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A Spatial Configuration Oriented Control System as a Mobile App for Educational Facilities Design in Turkey

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Abstract

Facilities has decreased due to the developing technologies around the world. The main objective of this study is to offer an alternative solution in terms of architecture to the use of copy-type projects which are still used by the Ministry of Education in Turkey. In this direction, it is aimed to develop a software to make the spatial configuration of an educational structure in the design process controllable. In this study it is planned to design a feedback mechanism that architects can use in the educational structure design process. The data obtained as a result of expert interviews, examination of guidelines by the ministry and examination of existing types of projects with the space syntax technique were transformed into software language. As a result of analysis done, evaluations were presented in line with the obtained data and findings. Out of these a pre-notification mechanism was designed to be used in the design process of educational buildings. The feedback system, which is defined as educational buildings in the current article, can be applied in different areas such as clinics, hospitals, shopping centres and university buildings in the next stages. By using the mobile application that is emerged as a result of the research, the designers will be able to identify problematic spatial relationships by providing data to the application at different stages in the process of designing an educational structure. Thus, it will be able to intervene in a timely manner based on the problems it detects.

Keywords:
Educational facilities, feedback, interior design, spatial configuration.

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INTRODUCTION

Education plays one of the most active roles in the self-determination of nations. In the 21st century, when the concept of globalization has become more prominent, this role causes the differences and similarities between the structure, process, purpose and policy dimensions of different education systems to gain importance (Balcı, 2018).

Schoolhouses have historically been the symbol of grassroots national education policy delivery (Uduko, 2015). In 2005, the OECD Programme on Educational Building (PEB) organised two international experts' group meetings to discuss how countries define and evaluate quality in educational facilities. According to the research and experiences of six experts the meaning of quality in educational facilities were defined. All individuals have the right to have a quality educational and a physical space that facilitates the learning process as an educational facility which is cost-effective over time, respectful with the environment, encourages social participation, and provides a healthy and comfortable environment. They also mention that universal parameters that reflect temporary, local and tangible quality dimensions such as flexibility, sustainability, and preventive and corrective maintenance can be used to evaluate the physical space that defines a school worldwide (Abend et al.2006). Moreover, studies have been done on methods of evaluating and optimizing environmental comfort parameters (thermal, acoustic, natural lighting and functionality) of school buildings during the preliminary stages of design which shows the importance of educational facilities design process (da Graca et al.2007).

Learning is the most important activity in educational facilities. Understanding the physical conditions of these structures and the effects of it on students' motivation is a complex process. Teaching resources, teacher quality and education plans and programs have an important place in the education process of the child and these factors are effective on student success (Lyons, 2001). The physical and environmental conditions of educational facilities are the primary conditions that directly affect students' ability to be productive and learn. Conditions that will ensure the physical comfort of individuals such as ventilation, heating-cooling, natural lighting, healthy material selection and acoustic comfort are a few of them (Tavşan & Yanılmaz, 2019).

The main purposes of educational facilities are to ensure the integration of the individual into the society, to provide education and to produce and transfer culture (Johnson, 2006). Other purposes of these facilities are to present the educators as role models for students, to transfer valid behavior patterns and beliefs, to disseminate the traditions approved by the society, and to provide cultural change by discussing, testing and selecting the values affected by great changes and passing them on to new generations. One of the international

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drivers behind the transformation of school design has been the promotion of the child-centered learning model in primary education pedagogy (Woolner, 2010; Hille, 2011). As a result, classroom elements like windows and learning spaces have been designed at a more intimate scale to meet the needs of children. For collaborative learning, child-sized furniture should also be placed in groups (Uduku, 2015).

In accordance with the central government principle adopted in the Constitution in Turkey, the Ministry of National Education has to carry out all educational activities managed centrally in the Republic of Turkey. Education levels consist of Preschool, Primary Education, Secondary Education and Higher Education (Eurydice, 2015).

Each level is 4 years in terms of primary school (1st, 2nd, 3rd and 4th grades), secondary school (5th, 6th, 7th and 8th grades) and high school (9th, 10th, 11th and 12th grades). It is implemented on a compulsory 12-year gradual basis. In addition, primary, secondary and high school levels are compulsory for individuals with special education needs, as well as pre-school education (Eurydice, 2015).

It is stated in the revised "Ministry of National Education Educational Buildings Minimum Design Standards 2015 Guide" (which will be represented as “MEB Guide 2015” for the rest of article) that "new or repaired education facilities, special projects prepared by governorships or philanthropists, are aimed to meet today's expectations and needs of education. According to the data obtained from 2017 Ministry of National Education statistics, It has been noted that significant repairs and upgrades to existing schools typically focus on strengthening the structural foundation and enhancing the physical facilities (Çakır & Tuna Taygun, 2021). It should also be done in accordance with the developments in technology in education and training, the legislation in force, region and land conditions, region and land conditions, qualified education environments, in addition to being safe, aesthetic, and accessible to everyone.”" (MEB guideline, 2015). The difficulty to assemble the rules of educational facilities designed by the designers due to the multiplicity of the rules of the Ministry of National Education is the main problem that was taken in consideration in this study.

Copy-type projects are projects that are based on certain data to be used in the construction process of buildings based on the repetition of similar organizations. The main reasons for the continuation of copy-type project applications in Turkey are primarily to minimize the mistakes in the planning of school buildings and to provide economic profit from the construction. The reasons for the implementation of copy-type projects for educational buildings in Turkey are listed by experts as follows:

- Ease of preliminary cost evaluation for the investments to be made,
- Accelerating school investments,
- Providing standard opportunities for educational structures,

- Making a balanced use of the available resources throughout the country,
- Providing maximum project service with limited technical staff,
- Minimizing project costs (Gür & Zorlu, 2002).

Gür and Zorlu (2002) explained the disadvantages of copy-type project applications as follows;

- Such projects cause functional problems as it is not possible to predict educational and social developments.
- Educational buildings become too small or too big for the population of the region they are located at.
- Weaknesses in open and close area relationships.
- They are multi-storey, bulky structures that are not suitable for educational buildings.
- They are not physically aesthetic.
- İnconsistency of the climatic characteristics of different regions with structures (Gür & Zorlu, 2002).

Copy-type projects also have deficiencies in terms of meeting the psycho-social and cultural needs of children. The problem of uniformity in these structures affects the identity of the city and does not comply with the characteristic features of children such as originality and privilege. In high-rise copy-type projects where the relationship between the classroom and the garden is broken, the sense of trust and shelter that can be provided by the spatial arrangement of the children is ignored. With classrooms lined up along a corridor, high-ceilinged, dry, and colourless-copy-type schools are far from offering perceptual richness to children. In addition, since it does not contain a multi-purpose indoor space where children can spend time during recess, it is not possible for children to have a break during the winter months.

