Iranian Journal of Comparative Education, 2025, 8(4), 3878-3904
Research Article **DOI: 10.22034/IJCE.2025.373979.1451** http://journal.cesir.ir

A Comparative Study of Design Standards of Educational Spaces in Primary Schools of Iran and Finland

Maryam Ansari [1](Corresponding author)

ARTICLE INFO

Received: 23 November 2022
Revised: 18 Auguest 2024
Accepted: 04 July 2025
Online: 24 December 2025

K E Y W O R D S

Design Standards
Learning Spaces
Primary Education
School Facilities

ABSTRACT

The significance of educational spaces is widely acknowledged. The physical environment of schools has a direct impact on the students' learning processes and development. The purpose of study was to compare the design standards of educational spaces in primary schools in Iran and Finland. The research method was qualitative and comparative. The data collection method was documentary, and Bereday's approach was used for data analysis. The sampling strategy was based on selecting different social system and educational outcome. In this comparison, criteria such as per-capita educational space, classroom and school areas, number of pupils, and design of educational spaces were considered. The findings showed that the per capita educational space in Iran is approximately 2 m^2, while in Finland, it ranges from 11 to 13 m^2. In fact, Finland's per capita educational space is six times that of Iran. In Iran, the average number of students in a classroom is 24 to 30, while in Finland, it is 20 students. Additionally, the average classroom area in Iran is approximately 8 m^2, and in Finland it is 20 m^2. Also, Finnish educational spaces are more suitable than those in Iran in terms of speed, flexibility of space, and adaptability. According to the research findings, in order to increase the use of educational spaces, designing walls for recreational and educational purposes, flexibility of space according to the needs, facilitating the movement of learners and creating active learning environments have been suggested.

[1] Assistant Professor, Department of Educational Sciences, Payame Noor University, Tehran, Iran.
Email: m.ansary@pnu.ac.ir

1. Introduction

The quality of school spaces is a major concern for educational systems in many countries worldwide. Over the past two decades, some countries have tried to reduce this challenge and improve the quality of educational spaces through continuous assessments (Bozorgi Nejad and Zarei, 2017). Educational spaces play an effective role in interacting with learners from both physical and psychological perspectives. The importance of open space design and its positive effects on the performance and quality of education have been proven in numerous studies (Genn, 2007; Roff, McAleer & Skinner, 2005; Schönrock-Adema et al, 2012; WFME, 2003). In fact, the architecture of educational spaces is one of the key factors in improving the quality of modern education systems. The quality of these spaces affects the participation, satisfaction, and success of students (Schönrock-Adema et al., 2012).

Since the establishment of early schools, indoor educational spaces have been considered the main places for learning activities. Among them, the schoolyard is one of the important spaces that plays a significant role in learning and student interaction. In the outdoor space of the school, students can not only interact with each other, but also gain experience (Rafiei Nayini & Jahanbakhsh, 2016).

However, in many schools, the schoolyards are merely spaces covered with asphalt or paving stones that do not meet the necessary standards for educational activities. These spaces are mainly designed for sports or supervision (Schulma & Peters, 2007). Observing the principles of designing educational spaces can provide an environment that is appropriate to the interests of students. Interest in learning is formed in school, and the mismatch of the environment with individual expectations can lead to a decrease in motivation. Various elements, such as the form and arrangement of classrooms, color, lighting, ventilation, educational equipment, and interior decoration, play an effective role in enhancing primary students' interest in learning (Farokhnia, 2011). In fact, educational spaces should possess the capacity for diversity (multi-functional spaces), adaptability (mobility and accommodation for different activities and climatic conditions), and variability (division and integration of space) (Heydari et al, 2018).

In recent decades, the concept of "outdoor education" has expanded in primary schools in several countries, and experiences have shown that such environments have a direct influence on improving children's learning. Therefore, the open spaces of schools have hidden educational capital (Sylwester, 2003). Gifford (2016) emphasizes that the physical environment, including space, color, light, and sound, affects a person's perception; thus, the interplay between architecture

and psychology is essential in designing educational spaces. Proper design of educational spaces can affect the speed of learning, the quality of teaching, the social behavior of students, and the creation of collaborative environments (Eskandari, Hosseingholizadeh & Kamelnia, 2019).

In developing countries such as Iran, classrooms are usually small, enclosed, and primarily suitable for teacher-centered instruction, with students unable to actively participate (Azemati and Nassiri, 2012). In Iran, the formulation and implementation of standards for school spaces lie with the Ministry of Education and the Organization for Renovation, Development, and Equipment of Schools. These standards include classroom dimensions, lighting, ventilation, as well as cultural and athletic facilities. Nevertheless, many Iranian schools struggle with challenges such as limited space, aging infrastructure, and overcrowding. In some cases, schools operate in buildings originally constructed for non-educational purposes (Shafaee and Madani, 2010).

The increasing need for public education has led to the construction of numerous schools, but without the desired quality. Despite the progress in educational content, the dominant pattern in the design of current Iranian schools, regardless of the educational functional capabilities of the open space, is more or less small spaces according to the landscaping pattern of residential complexes and places, covered with asphalt with some limited elements and equipment for games and physical activities, which is ineffective in the learning process of students (Dehani and Mo'tamed, 2017). In fact, school buildings in Iran are divided into several categories, including new schools built for educational purposes, houses dedicated to education, changed their use and been converted into schools, and old school buildings that have been renovated. A common feature among school buildings is the inability to move the school and relocate it to another location (Alaghmand, Salehi & Mozaffar, 2017).

Given the above, it is necessary to first review the findings of previous researchers in various countries, including Iran. Sun and Abdul Aziz (2024), in their article titled "Design Guidelines for Formal Learning Spaces", stated that learning spaces frequently overlook real user needs, which results in conflicts and contradictions between the spaces provided and users' requirements. Furthermore, given the evolution of learning content and 21st-century experiences and technological integration in learning environments, specific learning space guideline aspects might unintentionally limit learning. Lee (2024), in his study, referred to "three types of learning environments": physical, psychological, and emotional. The physical learning environment encompasses all tangible aspects of a learning space, including the physical layout and classroom design—from active, playful settings in primary schools to more structured arrangements in

colleges and universities. These learning environments significantly influence the educational experiences of students at the primary, secondary, and post-secondary levels.

