuals to be creative: the need for new and distinguished patterns, the need to share ideas, and the need to solve problems.

Studies indicate that thinking outside the stereotypes' framework is a factor for growth in creativity. Adults mainly design children's spaces, so these spaces do not consider children's viewpoints. Therefore, designers must ask children about their ideas about the space they will be there to consider children's mental growth (URL1 2021). The systematic model of interconnected creativity is a novel culture that shapes individuals' perception of spatial patterns and the quality of that space by attending to a system. Therefore, creativity and space quality occur as a cycle that influences each other (Csikszentmihalyi 2013, 68). Figure 1 summarizes the research background.

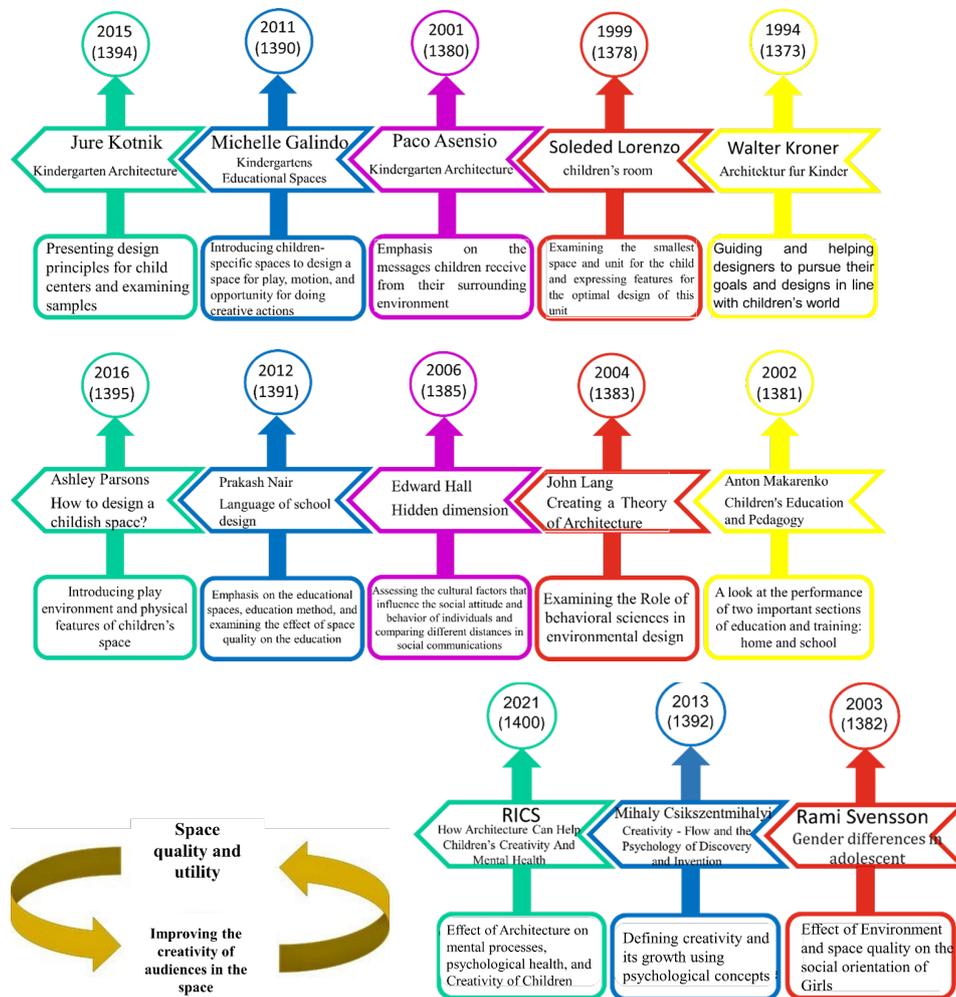


Fig. 1. A summary of Research Background

3. THEORETICAL FOUNDATIONS

Various dimensions and theories presented by scientists, experts, and theorists about the subjects must be reviewed to identify and gather more information about them. In other words, these findings are the main frameworks of the research that provide helpful information.

