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The Role of Classroom Geometric Form in Implementing Various Teaching Patterns in Multi-Grade Rural Elementary Schools of Yazd Province: A Phenomenological Analysis Using GIS

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ABSTRACT

Objective: Adapting the geometric form of the classroom space to teaching patterns plays a crucial role in a teacher's success in delivering educational content. A review of elementary schools in Iran's education system shows that a significant number of students are still being educated in multi-grade classrooms.

Methods: Using a qualitative approach and thematic analysis method, this study examines all multi-grade rural schools in Yazd Province, selecting 19 multi-grade teachers through purposive sampling. After analyzing the data and validating the findings through participant and architectural expert reviews, two main categories physical and functional components were identified. These were further classified into four key themes: spatial form, classroom size, spatial organization, and visual and environmental comfort, leading to 15 sub-themes.

Results: This study, using a phenomenological approach, examines the impact of classroom geometric form on the implementation of various teaching patterns in multi-grade classrooms. Preliminary investigations indicate that due to the diversity of teaching patterns and the presence of students from different grades in a single classroom, the geometric form of the classroom space should have characteristics that accommodate this diversity. However, classroom designs in many regions of the country remain rigid and inflexible, failing to fully respond to the dynamic and variable nature of teaching patterns.

Conclusion: The study's findings indicate that each teaching pattern has specific requirements, and using centralized and combinatory forms integrated with a primary space such as cruciform and octagonal designs proves to be more suitable for designing spaces that meet the needs of multi-grade classrooms.

1. Introduction

In recent decades, the quality of education in rural elementary schools, particularly in multi-grade classrooms, has become one of the fundamental challenges of the educational system. These

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challenges stem both from educational limitations and the inadequate design of learning spaces, significantly impacting students' learning processes. Multi-grade classrooms, recognized as one of the most complex and widely debated types of classrooms, require specific teaching models and appropriate architectural designs due to the presence of students with varying ages and academic levels (Asadi & Eskandari, 2023).

Numerous studies have shown that the design of educational spaces can have a direct impact on the quality of teaching and learning. This impact is even more pronounced in rural schools, where multi-grade classrooms are commonly used. This study seeks to gain a deep understanding of the experiences and perspectives of teachers and students in such classrooms to identify the challenges and opportunities in teaching methods and the geometric and spatial design of multi-grade classrooms.

Furthermore, this research aims to propose solutions for designing more efficient and flexible educational spaces to enhance the quality of teaching and learning in these classrooms. By gaining a better understanding of teaching models and architectural design requirements, it is possible to create improved educational conditions in multi-grade classrooms in rural elementary schools (Nikan, Saemi, Bayani, 2023).

Research Questions:

- How does the geometric form of the classroom affect the implementation of diverse teaching patterns in multi-grade schools?
- Which geometric forms are more suitable for designing multi-grade classrooms in rural elementary schools?

2. Theoretical Foundations of the Research

2.1. Teaching in Multi-Grade Classrooms

Multi-grade classrooms in rural elementary schools have become a necessity due to the small student population and limited resources (Sarraf, Alborzi, & Amini, 2023). One of the main challenges is the educational differences and learning levels among students from different grades. The teacher must plan in a way that addresses the needs of all students while having limited time and resources. This not only reduces the quality of education but can also affect students' motivation and enthusiasm for learning (Akbarzadeh, Heidarnattaj, Ahmadi, & Baezzat, 2020).

Many rural schools lack appropriate educational spaces that can adequately meet the needs of multi-grade classrooms. Insufficient space, limited equipment, and the lack of suitable facilities to separate different age groups are among the architectural problems of these classrooms, which can intensify teaching challenges. In some cases, unused classrooms in existing schools are repurposed to teach students from different grades, which hinders the effective implementation of suitable teaching patterns in multi-grade schools (Dehcheshmeh, Liaghatdar, & Davarpanah, 2021).

2.2. Diagnosis: The Mismatch Between the Geometric Form of the Classroom and the Needs of Multi-Grade Rural Classrooms

Proper architectural design can create an environment where teachers can better manage time and educational resources. For instance, dividing spaces based on the different needs of students in each grade, or creating flexible spaces that allow teachers to work simultaneously with different groups, can improve teaching quality (Targhi, Omran, & Fazli, 2023). Rural schools typically have a structure similar to single-grade schools, while the educational and developmental needs of students in different grades require different types of spaces.

Currently, multi-grade classrooms do not have fixed dimensions; instead, the number of students and teaching models are the primary factors in determining the area, form, and geometric shape. Unfortunately, for years, classrooms in our country have been designed based on Publication No. 232 from the Planning and Budget Organization, which likely considers an average number of students and only one teaching model (lecture) (Mohammad, Nazarpour, Norouzian, & Maleki, 2019).

The core content in most schools in the country involves the direct transfer of information, where thinking and creativity have no place. The standardized form of classrooms is typically a room with dimensions of 6×8 or 8×7 meters (Kamelnia, 2009, 105 & 185). The rectangular shape of the classroom, the presence of a blackboard and podium, desks, and their linear arrangement all contribute to creating a direct axis in the classroom, which implicitly guides the teacher to use the lecture teaching model and direct content delivery. Some teaching models require additional spaces adjacent to the main classroom for supplementary educational tools and other activities, while such options are not available in current multi-grade classrooms. Moreover, using centralized models (such as group discussions) or models that require spatial separation (for group work) will also face challenges in these classrooms (Ahmadābādi, Pourroostā, Ardakāni, Farrokhi, & Mohtadi, 2021).

2.3. Form and Geometry of the Classroom

Form can be considered the language of space, as what architects want to express in a space is conveyed through its form. Therefore, form plays a crucial role in the creation of space. The desired form must have the necessary capability and flexibility to accommodate the intended functions, acting as a container for them. This is especially significant in the design of educational spaces; the geometric form of multi-grade classrooms must be designed in such a way that it facilitates effective interaction between the teacher and students, as well as between students themselves. In these types of classrooms, the diversity of educational levels requires flexibility in the space. The forms that can be used in the design of classroom geometry are listed in Table 1:

Table 1. Types of geometric forms used in educational spaces (Source: Authors)

Type of Form	Features
1. U or Semi-Circular Form	This form provides easier visibility and access for the teacher to all students. Students can also easily communicate with each other.
2. Asymmetrical Polygon Form	This form creates an open and flexible space, allowing the teacher to manage small groups. It is suitable for collaborative or project-based activities.
3. Modular Form	The arrangement of desks and chairs in separate and adjustable configurations for each group or grade. This layout helps the teacher divide the class into smaller sections.
4. Multi-Purpose Open Space	Removing walls or using adjustable partitions creates a suitable environment for teaching multiple levels simultaneously. The layout can be quickly adjusted for various activities.