The use of the copy-type project application for the design of educational buildings has decreased throughout the world due to the problems it creates in the usage process. The positive effects of a properly designed education structure on the education received by the student are one of the frequently encountered issues in national and international research areas. The main purpose of this research, considering these two factors, is to develop a method proposal so that the educational buildings built by the Ministry of National Education in Turkey can go beyond the boundaries of the copy-type projects and the designer effect can be seen more in the design process of these buildings. Accordingly, another aim of the study is to propose an inspection model that can prevent the problems that may arise in the implementation of the requirement lists and copy-type projects recommended for educational buildings.

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student are one of the frequently encountered issues in the national and international literature. The fact that the number of functional areas in the educational buildings, which is the focus of this study, and the fact that the relationships established between these areas are faulty, can leave irreversible traces to the user group, making the decisions taken during the design process of similar buildings more important. By using the mobile application that is emerged as a result of the research, the designers will be able to identify problematic spatial relationships by providing data to the application at different stages in the process of designing an educational structure. Thus, it will be able to intervene in a timely manner based on the problems it detects.

SPATIAL CONFIGURATION

The potential transitions that occur as a result of the existence of boundaries in the spatial order and as a result of spatial merger or rupture are called spatial configuration. In this sense, spatial configuration includes the sequencing and succession of the transition between spaces, the change of the movement route in the transition, the existence of alternative transitions and the intersection of the transition routes in different directions (Erman, 2017). The plan is used as an expression and application tool, which is necessary for the realization of the design, which is determined beforehand and shows the relationship between the spaces of the building. It ensures that design studies are organized according to architectural data and the design is explained as a plan (Arcan & Evci, 1999).

FEEDBACK IN DESIGN

Feedback is all kinds of information and notifications given back by the system to the user about the situation he is in and the action he has taken. A set of outputs from a system that corresponds to input of information is called feedback. Information such as whether the system is working, whether an action was taken correctly or incorrectly, whether the user interacted or not, and similar information is presented to the user as feedback (Kurtuluş & Kaymaz, 2007). Designers apply different processes, such as developing ideas, narrowing idea options, and deriving more alternatives, to determine a final design. These processes require divergent thinking to create choices that can come to the fore, and convergent thinking to narrow and select these choices (Yılmaz & Daly, 2016).

Through automatic control, the operating conditions of a system can be changed to meet certain performance characteristics, which may include enhanced performance and additional safety requirements. Moreover, many systems such as chemical processes, mechanical systems, electronic devices and complex structures will not function properly without additional control. Therefore, control has played and continues to play an important role in the design of industrial and

engineering processes that must meet improved performance requirements (De Callafon, 1998).

As a result of the combination of these three parts, it has been revealed that a mechanism that will provide feedback to the architect about the spatial configuration of the building can be designed during the design process of educational buildings. In the section of the studies carried out, detailed information is presented along with the design of this feedback mechanism and data collection techniques.

METHODOLOGY

As stated in the aim of the study, in order to create a mechanism to control the spatial configuration of educational buildings, it is necessary to first reveal the truths and wrongs related to this subject. In order to reveal these truths and falsehoods, the interrelationships of all functional areas specified in an education structure spatial requirement should be examined. The entire architectural process, including the design, implementation and inspection process of educational buildings in Turkey is carried out by the Ministry of National Education, Construction Affairs Department. For this reason, in this study, the "Minimum Design Standards Guide for Educational Buildings" published by the Ministry of National Education in 2015 and the copy-type projects used for buildings were taken as reference. According to this guide, the functional areas that should be found in schools to be built at different levels in Turkey are as follows (Table 1).

Table 1. Primary, secondary and high school spatial requirement list

Administrative spaces	• Principal's office • Vice Principal's office • Administrative Staff Room • Teachers' room • Group Teachers' Room • Archive and Document Room	• Counseling Service Room • Parent Meeting Room • Parents' Association Room • Infirmary • Staff WC
Educational Spaces	• Classroom • Music Classroom • Visual Arts Classroom	• Laboratories (Science-Technology-Chemistry-Physics-Biology)
Public places	• Library • Multipurpose hall • Performing Arts/Conference Hall	• Praying Room • Physical Education Hall • Canteen- Cafeteria • Dining Hall
Circulation Areas	• Entrance Halls • Corridors • Indoor Break areas	• Staircase • Fire escape • Elevators
Wet Areas	• Students WC • Disabled WC	• Teachers WC
Technical Spaces	• Heat Control Center • Electric Room • Generator Room • Ventilation Control Unit • System Room	• Technician and Stuff Rooms • Storage • Shelter
Open Spaces	• Outdoor sports Areas • Social Areas • Entry area and security	• Service and rescue road • Parking Area

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- Garden

The data to be used in the design of the mobile application, which is aimed to be prepared within the scope of the study, was obtained using three different techniques and presented in the findings section. In this section, the process of transforming the rules to be defined in the mobile phone application as a result of the interpretation of the data and the establishment of relations with each other is explained.

MEASURES AND TECHNIQUES

It is a robust technique for describing and analyzing patterns of architectural space at building and urban level. It establishes an objective method to evaluate and investigate the relationships between morphological structure of man-made environments, social structures, or events.

a. Interview:

The interviews conducted within the scope of the study were carried out with two different groups consisting of 5 academicians in the field of educational studies and 43 experienced school administrators. Within the scope of this study, the selection of interview techniques was carried out under the guidance of pre-prepared questions. Detailed information about the questions in the interview forms and why these questions were included are given below.

The interview forms prepared for the study were shaped in two stages. In the first stage, after the questions were prepared, an interview was held with an expert from both groups. The titles and questions in the final version of the interview forms are explained below.

In the first interview form, three different groups of questions were formed, each containing three questions: "The relationship between education quality and education space", "Existing educational structures problems" and "Necessities of the future education structure".

