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Research for evaluating perception of concrete material by using visual research methods in learning environments

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Abstract

While perceptual-cognitive and social-emotional processes develop from birth to adulthood, the school environment has a vital importance in children's psychology and relationships with their environment. Considering the fact that most of the learning processes are spent in the school environments in the process of child development, the importance of research on these environments becomes evident. The field study which is presented within the article aims to reveal the attitudes and preferences of the students between the ages of 6-7 whose cognitive processes are in the development stage and to evaluate their perceptual performance of concrete material in learning environments. In this study, two classroom environments with differentiated interior materials modeled with VR technology were evaluated. The first classroom is designed in accordance with the "Minimum Design Standards Guide for Educational Buildings in Turkey", while the other classroom is designed as an alternative where concrete material is dominant as an interior design element. In the analyzed definitions, it was seen that the students' responses focused on the situational characteristics of the environment and the materials, illumination and cognitive factors remained in the background. This situation is considered as the pre-operational period of children in this age group concentrate on the identifiable objects they see rather than their own emotions and personal interpretations. In addition, the study showed that the physical environment was effective in the perception of the objects that it surrounds, and that the objects with the same properties can be perceived differently within different physical environments.

Keywords
Children's perception, Concrete, Learning environments, Visual preference.

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1. Introduction

The research of learning environments based on the psychosocial context of the classes has revealed important information as a field of study for almost half a century. In recent years, research on the learning environments is useful in solving many educational problems, and it has been emphasized that psychosocial factors in the classroom are important in creating productive learning environments (Khine et al., 2017).

In the period from birth to adulthood, while the perceptual-cognitive and social-emotional processes are developing, the school environment is of vital importance in the psychology of children and their relations with their environment. Considering that most of the learning processes are spent in the internal environments of the school in the developmental age of children, the importance of the research on these environments becomes evident. In Turkey, new school buildings, which have increased rapidly in recent years, provide an open laboratory environment to investigate the perceptual relationship between children and school environments. The outputs of the work to be carried out in this area will offer the potential to develop a preliminary guideline for the ongoing new school buildings and will obtain the driving force for the design of more qualified and learning-oriented structures.

Between 2012 and 2015, 44 new school buildings were built in Istanbul as part of the ISMEP Project (Istanbul Seismic Risk Removal Project). The bare concrete surfaces of the built schools are presented as a designer decision and appear as the designer's own suggestion. Especially bare concrete surfaces in the interior, which reveal a contemporary architectural language, dominate the general space, and become the frequent characteristic feature of the buildings. The use of bare concrete in school interiors and spatial elements is not a general situation in educational buildings. Especially social judgments and cultural perspectives make it important to investigate the effect of this material on the space. Based on this point, revealing the relationship between educational structures - child perception - concrete material is the main scope of the study.

According to Tabaeian and Einifar (2011), the mental and psychological effects of architectural frameworks on humans continue from the first shelters to the modern structures of today. Action areas are concepts that have both physical properties and experience for users and have psychological effects on users (Mahmoud,2017). Today, especially in the last twenty years, interior design spaces have affected the human sense in many ways, and therefore new developments, innovations related to technology and materials have changed the field of interior architecture and the perception of users. This effect of spaces on the psychology, moods and daily activities of people makes it critical and important to investigate the spatial experiences and the perceptual status of users (Sheemesh et al., 2015). On the other hand, the variety of materials, forms and functions, especially in interiors, provides more opportunities than ordinary places to practice different spatial experiences and enrich daily routine actions. The visual perception we have obtained with environmental experience is the most effective and primary sense in making sense and understanding of the environment.

According to Berger (1989), the sense of vision includes more than eighty percent of the information received from the environment for perception of the environment. It also has one of the most important roles in space perception because spatial elements such as color, texture, and form comprised the basis of visual perception (Aydınlı, 1986). The visual environment and perception ensure that the user touches the space and transforms into actions such as directing, navigating, experiencing, and responding by building a bridge between oneself and the individuals (Figure 1). An average person is exposed to more than 5000 photographs per day (Alawadhi, 2010). Perception mostly starts with a vision and continues with the help of different parameters. As seen in Figure 1, perceived space thought results in the perception of space with the effect of previous experiences such

as thought, memory, and imagination (Pop, 2013). In the process of visual perception, individuals experience a superficial acquisition process related to perceived concepts. This process is a two-dimensional perception. At this stage, individuals perceive images as width and height, but after this step, they begin to form a deeper model regarding the concept of visual perception. Within these processes, the perception of depth is included in the third dimension. This whole process gives meaning to the concepts with cultural background and the concepts identified (Erişti et al. 2013). The perceived reality gains meaning with an image produced by the understanding of society. At that time, image recall begins to form the basis of the concept of experience and perception in the social environment (Halbwachs, 1925).