These designs increase flexibility and educational interactions, providing the best learning experience for multi-grade classrooms. The geometric shapes used in classroom design primarily depend on learning needs, the number of students, and the type of educational interactions. The most common types are explained in Table 2:

Table 2. Types of Geometric Shapes in Classroom Design (Source: Authors)

Geometric Shape Type	Features
1. Rectangular Shape	The most common shape for classrooms, providing a systematic arrangement for desks and chairs. It has a dominant perceptual axis along the length of the classroom. Suitable for traditional teaching methods where the teacher is positioned at the front of the class.
2. Square Shape	Used for smaller classrooms that require more student interaction. Offers high flexibility for different layouts.
3. Circular or Oval Shape	Specifically designed for creative classrooms or group learning. Facilitates face-to-face communication and increased interaction among individuals.
4. Polygonal Shape	Suitable for creating modern, multi-functional learning environments. Has high visual appeal and is used to encourage creativity.
5. Linear or Corridor Shape	Suitable for limited spaces and focused teaching. Practical for schools with small areas.
6. Open and Flexible Shape	Without fixed boundaries, allowing students more freedom to interact. Used in modern educational environments emphasizing creative learning.

The choice of these shapes depends on the functional needs of the classroom and the educational philosophy, and their selection helps achieve learning goals.

The types of architectural floor plans for schools are categorized based on design approaches and the functionality of spaces. These floor plans are designed according to educational goals, climatic conditions, and the needs of students, as shown in Table 3:

Table 3. Types of School Architectural Floor Plans (Source: Authors)

Type of Floor Plan	Features
1. Linear Plan	In this design, classrooms and educational spaces are organized in a single row or two parallel rows. Suitable for limited spaces and small schools. Provides direct access to natural light and ventilation.
2. Centralized Plan	Classrooms and spaces are designed around a central core, such as a courtyard or assembly hall. Suitable for creating interaction and integration between different school spaces. Often used in larger schools.
3. Branching Plan	Classrooms extend as arms from a central core (such as a main corridor). Offers high flexibility for adding new spaces.
4. Open Plan	Spaces are designed without fixed walls, and movable partitions are used for separation. Suitable for modern and group-based teaching approaches.
5. Modular Plan	Use of standard modules for designing classrooms and spaces. Low construction cost and easy expansion.
6. Hybrid Plan	A combination of the above forms to achieve specific design goals. Especially used in multi-purpose schools with diverse functions.

The design of an appropriate form should be done considering educational needs, cultural conditions, and environmental factors to provide maximum efficiency for students and teachers.

2.4. Teaching Methods in Multi-Grade Classrooms

The selection of appropriate teaching methods plays a key role in improving the quality of education in multi-grade classrooms.

Table 4. Types of Teaching Methods in Multi-Grade Classrooms (Source: Authors)

Teaching Method Title	Features
1. Group Method: Presenting Similar Topics	A method for managing the class by "teaching the same lesson simultaneously to all grades."
2. Core Method: Presenting Dissimilar Topics	A method for "teaching different subjects with common objectives to multiple grades at the same time."
3. Combined Core and Group Method	In this method, some lessons are taught in a group format, while others are taught in a core format.

In using the group method, the teacher should present the educational content to students of different grades simultaneously in one session, without separating them or positioning one group at the core and the others in a peripheral role. In contrast, the core method allows the teacher to focus more on the class schedule, teaching different subjects with shared objectives in one session. While this method is essential in multi-grade classrooms (especially in grade six), it has several drawbacks, including:

a) The noise and additional activities of students in the non-core group can disrupt the teaching of the core groups (failure to maintain order in the entire multi-grade class).

b) The teacher’s inability to supervise the activities of non-core students, leading to underperformance of the non-core group (Khademi et al., 2022; Bahramani, 2023).

2.5. Application of Some Teaching Methods in Multi-Grade Classrooms:

None of the teaching methods are inherently good or bad; rather, it is the way and circumstances in which they are used that determine their strengths or weaknesses. Therefore, the teacher must choose the most appropriate method for effective teaching, taking into account the educational objectives of each lesson, the needs and interests of the students, the classroom environment, the student density, and the number of grades present in the class (Badakhshaan Toroghi, SoleimanPour, & Fazli, 2023).

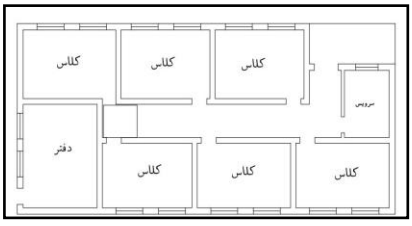
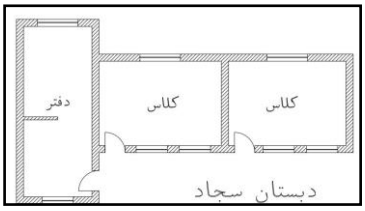
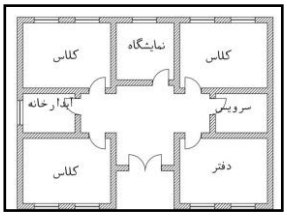
Table 5. Types of Teaching Methods in Multi-Grade Classrooms (Source: Authors)

Method Title	Features
1. Lecture Method	The presentation of concepts orally by the teacher, with students learning through listening and note-taking, forms the basis of this method.
2. Question and Answer Method	This method encourages students to think about a new concept or express an idea. The student attempts to move from the unknown to the known through mental effort.
3. Cooperative Method	In this method, students learn that they either succeed or fail together. Each student, when in need of help or has something to share, can rely on their classmates.
4. Problem-Solving Method	In this method, educational activities are designed in such a way that a problem is created in the learner's mind, making them interested in finding a solution to that problem through their efforts. The problem-solving method can be implemented individually or in groups.
5. Experimental Method	The experimental method includes activities where students engage with tools, equipment, and materials to gain experience related to a specific concept.

In Table 6, several case studies of multi-grade classrooms in Yazd Province are presented. These classrooms were not designed based on the number of students and their specific needs. Additionally, some floor plans of multi-grade classrooms, designed and constructed as standardized (template) models by the Yazd Province School Renovation Organization, are also included.

Table 6. Images and Sample Floor Plans of Multi-Grade Classrooms in Yazd Province (Source: Authors)

		
Multi-Grade Classroom in Sarv Village	Multi-Grade Classroom in Khoramiz Village	Multi-Grade Classroom in Mirkabad Village

		
Multi-Grade Classroom in Shamsi Village	Multi-Grade Classroom in Esmatabad Village	Multi-Grade Classroom in Aliabad Village
		
Floor Plan of Saadi Elementary School in Madvar Village	Floor Plan of Sajad Elementary School in Sarv Village	Floor Plan of Imam Hassan (AS) Elementary School in Khoramiz Village

3. Research Background

3.1. The Impact of the Educational Environment on Students' Learning

In Iran, for nearly a century, the imported linear corridor-classroom model has been repeatedly implemented across different climates and cultural contexts. Numerous studies have shown that the educational environment plays a crucial role in students' learning. Webb (1976), in a study, examined the impact of the physical school environment on students' behavior and academic performance by comparing traditional and modern facilities. He confirmed Lewin’s (1938) theory that "the educational environment is an essential component of education" and Prohaska’s (1970) theory that "the environment significantly influences students' behavior and performance." Therefore, it appears that paying attention to the educational environment and designing appropriate learning spaces can play a significant role in improving students' learning.