The questions in the forms used in the interviews with experienced school principals are focused on spatial relations. The aim of these questions was to reveal the spatial relationships that can affect the quality of education. For this, the participants were expected to mark and briefly explain the areas where they think that there are problems in the relations of different areas in the education structure with each other. Since it was difficult to reach more school principals and to carry out face-to-face interviews during the period when the interviews were held, due to the pandemic, online formats of the interview forms were prepared and the data was collected online.

b. "Ministry of National Education Educational Buildings Minimum Design Standards 2015 Guide" Scan:

"Ministry of National Education Educational Buildings Minimum Design Standards 2015 Guide" was prepared by the Ministry of National

Education to direct and supervise the design, structuring and repairs of new or to be repaired education facilities. The details of all functional areas that should be present in educational structures at all levels are explained in detail in different tables in the guide. In these tables, the spatial relations of the functional areas are examined in order to reveal the necessities and limitations. As a result of this examination, the relations of the functional areas with each other were put forward in the form of items. In these tables, there are also detailed explanations about the purpose of use, location, area, door window details and material properties of the functional area. These expressions have been examined in order to reveal the spatial relationship imperatives and limitations of the functional areas. As a result of this examination, the sentences related to the function field relations in the tables are separated.

c. Space Syntax Analysis:

Space syntax theory can be simply defined as a data collection technique developed by a research group led by Bill Hillier at Barlett School, University College London. The basic idea on which this technique is based is on the idea that the social structure that constitutes the space can be understood by examining the physical structure of the space. The spatial setup has a structure that affects the social structure and the components that make it up. Therefore, there is a reciprocal relationship between social structure and space (Hillier & Hanson, 1989).

In this study, depth charts were created using the "Depthmap X" program in order to reveal the relations between each of the functional areas, among the analysis options offered by the space syntax program. These graphs were applied separately for each functional area in the structures mentioned in the next section, and the interrelationships of these areas were revealed. As a result of synthetic analysis, spatial confirmation lines in copy-type projects were revealed. The data obtained from these analyzes are defined as rules to practice.

The archive containing all copy-type projects implemented throughout the country until February 2020 has been provided. In this archive, there are all the projects of buildings which are still used for applications such as primary schools, secondary schools, high schools, special education centers, public education centers, research units, cafeteria and dormitories prepared in 2014, 2017 and 2019. Architectural projects of primary, secondary and high school buildings in this archive were separated and examined. As a result, seven primary school projects with 4,8,12,16,20,24,32 classrooms, and eight secondary school projects including 8,12,16,20,24 classrooms accessed. Likewise, nine high school projects, 8,12,16,24,32 and 40 classroom high school were accessed.

Within the scope of the research, all different school levels were included in the analysis stage in order appeal control mechanism to any type of educational structure design process. As a result of this, 12

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different building types were analyzed, including primary school, middle school and high school buildings with 8, 12, 16 and 24 classrooms. Since structures with 24 and 32 classrooms have no functional difference and differ only in the number of classrooms, only structures with 24 classrooms were preferred.

The “Space Syntax” analyzes were carried out in order to reveal the common spatial configuration characteristics for the 12 selected types of projects. In this process, the following steps were carried out using the "Depthmap X" software.

1. The floor plans of the schools are divided into different sections to create convex spaces. While making these distinctions, each region where the user has to change direction and the areas where the transitions are located are separated from each other.
2. In the Depthmap x program, the relations between the regions whose area boundaries are specified are defined (Figure1).

Figure 1. The relations between the functional areas with each other

1. As a result of defining the relations between the functional areas, the floor plans were prepared for the analysis to reveal the depth graphics. These analyzes (Step depth) will reveal the depth of field and how many different steps can be reached in other areas from the basically chosen area. As a result of this analysis, the relationship of the selected area with other areas will be revealed with the schemes indicated in different colors. While the area specified as the source of the analysis is indicated in blue, the areas that reach this area in the most steps are indicated in red. Intermediate stages are determined by intermediate tones between blue and red according to the number of steps (Figure 2).

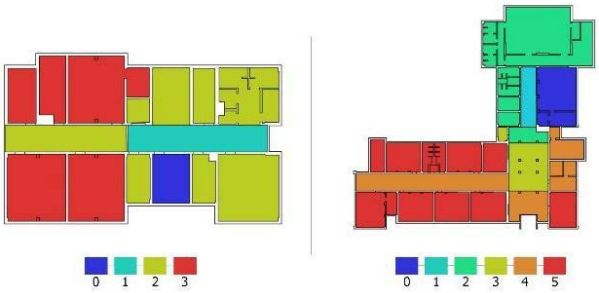


Figure 2. The relationship of the selected area with each other

Using the depth graphs obtained, information is given in Figure 2 to indicate which areas each functional area is associated with in the 2nd and 3rd steps (Figure 3).

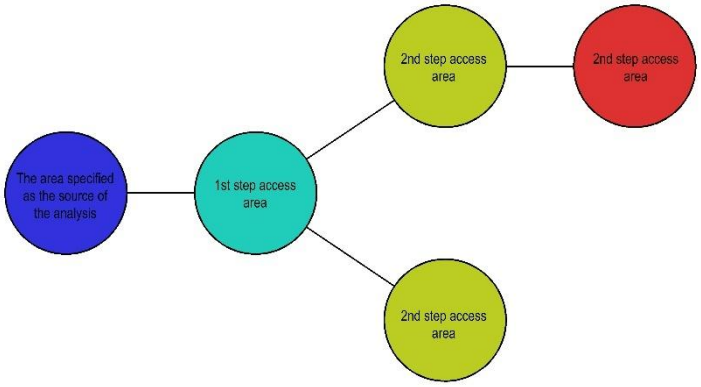
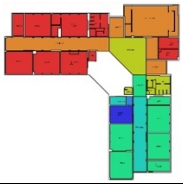


Figure 3. The 2nd and 3rd step relationships of each function area to be defined in the depth charts

2. The data obtained from these analyzes were replicated for all functional areas in all 12 structures and depth graphs were presented (Table 2).

Table 2. depth graphs examples for all functional areas in all 12 structures

Area	Analysis			
	Primary School		Secondary school	High School
	Number of Analyzed Plans	Example	Example	Example
Principal's office	12			
Vice Principal's office	12			