3.1. Creativity

Creativity is a process through which a new work, including a new idea or thing, is generated that may be verbal or non-verbal, objective or subjective (Afroz 2006, 38). Creativity is not similar to knowledge that can be taught, but Creativity resembles ability and talent (Hojjat 2014, 33). Children and their self-

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confidences must be considered to improve their creativities (Janbozorgi, Noori, and Agah Heris 2011, 124). A child's psychological health depends on his/her quality of life (Azad 2012, 243). Children need to express their new and learnable ideas (Epstein 2004, 12 and 14). Children must be helped to achieve their full capacities. In this way, they become what they think (Johnson 1995, 49 and 93). Collective Creativity is an approach to creative activity appearing in cooperation and collaboration between individuals, so new forms of topics are generated innovatively. Creativity is defined as the tendency to create or identify ideas, alternatives, or amenities. In the first phase of being creative, individuals must see issues from a new or different point of view (Franken 2020, 17).

3.2. Education

Education or training means helping to emerge desired changes in individuals. Training or pedagogy includes two types, formal and informal, while formal pedagogy is critical in developed communities. Educational institutions are increasingly searching for methods to provide holistic growth for children (Nair and Fielding 2012, 15). All issues, including beliefs and ideas, are rapidly changing in the current world. Hence, children's education must also be consistent with this change (Azad 2012, 258). Children learn in three ways, which are models and patterns (Johnson 1995, 131).

3.3. The Educational Importance of Creativity

In the opinion of Kant, the Enlightenment-era philosopher, two affairs of statesmanship and the art of pedagogy is the most problematic cases in human affairs (Nair and Fielding 2012, 15). On the other hand, he suggests educational planners that children not to be trained just for the present but for the future. In this way, planners can foster humans ready for thinking, creativity, and cognition and cope with unknowns and difficult situations. Schools must be able to promote healthy, aware, thoughtful, and creative people who can shape a desired community. The influence of the architectural body on creativity cannot be ignored (Alimardani, Amiri, and Aram 2016, 6).

3.4. Physical Factors of Education Spaces

Educational space highly depends on the quality of "classroom" or "education rooms." The importance of studios and educational workshops cannot be eliminated since skill orientation is one of the main issues in the modern world that increases creativity. Moreover, the arrangement and layout of classrooms (Figs. 2, 3, 4) are also essential cases (Nair and Fielding, 2012: 40). In the case of the features of surfaces and apparent specification of classroom, floor, walls, and ceiling of classes must be washable, flat, and seamless not being slippery and wet (Kamelnia 2009, 105 and 185). It is possible to implement a sense of intimacy and security individuals receive from the "home"

by allocating a personal space to each person in the complex.

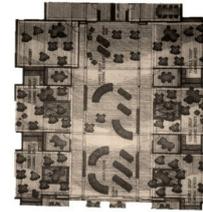


Fig. 2. A sample of Classrooms Layout/Plan with Free Arrangement

(Kamelnia 2009, 109)

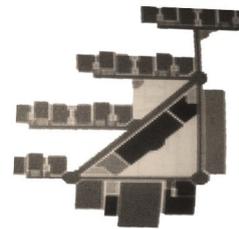


Fig. 3. A Sample of Classrooms Layout/Plan with a Linear Arrangement

(Kamelnia 2009, 107)

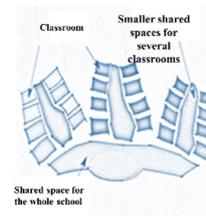


Fig. 4. A Sample of Classroom Layout/Finger-Shaped Plan

(Nair and Fielding 2012, 40)

3.5. Openings and Relevant Variables

In education, a major part of learning is done through the sense of sight. Lighting and suitable ventilation in educational space provided by openings aim to create an environment in which the learning process is pursued (Nilforoshan 2014, 45-59). Martin Laroni defines security as ensuring future welfare. The importance of ventilation and natural light in architectural design is clear to all. Normally, a child's creativity is not developed in a space with improper light and ventilation (Bozan 1987, 54).

3.6. Suitable and Comfortable Furniture

Furniture is an intermediary between architecture and people. Spaces that are always in use require durable and high-quality furniture. The form, lines, color, texture, and scale of pieces affect the spatial qualities (Ching 2011, 304-305). When selecting

furniture for children's space, the following points must be considered: being matched with the age and physical conditions of children, being diverse, being safe and durable, ease of use and cleansing, being flexible, using natural materials as much as possible,

using calming colors, harmony between colors and soft texture of furniture (Kotnik 2015, 23-24). Figure 5 depicts a sample of furniture form that is proper for children.