School circles are the physical environments in which the development of their own cognitive processes occurs as well as the places where children perform the learning action. The development of senses such as seeing, hearing, taste, smell, and touch continues to develop with learning in the school environment. Children who touch the environment at any moment create their own world by using every information they receive from the environment. While having the most important stage of their psychological processes in schools, all of these situations increase the sensitivity of the educational structure from a social perspective.

The development of the senses such as seeing, hearing, taste, smell and touch have continued to develop along with learning in the school environment. Children who are in contact with the environment in every moment create a world of one's own by using every information they receive from surroundings. While they are spending the most important phase for their psychological process in schools all of these situations increase the precision of educational structure in social point of view. Therefore, educational buildings have importance on society and shape the future. Gür suggests that, child behaviors are determined by the psycho-social environment and space rather than their personal characteristics such as personality and intelligence (Gür, 2002).

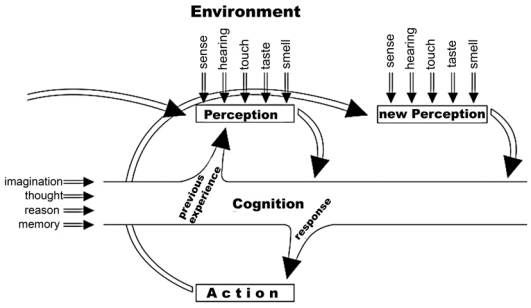

Figure 1. *Space Perception (Pop, 2013).*

Educational Structures Minimum Design Standards Manual – 2015, describes the features that educational structures should have in Turkey (Figure 2). Accordingly, the concepts of social facilities, workspaces, comfort, flexibility and sustainability come to the fore, and in this direction, every material and product used in the design should be suitable for the psychological, cognitive and mental development of children. However, the standards guide does not contain a description of possible new materials, possibilities and new technologies. Moreover, the research about the effect of interior materials on children perception are limited.

According to ESMDSG (2015), some of basic standards about material and color are listed below,

- All floor coatings have to be hard, stable, impact resistance, low maintenance and nonslip.
- Doors, windows and different floor heights must be highlighted with vivid and warm colors.
- Special color must be used on most single walls of each interior spaces and gender discrimination with the use of colors like pink-blue must be avoided.
- All ceilings and wall paints have to be water-based and must not contain chemicals that are harmful for human health.
- Metal cabinets must be painted with polyester or epoxy polyester powder coated painted with the electrostatic painted practice.
- In the facades, instead of dark and bright colors pastel colors must be prefered.

Figure 2. *A standard type of school interior.*

- In exterior facades, colors such as blue, navy blue, claret red, red, dark green must not be used.
- In facades without windows may be used little darker colors and consist of two colors.
- In facades with windows brighter colors must be prefered to use.
- In interiors, up to 1.50., oil painting applications should be in pastel colors like salmon pink, champagne, lilac etc. For surfaces above 1.50m, specified colors' tint should be used.

In this context, it becomes important to reveal the effects of new design trends and material choices on educational structures, students and development processes and to conduct research on the subject.

The use of materials in the design affects the perception process. Material is not only important because of the requirements such as aesthetics, production techniques, time, financial condition, sustainability, but also because it interacts with past experiences, social identities, cultures (Zuo, 2010). A study by Zuo reveals that physical parameters such as surface temperature, smoothness, softness and brightness of the material affect human perception and differentiate the relationship of users with space. Accordingly, the materials used in the space affect the definition of the space and help us understand the perception of the user. The material also helps users define the concept of perception and make sense of daily life by defining the space with physical words and senses.