In another study, Sun and Abdul Aziz (2024), in their article titled " A Systematic Literature Review of Design Considerations, Challenges and Guidelines in Primary School Physical Learning Space Design," concluded that learning spaces foster more flexible, innovative, and open learning environments that support student-centered pedagogical approaches, The primary considerations are physical space and pedagogical organizational design, challenges from users and designers and current research and guidelines for users and designers. Based on the study results, this research proposes suggestions for physical learning spaces. There is an urgent need to design guidelines to promote primary school learning efficiency and create an environment that students and teachers like.

Ebrahimzadeh et al, (2020) showed that from the perspective of the experts, the independent variables can be classified into five groups of influential factors on the basis of the answers of the respondents. Hence, the variables such as the environmental mobility, space flexibility and cozy corners under (interactive factors), familiar environment, the study period, the child's gender and culture-economic class (individual factors), dimensions of the open space, physical comfort of the environment, spatial diversity and spatial perception (physical factors), child participation, natural elements of the environment, safety and sense of security (socio-group factors) and playfulness, stimulation of the environment and its color and texture subset (activity factors) were classified.

Arghiyani, Yazdanfar & Feizi (2019) showed that closed educational spaces are the platform for social interactions between users, so it is necessary to review and pay special attention to the design of educational closed spaces as a collective space in many types of education today. The results of this study emphasized the importance of spatial features in the evaluation of collective feeling in a place. Accordingly, the mental-psychological and behavioral-activity dimensions are other effective criteria in the collective feeling among users.

Innova Design Group (2017) proposed a model featuring four key characteristics of the DEEP (Dynamic, Engaging, Ecological, and Participatory) model, which focuses on the main elements of a 21st-century learning environment summarized below:

- Dynamic: Learning spaces that have the flexibility to change in both space and time, allowing the layout to be reconfigured to suit individual or group learning now and well into the future.

- Engaging: Creating a learning space that can be diverse and inclusive of all pedagogical approaches that adapt to all types of learning styles, such as practical experiments, informal and independent group activities, virtual learning, podcasting, and more….This design approach should also take into consideration environmental factors such as light, temperature, sound, air quality, circulation, and technology-Dependent on the ability of the teaching staff, it opens the way to deeper student learning.
- Ecological: A learning space that focuses on environmental aspects such as sustainable procurement and ecological architectural design, which meet the high standards of material sustainability, ecological sensitivity, and energy efficiency.
- Participatory: A learning space that can allow for 'flipped learning', which accommodates both student and tutor needs. The idea behind flipped learning is that the teacher is on hand to coach, advice, and encourage students in a consultative manner. Rather than lecturing them, this style of learning empowers students to take control of their lessons. (p. 3)

Fraser and Wubbels (2015) highlighted that students in resource-rich classrooms with diverse *learning* aids perform significantly better. Also examined how educational space design affects students' engagement and motivation, addressing different learning environments, classrooms, schools, and homes, interactions between these environments, improvements in learning environments, and their future directions. (Schönrock-Adema et al., 2012) identified key elements including human-centered environments, personal development, goal orientation, relationships, and system maintenance and adaptation.

Iranian researchers have also explored school space conditions. For instance, Forud, et al (2021) found a direct and significant relationship between architectural system factors (flexibility, quality of light, and access to nature) and learning system factors, including basic, behavioral, and motivational needs. Ghazanfarpour et al (2021) concluded that newly developed urban areas lack adequate access to educational spaces, and overall quality of learning environments is low. Additionally, the distribution of educational spaces is unbalanced, with notable shortages in newly developed urban areas. Nazarpour, Heydari, & Samadi (2021) introduced two models for spatial configuration in educational buildings. These models aim to integrate the strengths of contemporary and traditional layouts, focusing on readable, accessible, nature-oriented, flexible, and visually and physically zoned learning spaces. Eskandari et al (2019) proposed a conceptual framework for primary school physical space design based on participatory learning theory. Their findings highlighted key components, including contextual and interactional factors, encompassing

spatial dimensions (color, landscaping, flexibility), psychological (informal social zones), physiological (temperature, ventilation, light, and noise), and behavioral (U-shaped layouts, round tables, play spaces, private and public learning zones such as "learning streets"), which collectively represent an optimal model for primary school physical environments.

Findings by Bareshadat, Shoaei & Rezvani (2019); Daneshjoo et al (2019); Ghataghi Kalashami et al, (2016) and Samadpour & Tahbaz (2018) indicated a significant relationship between schoolyards and students' learning. Hosseini Vaez et al, (2017) identified major issues in Iranian school construction, such as neglecting scientific and technical standards for needs assessment, site selection, and building design. Many deficiencies (including inappropriate space types, inadequate minimum area per space, suboptimal functionality for activities, and poor alignment of educational spaces with students' physical and psychological needs) were observed, indicating non-compliance with Iranian standards**.** Azemati et al, (2016) highlighted that safety factors in primary school educational spaces include environmental hygiene, spatial safety, and proper furniture design and placement.

Given the significance of the topic and previous research, the present study aims to compare the design standards of educational spaces in primary schools in Iran and Finland and propose strategies to improve the design of these spaces. Accordingly, the following research questions are addressed:

- What are the design standards of educational spaces in primary schools in Iran and Finland?
- What are the similarities and differences in the design standards of educational spaces of primary school between Iran and Finland?

2. Research Method

The present study employed a qualitative research design with a comparative approach. The research domain included both primary and secondary sources. Primary sources consisted of upstream documents and design standards for educational spaces, derived from officially published documents in the Iranian educational system (Ministry of Education, 2011) and Finnish educational system, educational space design documents, and the School Building Guidelines (Finnish National Agency for Education, 2024). These Finnish guidelines include instructions from the Ministry of Education and Culture as well as associated authorities responsible for the construction and maintenance of schools, outlining standardized criteria for educational space design. Secondary sources comprised books, scholarly articles, and reputable online resources related to the

educational systems of Iran and Finland, covering publications up to 2024. Data were collected through documentary analysis using a note-taking tool. The collected information was organized systematically to answer the research questions. The strategy for selecting Iran and Finland was based on their different social systems and distinct educational outcomes. For data analysis and presentation of findings, Bereday's (1964) comparative approach was used, including four stages: description, interpretation, juxtaposition, and comparison (Aghazadeh, 2017).

3. Findings

Description

Iran

The Educational spaces are generally categorized according to two models. The first model classifies schools based on educational levels (preschool, primary, and secondary), which vary across countries depending on their respective educational systems. The second model categorizes learning environments according to internal educational spaces (classroom, schoolyard, library, laboratory, etc.), a structure that remains relatively consistent across nations.