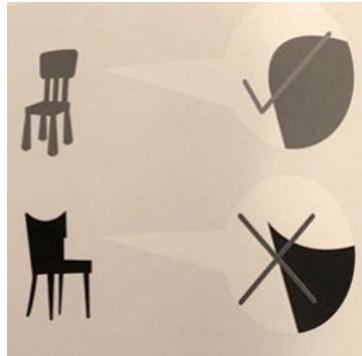


Fig. 5. Suitable Furniture for Children
(Kotnik 2015, 24)

The environments that encourage children to discover undefined and unplanned spaces are places where children can show independence in their actions (Parsons 2016, 10). Safety facilities provide health for students, and such met needs influence the creative growth in children (Ghermezi 2014, 37).

3.7. Color

Calming colors must be used when classrooms are painted. Legibility of environmental information that also includes the color of space is one of the core factors in the design of learning environments (Kamelnia 2009, 90). Color can bring dynamism, mobility, and happiness to children. Colors create different effects in the space; bright colors present the space larger, for instance. It is worth noting that the influence of these components on physical elements of architecture, such as the floor, ceiling, walls, and furniture is evaluated because the color is a visual element.

3.8. Transparency, the Connection between Interior and Exterior Space (Using Physical Elements of Wall and Body)

Nature can always inspire humans. If a natural environment with some elements such as trees, water, etc. can be created for children without interrupting this connection with a wall or window, children's creativity will be increased. Space transparency creates internal and external visual interaction giving peace of mind to the audience.

3.9. Green Space

In terms of function and performance, environment and green space are highly important in the design of children-specific environments. These spaces must be defined as a place where children feel secure and

play independently in such spaces while feeling the support of parents (Dudek 1996, 21). Connection with green space and its qualities would improve the environmental conditions (Omidvar, Alizadeshoraki and Zareshahi 2011, 49). Noise or sound pollution such as the car sound can be reduced by using trees and green space (Shieh 2016, 19).

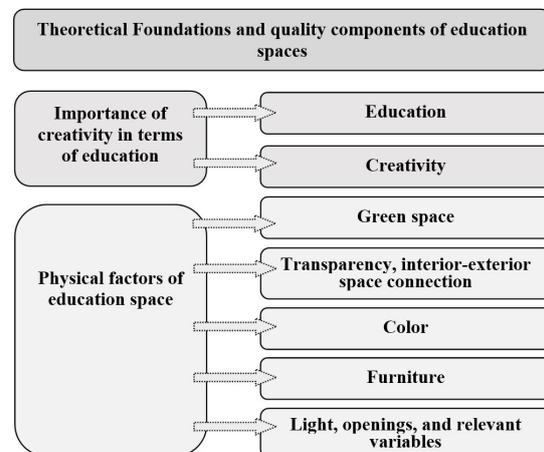
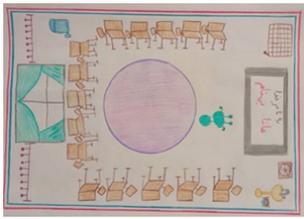


Fig. 6. Graphical Expression of Theoretical Foundations

A logical relationship can be found between creativity and physical factors of architecture by reviewing theoretical foundations and using them as theoretical frameworks of study. The figure depicts a summary of reviewed points, and Table 1 indicates three random samples of the graphical viewpoint of children about their favorite classroom shown in their paintings.

Table 1. Three Random Samples of Children's Paintings Expressing Components

Pictures			
Explanation	Random sample 12: - Consideration of colors - Consideration of flooring - Consideration of shelves	Random sample 36: - Consideration of the arrangement of furniture - Consideration of green space - Consideration of view, perspective, and transparency	Random sample 96: - Consideration of colors - Consideration of the arrangement of furniture - Consideration of the outside view

4. METHODOLOGY

Research background, theoretical foundations, children's comments, and demands about their favorite classes indicate the importance of physical activities in classrooms. Graphical analysis of children's paintings was done through MAXQDA 2020 software to improve children's creativity using physical elements of architecture in educational spaces and analyze the graphical data in the frame of children's paintings based on the qualitative method. In other words, this study aims to find how physical elements of architecture in educational spaces can improve children's creativity. It should be noted that the research method of this study was qualitative and quantitative, which was done through a survey method.