Wastiels et al. (2013), in his field study, reveals that prejudices about materials are effective in the perception of space. In his study on 116 students, Wastiels et al. (2013) revealed that prejudices are effective especially in visual evaluation while evaluating materials within the scope of visual and cognitive perception. For example, concrete material, which is described as similar to wood material when touched and evaluated positively, was evaluated with negative adjectives such as cold and hard in visual evaluation. Wastiels et al. (2013) concludes that prejudices and stereotypes can disappear if physical properties are perceived similarly with different senses. While it is possible to discuss prejudice and past experiences in this study conducted with people between the ages of 17-25, it may be thought that the results will be different in children who are in the age of growth and whose cognitive development is not completed. Children with less previous experience may have different prejudices or appear less biased. It is precisely at this point how children, who have not completed the cognitive development process, perceive the environment and how they are affected by the environment they are in.

From another point of view, it is mentioned that the materials cannot be compressed into a single interpretation. According to Zumthor (2006), thousands of possibilities are hidden within a material. Materials open the doors of infinite perceptions with their components, states, colors, locations within the space. With this definition, it is concluded that the materials gained meaning along with their own context and content.

To understand the tendency of using concrete in design, it is important to look over the changing tendency of using concrete in history. Known as a durable material, concrete has a long journey in design history.

2. Concrete as a physical and phenomenological asset

Concrete is the second most consumed material after water (Essays, 2013). Considering the physical features and factors such as cost, process, durability, procurement, construction technique, workmanship, sustainability, concrete has great importance in terms of architecture.

In architecture, reinforced concrete has an autonomous role practically in all areas of building practice (Bake & Nolan, 2009). It is also an individually identifiable material within the structure in different forms. "Concrete had its own roles in this pattern of complex, chaotic political compromise and expedient bodging" (Calder, 2015). Beyond being a material since the period before Christ that concrete directs architectural trends, it continues to exist in different forms by increasing its importance and with the help of developing technology.

Since this material was made from natural materials in ancient times, modern concrete was created by industry which was introduced in 19th century. In that time concrete had been used only for bridges, piers and heavy walls. However, at the end of the 19th century it was begun to use it for creating high rise buildings thanks to reinforced concrete (Ambrose & Tripeny, 2007).

For the load-bearing systems, factors such as cost, duration, strength, exterior conditions, workmanship, ecology and sustainability should be considered in detail. Reinforced concrete structures produced by on-site casting system provide a continuous form. This form gives a different meaning and character to the structure. Due to fragmentary (jointed) structure of prefabricated systems, the cracks and hence deteriorations in the monolithic structure.

In the history, concrete has also been important for defense because of its physical endurance. In the Second World War, the blockhouses / concrete bunkers had been need to arise to defense against the developed war and attack technologies under that period's conditions. These structures were constructed at strategic locations in order to see the maximum area with minimum visibility and these structures had also thick walls and less gaps (Ocak & Tekin, 2019). Concrete has helped this type of structure -unlike previous defence structure – without joint, fragmentation and deterioriation as a whole and this has provided opportunity for better protection. The bunkers, which were built from concrete for protection were described by Virilio (Virilio, 1975) with their restrained volumes, rounded angels and rare openings. Today most of these bunkers are used as a museum and art spaces that put forth the duality between the cold atmosphere of bunker and new alternatives for art. In these structure concrete can be seen as a representation of robustness and safety. After the World War I, modernist architects utilized from concrete the deconstruction of new cities. Le Corbusier was the one of them. Corbusier fascinated using concrete as an architectural elements both in exteriors and interiors. Le Corbusier used the ability of concrete to create various molding forms, open floor plans, wide windows and free façades. These characteristics can be seen in the Villa Savoye. Tactual expressiveness of concrete took Le Corbusier's attention, which could provide primitive purity and wider scale building typology (Calder, 2016). That is why Corbusier used concrete as a poetic engineer, it can be seen at monastery of La Tourette and Chapel Ronchamp. It was the time that actually Le Corbuser processed the bare concrete, and then brutalism and new brutalism movement occurred. After than clearly can be said that, concrete material become something more than material, but also the way of looking to simplicity and clarity.

In the socialist era, concrete had his own new meaning and become a part of the new manifesto. Beside the durability and speed of construction, the perception of eternity and confidence became the main relation between social community and manifestation of strong nation. Concrete monuments and urban furnitures started to be seen in every point of the new designed socialist cities.

