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SCIENTIFIC AND PRACTICAL FOUNDATIONS FOR USING INTERNATIONAL BRAILLE GRAPHIC STANDARDS IN THE CREATION OF TACTILE ATLASES AND UNLABELED (CONTOUR) MAPS FOR STUDENTS WITH VISUAL IMPAIRMENTS

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Abstract
The article provides an in-depth analysis of the scientific and practical foundations for using international Braille graphic standards in the development of tactile atlases and contour maps for students with visual impairments. The necessity of systematizing tactile symbols, global experience, and established standards is examined. Special attention is given to BANA, ISO, and GOST R standards, their functions, advantages, and research-proven effectiveness. The relevance of adapting international standards to the conditions of Uzbekistan without developing a separate national standard is substantiated.

Keywords: Tactile atlas, contour map, tactile symbols, Braille graphic standards, BANA, ISO, GOST R.

Introduction

Аннотация
Мақолада кўришида нуқсони бўлган ўқувчилар учун мўлжалланган тактил атлас ва ёзувсиз (контур) хариталарни яратишда халқаро брайл график стандартларидан фойдаланишнинг илмий ва амалий асослари ёритилган. Тактил белгиларни тизимлаштириш зарурати, жаҳон тажрибаси ва мазкур йўналишда қабул қилинган стандартлар таҳлил қилинган. BANA, ISO ва ГОСТ Р стандартларининг мақсади, вазифалари, функционал имкониятлари ва афзалликлари кўриб чиқилган. Ўзбекистон шароитида алоҳида миллий стандарт ишлаб чиқиш шарт эмаслиги, мавжуд халқаро стандартларни

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миллий тил, алифбо ва табиий-иқтисодий хусусиятларга мослаштириш орқали самарали тактил график маҳсулотлар яратиш мумкинлиги асослаб берилган.

Калит сўзлар: тактил атлас, контур харита, тактил белгилар, брайл график стандартлари, BANA, ISO, ГОСТ Р.

Аннотация

В статье подробно рассмотрены научные и практические основы применения международных стандартов брайлевской графики при создании тактильных атласов и контурных карт для учащихся с нарушениями зрения. Обоснована необходимость систематизации тактильных условных знаков, проанализирован мировой опыт и действующие стандарты. Отдельное внимание уделено стандартам BANA, ISO и ГОСТ Р, их функциям, преимуществам и подтверждённой научными исследованиями эффективности. Доказана целесообразность адаптации международных стандартов к условиям Узбекистана без разработки отдельного национального стандарта.

Ключевые слова: тактильный атлас, контурная карта, тактильные знаки, стандарты Брайля, BANA, ISO, ГОСТ Р.

Introduction

Studying international standards and global experience in creating tactile graphic materials – particularly tactile atlases and unlabeled (contour) maps – for students with visual impairments is one of the most pressing scientific and practical challenges facing modern education. Such materials enable learners to perceive geographic information not through visual channels, but through tactile perception.

Conveying geographic information in a tactile form requires a high degree of precision, systematic organization, and consistency. If there is no unified approach and common rules for creating tactile maps, each author or manufacturer may interpret symbols differently. This slows the formation of territorial, regional, and spatial concepts in students and creates difficulties in

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mastering educational material. Therefore, relying on international Braille graphic standards helps address the key problems in this field.

The Role of Tactile Atlases and Unlabeled (Contour) Maps in the Educational Process. A tactile atlas, by its content, is an important didactic tool that both provides information and reinforces students' existing knowledge. At the same time, it can also serve the function of an unlabeled (contour) map. In this case, the learner independently analyzes the placement of map elements, their interconnections, and spatial relationships by feeling them with their hands.
Unlabeled maps serve to activate prior knowledge, ensure correct placement of objects, and develop spatial thinking. Just as working with a pencil or paint is important for sighted learners, working with tactile atlases and contour maps has equal pedagogical value for learners with visual impairments.