The statistical society of this study comprises children from the age range of 7-12 who were studying at the elementary level, had experience attending educational spaces and classrooms, and were selected randomly. Graphical data of children from first to sixth grade of three female elementary schools in

Qazvin (Meshkat School with around 300 students, Shaheed Farhang Ebrahimi School with around 160 students, and Shokoofeha School with around 120 students) were randomly collected. In this way, children were asked to draw their favorite class and show its features in their paintings. The sample size was calculated based on the Cochran formula, which equaled 100 students. Therefore, 100 students of the 7-12 age range were from three female elementary schools located in Qazvin, Iran.

Selected students expressed the features of their favorite classes with simple sentences through interviews and written data in the next step. The qualitative aspects of these data were assessed, then pictures were analyzed through MAXQDA 2020 software, and some codes were defined based on the children's paintings and written data, and the codes were analyzed. Table 2 reports the components reviewed and analyzed through the software. It is worth noting that the base theory of this study was adopted from the definition of creativity proposed by Franken, as mentioned in theoretical foundations.

Table 2. Components Evaluated and Analyzed through Software

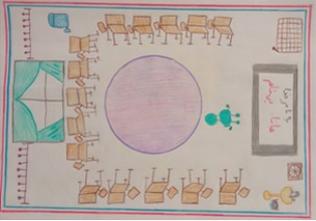
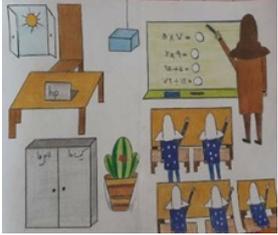
Openings	Furniture	Color	Green Space	Space Transparency
- Suitable windows - Proper ventilation - Sufficient light	- Using modern technologies and devices - Single-person tables and chairs - Ease of access to devices - Suitable arrangement of tables and tools	- Use of color in physical elements, such as flooring, wall, devices, and furniture	- Using plants and flowers	- Proper communication and view between outdoor and indoor space of classroom (using physical wall and body)

5. DATA ANALYSIS

The following points were extracted from hundreds of collected paintings and graphical data: proper view of outdoor space, green space and plants outside and inside the classroom, colorful flooring and bodies or facades, classroom arrangements, customization of devices and furniture, and presence of shelves for

classification of high-tech devices and equipment in the classrooms. Qualitative analysis was done based on these codes through MAXQDA 2020 software. These coding processes included shared and tangible features then results were presented through diagrams and charts. Table 3 reports some samples of paintings and side notes mentioned by children.

Table 3. Random Samples of Paintings and Explanations Presented by Children

No.	Painting	Explanation Written by Children
5		<p>I always wanted my classroom to be in nature and chairs to be single and comfortable.</p>
15		<p>Happy colors should be used, and we need laptops on our tables to study better.</p>
25		<p>We can sit around the classroom in a circle to see our friends and teacher. Our classroom should be bright, and the air must be fresh.</p>
35		<p>We need sunlight inside the class, we should be able to sit with our friends, and we need a large locker to put our things in it.</p>
45		<p>We should be able to sit around a large table with our friends, and put colorful vases in the classroom.</p>
55		<p>We must be able to arrange shelves and can pick up tools on the shelves, and we should stick our paintings and crafts on the wall, making it beautiful so the wall is not empty.</p>

No.	Painting	Explanation Written by Children
65		We should have a library in our classrooms, tables to put our things on it, and flowers and vases in the classroom.
75		The classroom floor can be colorful, our tables be colorful, and many windows be there.
85		We need chairs and tables for ourselves, the classroom walls to be more colorful, and I will be able to sit next to the window.
95		I want to sit next to my friends to talk to them and study with them, and a beautiful window should have to see the vases outside of the classroom and breath fresh air.

6. FINDINGS

Graphical data and paintings gathered from children were analyzed and coded through MAXQDA 2020 software (Fig. 7), and were examined as architectural data then each code was divided into architectural

elements, which are shown in Figure 8.

Elements available in each painting were classified as codes called architecture elements and then converted into colored codes. The frequency of these data was analyzed in the next step.