Nowadays concrete maintains its importance and designers still prefer to use the material both in buildings and in their interiors. When the concrete material is seen as a form of simplicity by architects, it will not be fair to expect the same from the users.

The tendency of governments of Turkey to design new group of schools in Turkey, gave the opportunity to investigate the students' perception of learning environments. More importantly, concrete which was the main interior material, create a new platform to discuss and investigate the impact of material on perception.

ISMEP project was created as an educational policy since Turkey is in the earthquake zone, and it is an innovative approach in the context of improving the educational structures, including 44 new schools, which are built in a short time and whose architectural projects are carried out by Uygur Architecture. The selection of school building interior material as concrete appears as one of the most characteristic features of the project (Figure 3). Uygur (2015) attributes the use of bare concrete surfaces indoors to physical properties such as fire resistance, easy availability, scratch resistance, impressiveness, courage and inspiration, and also underlines that concrete can be used as a creativity board. These schools, which are defined as "Local School" have been suggested to establish new relationships between students and the student-school space (Uygur, 2015).

With a preliminary study photograph and survey method that examines this new design concept based on reinforced concrete material on a group of 80 people with architectural education and without architectural education, Uygur discussed the concept of bias proposed by Wastiels et al. (2013) and the effect of materials on interior designations. The study revealed that students who did not have an architectural education considered the place to be more positive than those who received architectural education, and although the place was defined as "cold", it was not defined as a negative feature (Seymen, 2019). According to the results obtained, it was observed that the physical properties and architectural composition of the space, such as space volume, corridor widths, were more effective than the material features such as color and texture in the participants' preferences.

3. Method

Aim of the study is broadly about to understand both relation and results of material and perception concept together within the scope of environmental psychology and interior architecture. Furthermore, try to express the role of material is not only as a physical element but also as a metaphoric meaning of the material. Objectives of the thesis can be clarified as below.

- To introduce metaphorical and contextual relation between architectural interior spaces and perception
- To evaluate the effect of concrete on spatial perception in learning environment.

Within the scope of the article, a field study was conducted to investigate the tendencies and preferences of primary school students towards classroom interiors in order to evaluate the perceptual performance of concrete material in learning spaces. Considering the school environment, it can be said that students spend most of their time in classroom settings where learning ac-

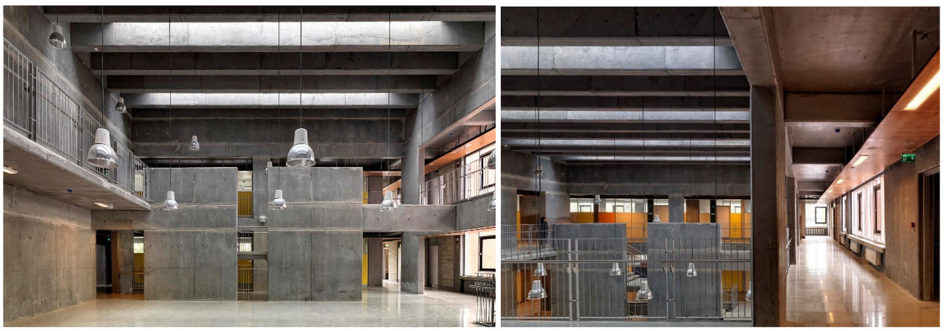

Figure 3. *Beşiktaş Yenilevent High School (An ISMEP project).*

tivity takes place rather than corridors. In the field study in which 33 first-year students were treated as subjects, two classrooms modeled with VR technology and interior materials differentiated were evaluated. While the first of the classes was designed based on the Educational Structures Minimum Design Standards Manual, the other class was created as the second option where concrete material is dominant as an interior design element. Students experienced classroom spaces through VR glasses and questions were asked to evaluate their perceptions with the face-to-face interview method. In the last stage of the study, the answers given by the students were analyzed and evaluated.

The reason of using VR method is to give opportunity for participants to feel the space more realistic and to give an objective line of vision. Virtual reality is defined as a 'real or stimulated environment in which perceiver experiences intelligibleness – telepresence. Telepresence is also defined as the experience of being in an environment through a communication medium (Mineev, 2017).