Table 7. Introduction of Researchers on Educational Spaces (Source: Authors)

Researchers	Title of Work	Type of Work	Year	Research Field
Mahsa Tahan, Ahmad Khoshnevis	A Review of the Relationship Between Modern Educational Space Design and Teaching-Learning Effectiveness	Article	2022	Classroom design is considered one of the key factors in educating students and fostering their growth and development.
Tarlan Zarnehsani Asl	Examining Policy-Making of Architectural Components with an Approach to Improving the Quality of Educational Spaces	Article	2022	Establishing a connection with educational spaces through architectural components to enhance the quality of education.
Bahram Ahmadkhani Maleki, Zohreh Rostamzad Jalali	Identifying Architectural Components in Enhancing the Quality of Educational Spaces	Article	2021	The main criterion for evaluation is user satisfaction, which depends on the alignment of the physical environment with human needs and expectations.
Yesica Paola Villarreal Arroyo	Influence of Environmental Conditions on Students' Learning Processes: A Systematic Review	Article	2023	Research aimed at determining how environmental factors in school buildings affect teaching-learning processes.
Ali Ahmadi, Maryam Banaei	Emotional Evaluation of Architectural Interior Forms Based on Personality Differences Using Virtual Reality	Article	2019	Architectural interior forms can influence the emotional state of occupants, and there is a relationship between forms and emotional states for different personality traits.

3.2. The Role of the Physical Environment in Shaping the Geometric Form of the Classroom

Relph believes that the physical environment and activities are key components in fostering attachment. Malinowski and Thurber state that in early childhood, places are chosen based on their level of sociability. However, in later childhood, around ages 9 to 12, places are categorized based on their intended use. By designing appropriate spaces that consider individuals' needs and preferences, place attachment can be strengthened, ultimately enhancing the quality of life.

In childhood, fixed environmental cues play a crucial role in children's recognition and orientation. During middle childhood, children develop a dependency on familiar places and their surroundings. The design of seating areas, classrooms, selected spaces, and child-friendly environments can help strengthen their attachment to the environment.

Table 9. Introduction of Researchers on School Space Form (Source: Authors)

Researchers	Title of Work	Type of Work	Year	Research Field
Saber Hoseledar, Reyhaneh	Assessment of Cognitive Map Reception of the Physical Environment in Schools Using Spatial Layout Techniques	Article	2022	Readability indicators are directly related to plan structure, the number of subspaces, courtyard forms, and the symmetry or asymmetry of the overall plan structure.
Mohaddeseh Sarraf, Fariba Alborzi, Amirhossein Amini	Examining the Impact of Physical Elements in Educational Spaces on Enhancing Children's Creativity Using Graphic Analysis of Drawings	Article	2023	Furniture is the top priority, followed by openings, color of physical elements, green spaces, and spatial transparency (physical boundaries and classroom structure) in enhancing children's creativity.
Nosrat Pourdarya	Recognition of Architectural Forms for Lightweight Building Design	Article	2010	Architects should consider proportions, solid and void spaces, appropriate composition, form typology, and efficient form design in the design process.
Mahnaz Mahmoudi Zarandi	Analyzing the Use of Geometric Patterns on Ceilings and Classroom Walls to Improve Visual Efficiency in Hot and Dry Climates	Article	2022	Examining and analyzing ceiling geometry and classroom height to assess visual comfort and energy efficiency in hot and dry climates through simulations.
Hossein Soltanzadeh	Explanation of the Architectural Transformation of Classroom Layouts Based on Modern Teaching Methods in Iranian Primary Schools (2001-2021)	Article	2023	The geometric form and layout of primary school classrooms are crucial for improving teaching quality and selecting the most appropriate teaching methods.
Sahereh Mehrabian, Hossein Safari	Explanation of Effective Physical Indices in Improving Students' Place Attachment in Primary School Plans (Case Study: Eastern Gilan Primary Schools)	Article	2019	Since children spend a significant portion of their time in schools, special attention to the qualitative features of schools is essential.

Educational environments should be designed in a way that facilitates active learning and social interaction among students. The design of educational spaces should include various areas for group activities, individual learning, and creativity to meet diverse learning needs.

Table 10. Introduction of Researchers on Multigrade Classrooms (Source: Authors)

Researchers	Title of Work	Type of Work	Year	Research Field
Badakhshan Taraghi Esmat, Soleimanpour Mahbubeh, Fazli Rokhsareh	Identification of Influential Factors in Enhancing the Quality of Multigrade Primary Classrooms	Article	2022	Five main themes influence the quality of multigrade classrooms: professional competence and teacher-related characteristics, family, physical condition of classrooms and schools, macro educational policies, and learner-related themes.
Ghasemi Saeedeh	Educational Justice in Iran's Education System	Article	2022	Education is a natural, innate, and fundamental human right; it is also considered the highest spiritual experience of humanity on an individual level.
Mortezazadeh Araei Sajad, Abedi Firouzjai Mahdieh	Performance Analysis of Multigrade Schools in Iran with a Comparative Perspective on Other Countries	Article	2022	Examining the existence of such classrooms in both developed and developing areas and comparing measures taken in England, Turkey, and Canada.
Mortezavizadeh Seyed Heshmatollah, Hasani Mohammad	Analysis of Teachers' Experiences Regarding Influential Factors in Managing Teaching-Learning Time in Multigrade Classrooms	Article	2021	Categorizing the experiences of multigrade teachers into two broad categories: positive and negative.
Karaçoban, Fatma; Karakus, Memet	Evaluation of the Curriculum of the "Teaching in Multigrade Classrooms" Course: Participatory Evaluation Approach	Article	2022	The evaluation aims to assess the curriculum designed for the "Teaching in Multigrade Classrooms" course in pre-service teacher education using a participatory evaluation approach.
Oliveira da Silva F	Educational Practices in Teaching Work in Multigrade Classes: Ways of Dealing with Differences in School	Article	2021	The effectiveness of multigrade classrooms depends on classroom management. Utilizing educational technology is one of the effective ways to manage such classrooms, facilitating learning and improving performance.

3.3. Analysis and Critique of Existing Literature

In the field of examining the impact of classroom geometric form on improving the learning performance of multigrade students, various studies and research have been conducted. However, there are still some research gaps that require further investigation:

1. **Lack of Comprehensive Empirical Research**: Many existing studies have primarily focused on examining the impact of specific classroom designs on learning at a general level, with less attention given to the specific effects of geometric forms in multigrade classrooms. There is a need for field-based and empirical studies to precisely assess the impact of various geometric forms (such as circular, U-shaped, rectangular, etc.) on educational interactions and learning outcomes in multigrade classrooms.

2. **Limited Focus on Various Learning Domains**: Existing research generally concentrates on broad aspects of learning, such as attention and interaction, and has not explored specific domains such as problem-solving skills or critical thinking in multigrade classrooms. Studying the effect of classroom geometric form on these aspects could provide a deeper understanding of how the physical environment of the classroom influences learning.
3. **Diversity in Educational Environments**: Most studies on classroom geometric forms have been conducted in urban areas, and the impact of these forms in rural schools or regions with different environmental conditions has been less explored. A comparative study between different regions could reveal the varying effectiveness of classroom geometric forms.
4. **Management of Multigrade Classrooms**: Due to the unique characteristics of multigrade classrooms, such as the presence of students at different educational levels, there are distinct challenges in classroom design. More research is needed to determine which geometric forms can facilitate the management of multigrade classrooms and optimize the learning process.