In Iran, the classification of educational spaces based on educational levels is as follows (Organization for School Renovation, Development and Equipment, 2016):

- *Preschool*: This stage consists of a two-year program designed to provide educational services for children aged 4 and 5.
- *Primary School*: A primary school is an institution that offers a six-year educational program. Students enter at the age of six and, after completing the six grade levels and successfully passing the required examinations, receive a certificate of primary school completion. The population of primary school students in Iran in 2024 was reported to be approximately nine million (Safi News, 2024).
- *Lower Secondary* (First Cycle of Secondary Education): This three-year cycle is situated between primary school and upper secondary education. Upon completion, students are awarded the lower secondary school certificate. This stage includes grades seven, eight, and nine. The student population at the lower secondary level in 2024 was estimated at four million (Safi News, 2024).
- *Upper Secondary* (Second Cycle of Secondary Education): Upper secondary schools include academic, theoretical, technical–vocational, and work–study (kar-o-danesh)

tracks. Students select their field of study based on academic performance and personal interests. This cycle consists of grades ten, eleven, and twelve.

In all educational stages in Iran, boys and girls attend separate schools. According to the Fundamental Reform Document of Education in Iran, the sub-system of Spaces, Equipment, and Technology encompasses all activities related to planning, organizing, designing, implementing, supervising, and supporting the physical infrastructure of formal and public education. This includes the provision of educational facilities, equipment, and technologies in alignment with the domains of education, architectural and urban design components, construction technologies, resources (human, material, and financial), as well as engineering and technical management, all aimed at achieving the goals of the national education system (Ministry of Education, 2011, P. 399).

Within this sub-system, the educational environment is not limited to the classroom; rather, education occurs across the broader learning environment, which includes classrooms, school courtyards, laboratories, workshops, and even out-of-school settings. In all these environments, educational messages are conveyed to learners. Therefore, to achieve the intended educational goals, all these environments must be coherently managed and aligned (Ministry of Education, 2011).

Since Iran's educational system is centrally administered, national standards for the design of educational spaces are established by the School Renovation and Equipment Organization and applied uniformly across the country.

The per capita allocation for educational spaces, based on educational and developmental needs, student capacity, and the required furnishing, is divided into three categories: Close spaces, Open spaces, and Semi-open spaces. According to Iran's national design standards, the number of students per class for all educational levels is set at 24 students, with a maximum acceptable limit of 30. In rural schools, the class size standard is 18 students per grade. The primary standard for designing an educational facility is the educational space per capita, which includes classrooms, workshops, laboratories, audiovisual rooms, and computer rooms. This allocation ranges For primary schools: from 1.75 to 2.24 square meters per student, and For secondary schools: from 2.28 to 2.39 square meters per student, and In rural schools: up to 2.29 square meters. The per capita allocation for educational-support spaces (guidance room, prayer room, library, auditorium, health room, counselor's office, and student organization rooms) is: Primary schools: from 1.27 to 1.44 square meters and Secondary schools: 1.61 square meters. The per capita allocation for administrative spaces (principal's office, deputy offices, teachers' lounge, parent meeting room,

printing/duplication room) is 0.28 square meters. The per capita allocation for circulation and infrastructure areas is: Primary schools: 2.13 to 2.40 square meters and Secondary schools:2.66 to 2.71 square meters. The per capita allocation for covered service areas (restrooms, drinking water facilities, entrance gate, cafeteria, and janitor's room) is: Primary schools: 0.51 square meters and Secondary schools: 0.57 square meters. Also For outdoor spaces (assembly yard, playground, sports field, green space, and parking), the per capita allocation is: Primary schools: 2.14 to 2.40 square meters and Secondary schools: 3.35 to 4.32 square meters. The standard classroom area is approximately 8.5 square meters. The open yard space ranges from a minimum of 438 square meters to a maximum of 1081 square meters. The total school area ranges from a minimum of 792 square meters to a maximum of 2121 square (Organization for School Renovation, Development & Equipment, 2016, P: 21-25).

Despite the existence of these standards, current conditions indicate that they are not consistently implemented. Key characteristics of Iranian school spaces include:

- Rowed desk and chair arrangements, facing the blackboard.
- Lack of flexibility in rearranging classroom and school furniture.
- Emphasis on natural lighting and ventilation.
- Learning spaces are non-flexible and mostly confined to classrooms.
- Limited access to open spaces and schoolyards, mainly for recess and physical education.
- Insufficient vegetation and climate-appropriate greenery in outdoor areas.
- Open space designs pay limited attention to students' educational, physical, and psychological needs (Nazarpoor et al, 2021).
- Physical safety of educational spaces is rated as moderate and acceptable (Bagheri & Azemati, 2011).

According to the most recent school safety reports, no school in Tehran is classified as critically unsafe (Shargh News, 2025). However, overall school safety in Iran remains suboptimal. While some schools meet acceptable hygiene and safety standards, a significant proportion, especially rural and older schools, continue to face considerable challenges in terms of safety and health.

Figure 1. The spaces of top schools in major cities in Iran

Figure 2. Educational spaces in underprivileged areas of Iran

Finland

The Finnish education system, in contrast to that of Iran, is a decentralized system. In this structure, school curricula are developed by teachers in each school based on the specific needs and characteristics of their own students. While general regulations are set by the Finnish Ministry of Education, teachers have considerable autonomy in selecting instructional methods and are able to adapt their approaches flexibly according to individual learner characteristics. In the Finnish system, students learn collaboratively through play and experimentation (Butler, 2016). Finnish

children begin pre-primary education at the age of six, spend less time in classrooms, and receive fewer homework assignments compared with children in many other countries, yet they consistently achieve excellent learning outcomes.

Excluding kindergarten and pre-primary education, the Finnish education system is divided into two levels:

- *Comprehensive education* (ages 7–15): This stage covers nine grades in comprehensive schools, the main educational institutions in Finland, which admit students at age seven. Completion of each grade takes one academic year, totaling nine years.
- *Upper secondary education* (ages 15–16 onwards): This optional stage lasts three to four years and is divided into vocational schools and general upper secondary schools. Students must decide whether to pursue vocational training to enhance career skills or attend general upper secondary schools that prepare them for higher education in fields such as medicine, law, and other sciences (Skantsi, 2022).