The children who are conducted in study were in operational period of perception and when they perceive the concrete classrooms they can not only perceive the concepts but also express their feelings objectively and without prejudices.

To understand and examine this ideas, two different classrooms were designed with material variations. For both classrooms, physical elements / furniture were remained same however material and texture changes were applied. The material discrepancies were practiced for only walls and floors which are architecture elements when desks, chairs, chalkboard, door and windows, which are physical elements, were identified same color/material for both classroom designs.

3.1. Case study

In the field study conducted within the scope of the research presented in the article, students between the ages of 6 and 7 were considered as the subject group. The most important reason for choosing this age group is that they have not completed their cognitive processes and in this context, their spatial or sensory bias is minimal. The period between the ages of 2-7 is when the brain is most open to the senses and can organize them. In this period, which is defined as the preoperational stage by Piaget, children can use word and image symbols to represent objects, be influenced by the images they see and classify objects (1969). In the period between 6-12 years old, the environmental image is processed in children (Özak, 2008). In the pre-procedure period, information about problem solving is gained and rules can be understood (Kol, 2011). During this period, non-congenital information based on environmental data is obtained. According to Piaget, they perceive the volume, weight, size, and concrete properties of objects and gain the logical thinking ability called "series" (Babaoğlu, 2007).

In the field study, where 33 first-year students were treated as subjects, the classroom environment that students will evaluate was modeled with VR technology and its interior was created with two different materials (Figure 4). VR is a technology that provides the environment we can be a part of and includes the space in real-time (Algahtani et al, 2017). In the modeling of the first class, Educational Structures Minimum Design Standards Guide was taken as reference (Milli Eğitim Bakanlığı İnşaat ve Emlak Dairesi Başkanlığı, 2015) and indoor material and color features were created based

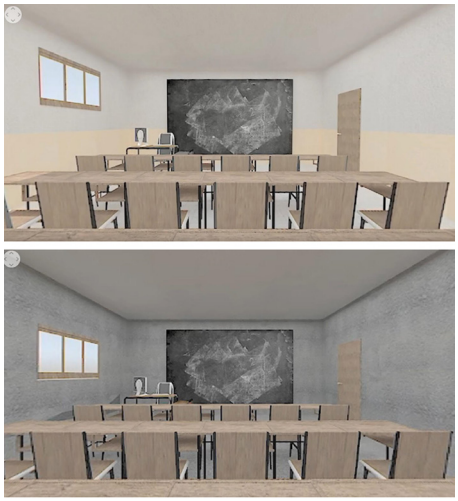

Figure 4. *Classroom interiors presented with VR technology.*

Figure 5. *Concrete texture which is used in renders.*

Figure 6. *Photograph was taken during the case study.*

on the given regulations. Tables, teacher's desk, chairs, windows and door material were determined as wooden texture, and the wall color is processed in two colors with bright and toned. Floors were determined as shiny ceramic texture.

The other class to be evaluated has been created as an option in which reinforced concrete material is dominant in the interior, regarding the class characteristics in primary schools prepared within the scope of ISMEP Projects. Textured surface material was used to increase the emotional appearance effect and strengthen the perception of concrete material (Figure 5).

The modeling of the two classes was carried out in 3DsMax, a 3D drawing software, created as a video for viewing in VR technology, and a playlist was created to allow the movements according to the user's requests. "Everest Vr Glas - VR022" model was used to display VR videos over the internet interface. As a methodology, the children used as subjects were asked to perform three different tasks in one-on-one interviews:

- Describe both classes with two words.
- In which class they chose to have their lessons
- They were asked to say for what reasons the selected class was chosen.

In the creation of tasks, sensitivity was shown to make the questions short, clear and understandable, and children who tend to be affected by each other to complete their duties separately.

In the first step, OCD or CDCD was showed to children and asked to express their thought in two words while wearing glasses. In second step, the image was changed to other classroom design and firstly asked about the classroom choice to attend a class and the reason of the choice. In the third and last step they are asked about their expressions in two words for second seen classroom. The reason for the asking about the choices before second video was to get first impressions and not forget to first video.