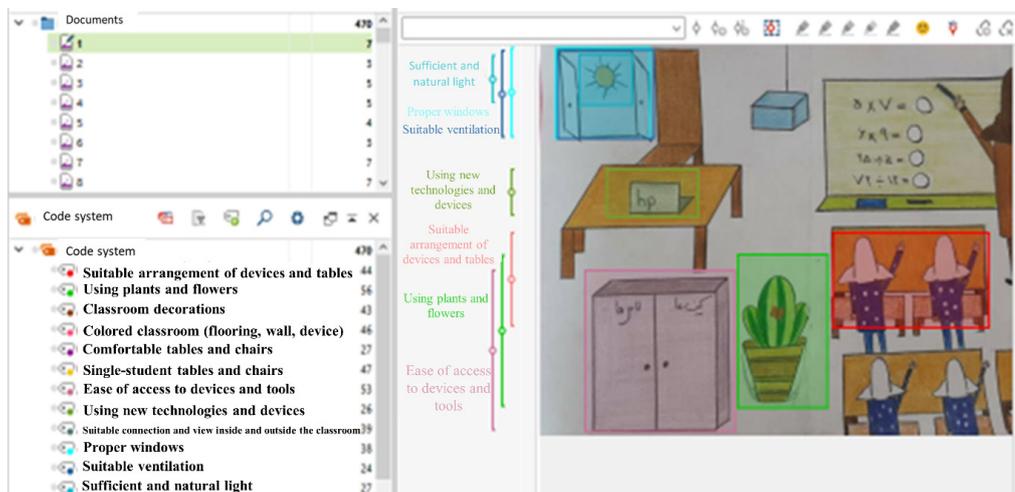


Fig. 7. A Sample of Coding Data through MAXQDA 2020 Software

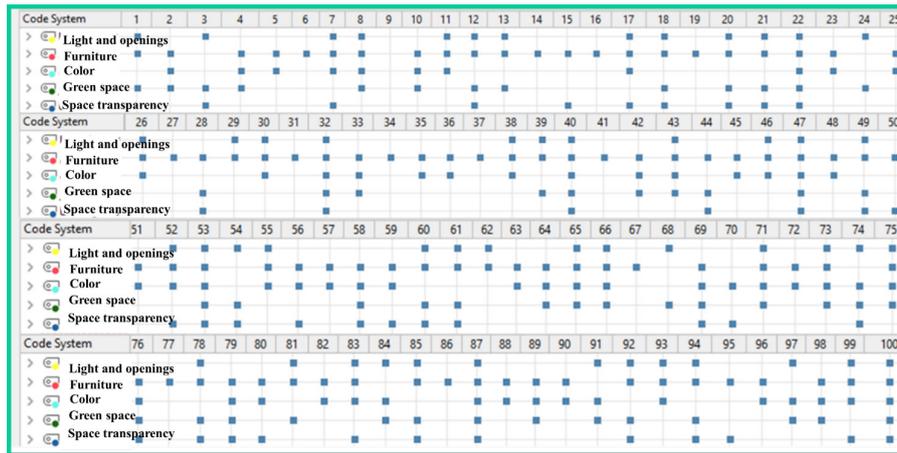


Fig. 8. Graphical Analysis of the First Layer of Architecture Codes

According to graphical analysis of data, the most frequent options are using plants and flowers, ease of access to tools, and single-student chairs and tables.

These codes are an introduction used for analyzing the second layer. Figure 9 depicts the second layer of coding and code analyses.



Fig. 9. Graphical Analysis of the Second Layer of Paintings

The next step is analyzing written data mentioned by children. These data are coded and analyzed through MAXQDA 2020 software. It is worth noting that these codes are highlighted with specific colors. Figure 10

depicts the analysis of children's notes in detail, while Figure 11 indicates the frequency of architectural components and elements mentioned by the children generally.