4. Research Methodology

In terms of its objective, this research can be classified as theoretical research with practical applicability, as it leads to solutions for addressing spatial issues in the learning environment of multigrade classrooms in Yazd province. In the first section, since the main approach is qualitative and phenomenological, the focus is on exploring and examining the physical and functional characteristics that affect the creation of a functional space for managing teaching across different grade levels, based on the lived experiences of teachers and students. A total of 19 primary schools in the city, as shown in Map 1, and 19 teachers of multigrade classrooms in Mehriz city, Yazd province, were selected as the sample using purposive sampling (based on expertise, years of service, teaching experience in multigrade classrooms, and availability) in 2023.

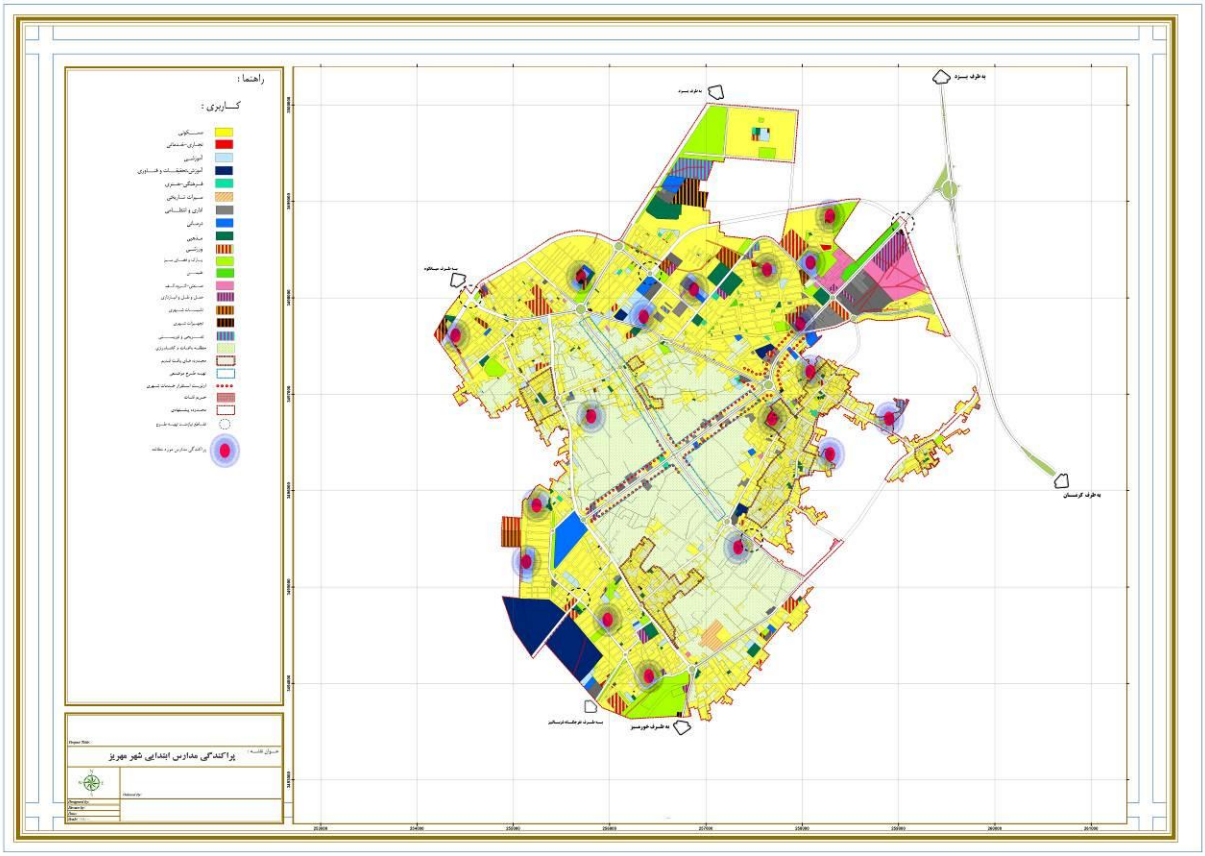


Fig (1): Distribution of Primary Schools Studied in Mehriz City

To determine the sample size, theoretical saturation of the data was used. This means that the interviews continued until the interviewer reached saturation in terms of information, and the responses from the interviewees became repetitive. In the second section, research and documentation related to multigrade classrooms were reviewed, and based on the obtained information, a conceptual framework for factors affecting the quality of teaching and learning in multigrade classrooms was designed. Direct observation of multigrade classrooms allows the researcher to examine interaction patterns and space usage, identify design issues, and determine needs. The data collection tool used in this research was semi-structured interviews. During the interview process, participants were assured that their information would remain confidential, and after obtaining permission from the interviewees, the interviews were recorded using a voice recorder and then transcribed for analysis. Data analysis was conducted concurrently with data collection, meaning that after completing the analysis of each interview, the next interview was conducted.

The analysis of the interviews was conducted using content analysis based on Smith's (1995) interpretative phenomenological analysis in three stages: In the first stage (data generation), the content of each interview was transcribed immediately after it was conducted. In the second stage, which is data analysis, after transcribing the interview content, each interview was carefully reread and

actively judged by the researcher multiple times. Initial themes or interpretations, which included certain associations, questions, or concepts that came to the researcher's mind and could be used in later stages, were identified. In the next stage, the process of listing and clustering categories (main and sub-themes) was carried out. For this, after extracting and identifying sub-themes, similar sub-themes that overlapped with each other were combined and named as a main theme. In the final stage, to synthesize the cases or themes, all the tables were placed together, and through immersion in the data, constant comparison, and identifying similarities and differences, the main and sub-themes were categorized in a table. The data from this table served as the basis for reporting the research findings, and in the third stage, the validation of the conceptual model was carried out. Since self-reports and verbal feedback from children cannot be relied upon to understand how children perceive and use their environment, the research shifted towards a more participatory approach with children and used an adult-centered orientation in studies about children.

To identify and explain the strategies for establishing effective communication in multigrade classrooms, data obtained from interviews with teachers and field observations from multigrade schools were analyzed. The main and sub-categories were extracted, which, after two general classifications, resulted in 4 concepts, and for each concept, the corresponding subcategories were identified.

Fig 1. Categorization of main and sub-themes (Source: Authors)

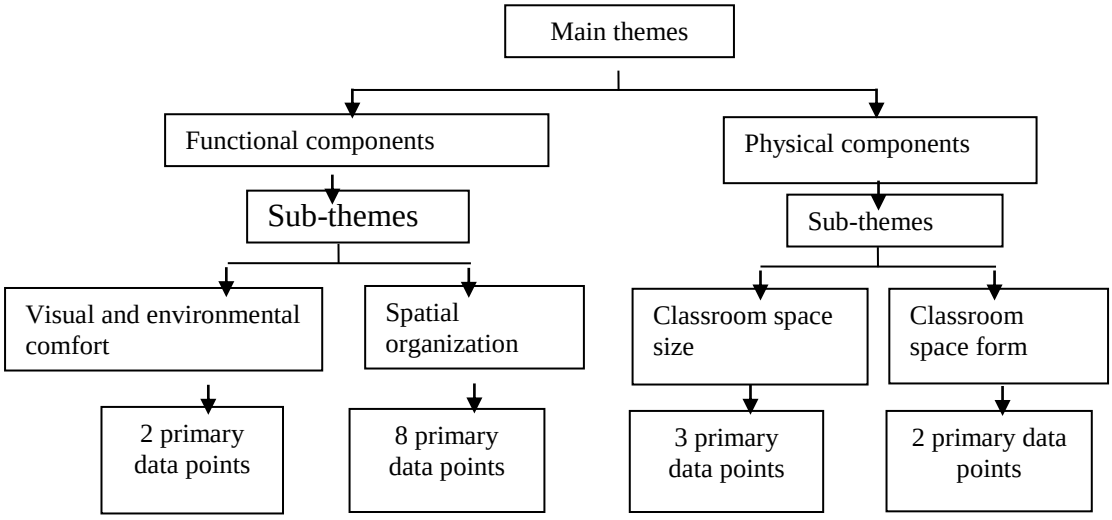


Table 11. Sub-themes and Primary Data Obtained from Interviews with Multigrade Classroom Teachers (Source: Authors)