Finnish schools are recognized as among the "best in the world", transitioning from traditional factory-style classrooms (rows of desks in corridors) to modern campuses. These schools follow guidelines issued by the Finnish Board of Education to create learning environments that are physically, mentally, and socially safe, promoting children's growth, health, learning, and positive interactions with teachers and peers (Sparks, 2012). Key characteristics of Finnish school design standards include:

- ❖ Flexible learning spaces: Classrooms and learning areas are designed to be reconfigurable for different educational activities, using movable and adjustable furniture to facilitate changes in layout.
- ❖ Emphasis on natural light and ventilation: Maximizing natural light and providing HVAC systems to ensure fresh and healthy indoor air.
- ❖ Access to open spaces and nature: Direct connections between indoor and outdoor spaces, including gardens, schoolyards, and green areas, to support learning processes.
- ❖ Modern equipment and technologies: Provision of digital and modern technological resources in classrooms, including smart boards, projectors, and high-speed internet to support contemporary teaching methods.

- Attention to acoustics and noise reduction: Use of materials and design strategies to minimize disruptive sounds and create calm environments for better concentration.
- Shared and interactive spaces: Areas designed for group work and student interaction, including relaxation and discussion zones to strengthen social relationships (Fraser & Wubbels, 2015).

Finnish educational space standards are student-centered and flexible, aiming to create dynamic environments that accommodate diverse learning needs. Rather than using the term "classroom," Finnish schools refer to "learning spaces", treating the entire school building as a learning environment. In the design process, considerations include: space types and functions, flexibility, clarity, educational use, 21st-century learning skills, deep learning, teachers' cognitive frameworks, spatial topology, and the diversity of learning environments (Sahlberg, 2010).

In the design of school buildings in Finland, the indoor classroom space allocated per student ranges from 11 to 13 square meters. The number of students per classroom is reported to be approximately 20. Educational spaces constitute about 50 percent of the total school space. Administrative spaces account for nearly 23 percent, circulation areas for 19 percent, communal spaces for 7 percent, and interactive learning spaces for 1 percent of the overall school environment. The total floor space of a school typically ranges from 6,000 to 11,000 square meters, accommodating between 450 and 950 students, with a per-student space allocation of 11 to 17 square meters (Duthilleul et al, 2018, p. 12).

Figure 3 – Interior environment of schools in Finland

Finnish schools are noted for their building flexibility and use of transparent, glazed, or glass walls and doors, which systematically foster a new learning community and allow rapid reconfiguration of functional spaces. Although concerns have been raised regarding potential student distraction due to transparent walls, measures have been implemented to cover portions of the glass with patterned films, creating semi-transparent spaces and achieving a balance between openness and focus. Some classrooms are interconnected by doors, and in general, classrooms are arranged around a central space, providing additional learning opportunities within this extra area (Duthilleul et al, 2018; InfoFinland, 2024). Some design features that prioritize the provision of suitable spaces for diverse activities and the maximization of natural light include:

- Spacious lounges and large work areas that allow teachers to hold informal meetings and access quiet spaces for lesson preparation.
- Cluster-type buildings with ample indoor and outdoor gathering areas.
- Well-lit atriums that connect staff areas to classrooms.
- Outdoor courtyards that are sheltered from the wind while maintaining clear sightlines for student supervision.
- Large floor-to-ceiling windows and skylights (Sparks, 2012)

Interpretation

Iran

The history of schools and educational spaces in Iran spans multiple historical periods, undergoing significant transformations over time. Jundishapur School, founded by Ardeshir in the 3rd century CE, represents one of the earliest educational spaces in Iran. Following the advent of Islam, the evolution of schools progressed from teaching within mosques (e.g., Fakhriyeh School in Sabzevar during the Fakhr al-Dawla Daylami era) to the construction of schools inspired by caravanserais, such as Charbagh and Ghiyathiyeh Schools in the Seljuk era (four-iwan layout), Doodar/Yousefieh School in the Timurid era, and Aghababakhan or Vakil School in the Zand era. Over time, and influenced by historical, cultural, and social changes, educational spaces evolved from maktab houses to modern-style schools.

Therefore, Iranian educational spaces can be categorized into three periods: traditional, transitional, and modern. The traditional period followed the maktab system, in which teaching primarily consisted of lectures by the instructor on a particular topic, followed by discussions and debates between the teacher and students (Nasiri, 2005).

Historical examples of successful schools, such as Charbagh School in Isfahan or Aghabozorg School in Kashan, demonstrate effective design patterns, including centralized axes, layered spatial organization, interlinked courtyards, reflective surfaces, gardens, and roof diversity (Kamelnia, 2015). Key characteristics of traditional Iranian schools include:

- Simultaneous presence of open, enclosed, and semi-enclosed spaces.
- Flexible and multifunctional spaces.
- Integration of water features and plants, allowing tactile interaction.
- Use of decorative elements and architectural embellishments.
- Environments that foster quiet, calm, and a sense of belonging.
- Dynamic spatial arrangements that encourage exploration and learning (Ahmadi Azarmoghadam & Satarzadeh , 2015).

Figure 4 – Chaharbagh School, Isfahan

During the transitional period, which corresponds to the first half of the 18th century CE, significant changes occurred in Iran, including the adoption of modern European-style education. Iranian rulers, particularly certain statesmen, sought to expand modern education in major cities. The first modern-style elementary school in Iran was established during the Qajar era by Mirza Hasan Roshdieh (1287 AH / 1908 CE), and the Dar al-Fonoon School (1260 AH / 1844 CE) was founded by Amir Kabir, serving as a pivotal institution in the introduction of modern education in Iran.

Figure 5 – Dar al-Fonun School (1851 CE / 1230 SH)

The third period, which began during the reign of the first Pahlavi and gradually expanded over time, Western-educated graduates assumed the leadership and direction of the educational system (Alaghmand, Salehi & Mozaffar, 2017).

The most significant physical transformation in the history of Iranian school construction was the replacement of the central schoolyard with corridors in schools of the recent century. This change effectively marked the end of traditional school layouts and the beginning of modern school design, representing a decline in the concepts of schoolyard-centered planning and traditional spatial hierarchies. At the start of the 20th century, a typical school layout featured uniformly aligned classrooms, straight rows of windows on the façade, and rows of desks arranged linearly within the classroom (Sami Azar, 2000). The first period is termed the traditional period, the second the transitional period, and the third the modern period (Khodabakhshi et al, 2015).

Consequently, the characteristics of traditional schools gradually disappeared with the advent of the modern era. Features of modern schools include:

- Analysis and removal of vestibules and spatial hierarchies
- Lack of a sense of belonging
- Static and uniform spaces
- Multiple large windows facing the street
- Introduction of new elements such as balconies, stair landings, stairs, and corridors
- Elimination of traditional elements such as domed halls, iwans, vestibules, windcatchers, pools, and gardens (Nazarpoor, Heydari and Samadi, 2021).