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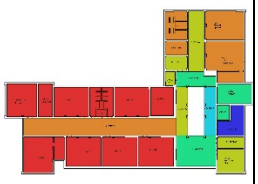
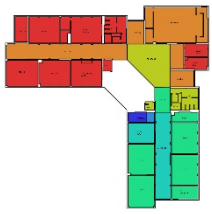
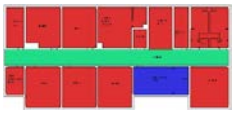
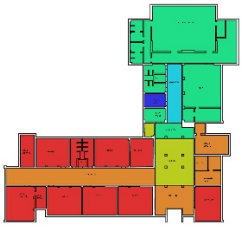
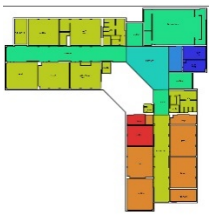
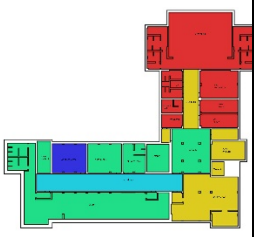
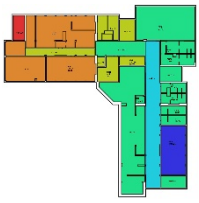
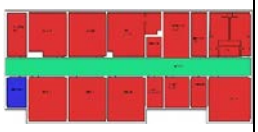
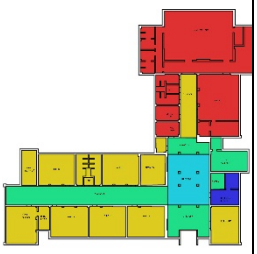
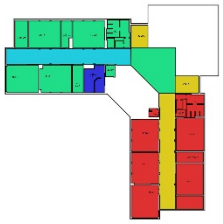
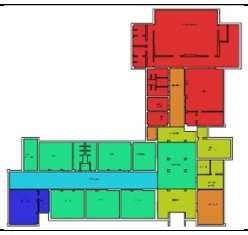
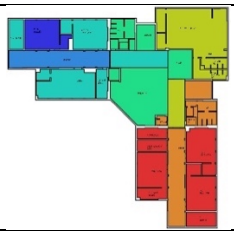
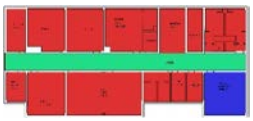
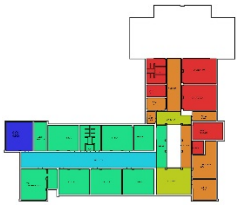
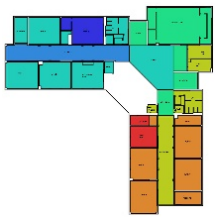
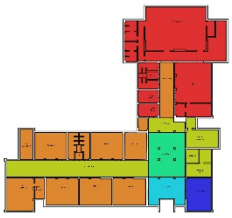
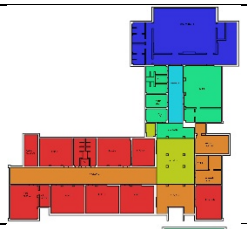
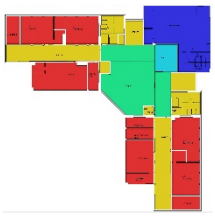
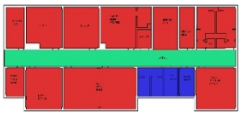
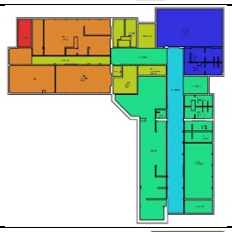
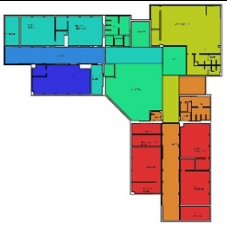
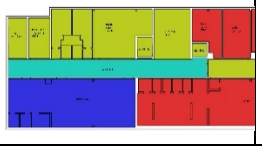
Admin. Staff Room	11			
Teachers' room	12			
Group Teachers' Room	14			
Archive & doc. Room	12			
Counseling Service Room	12			
Parent Meeting Room	11			
Music Class	12			

Visual Arts Class	12			
Laboratories	23			
Library	12			
Multipurpose hall	12			
Praying Room	10			
Physical Education Hall	12			
Canteen- Cafeteria	12			
Dining Hall	7			

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Entrance Halls	12			

3. In this process, the functional areas mentioned below were excluded from the analysis for different reasons.

+ Considering the requirement list of the MEB 2015 Guidelines, all functional areas under the title of technical spaces were excluded from the analysis. Since these areas are not directly related to both students and trainers, they are required to be located in the basement of the schools. Therefore, they were excluded from the analysis process.
+ Vertical circulation elements (stairs, fire escapes and elevators) were not analyzed separately as it can be predicted that they are located on each floor and can be interpreted in line with the data obtained from the analysis of other areas.
+ Since stairs, fire escapes and elevators continue on all floors and contact a corridor first on the floors they connect, the other functional areas analyzed will not be able to establish a 2nd and 3rd step relationship between floors. Therefore, the other floors of the buildings were not included in the depth maps.
+ The sub-units or support areas of the functional areas in the requirement list were considered as a singular area. These areas are:

- Canteen/Cafeteria: Kitchen, preparation area, warehouse and service area
- Physical Education Hall: Sports area, Changing rooms, Shower and WC
- Multi-purpose Hall: Backstage, preparation, warehouse, projection room and WC
- Worship Areas: Female/Male Masjid, WC, Ablution areas
- Laboratory: Warehouse, Sink
- Guidance: Private meeting room
- WC: Female/Male WC, Disabled WC and Teachers WC

Choosing a Software Platform: Mobile devices are all devices that we can carry with us at any time of the day and use independently (Ayres ve Sweller, 2005). Commonly used mobile devices are smartphones, tablet computers, portable gaming devices and laptop computers (Traxler & Wishart, 2011). Mobile applications are managed by application markets that own mobile operating systems such as App Store and Google Play and take their place on distribution platforms through companies (Bilgin, 2019). Commonly used platforms for applications are iOS developed by Apple and Android, developed by

Google Play. Different devices and different programming languages are used for each environment (Keskin & Kılınç, 2015).

The prototype of the mobile application developed for the study was developed on the Android system because of the flexibility of the encoding platforms. The use of smartphones and tablet computers has increased in recent years. A mobile phone and tablet-based infrastructure was preferred so that the application planned to be designed within the scope of the study could be used at every stage of the designer's education structure design process. The easy portability of these devices will enable the designer to use this application in the research, analysis, synthesis and evaluation stages of the design process without the limitations of time and space.

d. Examination of Data and Transformation into Rules

When the user enters the spatial configuration data in the mobile phone application, the application is expected to provide a preliminary notification about these spatial relationships. The spatial configuration realized in an architectural design process can be given feedback in two different ways. The details of this process will be explained using a schematic method.

In Figure B, there are 4 different functional areas as A, B, C and D. In the architectural design process, it can be made a rule that two areas should be "related" or "not related" to each other. The spatial relationship scenarios between these areas are presented below.