Interview with Multigrade Primary School Teachers (Primary Data)	**Basic Concepts**
1) The Impact of Architectural Space Components (Diversity in Form, Geometry, and Materials Used, etc.) on Teacher Management in Multigrade Classrooms Question 1: How does the diversity in form and geometry of the classroom affect your management style? Question 2: How does the use of creative forms in classroom design impact student motivation? Question 3: How does classroom design and the use of materials affect the management of student diversity? Interview Responses: Code 1: Classrooms with diverse spatial designs and the use of various geometric shapes can attract students' attention. Spaces with non-rectangular forms may help create a sense of comfort and diversity in learning. Code 5: The type and quality of materials used in the educational space, such as wood, stone, or concrete, can enhance students' feelings of comfort and tranquility. This is particularly important in multigrade classrooms, which require more control and attention to individual differences. Code 11: In my multigrade classrooms, geometric designs like semicircles and U-shapes have helped me establish better connections with all students. These designs provide more space for movement, making it easier for me to move from one group to another and supervise better. Code 15: Changes in classroom form, especially designs that allow full visibility of the classroom, have helped me better monitor the classroom's condition. Designs with different angles and open spaces allow me to observe all parts of the classroom from any point.	Classroom Space Form
2) The Impact of Classroom Furniture Arrangement (Desks and Other Furniture in the Classroom) on Enhancing the Quality of the Teaching-Learning Process Question 1: What is the impact of furniture arrangement on addressing the individual and group needs of students? Question 2: Has changing the furniture arrangement in the classroom affected student interactions? Interview Responses: Code 4: Arranging desks in groups or circles can help increase student interactions and improve class participation, which leads to better and more effective learning. Code 13: Changes in furniture arrangement, particularly the creation of diverse spaces for individual and group activities, helped students participate more effectively in the learning process. This arrangement allows me to move easily between groups and monitor each activity. Code 17: Arranging furniture in various shapes, such as movable desks and open spaces, has allowed me to create a dynamic and engaging environment for students. These changes have increased students' motivation and attention to lessons and class activities.	Classroom Space Form
1) The Impact of Architectural Quality (Shape and Size) of Multigrade Classrooms on Students' Social and Individual Behaviors and Emotional States Question 1: What is the impact of the architectural quality of the classroom, including its shape and size, on students' social behaviors? Question 2: How do the dimensions and shape of the classroom affect students' social relationships? Interview Responses: Code 1: The shape and size of the classroom can provide the necessary space for social interactions. Classrooms with appropriate space and an open design can facilitate communication between students and create more positive social interactions. In this way, students can grow in a more collaborative and friendly environment.	Classroom Space Size

Code 4: Classrooms with inappropriate dimensions or design may cause feelings of loneliness or isolation for some students. A limited and enclosed space can negatively affect students' emotional states and lead to anxiety or stress. Code 6: In classrooms with proper design and the use of calming colors, students feel more comfortable, and their anxiety and stress levels seem to decrease. This type of design improves attention and participation in class. Especially classrooms with better seating arrangements and good ventilation help increase concentration and more effective learning.	
2) The Impact of Classroom Dimension Proportions in Multigrade Classrooms in Relation to Existing Standards for Architectural Design Question 1: How do the proportions of classroom dimensions affect the quality of teaching and learning? Question 2: How do the proportions of classroom dimensions impact the management of individual and group behaviors of students? Interview Responses: Code 5: In multigrade classrooms, there is a greater need for space to accommodate different age groups and diverse educational activities. Appropriate classroom dimensions based on standards meet this need and provide enough space for movement, interaction, and learning. Code 9: Proper design and dimensional standards prevent overcrowding in the classroom. This allows students to interact better with each other, and teachers can have more control over the class, leading to improved classroom management. Code 10: Proper proportions and adherence to architectural standards create a healthy and suitable learning environment. This environment, with proper light, air, and sound, helps improve students' emotional states and increases their concentration, directly impacting the quality of education. Code 13: In classrooms where the dimensions align correctly with architectural design standards, a more suitable learning environment is created. Larger spaces with proper ventilation allow teachers to carry out more group activities and manage the class more easily. Additionally, proper proportions help students feel more comfortable and less distracted.	Classroom Space Size
3) Attention to the Ergonomics of Different Body Types of Students from Grades 1 to 6 in Multigrade Classrooms (Cabinets, Desks, Blackboards, etc.) Question 1: How does attention to ergonomics in the design of cabinets and desks affect the quality of teaching in multigrade classrooms? Question 2: How does attention to ergonomics in the design of multigrade classrooms impact the comfort and health of students? Interview Responses: Code 3: In multigrade classrooms, attention to ergonomics is important because students of different ages and heights are studying in the same space. The use of adjustable and suitable desks, the proper height of the blackboard and boards helps students sit and write in a comfortable and proper position. This attention to ergonomics can prevent physical problems such as back and neck pain, which in turn improves focus and learning. Code 8: In multigrade classrooms, if the dimensions of cabinets, desks, and other furniture are not properly adjusted, students may experience physical problems. For example, improper desks can cause fatigue and pain in the lower back and legs. Additionally, if the blackboard and boards are not at an appropriate height, students will be forced to sit in uncomfortable positions, which can lead to neck and back pain. Ergonomic adjustment of these items is of special importance. Code 14: The blackboard and boards should be positioned at a height that all students can easily use. Incorrect height can cause neck strain and vision problems. Furthermore, the board should have the proper color and lighting to provide better visibility for students and prevent eye fatigue.	Classroom Space Size