As a result, the evolution of schools and educational spaces in Iran has not only lagged behind global trends but, in some cases, regressed. The current Iranian education system lacks schools that can provide pleasant, student-centered learning environments that meet the needs and preferences of learners. Historical developments show that after the Islamic Revolution, school architecture under the supervision of the Iranian School Renovation Organization became uniform and stereotyped, characterized by rectangular brick buildings, long monotonous corridors, right-angled classrooms with tall protective windows, and asphalted courtyards with toilet facilities tucked in a corner (Kamelnia, 2015).

Finland

Finnish schools are recognized as one of the most successful educational systems in the world, with a unique historical development. During the middle Ages, education was primarily controlled by the Church, and elementary schooling was largely conducted in churches, focusing mainly on religious instruction and texts (Risku, 2014).

By the mid-19th century, Finland was under the rule of the Russian Empire, and its educational system was influenced by Russian educational reforms. During this period, Finland gradually began to develop a public education system. Elementary public schools began to emerge, and in 1866, the first Public Education Act was passed, making elementary education compulsory for all children (Jordan, 2019).

In the early 20th century, following Finland's independence in 1917, more significant educational reforms were implemented, aiming to establish an equitable and advanced education system for all children. Special attention was given to public education, particularly in rural areas.

One of the most important milestones in Finnish education occurred in the 1970s (Sahlberg, 2010). During this decade, major reforms transformed the educational system into the modern Finnish model, emphasizing the creation of dynamic and innovative learning environments that foster creativity, critical thinking, and independent learning. This period also saw the establishment of a new system for hiring qualified teachers with advanced education and high standards.

From the 1990s onwards, Finland's education system has been recognized as one of the best globally. Its success is attributed to social equity, reduced exam pressure, the importance of high-quality teachers, emphasis on stress-free learning, and well-coordinated educational institutions (Colagrossi, 2018). Today, Finnish educational spaces are considered a global model, inspiring many countries worldwide.

Juxtaposition

According to the third stage of Bereday's method, the juxtaposition of the educational system standards and the school learning spaces in Iran and Finland was examined, as shown in Table1.

Table 1 . Comparison of Educational Space Standards in Iran and Finland

Students per class (persons)	24–30	20
Classroom area (m^2)	4–8	20–90
Student learning area per capita (m^2)	1.7–2	5–7
School outdoor area (m^2)	150–1081	410–2133
Total school area (m^2)	792–2121	2160–11229

Source: Ministry of Education, 2011; Finnish National Agency for Education, 2024

As shown in Table 1, the number of students per class in Iranian schools is 24–30, whereas in Finland, each class accommodates 20 students. Comparing the data reveals that the total area of Finnish schools is approximately six times larger than Iranian schools, while the number of students in Finnish schools is less than double that of Iran. Moreover, the classroom area per student in Iran is only 8 m^2 for 24 students, compared to 20 m^2 for 20 students in Finland, indicating insufficient learning space in Iranian classrooms and a lower per capita learning area in enclosed spaces. In addition to these differences, the design of buildings and educational spaces in Iran and Finland is notable, as shown in Table 2.

Table 2. Comparison of Learning Space Design in Iranian and Finnish Schools

Uniform desks and chairs for students (benches or single-seat chairs)	Diverse and comfortable desks and chairs (including wheeled chairs, multi-sided movable desks, sofas)
Desks and chairs arranged in rows facing the board with no flexibility in layout	Flexible arrangement of desks and chairs; rugs on the floor for students who prefer to sit on the ground
Lack or scarcity of collective learning spaces (workshops, assembly halls, dining halls, prayer rooms)	Presence of diverse collective learning spaces with multiple access points
Lack or scarcity of vegetation and green spaces	Presence of diverse vegetation, water features, and climate-appropriate green spaces
Inadequate courtyard flooring (simple asphalt)	Safe and appropriate courtyard flooring
Lack of transparent or semi-transparent walls	Use of glass and skylights to maximize natural light
Limited or absent outdoor furniture (few benches)	Variety of outdoor elements (e.g., fountains, educational installations)
Lack of recreational and sports equipment, limited to basketball and volleyball courts, accessible only during sports hours	Presence of diverse recreational and sports equipment accessible throughout the day
Uniform and repetitive school layouts (buildings located at the end or side of the courtyard)	Unique and creative school layouts and spatial organization
Courtyard flooring designed solely for lining up without educational or recreational purpose	Purposeful courtyard design for both education and recreation
No multifunctional use of furniture and equipment	Multifunctional use of furniture and equipment; presence of whiteboards and screens in all classrooms

Source: Ministry of Education, 2011, Finnish National Agency for Education, 2024

According to the findings presented in Table 2, Finnish schools are designed with a creative approach that emphasizes flexibility, multi-functionality, a stronger connection to nature, attention

to students' comfort and well-being, and the optimal use of available facilities. In contrast, schools in Iran are generally characterized by traditional, uniform, and less flexible designs, and in many cases lack diversity in educational spaces as well as supplementary facilities.

Comparison

Table 3 – Comparison of Differences and Similarities in Educational Space Standards between Iran and Finland

School area and capacity (spacious areas with low density)	✗	✓
Classroom design and flexible/multifunctional seating arrangement	✗	✓
Maximum utilization of natural light	✗	✓
Teacher skill development considering diverse learning spaces	✗	✓
Spaces equipped with advanced digital technologies	✗	✓
Availability of extensive outdoor and green spaces	✗	✓
Emphasis on educational equity and equal opportunities in space design	✓	✓
Inclusive design for all, including students with disabilities	✗	✓
Focus on student well-being and optimal learning environment	✗	✓
Family participation in education and school facilities	✓	✓
Compliance with international safety and health standards	✗	✓
Extensive and diverse collaborative spaces for students	✗	✓
Creative use of colors to stimulate cognition	✗	✓
Organization of learning environments	✓	✓
Sustainability and environmental considerations in learning spaces	✗	✓

The comparison reveals clear differences between Iranian and Finnish educational spaces. Out of the 15 criteria examined, 12 show differences, while only 3 indicate similarities. Finland, as one of the leading countries in education, adopts a distinctive approach to school design, emphasizing

flexibility, modern technology integration, environmental sustainability, natural light utilization, and the creation of calming learning environments. In contrast, Iran faces significant limitations in these areas. However, by drawing on Finland's experience, Iran could improve its educational infrastructure, adopt modern technologies, and design environmentally compatible schools.