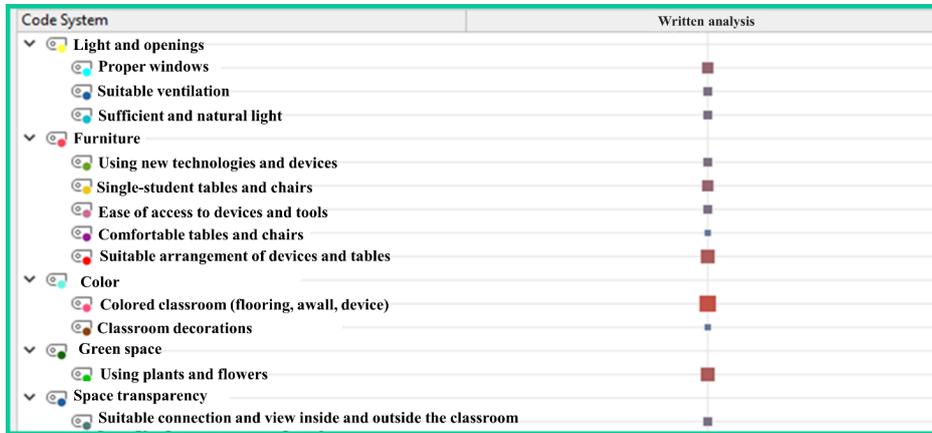


Fig. 10. Written Analysis of Data in Detail

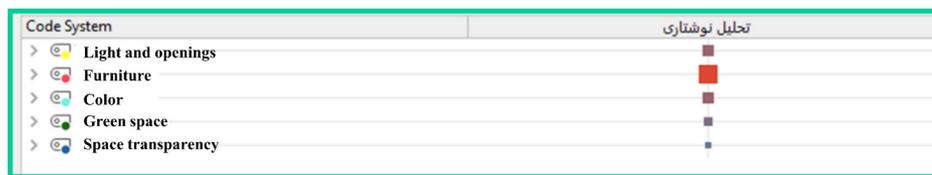


Fig. 11. Written Analysis of Data in General

The results and analysis of Figure 11 can be used to explain the considered factors. According to graphical analysis, these components are ranked as follows: furniture at first rank, openings and color and second rank, and green space and space transparency at third and fourth ranks, respectively. Another point is that this propitiation is obtained from the factors repeated

in students' paintings. In other words, students have repeated these factors and elements based on the mentioned priorities and different graphics and expressions about the same topic of "favorite classroom." This different graphic about the same topic can be the first step to creativity.

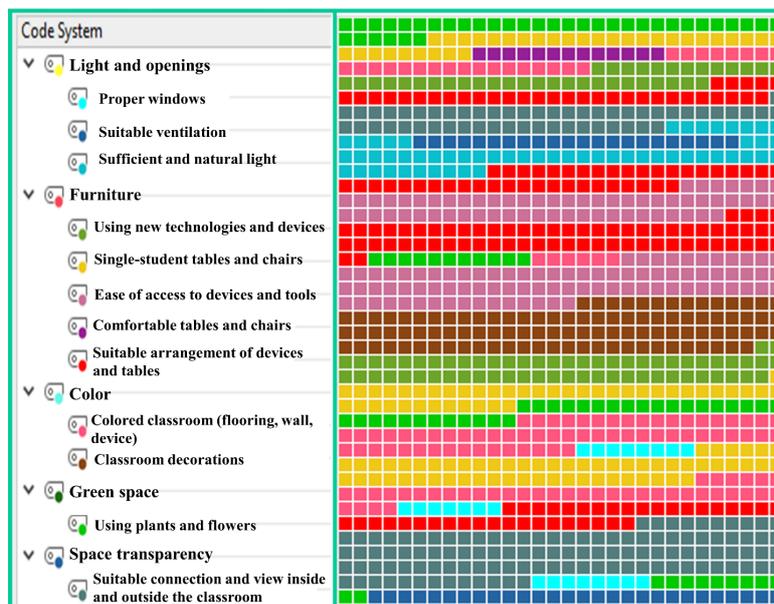


Fig. 12. Written Analysis of Data in Colored Codes

Figure 12 indicates the analysis of written data through colored codes. In this case, each color has been shown next to the architecture code defined for it.