- Fields A and B must be related. ---------- Rule I
- Fields A and C must be related. ---------- Rule II
- Fields B and D should not be related. ------ Rule III
- Fields C and D must be related. ---------- Rule IV

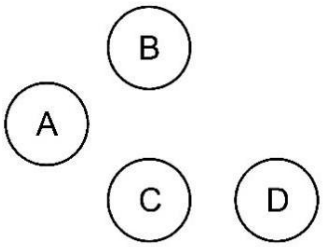

Figure 4. Cells representing functional areas defined to the application

As indicated in Figure 5.b, the designer will define A, B, C and D fields in the first step while using the mobile phone application. As stated in the plan designed by the designer in Figure 5.a, the spatial relations that he foresees and defines to the program are the relations between A-B and A-C and B-D. After these definitions are made, the application will be able to make the following comments according to the rules defined in the infrastructure as preliminary notification (Figure 6).

- According to “Rule I”, the A-B relationship is correct and no further explanation will be given.

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● According to “Rule II” the relationship A-C is correct and no further explanation will be given.
● According to “Rule III”, the B-D relationship is not correct. B and D must not be related.
● According to “Rule IV”, C-D fields must be related. Since the user did not establish this relationship, C and D must be related.

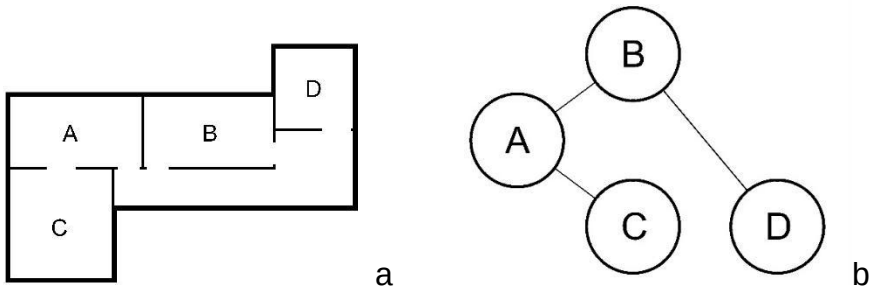

Figure 5.
a. The spatial configuration created by the designer within the boundaries of the space,
b. The spatial relationships that the designer defines to the mobile phone application based on his own design

In addition to these rules, places where spatial relations are not mandatory but the status of being related will be positive will be presented as "recommended relationship". Accordingly, if the "B and C fields are recommended to be related" rule is defined in the previous example, it will appear as a warning because the user does not establish this relationship (Figure 6).

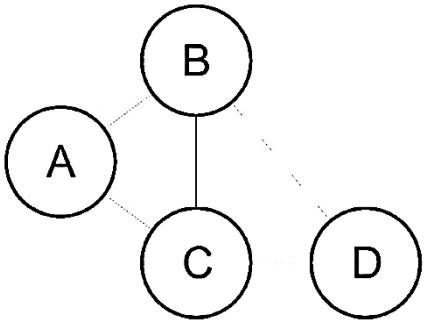

Figure 6. Submission of “recommended to be relevant” as preliminary notification

In line with this setup, the data that transforms to the rules obtained from all three techniques is explained in the finding section.

FINDINGS

Data Obtained from Interviews:

As explained before, the interviews were conducted with two different groups of educational scientists. As these interviews were done with professionals no statistical outcomes were expected. The interviews were recorded during the interview. The records were re-evaluated and the most common and important answers were listed according to the question groups in line with the answers given by the interviewers to the questions. Some examples of answers to questions from both expert groups are given in Table 3.

Table 3. Examples of answers to questions from both expert groups

Question Topic	Findings from the answers given

Interviews with Education Scientists	The relationship between education quality and education space	The educational structure meets the students' physical needs as well as their psychological and sociological needs.
	Existing educational structures problems	Classroom arrangements are teacher-centered. It causes students to communicate least socially with each other.
	The requirements of the education structure of the future	Classes should be replaced by practice centers. Simulation rooms and skill laboratories should be designed.
Interviews with School Principals	Which areas do you think have problems in their relations with administrative spaces?	The fact that classrooms and administrative units are related facilitates students' control over their behavior.
	Which areas do you think have problems in their relations with the classrooms?	Classrooms should be far from places such as music rooms and practice workshops in order to prevent noise from these environments for more efficient education.
	Which areas do you think have problems in their relations with the shared Areas?	Correct relationship between shared areas and classrooms, socialization, belonging and self-confidence positively affect students.
	Which areas do you think have problems in their relations with circulation areas?	Arrangement of circulation areas may pose a danger to the safety of students.
	Which areas do you think have problems in their relationship with the WC?	Since the door of the toilet opened directly to the common area, there was a privacy and odor problem.

By considering the method specified before, the findings obtained in the previous section have turned into rules. These rules are all supported by data obtained other two methods for certain outcome. Examples of rules derived from interviews section is given in the table below (Table 4).

Table 4. Examples of rules derived from the interviews section

Transforming the data obtained from the interviews into rules	
Answers Given	Rules
The correlation of classrooms and administrative sciences facilitates students' control over their behavior.	Principal Room-Classrooms are recommended to be relevant
Classrooms should be far from places such as music rooms and business workshops in order to prevent noise from these environments for more efficient teaching.	Entrance hall – Classroom should not be related

Data Obtained from the Review of the MEB Minimum Standards Guide:

Detailed explanations of all functional areas that should be found in educational structures at all levels are included in the tables between

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pages 61-152 in the guide. In these tables, there are detailed explanations about the purpose of use, location, area, door window details and material properties of the functional areas. These expressions have been examined in order to reveal the spatial relationship imperatives and limitations of the functional areas. As a result of this examination, the sentences related to the function fields relations in the tables were separated. An example sentence under each heading from the sentences obtained from this review is given below.

Administrative Spaces: "The principal's rooms will be located in a position where students can be watched easily, especially during extracurricular activities and between classes, and will be in a position that will dominate the school's entrances from the point of view, and will be in contact with the Administrative staff room."

Classrooms: "Classrooms of branches that are close to each other will be designed in the same location."

Shared spaces: "The library will be planned for group and individual study together with a computer classroom on the ground floor. They will be in an easily accessible quiet area, with computer equipment, internet connection, e-library, and sound insulation."

Circulation Areas: "The entrance halls should be designed in direct connection with the main circulation lines in a size and shape that will allow the students to disperse easily and to leave the education structure quickly without crowding."

WC: "All wet areas should be easily accessible from general areas and should preferably be designed near stairs and elevators, and should not be located above the laboratory, panel room, generator, system room and kitchen spaces."

Technical Spaces: "The electrical room should be resolved in the basement with the generator room and technician room in a close and central location."