The main aim to ask their classroom choices that research about preference in terms of material perception. To compare with the previous case study, survey was evaluated by the concept of children's choices. Children who are at the beginning of perception development were preferred because they do not have prejudices in terms of preference.

3.2. Analysis and evaluation of data

The evaluation was carried out in two stages. In the first stage, the class preferences of the students were examined; in the second stage, the definitions made for both class types were grouped and presented. In which class the subjects prefer to have a lesson is graphically shown in Figure 7. Students preferred both classes almost equally (42%, 46%) and four students (12%) showed abstaining preferences.

In the next step, students' definitions of classes are grouped and examined and expressed in Figure 8. Positive and

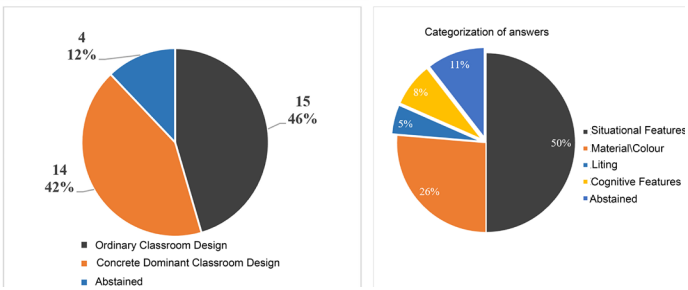

Figure 7. *Graphic that shows classroom evaluation for 33 students.*

negative judgments are put forward by grouping preferred class definitions and non-preferred class definitions. For example, if the "walls look different" assessment was made for the class of choice for the student, it provides a positive perspective, and if it is done for the class for which it does not choose the same definition, it is considered as a negative trend. While such a description table reveals with what adjectives of both classes are defined, it also gives information about the positive or negative usage tendencies of these adjectives (Figure 9).

The reinforced concrete class was evaluated positively with definitions such as "good environment," "few chairs," "beautiful rows," while the reinforced concrete wall was evaluated negatively with definitions such as "gray," "colorless," "black," and "closed" (Figure 9).

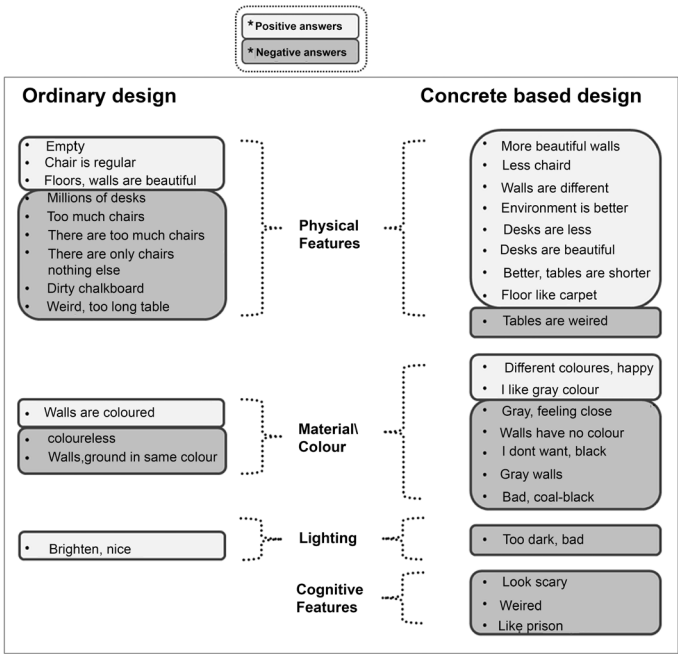

Figure 8. *Descriptions of two classrooms.*

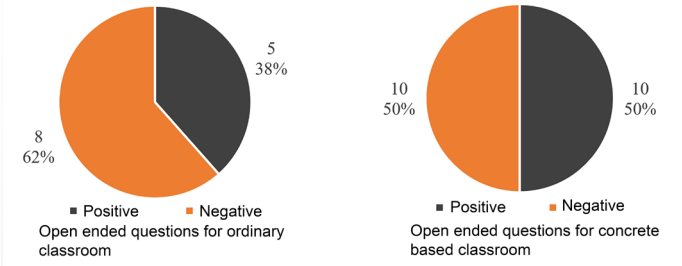

Figure 9. *Negative and positive responds to standard and concrete material used classrooms.*

Table 1. *Responses of abstaining students.*

Responses of abstaining students
- I dont want to attend a class in non of them, two classes are the same
- I dont want any of them
- I can attend the class in both of them, there is no difference
- Both are the same

While the standard class was considered negative with features such as a high number of chairs, high number of rows, it was evaluated positively with its regular and bright appearance. Overall assessment rates for both classes are given in Figure 7.