7. CONCLUSION

After the subject background was reviewed in this study, the objective was determined then the research process was pursued through a quantitative-qualitative method and survey study, and data collected from children were analyzed using MAXQDA 2020 software. The results obtained from these analyses indicate that furniture, suitable access to devices, using new devices and instruments, single-student and comfortable tables and chairs obtained the highest score, so children preferred them. The most frequent components were emphasized in both graphical and

written data. The other components emphasized by children who were involved in the included large windows, sufficient natural light, suitable ventilation in classrooms, and using happy colors and decorations. Using plants and flowers, visual connection with outdoor space, and sufficient and proper view inside and outside the classrooms were emphasized as other frequent variables. In terms of psychological issues, female students are more influenced by the surrounding environment, and space quality highly affects their behaviors and creativities more than boys. Some solutions have been presented to explain the relationship between studied factors and find the effect of physical factors on the improvement of creativity: using green space and furniture designed for children's physical and mental needs.

Table 4. Conclusion and Recommended Solutions

Components	Predicted Needs	Results Extracted from Graphical and Written Data	Recommended Solutions
Green Space	Suitable view of plants and green space outside the classrooms	Green space (flowers and plants) inside the classrooms and close connection with this space	Using green space, flowers, and plants inside and outside the classroom to beautify the classroom space
Furniture	Designing suitable furniture for each space and paying attention to details of architectural elements	Single-person chairs and tables, comfortable chairs and tables, ease of access to devices, and their usability	Using the furniture designed for this space regarding the physical and psychological needs of children and considering practical equipment
Color	Using happy colors in the floor, ceiling, walls, and elements of the classroom	Using happy colors and colorful ornaments and decorations made by children to decorate the classroom	Combining happy colors and decorations in the classrooms and considering some parts of the class for art activities for children
Light and Openings	Suitable windows for the classroom space to provide required natural light and air freshening of the classroom	Large windows for the direct entrance of sunlight and fresh air into the classroom	Using proper windows based on the body size of children to provide natural light and ventilation in the classroom
Transparency	Communication and suitable view and access to outside and inside of the classrooms	Good view of outdoor space and interaction between interior and exterior spaces of classrooms	Suitable view of the space of each classroom, possible interaction with outside space without interference with other spaces, the connection between interior and exterior spaces of classrooms

Table 4 summarizes the research process of this study. The substantial point is that the mentioned factors and solutions are interconnected in a disciplined circulation, so the quality of each component highly affects the quality of other components. It is worth noting that these architectural elements are interconnected and move towards improving children's creativity in line with each other. The best results will be obtained if space quality is an integrated case in applying physical elements. Therefore, each architectural component is interconnected with other

components. In terms of the effect of physical factors on the improvement of children's creativity, as mentioned before, creativity is about accepting different patterns and the ability to process new ideas. Asking children to describe and illustrate their favorite classrooms provides a new perspective of creativity. For instance, several students painted the furniture layout of the classroom in a different shape. Other different and creative viewpoints seen in paintings include classrooms in outdoor spaces (Table 5). Hence,

attendance in a space that differs from the available pattern and improvement of the space desirability that directly influences the behavioral quality of children contribute to sharing new ideas, accepting different alternatives, making the viewpoint flexible, enjoying new facilities, and improving children's creativity. It should be noted that the importance of teamwork and the nature of classroom space, which is a collaborative

environment and a small society for children, provides collective creativity, cooperation morals, and integration of ideas in the classroom environment after the creative growth of each student individually. Finally, these patterns and components help children to understand their surrounding environment and improve their creative ideation abilities.

Table 5. Several Samples of Paintings Show Distinguished Patterns

Pictures			
Explanations	Classrooms with High-Level Interaction in Outdoor Space	Using Color in all Physical Elements, such as Floor	Classroom in an Outdoor Space

Table 5 presents some examples of different viewpoints of children about classrooms. The ability to think differently and promote self-confidence in children in the first stage and presence in a space far from common frameworks and rules (different colors, lighting, etc.) allow children to examine issues from different points of view, which is the base of creativity. When children are present in a space that is matched their viewpoints, far from a monotone process, an appropriate field would be provided for growing their creativity. In other words, physical elements of architecture can be used to promote children's creativity, following the central hypothesis of this study.

The results of this study can be used to synthesize architectural elements and bodies with architecture knowledge and children's wants to design a classroom with high efficiency for children, who are the primary audiences of these classrooms. The reason is that modern architecture considers both primary and secondary needs and goals to achieve the best architectural quality. Regarding psychology, therefore, children can show more creativity when attending a space that is matched their demands and can meet their needs.

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