1) The Impact of Having Different Educational Levels of Students Together Simultaneously in a Multigrade Classroom on Its Architectural Quality (Increasing the Number and Diversity of Spaces, etc.) Question 1: How does the presence of different educational levels in a multigrade classroom affect the architectural quality of the classroom? Question 2: How does the increase in the number and diversity of spaces in multigrade classrooms impact educational performance? Interview Responses: Code 10: The presence of different educational levels in a classroom increases the need for designing a flexible and multifunctional educational space. For example, in classrooms that include different levels, there is a need for separate spaces for group and individual activities. This means that the architecture of the classroom must be designed in such a way that it provides enough space for various activities and educational equipment. Code 12: Increasing the number and diversity of spaces in multigrade classrooms can help improve educational performance. Spaces such as study corners, group desks, and individual focus points for each educational level allow the teacher to respond more flexibly to the different educational needs. Code 14: Changes in architectural design due to the presence of different educational levels can create challenges. For example, the need for appropriate design for various activities and creating sufficient space for each level can be complex. Additionally, coordination among different spaces and meeting the specific needs of each level are among the main challenges.	Spatial Organization
2) Holding Part of the Class Outdoors (Using the School Yard) Question 1: How do you use the outdoor space of the school to hold part of the class? Question 2: What are the advantages of holding class outdoors compared to indoors? Interview Responses: Code 2: Using the school yard for holding parts of the class can help bring diversity to the learning environment. For example, in science and biology lessons, I use the outdoor space for scientific observations. This not only helps students become more familiar with the natural environment but also allows them to use their energy more effectively, resulting in better focus and learning. Code 8: Using the school yard can present challenges, especially in multigrade classrooms that require more coordination. One of the issues is supervising students in the open space, which can be difficult. However, with careful planning and appropriate division of activities, these challenges can be minimized, and the outdoor space can be utilized effectively.	Spatial Organization
3) Using a Variety of Materials (in Color, Texture, and Material) for Organizing and Dividing the Classroom Space Question 1: How do you use the variety of materials in color and texture to divide the classroom space in multigrade classrooms? Question 2: What impact do different materials have on organizing the classroom space? Interview Responses: Code 1: Using different materials with varied colors and textures helps me divide the classroom into sections for different activities. For example, I use colorful wall coverings to designate study and play areas. This not only helps with spatial separation but also ensures that each area of the classroom is suitable for specific types of activities, resulting in better order and productivity in the class. Code 12: The diversity in texture and material, such as using soft flooring in rest areas and hard walls in activity zones, allows me to adjust the classroom environment based on the different educational and psychological needs of the students. This helps create a well-organized space that suits the educational requirements.	Spatial Organization

4) Using Partitions and Adjustable Dividing Walls (Creating Large Classrooms with the Possibility of Merging Two or More Classes, as Well as Dividing a Large Space into Smaller Areas) Question 1: How do partitions help improve the quality of teaching in multigrade classrooms? Question 2: Has the use of dividing walls helped with the management of time and class activities? Interview Responses: Code 3: We use adjustable partitions to change the classroom space based on daily needs. For example, during times when we need to conduct group activities, we move the walls to create a larger space. At the same time, for better concentration of students during other times, we divide the space into smaller sections. Code 4: By using adjustable walls, we can easily adjust the classrooms based on the number of students and the type of educational activities. For instance, when separate classes are needed for different grade levels, we can quickly divide the space into various sections. This helps us have better control over the space and time management.	Spatial Organization
5) Using Soundproof Walls to Partition Spaces in Multigrade Classrooms with Sound Control Question 1: How has the use of soundproof walls affected the quality of teaching in multigrade classrooms? Interview Responses: Code 2: The use of soundproof walls has greatly contributed to improving the quality of teaching. With these walls, we can divide the classroom into different areas while preventing sound interference. This helps each group of students focus on learning in their own space without being disturbed by the noise from other groups. Code 8: The use of soundproof walls has helped reduce problems such as noise and distractions in multigrade classrooms. These walls divide the classroom into independent sections, allowing each group of students to engage in their activities with greater focus and reducing issues caused by sound interference.	Spatial Organization
6) The Importance of Having a Main Space for Sitting on the Floor and Group Work (Effectiveness of Group Work Space in Multigrade Classrooms) Question 1: How has the floor seating space impacted group activities in multigrade classrooms? Question 2: What benefits have you observed from using floor seating space in multigrade classrooms? Interview Responses: Code 8: This type of seating space helps the teacher easily approach all the groups and provide the necessary supervision and guidance, which is particularly useful in multigrade classrooms with a large number of students. Code 11: The floor seating space in multigrade classrooms is very essential because it allows students to be easily organized into different groups and engage in group work.	Spatial Organization
7) The Importance of Having Smaller Subspaces Next to the Main Space (Effectiveness of a Quiet and Private Space for Students in Multigrade Classrooms) Question 1: How does the quiet and private space next to the main space in multigrade classrooms enhance learning? Question 2: What benefits have you observed from the presence of smaller subspaces in multigrade classrooms? Interview Responses: Code 1: The presence of a quiet and private space helps students who need more focus stay away from environmental distractions. This space allows students who are easily distracted or need individual activities to concentrate better. Code 3: The smaller subspace next to the main classroom area allows students to benefit from a quiet environment when they need to work independently or engage in individual activities. This space is particularly useful for students who are sensitive to noise or need some separation from the group. Additionally, this space helps the teacher to easily address individual students' needs.	Spatial Organization
8) The Importance of the Location of Restrooms (Separation of Boys' and Girls' Restrooms and Having	S p a

Full Teacher Visibility of Their Entrances) Question 1: How does the separation of restrooms and the teacher's full visibility of their entrances impact classroom order? Interview Responses: Code 6: The separation of boys' and girls' restrooms, along with the teacher having full visibility of their entrances, helps improve supervision and behavior management. This measure can prevent potential issues and contribute to creating an organized educational environment. Additionally, this supervision helps the teacher ensure that students behave appropriately when going to the restroom and return to their educational activities.	
1) Readability and Recognizability of Spaces Inside the Building (Shortening the Teacher's Movement Path to Access Different Spaces) Question 1: How does the readability of spaces affect the teaching process in multigrade classrooms? Interview Responses: Code 14: In multigrade classrooms, which usually include different age groups, the readability of spaces has a significant impact on the teaching process. Clearly defined and recognizable spaces help the teacher easily direct students' attention to different areas of the classroom and present instructional materials more effectively. This also helps maintain order and reduce disruptions. Code 15: The readability of spaces greatly impacts student interactions. When spaces are clearly defined, students can easily access different areas of the classroom and interact with one another more effectively. This is especially important in group activities that require coordination and collaboration.	Visual and Environmental Comfort
2) The Importance of Visibility of the Inside and Outside Environment in Multigrade Classrooms (The Teacher's Ability to Supervise All Spaces, Especially Informal Learning Environments) Question 1: How can the classroom design be arranged to ensure complete supervision over the learning spaces? Interview Responses: Code 4: Having complete visibility of all areas of the classroom is crucial for the teacher. It allows the teacher to effectively supervise and stay aware of informal learning activities as well. This is especially important in multigrade classrooms, where students are at different educational levels, helping the teacher pay the necessary attention to each age group and quickly identify any potential issues. Code 8: Having designated areas for informal learning activities and strategically arranging these spaces can help the teacher supervise these activities more effectively and allow the teacher to manage both the formal and informal environments in the classroom more efficiently.	Visual and Environmental Comfort

5. Discussion and Conclusion

In this study, after reviewing, analyzing, and evaluating the conducted interviews, the themes related to factors influencing the performance quality of teachers in multi-grade classrooms were extracted. Based on the content of Table 11, the perspectives of teachers and multi-grade education experts can be examined in four areas: the "form" and "size" of the classroom space, "spatial organization," and "visual and environmental comfort." The scientific findings obtained from the interview results and the standard deviation ellipse calculations based on GIS computations indicate that the geometric form of the multi-grade classroom, as an important environmental factor, plays an undeniable role in enhancing the quality of teaching and student learning. Most of the interviewees (15 people) referred to the architectural physical components, including the diversity of forms, geometry, and materials used in the school building, and their significant impact on how the teacher manages mixed classrooms.