Similarities between Iranian and Finnish school designs include:

- Organization of the learning environment: Both countries recognize the importance of well-structured educational spaces to enhance learning outcomes.
- Educational architecture as a learning factor: In both cases, school spaces are not merely physical structures but are designed to influence interaction, learning, and student development.
- Emphasis on physical design standards: Both systems address the need for adequate lighting, proper ventilation, and suitable spaces for learning.
- Role of teachers and students in learning: In both designs, teachers play a key role in the educational process.
- Attention to social interactions: Both perspectives acknowledge that learning occurs not only in classrooms but also through interactions among students.

4. Conclusion

The present study compared the standards of educational space design in Iran and Finland. The first finding revealed that in Iranian schools, the average educational area per student is approximately 2 m^2. This figure was calculated by dividing the total net built-up area by the number of students in each educational unit. The total number of students per school in Iran ranges from 180 to 540. Iranian schools are generally constructed following fixed models of 6, 9, 12, 15, or 18 classrooms, with each classroom allocated an area of 8.4 m^2. Such limited and rigid regulations appear to restrict the possibility of designing diverse, efficient, flexible, adaptable, and student-centered learning spaces, leaving designers and architects little room for innovation that aligns with contemporary educational needs and students' individual and social requirements.

In contrast, the educational area per student in Finnish schools ranges between 11 and 13 m^2. Achieving such a standard requires a significantly larger overall school area. Considering that each class in Finland comprises 20 students, the average classroom area is about 55 m^2 (with a minimum of 20 m^2 and a maximum of 90 m^2 per classroom). Finnish school design emphasizes collaborative, exploratory, and creative learning, paying particular attention to classroom furniture diversity,

flexible seating arrangements that allow students to sit in groups around tables, and outdoor environments that integrate natural and artificial elements for play and learning. The materials used for flooring are carefully chosen to be safe, minimizing the risk of injury.

Since this study is qualitative and innovative, its findings cannot be directly compared with previous research for consistency or inconsistency. However, regarding space inadequacy, noncompliance with construction standards, and uneven distribution of educational spaces in Iran, the results align with the findings of Barashadat et al. (2019); Daneshjoo et al. (2019); Ebrahimzadeh et al. (2020); Forud et al. (2021); Ghazanfarpour et al. (2021); Lee (2024) and Samadpour & Tahbaz (2018). Additionally, in terms of lack of flexibility, diversity, and adaptability in the design of Iranian educational spaces, the findings are consistent with Eskandari et al. (2019) and the Inova Design Group (2017), who emphasize the importance of designing spaces that can adapt to diverse teaching approaches and meet both individual and collective student needs. Furthermore, regarding the relationship between educational space architecture and learning enhancement, the results align with Schönrock-Adema et al. (2012) and Nazarpoor et al. (2021); in terms of creating motivation and calmness, they are similar to Ebrahimzadeh et al. (2020) and Lee (2024); and in capturing student attention and interest, they correspond with Fraser and Wubbels (2015) and Arghiyani et al. (2019).

The findings concerning Finnish educational space design, including the emphasis on collaborative learning, group seating arrangements, diverse furniture, and nature-oriented outdoor learning spaces, are consistent with studies by Fraser & Wubbels (2015); Lee (2024) and Sun & Abdul Aziz (2024). These studies highlight the necessity of designing spaces that provide a suitable psychological and emotional environment for student growth, facilitate interaction, engagement, and exploratory learning. Additionally, the importance of natural elements, open spaces, and play-based environments in Finnish schools aligns with research by Ebrahimzadeh et al. (2020) and Samadpour & Tahbaz (2018), which emphasizes the role of open spaces in enhancing student calmness and attachment to their school environment.

Overall, the design and architecture of educational spaces, alongside teachers, textbooks, students, teaching methods, school management, and family involvement, is recognized as effective factor in the learning process. In modern education, school spaces are not merely static or sterile environments; rather, they play an active and dynamic role in the quality of students' educational and developmental experiences. Outdoor spaces and schoolyards provide opportunities for social interactions and experiential learning, serving as a platform for energy release and skill development.

Contemporary learning environments must encourage students to explore new territories in an evolving world and adapt rapidly to educational technological advancements. Therefore, flexibility in learning environments is essential. A key design principle is the multi-functionality of spaces, allowing for continuous adaptation and expansion. In architectural terms, spatial flexibility involves organizing, structuring, and modifying spaces to meet evolving needs and new requirements. Open spaces that allow diverse functions and visual experiences are highly desirable and preferred by students. The primary goal in designing such open spaces is to meet students' educational, physical, and psychological needs. Natural environments contribute to calmness, stress reduction, revitalization, increased creativity, and a stronger sense of attachment to the school environment.

Given the importance of play and recreation for social development, school play and rest areas must be designed to enhance students' cognitive, linguistic, concentration, emotional, and social skills. For instance, physical activity during the school day can improve students' concentration, while outdoor play facilitates knowledge acquisition and social development. Activities requiring both planning skills and physical strength are particularly effective in achieving these objectives. Therefore, educational spaces must possess diversity, adaptability, and flexibility, enabling them to respond dynamically to students' evolving needs.

Based on the findings and drawing inspiration from Finnish schools, the following strategies are proposed to improve the efficiency and functionality of open spaces in Iranian schools:

- Design walls and boundaries with recreational and educational purposes in mind.
- Use vibrant colors in wall and boundary designs to stimulate creativity and engagement.
- Create diverse and exploratory spaces that are not immediately apparent at first glance, encouraging discovery and curiosity.
- Provide various playground and sports equipment in the schoolyard, such as horizontal bars, climbing frames, and other interactive installations.
- Use safe and comfortable flooring materials instead of asphalt to minimize injuries and enhance comfort.
- Ensure the environment responds to diverse student needs, accommodating a wide range of activities and learning styles.
- Promote spatial fluidity and permeability, facilitating easy movement and natural interaction between different zones.
- Develop active group spaces for collaborative learning and play.

