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Designing Educational Buildings and Learning Centers through Digital Technologies and Artificial Intelligence: The Role of Color Selection

Siddiqova Madinabonu
Qarshi State Technical University, Uzbekistan
siddiqovamadinabonu@gmail.com

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Abstract

This article explores the strategic role of color in the interior design of educational institutions, with particular emphasis on the integration of digital technologies and artificial intelligence (AI) to create color schemes that align with the psychophysiological characteristics of learners. Set within the context of Uzbekistan's transition to a digital economy, the study highlights how AI-driven tools are being increasingly used in education to enhance the effectiveness and comfort of learning environments. Drawing from national construction standards and age-specific psychological research, the study investigates how color influences student motivation, concentration, memory retention, and emotional well-being. The article outlines a step-by-step approach to AI-assisted educational center design, covering aspects from data collection and analysis to personalization of learning spaces. The findings emphasize the importance of interdisciplinary collaboration between educators, designers, technologists, and psychologists in shaping adaptive, student-centered educational environments. Ultimately, the integration of aesthetics, cognitive science, and digital innovation is shown to enhance both the visual

and functional quality of learning spaces, contributing to improved educational outcomes.

Keywords: Artificial Intelligence; Educational Design; Color Psychology; Digital Technologies; Learning Environments.

Introduction

The transition to a digital economy is a requirement of the times and one of the priority directions for the development of Uzbekistan in the coming years. The emergence of new-generation digital technologies—artificial intelligence, robotics, the Internet, wireless communication technologies, and others—demands changes in production, business, and social activity models. The effective use of new digital technologies defines the international competitiveness of both the entire country and individual companies by forming the necessary infrastructure and legal environment. At present, digital technologies and innovative solutions are actively being introduced and applied in various sectors of the economy and in social life in Uzbekistan to improve the quality of services and make people's lives easier. Digital technologies are applied in public administration, banking, industry, medicine, ensuring security, and in the safe and efficient design of buildings. The future of our country is closely linked with the widespread introduction and application of digital technologies [1].

Like in other fields, the education sector has also acquired its most modern forms in today's era of global renewal. On September 23, 2020, the President of the Republic of Uzbekistan, Shavkat Mirziyoyev, signed the new edition of the Law "On Education." According to this law, the types of education are defined as follows: preschool education and upbringing; general secondary and secondary specialized education; vocational education; higher education; postgraduate education; retraining of personnel and advanced training; and out-of-school education. It has been clearly proven that the comprehensive and proper design of an educational institution significantly influences the quality of education. According to the established building codes (QMQ) and sanitary norms (SHQN), the architectural and interior solutions of these educational institutions are determined, taking into account the psycho-physiological characteristics of students and learners, as well as the institution's educational orientation. In this process, strict adherence

to state construction norms and standards is required, where the state serves as both the supervisor and client. Today, preparatory and specialized training courses have already become an integral part of the education system and are viewed as the future of both preparatory and independent education.

Color has a scientifically proven and substantiated influence on human psychology and mental states. Therefore, when designing educational buildings and learning centers, it is advisable to select colors carefully, as they affect the creativity, psychological state, and information perception of both learners and educators. Digital technologies and artificial intelligence now provide opportunities to design the color schemes and interior solutions of buildings [2,3,4].

Methods

In the course of the research, methods such as the analysis of scientific and educational-methodical literature, pedagogical observation, comparative analysis, generalization, programming, and digital modeling were used.

Literature Review

When choosing a color palette for the environment, it is essential to consider the specific age group of students. To simplify this process, Frank H. Mahnke, the author of *Color, Environment, and Human Response*, provides guidelines on how to apply colors in educational settings based on age groups. Preschool children aged two to four and primary school students aged five to ten prefer warm and bright colors. The warm end of the color spectrum—red, orange, and yellow—harmonizes naturally with their extroverted nature. On the other hand, middle school students aged eleven to thirteen and high school students aged fourteen to eighteen tend to prefer lighter and calmer shades. Blue, green, and violet—colors belonging to the cooler end of the spectrum—help provide relaxation and concentration during the transition from childhood to adolescence [6,7].