By considering the methods specified before, the findings obtained in the previous section have turned into rules (Table 5).

Table 5. Examples of rules derived from Guide examination

Data from MEB guideline review	Rules
The principal's rooms will be located in a position where students can be watched easily, especially in extracurricular activities and between classes, and will also be located in a position that will dominate the school's entrances from the point of view of the Principal's Room-Administrative Staff.	Manager room – Administrative staff room should be related.
The teachers' room and the group teachers' rooms will be located in a way to observe the students and facilitate continuous communication, and will be resolved in different floors and regions within the school.	Teachers room-Classroom must be related Group Teachers room-Classroom must be related

Data Obtained from Space Syntax Analysis:

In this section, the analysis tables and results performed on copy-type projects using the space syntax technique are included. Numerical data was evaluated comparatively. The places with the highest value are determined in the 2nd and 3rd step areas in the tables. Stairs, fire escapes, elevators and wet areas are not explained separately as they are assumed to be available on every floor in all structures associated with all areas.

By considering the method specified before, the findings obtained in the previous section were turned into rules. Examples of rules derived from space syntax analysis is given in the table below (Table 6).

Table 6. Examples of rules derived from space syntax analysis

Space Syntax Analysis Results	Rules
There are 12 plans taken as the principal's room, the main point of the analysis. As a result of these analyses, we can see that the principal's office is mostly related to the administrative staff room in the 2nd step, while the 3rd step is related to the classrooms and laboratories.	Manager's Room-administrative staff room must be related Principal Room - Laboratories are recommended to be relevant.
There are 12 plans that "assistant principal's room" taken as the main point of the analysis. As a result of these analyses, we can see that the Deputy Principals' Rooms are mostly related to the Library and the entrance hall in the 2nd step, while the 3rd step is related to the music classroom, the library and the entrance hall.	Deputy Director room- Library must be related Deputy Director's room - entrance hall must be related Deputy Director room- Music Class are recommended to be relevant.

All the rules obtained in this section were converted into a software language and transferred to the mobile phone application. This process is explained in detail in the next section. In addition, all these rules are given in Table 46 under three headings. In cases where the rules obtained from different techniques are repeated, the rule is included in the table once. In addition, if a rule is "recommended to be related" to a technique and "must be related" to a technique, that spatial relationship is included in the table only once as "should not be related" (Table 7).

Table 7. All the rules that will turn into the software

	Rules	
Spaces that should be related to each other	• Principal's office– Administrative Staff Room • Teachers' room – Classrooms • Group Teachers' Room - Classrooms • Archive and Document Room- Administrative Staff Room • Entrance Hall - Parent Meeting Room • Visual Arts Classroom -	• Cafeteria - Music Classroom • Cafeteria– Entrance Hall • Laboratories - Classrooms • Counseling Service Room - Entrance Hall • Counseling Service Room - Parent Meeting Room • Parent Meeting Room - Vice Principal's office • Vice Principal's office – Entrance

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	Classrooms • Visual Arts Classroom - Music Classroom • Library - Entrance Hall • Library - Cafeteria • Multipurpose hall - Entrance Hall	Hall • Group Teachers' Room - Teachers' room • Counseling Service Room - Classrooms • Praying Room - Physical Education Hall
recommended to be relevant	• Principal's office – Classrooms • Library - Classrooms • Principal's office – Laboratories • Vice Principal's office - Library • Vice Principal's office - Music Classroom • Multipurpose hall - Vice Principal's office • Multipurpose hall - Cafeteria • Cafeteria - Vice Principal's office • Teachers' room - Principal's office • Administrative Staff Room - Classrooms	• Archive and Document Room - Praying Room • Archive and Document Room - Physical Education Hall • Laboratories - Entrance Hall • Laboratories - Principal's office • Counseling Service Room - Principal's office • Music Classroom - Entrance Hall • Visual Arts Classroom - Entrance Hall • Visual Arts Classroom - Vice Principal's office
Spaces that should not be related to each	• Praying Room– Classrooms • Physical Education Hall – Classrooms • Physical Education Hall – Principal's office • Physical Education Hall – Administrative Staff Room	• Entrance Hall - Classrooms • Entrance Hall – WC • Entrance Hall – Classrooms

RESULTS

The data to be used in the design of the mobile phone application, which is aimed to be prepared within the scope of the study, was obtained by using three different techniques and presented in the previous section. In this section, the process of transforming the rules to be defined to the mobile phone application as a result of the interpretation of the data and the establishment of relations with each other is explained.

User Interface Design:

Since the Android operating system is mainly used in smartphones and tablets, the GUIs of the applications are designed to get the best results on touch-screens. Since there are resolution differences between mobile devices, device-specific interface designs should also be made. Views in applications are created by adding predefined widgets to XML files belonging to that screen (View objects such as EditText, TextView, Button and RadioButton). The layout is provided with ViewGroup objects (URL-11). The working algorithm of the interface designed for the mobile phone application planned in this research is explained in detail in Figure 7.

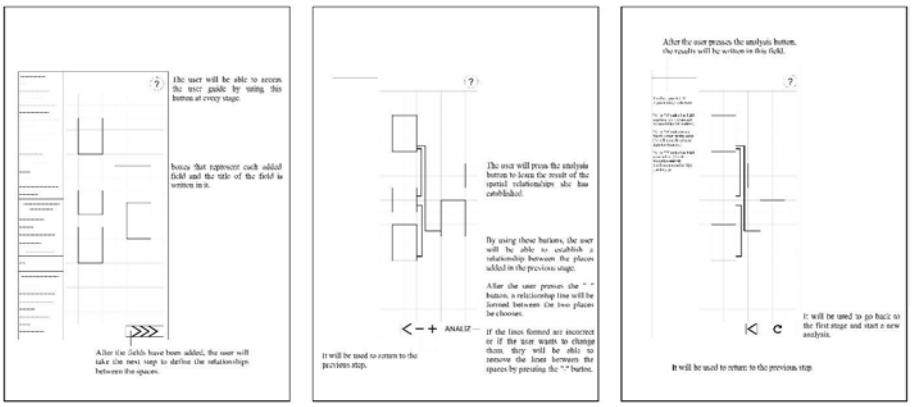
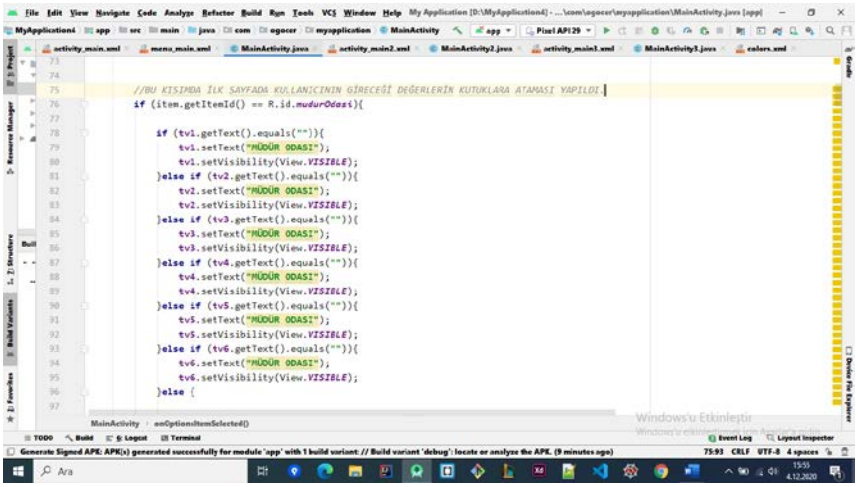