- Design the flooring for educational and recreational purposes, such as alphabet or number games.
- Provide seating areas and resting platforms for students during breaks.
- Incorporate educational elements in the schoolyard, such as weather vanes, water clocks, or other interactive installations.
- Integrate greenery and plant life into open spaces to enhance aesthetics and environmental learning.
- Revive the concept of a central courtyard inspired by traditional Iranian school architecture.
- Install birdhouses or similar elements to familiarize students with animals and nature.
- Use flexible furniture that can be quickly rearranged or stored to accommodate outdoor classes or group activities.
- Ensure transparency and connectivity between indoor classrooms and outdoor spaces to promote interaction and supervision.
- Facilitate group games and collaborative activities in the yard, including sports, collective art projects, or wall/floor painting.
- Provide furniture with diverse shapes and vibrant colors, scaled appropriately for different age groups, and adjustable to changing activities.
- Allocate parts of the yard for natural play, such as sand play, gardening, light and shadow interaction, and other sensory activities.

Additionally, it is necessary to consider land-use planning and demographic trends, engaging relevant organizations to secure suitable and ample land for new schools, prioritizing educational and training complexes, especially in urban areas. Construction of schools on small plots should be avoided. Efforts should be made to upgrade existing schools to medium or large-scale facilities, ensuring sufficient land for green spaces, playgrounds, and outdoor activities beyond the building footprint.

When equipping both new and existing schools, attention should be paid to ergonomic standards, student dimensions, and physical, cognitive, emotional, and gender-specific needs, integrating modern technologies, furniture, and educational equipment appropriate for the students' age and abilities.

References

Aghazadeh, A. (2017). *Comparative Education*. Tehran: SAMT Publications, [in Persian]

Ahmadi Azarmoghadam, S., & Satarzadeh, D. (2015). *The evolution of Iranian schools from the past to the present and presenting a model for contemporary school design,* National Conference on Native Iranian Architecture and Urban Planning**.** April 1-12. Yazd, Iran. Retrieved from https://civilica.com/doc/544896 [in Persian]

Alaghmand, S., Salehi, S., & Mozaffar, F. (2017). A comparative study of architecture and content of Iran's schools from the traditional era to the modern era, *Bagh-e Nazar, 14*(49), 5–20. https://sid.ir/paper/125361/en, [in Persian]

Arghiyani, M., Yazdanfar, A., & Feizi, M. (2019). The effect of the quality of closed educational space on the amount of user sense of community, *Educational Technology, 13*(4), 931–944, https://doi.org/10.22061/jte.2019.3367.1867, [in Persian]

Azemati, H. R., Norouzian, S., & KhanVali, N. (2016). Recognition of effective variables on physical safety in elementary school, *Educational Technology,* 10*(1), 1–10,* https://doi.org/10.22061/tej.2015.434, [in Persian]

Azemati, H., & Nassiri, H. (2012). *The effect of physical security in the promotion of education*. In Abstracts of the Fourth National Conference on Education, 347-349, retrieved from https://civilica.com/doc/213922, [in Persian]

Bagheri, M., & Azemati, H. R. (2011). Framespace as the curriculum : Fostering creativity in children in the school environment, *Curriculum Studies*, 6(22), 163–184. Retrieved from https://sid.ir/paper/471450/fa [in Persian]

Bareshadat, N., Shoaei, H., & Rezvani, A. (2019). Explaining the components and indices of environmental sustainability in Iran's educational spaces, with an emphasis on green educational building evaluation systems, *Environmental Studies, 45*(1), 171–192, https://doi.org/10.22059/jes.2019.271447.1007788, [in Persian]

Bereday, G. Z. F. (1964). *Comparative Method in Education*. Holt, Rinehart and Winston

Bozorgi Nejad, K., & Zarei, R. (2017). *Dimensions and quality indicators of schools.* 2nd International Conference and 4th National Conference on Management and Humanities Research. University of Tehran, Tehran, Iran, Retrieved from https://sid.ir/paper/897662/fa [in Persian]

Butler, P. (2016). *No grammar schools, lots of play: The secrets of Europe's top education system, The Guardian*. September 19. Retrieved from https://www.theguardian.com/ education/ 2016 /sep/ 20/grammar-schools-play-europe-top-education-system-finland-daycare

Colagrossi, M. (2018). Why Finland's education system is the best in the world: 10 reasons. *World Economic Forum*, https://www.weforum.org/stories/2018/09/10-reasons-why-finlands-education-system-is-the-best-in-the-world

Daneshjoo, K., Motavalli Haghighi, H., & Talaei, M. (2019). Collective spaces and school yards: 3D book approach to sustainable development education. *Manzar, 11*(49), 38–47. https://doi.org/10.22034/manzar.2019.135687.1793, [in Persian]

Dehani, I., & Mo'tamed, H. (2017). *Investigating factors affecting educational quality and the status of school spaces with emphasis on sociology*, Fourth Global Conference on Iran and World New Researches in Management, Economics, Accounting, and Humanities, 18 May, Shiraz, [in Persian]

Duthilleul, Y., Blyth, A., Imms, W., & Maslauskaite, K. (2018). *School design and learning environments in the City of Espoo, Finland*, Council of Europe Development Bank, Retrieved from https://coebank.org/media/documents/School_Design_and_Learning_ Environments_ in_the_City_of_Espoo_Finland.pdf

Ebrahimzadeh, F., Mahdizadeh, S. F., Norouzian, M. S., & Piri, S. (2020). Design indicators affecting the student's place attachment in open spaces of schools from the perspective of experts in architecture. *Educational Technology, 15*(1), 191–205. https://doi.org/10.22061/tej.2020.6244.2366[in Persian]

Eskandari, Z., Hosseingholizadeh, R., & Kamelnia, H. (2019). Providing a conceptual framework for the design of primary school physical spaces based on Vygotsky's collaborative learning theory. *Journal of Educational Innovations,* (72), 27–52. [In Persian]

Farrokhnia, Mina. (2011). How to captivate children with architecture, *Javan Newspaper*, 3573, [in Persian]

Finnish National Agency for Education. (2024). *School building guidelines*, Available at : https://www.oph.fi/en

Forud, H., Rahbari Manesh, K., Khansari, S., & Soltanzadeh, M. (2021). Principles for designing effective learning environments in primary schools, *Environmental Science and Technology, 23*(4), 21–37, [in Persian]

Fraser, B. J., & Wubbels, T. (2015). Classroom learning environments, in R. Gunstone (Ed.), *Encyclopedia of Science Education* (pp. 154–157), Dordrecht, the Netherlands: Springer

Fraser, B. J. (2015*).* Environments for education, In J. D. Wright (Ed.), *International encyclopedia of the social & behavioral sciences* (pp. 820–823), Elsevier, https://doi.org/10.1016/B978-0-08-097086-8.92077-4

Ghazanfarpour, H., Karimi, S., Khabazi, M., & Pourkhosravani, M. (2021). Analysis of the educational spaces in Kerman schools, *Desert Geography Studies, 9*(1), 65–86, [in Persian]

Ghataghi Kalashami, S., Ghasemi Sichani, M., & Mahdizadegan, I. (2016). *Impact of flexible open space design in primary schools on student learning*, National Conference on Key Issues in Civil Engineering, Architecture, and Urban Planning, Gorgan, [in Persian]

Genn, J. M. (2007). AMEE medical education guide no. 23 (part 1): Curriculum, environment, climate, quality and change in medical education—a unifying perspective. *Medical Teacher, 23*, 337–344.