Results and Discussion

Artificial Intelligence (AI) refers to a set of features for creating automated systems that control human-like intelligence and learn to manage cognitive tasks. AI consists of

automated algorithms and models capable of learning, analyzing, reasoning, and performing actions across various domains [9,10].

The main tasks of artificial intelligence include:

- Data Analysis: AI studies large amounts of data to identify structural patterns and metrics.
- Logical Reasoning: Based on given information and conditions, AI helps make decisions and logical judgments.
- Task Execution: AI performs assigned tasks such as problem-solving, preparing reports, and other automated operations.
- Creative Functions: AI assists in generating new ideas, developing concepts, and creating new information.

The key components of AI include processors, algorithms, models, data acquisition and analysis, and task execution. AI not only achieves better results in performing operations but also reduces the likelihood of human error.

Stages of designing educational centers with AI support may include:

1. Defining goals: specifying the objectives, curriculum, and requirements of the educational center.

2. Data collection: gathering relevant information about courses, curricula, requirements, instructors, and resources.

3. Data analysis: analyzing collected information to determine indicators for requirements and learning methods.

4. Starting the design: developing the structure of the center and curricula using intelligent algorithms.

5. Creating AI models: automating educational programs and directions based on data and analysis results.

6. Monitoring: using AI algorithms to control and assess student progress.

7. Student management: identifying individual needs and learning paths, applying AI integration for remote learning and support.

8. Integrating new information: improving the center's activities through new curricula, courses, or instructors.

9. Presentation and evaluation: applying AI integration to analyze, present, and assess student performance.

10. Planning future steps based on evaluations and feedback.

By following these steps, educational centers can achieve effective results in AI-assisted design. At the same time, human involvement remains vital, since educators and students hold essential insights into shaping and managing the learning process.

Human consciousness has a highly developed visual capacity that makes colors exert strong influence. Therefore, the study of colors is crucial in the process of learning [13,14].

Ways in which colors may affect learning:

1. Motivation and interest: Colors in guidelines, textbooks, articles, and other educational materials may attract attention, stimulate participation, and increase interest in learning.

2. Enhancing learning: Colors and design can make learning materials more effective. For example, infographics, structured textbooks, and animated graphics may simplify comprehension.

3. Concepts and memory: Colors play a role in remembering concepts and information. Preferred colors and complex designs may improve memory and recall.

4. Recognition and seriousness: Properly chosen and frequently applied colors can increase the perception of value and importance in learning materials, making education more engaging.

5. Concentration and structure: Colors and design provide quicker and easier access to information, reducing the time spent navigating through content.

6. Usability and comfort: Well-chosen colors improve usability, while poor design and uncomfortable color schemes may complicate learning.

Additionally, cooperation among educators, designers, students, and parents is essential in using colors and design to encourage effective learning. This ensures that learning centers become more engaging and supportive for students [11,12].

Conclusion

Artificial Intelligence (AI) in color selection can be based on multiple factors. Accordingly, there may be many variables influencing the process of choosing colors, such as:

1. Purpose: The main objective of AI-based color selection must be clearly defined. For example, selecting colors for an educational center's logo, branding materials, or website.

2. Data: AI can learn to select colors through data-driven calculations. For instance, analyzing branding colors of other educational centers, or choosing colors based on students' preferences and learning patterns.

3. Analysis: AI can select colors by evaluating variables and their effects. For example, educational center data might guide color selection according to students' age, gender, nationality, and other demographics.

4. Applications: There may be specific AI applications and algorithms used in analyzing variables, such as histogram analysis, k-means clustering algorithms, or Generative Adversarial Networks (GANs).

5. Student/User feedback: AI can also take into account user-generated inputs. For example, students may leave preferences on the educational center's website regarding colors they find appealing.

6. Practical domain analysis: The practical applications of AI—such as image analysis, pattern recognition, or mathematical modeling—can help identify relevant variables in color selection.

All these factors can be used together and may even have interacting or opposing effects. Nevertheless, AI can select colors that align with the goals of the educational center and influence how students perceive its design, enhancing both attractiveness and information retention.

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