Figure 7. Screens that the user encounters in the first, Second and third stage

Integration of Data with Interface:

The process of transforming the rules obtained in the previous section into a software language consists of two stages. In the first stage, coding was carried out in the "Android studio" environment, using the "java" language, in order to experience the relationship process between spaces in practice. In this version of the application, it was seen that the possibilities provided by the "java" software language were missing in the process of defining the relationship between spaces. Screenshots of these codes are in Figure 8.



```
//BU KISIMDA İLK SAYFADA KULLANICININ GİRECEĞİ DEĞERLERİN KUTUKLARA ATAMASI YAPILDI.
if (item.getItemId() == R.id.mudurOdasi){

    if (tv1.getText().equals("")){
        tv1.setText("MÜDÜR ODASI");
        tv1.setVisibility(View.VISIBLE);
    }else if (tv2.getText().equals("")){
        tv2.setText("MÜDÜR ODASI");
        tv2.setVisibility(View.VISIBLE);
    }else if (tv3.getText().equals("")){
        tv3.setText("MÜDÜR ODASI");
        tv3.setVisibility(View.VISIBLE);
    }else if (tv4.getText().equals("")){
        tv4.setText("MÜDÜR ODASI");
        tv4.setVisibility(View.VISIBLE);
    }else if (tv5.getText().equals("")){
        tv5.setText("MÜDÜR ODASI");
        tv5.setVisibility(View.VISIBLE);
    }else if (tv6.getText().equals("")){
        tv6.setText("MÜDÜR ODASI");
        tv6.setVisibility(View.VISIBLE);
    }else {
```

Figure 8. The coding process of the Android application created using the "java" language in the "Android studio" environment

Relationships between the defined areas in this version are indicated with different color coding when it passes to the next stage. Since the designer's ability to add his own design data, which is the main goal of the application, was disabled in this version, the process was stopped after it was merged with the interface and the second stage was started with the experience gained. The interface images of this application are shown in Figure 35 (Figure 9).

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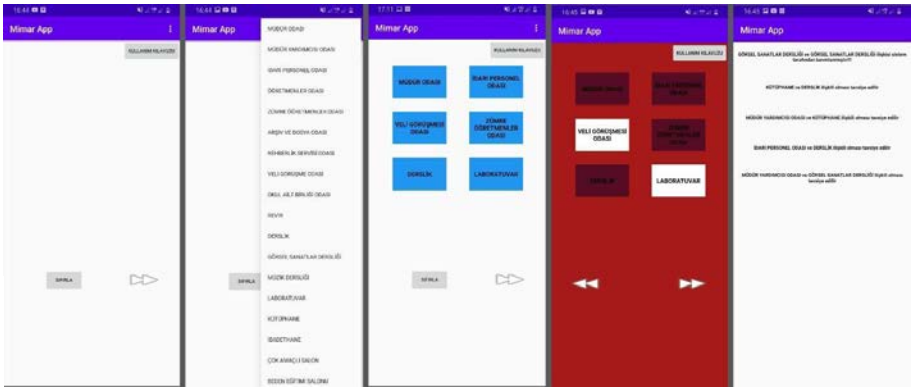

Figure 9. Interfaces of the first Android application, obtained by transforming the data into the software language

As mentioned before, support was received from software experts at this stage of the study. As a result of the emergence and experience of the first application, it was decided to use a different software language and a different software application in line with the opinions and suggestions received from experts. “Unity3D” program and “c#” software language were used in this process, which constituted the second stage of the process of transforming the data into a software language. The connection problems that existed in the application obtained in the previous stage were corrected here for the user to add or remove the desired place at any stage. Screenshots of the codes written in the "Unity 3D" program are shown in Figure 10.

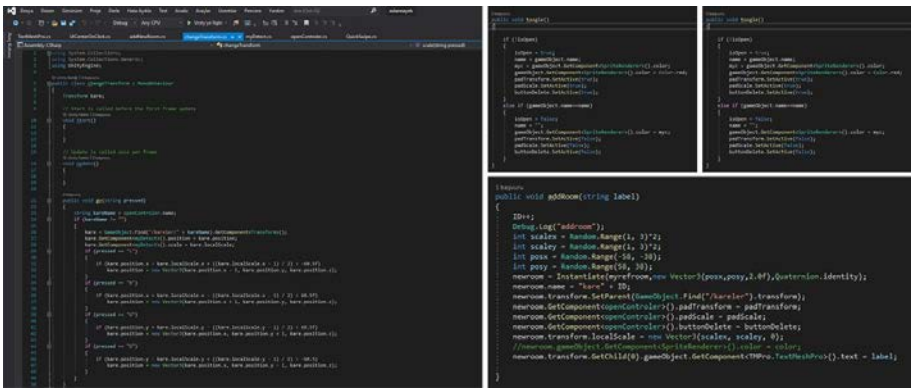

Figure 10. The coding process of the Android application created using the "c#" language in the "Unity 3D" environment

In the application obtained in the second stage, it was aimed to facilitate the use of the application by adding features that will facilitate the user experience. These features are presented below, depending on the application usage process. The interface images of the application are shown in Figure 11.

- The user can always access the list of places that can be added at the bottom of the interface.
- Functional areas have been placed under general headings and access has been made easier.
- It can pass the cells representing the spaces added in the area by selecting them.
- The colors of the cells can be changed to facilitate the management of the added spaces.

- Cells can be zoomed in and out (Zoom in/Zoom out) using two fingers.
- After the added cell is selected, it can be deleted by pressing the delete button.
- By choosing two places, a connection can be established between them.
- Added relationships can be deleted before analysis.