Four students, who refrained from a vote in their preferences, stated that they did not want to make a choice and that their thoughts were the same in both classes (Table 1). It can be said that these students do not see a significant difference between the two spaces and therefore did not respond.

When the definitions made for the class design with concrete material are grouped, mostly positive definitions about the situational properties of the space have been made, whereas negative comments have been centered upon color and material. Although the number of rows and tables is the same in both classrooms, in the standard class where the wall color and the table color are the same, the number of tables and chairs was perceived as excessive, and this came out as a negative feature. At this point, it has been observed that the physical environment is effective in the perception of the objects in it, and the same number of objects can be perceived differently in two different physical environments. Especially considering that wall colors form a background for human perception, their effects on general perception emerge.

In the definitions made for classes, it was observed that the responses focused on the situational characteristics of the space, and the material, illumination and cognitive factors remained in the background. This situation can be evaluated as the fact that the children in this age group, which is de-

fined as the preoperational stage, are focused on the identifiable objects they see rather than their own emotions and personal comments. Therefore, definitions such as "being large", "being small" and "crowded" can be seen as an expected situation. In the development of perception, children in the concrete operations period evaluated the place where they were located, as predicted in the hypothesis, independently of cognitive factors. Although reinforced concrete does not see the traces of social perception and prejudices predominantly, dark color feature and darkness features are emphasized in class descriptions.

4. Conclusion and discussion

Process of perception is started with the senses like seeing, smelling, touching and therefore spaces are perceive with the help of each element in design including material. Children perception is also affected from every impact from the environment in each perceptual stages. Therefore, children perception is not only important for their development, but also have significant impact on societies.

In addition to the fact that the concrete has many significant contributions to the structures physically, the areas of use is quite wide thanks to different forms and components. The importance of concrete in construction and design history also affects today's structure. Besides being used as the main element in structures, concrete is included in the designs as interior architectural elements. Therefore, the idea of concrete as a phenomenon provided research concept in this research.

While the learning activity is carried out in the classroom, the progress of the students is usually determined and performed through tests and exams, but the psychosocial aspects of the class spaces are often neglected in this process (Fraser, 2014). Classes can be defined as micro-community spaces that create their own ecosystem and affect cognitive outcomes during learning behavior (Khine et al., 2017). The theoretical background of the study presented in this article is based on perceptual development, learning spaces and material perception in children. Learning environments have many different parameters. These structures are the places where the most important stages of the development period in children take place, and children spend most of their time in these places. For this reason, while providing physical comfort ideally, psychological and perceptual development of children should be taken into consideration in the context of interactions with the space and should be included in the design processes.

Although design and use parameters of the educational structures in Turkey is defined in "Educational Buildings Minimum Design Standards Manual" these specifications do not have descriptive data on possible new trends and material alternatives. 44 new schools which are carried out within the scope of application and project of ISMEP Project in Turkey open up a new trend with the features they host and the places they offer. New materials and usage types in these schools, provides a platform to discuss concepts such as social habits, cultural judgments and spatial perception in school buildings. The information and findings to be obtained about these structures, which we can define as a "new type of project", can play a role in designing healthier and more effective education structures by feeding the design processes. Besides, these structures, which define new habits along with new materials, will also support the discussion of concepts such as social prejudice and cultural perception.

The field study presented in the article examines the preferences of students in the 6-7 age group who have not completed the cognitive development period about their class spaces, and especially focuses on the role of concrete walls in these choices. A study (Duyan & Ünver, 2016) investigating the effect of classroom colors on performance revealed the performance of different colors using the attention test, and revealed that different colors had different effects on students' attention. The study in question showed that the purple color shows the highest performance and the red color the lowest. This study, conducted in the 8-9 age group, focuses only on colors and discusses the

color scale. Besides, it will be useful to examine the materials with different environmental parameters as well as their physical properties.

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