Based on the conducted studies and the consensus of most interviewees regarding teaching patterns and the space each requires, a summary of their views on this matter is presented in Table 12:

Table 12. Teaching Patterns and Space Requirements (Source: Authors)

		Teaching Patterns and Space Requirements
1	Individual Teaching Pattern	This pattern requires a calm and quiet space so that students can focus on their activities without being disturbed.
		Codes: 3, 4, 7, 9, 10, 11, 13, 14, 16, 19
2	Lecture Teaching Pattern	This model requires an open space where students can see the teacher completely.
		Codes: 1, 2, 4, 7, 8, 11, 12, 14, 17, 18
3	Discussion Teaching Pattern	This pattern requires a space that allows moving and arranging chairs in a circle or group.
		Codes: 2, 3, 4, 6, 7, 9, 11, 13, 14, 15, 16
4	Inquiry-based Teaching Pattern	This model requires a space that has various educational equipment and materials and provides the possibility of doing practical activities.
		Codes: 3, 5, 6, 7, 9, 10, 12, 13, 15, 16, 18

According to over 80% of the interviewees, different teaching patterns such as individual, lecture, discussion, and inquiry-based require distinct spaces with specific layouts. Some teaching patterns, like the individual teaching pattern, where the teacher plays a central role in delivering lessons, require a space with a linear layout to keep students focused on the teacher and the chalkboard. Other teaching patterns, such as direct teaching and lectures, need a space where the teacher's position is highlighted as the focal point of instruction. In contrast, the group discussion pattern requires a circular or semi-circular space to facilitate student interaction and discussion with one another. Patterns such as group discussion and inquiry-based teaching need an open and flexible space that allows for furniture rearrangement and group activities. The simplest (and most well-known) form of such spaces is a centralized layout, such as a cross or octagonal shape.

Sixteen interviewees, while expressing satisfaction with the fact that cross-shaped forms provide more flexibility for various educational activities, believe that the teacher can easily adjust the classroom for individual, group, or class discussions to meet different needs. Given these advantages, cross-shaped and octagonal forms are particularly efficient in multi-grade classrooms, which require more interaction and effective management. These forms create a sense of separation between groups, allowing for the adaptation of form and function in small learning groups. Otherwise, group activities may cause distractions and unproductive interaction.

Based on the analysis of the conducted interviews, it can be concluded that in multi-grade classrooms, specific geometric forms can help improve educational performance. Some of the effective forms (Table 13) include:

Table 13. Geometric Forms for Multi-Grade Classroom Layouts (Source: Authors)

1	Circular Layout	This form allows the teacher to establish uniform communication with all students and facilitates group interactions. In multi-grade teaching, the circle helps the teacher keep all students under supervision and quickly address their various needs.
		Codes: 2, 4, 6, 7, 8, 11, 12, 13, 14, 16, 19
2	U-shaped or Horseshoe Layout	This form allows the teacher to be positioned in the middle of the classroom, making it easier to communicate with all students. It also provides more space for group activities and collaborative projects. This layout is suitable for teaching various subjects to groups of students from different educational levels.
		Codes: 1, 3, 4, 6, 7, 10, 11, 13, 14, 15, 17
3	Cluster (Group) Layout	This form enables students to work in small groups and easily exchange ideas. For multi-grade teaching, this layout helps the teacher more effectively address the needs of different student groups and facilitates collaborative activities.
		Codes: 1, 2, 4, 7, 9, 11, 13, 14, 17, 18, 19

Geometric forms such as circular, U-shaped, and cluster layouts each have their own specific advantages and can offer various optimizations based on the specific needs of multi-grade classrooms. Therefore, the optimal geometric form for multi-grade classrooms should be designed to facilitate effective interaction between the teacher and students, as well as between students themselves. Based on the opinions of 90% of the interviewees and observations in multi-grade classrooms in rural schools of Yazd Province, the following solutions can be applied in the design of multi-grade classroom spaces (Table 14) to help teachers improve their performance in implementing teaching patterns:

Table 14. Design Solutions for Multi-Grade Classrooms (Source: Authors)

1	Changing the Plan	This form allows the teacher to establish uniform communication with all students and facilitates group interactions. In multi-grade teaching, the circle helps the teacher keep all students under supervision and quickly address their various needs. Codes: 2, 4, 6, 7, 8, 11, 12, 13, 14, 16, 19
2	Using Architectural Elements	This form allows the teacher to be positioned in the middle of the classroom, making it easier to communicate with all students. It also provides more space for group activities and collaborative projects. This layout is suitable for teaching various subjects to groups of students from different educational levels. Codes: 1, 3, 4, 6, 7, 10, 11, 13, 14, 15, 17
3	Spatial Division	This form enables students to work in small groups and easily exchange ideas. For multi-grade teaching, this layout helps the teacher more effectively address the needs of different student groups and facilitates collaborative activities. Codes: 1, 2, 4, 7, 9, 11, 13, 14, 17, 18, 19
4	Using Spatial Modules	Repeating spatial modules can be used to create separate areas.
5	Connection to Open Spaces	The classroom can be directly connected to open spaces such as yards or porticos, which can soften the classroom environment, increase freedom of movement, and help create a sense of intimacy among students.

With proper classroom design in multi-grade classrooms, conditions can be created that allow students in these classrooms to benefit from effective and enjoyable learning experiences.

6. Conclusion

The results of this study, based on the lived experiences of teachers in multi-grade primary classrooms in Yazd province, show that the physical design of the classroom, including its geometric form, is recognized as an important and effective variable in the teaching-learning process. This variable can impact the quality of teacher-student interactions, the quality of interactions among students, the level of teacher supervision and management over students from different grades, the organization of educational activities, and ultimately, the effectiveness of various teaching methods.

Considering the nature and how the teaching-learning process unfolds in multi-grade classrooms, along with the complexity of its various aspects, the design of the form and geometry of the educational space in such classrooms should be such that it facilitates the implementation of diverse teaching patterns while providing the necessary flexibility and appropriate capabilities for the teacher to effectively manage different grade levels. Based on the findings of the research, the following solutions can be proposed for designing educational spaces that meet the needs of multi-grade classrooms:

Table 13. Solutions for Designing Educational Spaces to Meet the Needs of Students in Multi-Grade Classrooms (Source: Authors)

No.	Solution	Description
1	Diversifying the use of the physical space of the classroom and school	Teachers can utilize the school yard, walls, and floor of the classroom to create variety in learning activities. Using outdoor spaces for group and physical activities can help increase students' motivation and focus.
2	Dividing the classroom into separate sections	Since students in multi-grade classrooms learn at different educational levels, the classroom can be divided into sections for each grade. This helps students focus better and allows for grade-appropriate teaching. Additionally, dividing the classroom into different areas can provide space for various teaching patterns and a quiet area for individual student study.
3	Flexibility in seating arrangements	Teachers can adjust the seating of students in the classroom to match the learning needs of each grade level. Placing the core grade levels in the front of the classroom and self-directed students at the back helps the teacher manage time effectively and attend to all students.
3a	Considering closely related grade levels	In desk arrangements, closely related grade levels can be placed together in one section of the classroom. This helps in class management and providing relevant lessons to students of similar educational levels.
3b	Creating separate spaces for each grade	Each grade should have its own designated educational space with appropriate facilities and resources.
3c	Designing shared spaces	Shared spaces, such as libraries, laboratories, and gyms, can be designed for use by students from various grade levels.
4	Using lightweight and adjustable furniture	Using lightweight and adjustable desks and chairs enables teachers to easily prepare the classroom for different educational activities.
4b	Using soft flooring	Soft flooring such as carpets or rugs can help create a warm and welcoming classroom environment. Additionally, carpeted or rug-covered floors significantly reduce noise caused by moving desks and chairs, as well as students' footsteps.