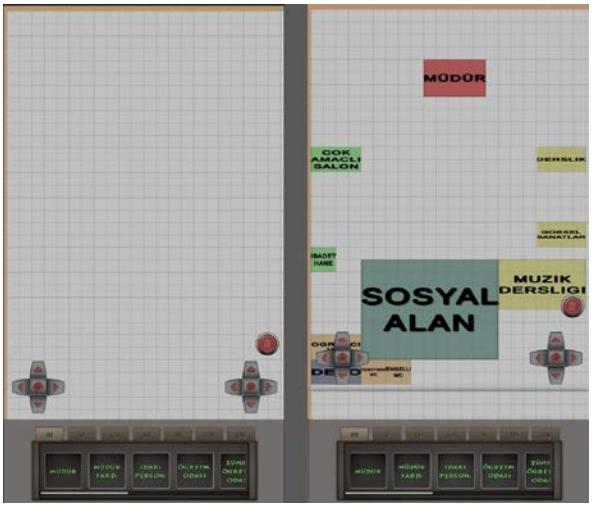

Figure 11. The interfaces of the second Android application obtained by converting the data into the software language

DISCUSSION

The development process of the application obtained during the working process, the interface design and the work with the software experts will continue so that the data can be added and removed continuously. Similar application design processes developed in line with technical knowledge emerge after a long experience process with qualified experts, technical equipment and financial support. In the future, it is expected that the application will be produced and experienced with different user groups, and the application will be offered for sale as a result of receiving preliminary notification. While students, professional architects and companies can use the application in the education structure design process, the Ministry of National Education and affiliated institutions can benefit from the application for the supervision and control of the projects. It is necessary to make long-term plans in order for the produced application to be constantly updated, sustainable and producible for different building types.

Since the mobile phone application produced through this study is the first version of its kind, advanced versions can be produced as a result of experiments with designer subject groups at later stages. These processes can be updated by experiments with small sample groups at first, and then with professional designers at the next stage. In the application with an open database, new data obtained at each stage can be added to the system and reduced to eliminate errors where necessary.

This feedback system, which is defined as educational buildings in the current project, can be applied in different areas such as clinics, hospitals, shopping centres and university buildings in the next stages.

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For this, the data of the structure type obtained by user groups and experts can also be converted into rules and added to the application.

ACKNOWLEDGEMENT

The materials used in this article are a part of a PhD thesis done by authors. All the references and details of the process can be accessed in case of need.

CONCLUSION

Compared to the teacher-centered factory model of the 20th century, educational objectives and practices have changed considerably. Thus, students in the 21st century need learning environments that meet their needs (Chism, 2006). As a result of the paradigm shift based on active learning and student-centered classrooms, the study of the effects of school buildings on learning behaviors and teaching is gradually increasing (Leung & Fung, 2005), (Scott-Webber, 2004). Due to the idea that physical elements in the environment can provide clues for learning, architecture is considered to have pedagogical value (Wilks, 2010). In this regard, school design should be seen as a chance to improve educational outcomes by creating better learning environments and considered in each of the four stages of architectural design consisting of information gathering, analysis, synthesis and evaluation, the design of the functional areas of the building and their interrelationships. Although this issue is important in every type of building, it can be used in hospitals, clinics, schools, etc. It becomes more important because the number of users in the structures is high and it should allow functionally different services to be offered. A design mistake made in these structures affects many people negatively during the usage process and it is more difficult to fix this problem in the future.

In this context, the role of the architect becomes very important in the design of buildings such as educational buildings and hospitals. One of the most important reasons for the use of copy-type projects, which is also effective in the preference of educational buildings in this design process, is to minimize these errors. Considering that the use of copy-type projects is without identity and cannot adapt to today's developing technologies, architects should be given the opportunity to put forward different designs. In this design process, control mechanisms should be produced in order to minimize errors. In this study, a pre-notification mechanism was designed to be used in the design process of educational buildings. Architects will be able to receive preliminary notification of the spatial configuration of the educational structure they have designed at every stage of the educational structure design process via a mobile phone application.

The most important benefit of this mechanism being implemented over a mobile phone application with an "open database" system is that it makes this mechanism a dynamic system. This mechanism consists of

4 different components: the designer, the mobile phone application, the architectural structure and the user. By providing a continuous flow of data between these four components, as indicated in Figure 12, the mechanism will have a self-renewing cycle.

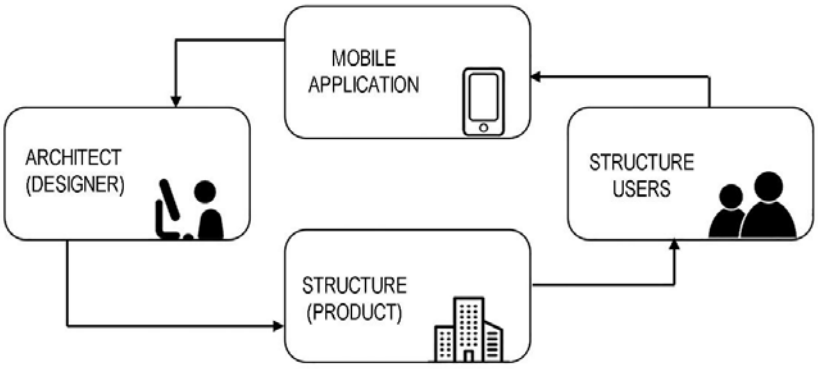

Figure 12. Data flow diagram between designer, mobile phone application, architecture and building user

In this cycle, the user of the architectural building will provide data about the use of the building as they experience the building. Students and teachers who could be mentioned as active users of the educational structure should be included in the design process and it should be ensured that they express their expectations with the structure (Şenyiğit & Memduhoğlu, 2020). This data will continuously update the infrastructure of the mobile phone application. The architect, on the other hand, will design a new structure using the application updated with this data. This cycle will be completed when the newly designed structure meets its new users. The information obtained from new users, new designers and new structures will ensure that this cycle is constantly renewed and will make the preliminary notification mechanism based on the research dynamic.

Although architectural design decisions result from a variety of contextual factors, budget realities, such as local regulations, site considerations and planning codes using syntactic techniques reveals common and specific design patterns in plan layouts (Liao, P., Gu, N., Yu, R., & Brisbin, C. 2021). In this research, it is aimed to propose an innovative interior configuration-oriented preliminary notification model that designers can use in the architectural design process. Considering the result of the study, we believe that the desired goal has been achieved with the data obtained in terms of theory and practice.

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