The Need to Systematize Tactile Symbols. One of the main methodological issues in creating tactile atlases and unlabeled maps is the establishment of a unified system for using tactile symbols. Line thickness, dot height, relief shapes, and the distances between them must correspond to human tactile sensitivity.
If there is insufficient distinction between symbols or if they are placed too densely, learners may misinterpret information. Therefore, extensive scientific research has been conducted worldwide to standardize tactile symbols, resulting in the development of several international standards.
The BANA (Braille Authority of North America) standard is one of the most widely used and scientifically grounded standards for creating tactile graphic materials worldwide. It was developed based on studies of the tactile perception capabilities of individuals with visual impairments, with strict norms established for the dimensions, height, and spacing of dots, lines, textures, and relief elements. The main purpose of the BANA standard is to ensure rapid, accurate tactile perception with minimal cognitive load.
In the BANA standard, symbols for tactile maps and atlases are differentiated according to their functional purpose. For example, different tactile shapes and textures are prescribed for administrative boundaries, natural features, and infrastructure elements. This facilitates comparison, differentiation, and memorization of map objects. Scientific studies have proven that students who

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work with tactile maps prepared in accordance with the BANA standard develop spatial representations more quickly and sustainably.

Another important aspect of this standard is its adaptability to the educational process and its reusability. Tactile atlases developed according to BANA are effectively used across various subjects, particularly geography, history, and biology. Therefore, the BANA standard is recognized as a reliable methodological foundation for both research and educational practice in creating tactile graphic materials.

ISO (International Organization for Standardization) standards are aimed at harmonizing tactile graphic materials at the international level, ensuring quality and functional consistency of tactile maps produced in different countries. These standards are developed with consideration for human tactile sensitivity, motor coordination, and information processing speed, allowing tactile graphic products to be used not only in education but also in public infrastructure.

ISO standards specify the dimensions of tactile symbols, relief height, minimum distances between elements, and the physical properties of materials. These requirements ensure safety and convenience in the use of tactile maps. Preventing excessive density of symbols, especially on information-rich maps, is one of the key objectives of ISO standards.

Scientific research shows that tactile maps based on ISO standards enhance the ability of students with visual impairments to generalize and analyze geographic information. Consequently, ISO standards serve as a universal platform for national standards. In Uzbekistan as well, relying on ISO standards enables the development of tactile graphic products that meet international requirements.

GOST R standards constitute a national system developed in the Russian Federation for the production, distribution, and use of tactile graphic materials in educational institutions. These standards are aimed at ensuring consistent quality in the mass production of tactile maps and diagrams. They clearly specify production technologies, material quality, and operational requirements for finished products.

A distinctive feature of GOST R standards is their focus on the practical use of tactile materials in education. Special attention is paid to durability, long service life, and the preservation of tactile symbols. Tactile maps produced in accordance with these standards maintain their functionality even after repeated use.

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Research results indicate that tactile graphic materials developed according to GOST R standards facilitate recognition, differentiation, and memorization of tactile symbols by students. Therefore, these standards can be applied in content harmony with BANA and ISO standards. In the context of Uzbekistan, utilizing GOST R experience serves as an important methodological basis for developing tactile atlases and contour maps tailored to practical educational needs.

In the United States, Europe, and Asian countries, the creation of tactile atlases and maps is supported at the level of state policy. Specialized research centers, educational institutions, and non-governmental organizations collaborate in this field. This experience demonstrates that reliance on international standards in creating tactile graphic products ensures the quality and sustainability of education.

Adaptation to the Conditions of Uzbekistan. There is no need for Uzbekistan to develop a separate tactile standard, as international standards have been created based on many years of scientific research and take into account human physiology, psychological state, developmental pace, and tactile perception characteristics.

However, these standards should be adapted to the Uzbek language, the Latin alphabet, and the country's natural and economic characteristics. Only then will tactile atlases and unlabeled maps created in Uzbekistan fully meet international requirements.

Conclusion

As a result of ongoing research, Uzbekistan is gradually joining the group of countries that produce tactile graphic materials. The creation of tactile atlases and contour maps contributes to forming the necessary educational and methodological base for the special education system. This, in turn, promotes the development of education for children with visual impairments and elevates the quality of the education system to a new level.

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