4c	Considering students' needs	When selecting classroom furniture, ergonomic design and the needs of students at different ages should be taken into account.
4d	Attention to classroom flooring	The classroom floor should be washable, flat, and seamless. Additionally, using light-colored flooring (especially white) helps brighten the classroom and creates a calming effect on students.
5	Connecting the classroom to open spaces (creating semi-open spaces)	Connecting the classroom to the central yard or semi-open spaces such as porticos and verandas allows the use of these areas for teaching, extracurricular activities, and outdoor educational sessions.
6	Using movable partitions	Movable partitions allow the teacher to divide the classroom into smaller sections, enabling separate educational activities for each grade level.
7	Multi-functionality	The educational space should be designed to accommodate various activities, such as teaching, discussions, individual study, and group work.
8	Proper acoustics	The educational space should have appropriate acoustics to prevent sound reflection and noise, aiding in better comprehension of educational content by students.
9	Appropriateness of educational space for students' physical dimensions	A minimum of 3.6 to 4.5 square meters of space should be allocated for each student. This ensures there is sufficient room for movement, rearranging, and conducting educational activities without creating a sense of overcrowding.
10	Classroom size	Larger classrooms allow for the simultaneous creation of multiple areas, while smaller classrooms can use flexible arrangements to create shared and independent spaces at different times.
11	Layout	Different layouts, such as U-shape, group seating, and movable partitions, can facilitate discussions, interaction and collaboration, as well as focus and learning for students.

References

Afrooz, F., & Mohammad, L. (۲۰۲۱). Using educational facilities is a step to facilitate the learning process. Education Research, 8(29), 1-14.

Ahmadābādi, M. N., Pourroostā, S., Ardakāni, I., Farrokhi, N., & Mohtadi, S. (2021). Identifying the effective characteristics of educational agent in learning environments. Quarterly Journal of Educational Innovations, 20(78), 61-78.

Alam, R., Saadati, M. (2017). Multigrade, a small but big class! (a guide to teaching and managing resources in multigrade classes). Red ruby publications. book

Akbarzadeh, Z., Heidarnattaj, V., Ahmadi, F., & Baezzat, F. (2020). The Effect of layout on Educational Spaces Design to Improve academic and cognitive performance. Architectural Thought, 3(6), 96-109.

Akhundi, A., Khanpour, B. (2015). Guide to teaching in multi-grade classes (with integrated approach). Altin Publications. book

Asadi, M. V., & Eskandari, H. (2023). Teaching and learning in multi-grade classes: Challenges and opportunities. Journal of Theory and Practice in Curriculum, 10(20), 45-84.

Badakhshaan Toroghi, E., SoleimanPour Omraan, M., & Fazli, R. (2023). Meta-Synthesis of Factors Affecting the Quality of Teaching in Multi-Grade Elementary School Classrooms. Quarterly Journal Of Education, 39(2), 161-184.

Bahramani, Z. Y. M. H. S. S. K. (2023). An Investigation of the Architectural Development of Classroom Design in Iranian Primary Schools Based on Modern Teaching Methods (2001-2021). باغ نظر, ۲۰(۱۲۳), ۵۵-۶۶. doi:10.22034/bagh.2023.343495.5195۱

Dehcheshmeh, A. Y., Liaghatdar, M., & Davarpanah, S. H. (2021). Identifing effective factors on the Quality of Performance of Multi-grade classes Teachers. Training & Learning Researches, 16(2), 129-146.

Hamid, E. R. (2017). Teaching strategies - multi-grade classes (what the multi-grade teacher should know) (Vol. 0): Zarih Aftab Cultural, Artistic and Publishing Institute.

Karimi, N., Khosronia, M., & Dezhpasand, S. (2021). Developing a model for spatial indicators of experimental learning and its application in designing learning environments. Journal of Iranian Architecture and Urbanism, 12(21), 111-125.

Kashmiri, H., & Sajjadi, Kh. (2020). Investigating the relationship between satisfaction with environmental factors and academic success of students. Education Technology, 14(3), 533-540. doi:10.22061/jte.2019.4160.2012

Khademi, N., Amir Ahmadi, F., & Majuni, H. (2022). Investigating effective teaching strategies in multi-grade classes in Iranian elementary schools. Research in combined and multi-level classes, 2(3), -.

Kordalo, M., Moradi, A., & Amir Ahmadi, Y. (2022). Optimal teaching strategies in multi-grade classrooms: a phenomenological study. Research in the teaching of combined and multi-grade classes, 1(2), -.

Mehdi, M. s. c., & Mostafa, R. R. (2015). The characteristics of the book, the process of teaching, learning and multi-level classes (an analysis of the educational experience in multi-level classes of elementary school) (S. Ali & G. K. Mohammad Eds. Vol. 0): Negar Taban.

Mirshfii Langari, S. D. (۲۰۰۵). A special situation called multi-grade (teaching method in multi-grade class in elementary school). growth of thought book

Mohammad, Nazarpour, T., Norouzian, S., & Maleki. (2019). Identifying the Effective Architectural Components for Promoting Students' Learning by emphasizing the open spaces of schools on the basis of the document of the fundamental transformation of education. Studies in Learning & Instruction, 10(2), 165-193.

Mortazavizadeh, S. H. (2016). Management and planning of multilevel classes. Korosh Publishing House. book

Mousavi, Sh., & Jami Odolo, M. (۲۰۲۰). The principles of environmental design affecting the learning and behavior of students in primary schools. The second national conference of psychopathology. https://civilica.com/doc/1436179

Nikan, M., Saemi, H., Bayani, A., & Fakoorihajeyar, H. (2023). Investigating and Identifying the Principles and Components of Blended Learning in Multi-Grade Classes of Elementary School. Journal of Educational and Scholastic Studies, 12(34), 129-150.

Saghafi, M. R. (2017). A Comparison of Design Patterns between Ordinary Schools and Open Schools in Terms Of the Efficiency of Learning Environment. Maremat & memari-e Iran, 6(12), 13-22.

Sarraf, M., Alborzi, F., & Amini, A. (2023). Investigating the Effect of Physical Elements of Educational Spaces on Promoting Children's Creativity with Graphic Analysis of Paintings. Journal of Architect, Urban Design & Urban Planning, 16(42), 91-105.

Targhi, E. B., Omran, M. S., & Fazli, R. (2023). Identification of factors affecting quality improvement of multi-grade classes in Elementary Schools. Quarterly Journal Of Educational Leadership & Administration, 16(4), 147-172.

Zamani, Eshrat, B., Isfahani, N., & Reza, A. (2008). Physical and cultural characteristics of instructional spaces in four developed countries from the viewpoints of Iranian parents and students. Quarterly Journal of Educational Innovations, 6(23), 55-.

Zadeh, S. A. M., Nili, M., Nasr, A., & Hosni, M. (2017). Identifying the components and indicators of the desirability of the educational space of multi-grade classes and comparing the current situation. Journal of Research in Education and Training, 53(53), 141-157.