Gifford, R. (2016). *Research methods for environmental psychology*, John Wiley & Sons.

Heidari, T., ArianMehr, A., & Karimian Shamsabadi, M. (2018). Architecture of residential complexes and flexible housing in Iran with emphasis on adaptability, *Urban Management,* 17(50), 257–281.https://sid.ir/paper/91923/en [in Persian]

Hosseini Vaez, M. S., Samari, E., & Fazlollahi Qamshi, S. A. (2017). *A comparative study of facilities, spaces, and educational equipment of elementary schools in Qom Province with Iranian standard indicators,* National Conference on Modern Research in Iran and the World in Psychology, Educational Sciences, and Social Studies, Shiraz: 16 November. https://sid.ir/paper/897271/fa. [in Persian]

Innova Design Group. (2017). *Top challenges and complexities of learning spaces.* https://www.innovadesigngroup.co.uk/news/top-challenges-and-complexities-of-learning-spaces

InfoFinland. (2024). *Education System*. Available at: https://www.infofinland.fi/en/education/the-finnish-education-system

Jordan, E. (2019). *Educational reforms in Finland: From public education to global success*. Centre for Public Impact. Available at https://centreforpublicimpact.org/public-impact-fundamentals/education-reform-in-finland-and-the-comprehensive-school-system/

Kamelnia, H. (2015). Iranian school architecture: Past, present, and future. *Art & Architecture, 36*, 34-38, [In Persian]

Khodabakhshi, S., Foroutan, M., & Samiei, A. (2015). The evolution of school architecture based on assessment of educational system influence , *Bagh-e Nazar Journal, 37*, 61–74, [In Persian]

Lee, S. (2024). *3 types of learning environments*, https://www.wgu.edu/blog/3-types-learning-environments2111.html

Ministry of Education. (2011). *Fundamental Transformation Document of Education in the Islamic Republic of Iran*, Tehran: Ministry of Education, [in Persian]

Nasiri, F. (2005). Underlying factors in establishing virtual education systems, *Peyk-e Noor, 3*(2), 120–125, [In Persian]

Nazarpoor, M., Heydari, A., & Samadi, M. (2021). Analysis and review of architectural configuration of Iranian Islamic school spaces: Comparative study of public and educational spaces in Iranian schools and contemporary layout models. *Education*, 37(2), 147–176.[in Persian]

Organization for School Renovation, Development and Equipment. (2016). *School building design guidelines: Harmonized architectural planning for primary and secondary schools* (Technical Report No. 697), Management and Planning Organization of the Islamic Republic of Iran. https://www.nezamfanni.ir

Rafiei Nayini, S., & Jahanbakhsh, H. (2016). *Impact of using open school spaces (yards) on students' cognitive development,* International Congress on Modern Sustainability in Architecture, Urban Planning, Civil Engineering, and Construction, [In Persian]

Risku, M. (2014). A historical insight on Finnish education policy from 1944 to 2011, *Italian Journal of Sociology of Education*, 6(2), 36–68, retrieved from https://ijse.padovauniversitypress.it/2014/2/3

Roff, S., McAleer, S., & Skinner, A. (2005). Development and validation of an instrument to measure the postgraduate clinical learning and teaching educational environment for hospital-based junior doctors in the UK, *Medical Teacher, 27*, 326–331

Safi News. (2024). *Number of students in the 2024–2025 academic year*. https://safinews.ir/125962-1404-1403/. [in Persian]

Sahlberg, P. (2010). *Finnish lessons: What can the world learn from educational change in Finland?* New York: Teachers College, Columbia University.

Samadpour, M., & Tahbaz, M. (2018). Strategies to improve open spaces in girls' primary schools from students' perspectives (Case study: Tabriz). *Educational Technology, 12*(2), 95–108. https://doi.org/10.22061/jte.2018.2921.1740, [in Persian]

Sami Azar, A. (2000). Concept and function of open space in traditional and new schools**,** *Safheh***,** *10*(31), 104–111. Retrieved from https://sid.ir/paper/94483/fa[in Persian]

Schönrock-Adema, J., Bouwkamp-Timmer, T., van Hell, E. A., & Cohen-Schotanus, J. (2012). *Key elements in assessing the educational environment: Where is the theory? Advances in Health Sciences Education Theory and Practice, 17*(5), 727–742. https://doi.org/10.1007/s10459-011-9346-8

Schulma, A., & Peters, C. A. (2007). GIS analysis of urban schoolyard landcover in three U.S. cities, DOI:10.1007/s11252-007-0037-4

Shafaee, M., & Madani, R. (2010). Principles for designing educational spaces for children based on creativity models. *Technology in Education, 4*(2), 117–124. https://doi.org/10.22061/tej.2010.1348. [In Persian]

Shargh News. (2025). *Latest status of school safety in Tehran*. https://www.sharghdaily.com. [In Persian]

Skantsi, J. (2022). *The Finnish education system and services*. https://www.educationfinland.fi/sites/default/files/2022

Sparks, S. D. (2012). *Finland rethinks factory-style school buildings*. *Education Week*, Retrieved from https://www.edweek.org/policy-politics/finland-rethinks-factory-style-school-buildings/2012/07

Sun, R., & Abdul Aziz, M. F. (2024). Design guidelines for formal learning spaces: A narrative review. *Multidisciplinary Review, 7*(4), e2024070. https://doi.org/10.31893/multirev.2024070

Sun, R., & Abdul Aziz, M. F. (2024). A systematic literature review of design considerations, challenges, and guidelines in primary school physical learning space design, *Pertanika J. Soc. Sci. & Hum. 32*(3), 971–998. http://www.pertanika.upm.edu.my/

Sylwester, R. (2003). *Skulls and school boxes: Student brains that want out*, University of Oregon, NCEF. www.edfacilities.org

WFME. (2003). *Basic medical education: WFME global standards for quality improvement*. Copenhagen.