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TO:
THE SCIENTIFIC JURY
RE:
Resolution 299/27.03.2026
of the Rector of UACEG

OPINION

by

Prof. Nina Nikolova, PhD
Sofia University "St. Kliment Ohridski"

on a dissertation thesis for obtaining a PhD
professional field 5.7. Architecture, Civil Engineering and Geodesy, Scientific Specialty:
Cartography (including Thematic Geographic Cartography)

Author of the Dissertation: Eng. Nikoleta Nikolova
PhD Candidate, Department of Photogrammetry and Cartography,
University of Architecture, Civil Engineering and Geodesy (UACEG)

Dissertation Title
ANALYSIS OF THE SEMIOTIC SYSTEM AND CONTENT OF WEB MAPS

The dissertation submitted for evaluation comprises 204 pages and includes an introduction, eight chapters, a conclusion, a statement of scientific contributions, a bibliography, and appendices. The bibliography contains a substantial number of references, demonstrating the author's thorough knowledge of the scientific literature in the fields of cartography, web cartography, geographic information systems (GIS), cartographic communication, and user interfaces.

Eng. Nikoleta Nikolova has fulfilled the minimum national requirements for the award of the educational and scientific degree of **PhD** and has submitted all the documents required for the public defence procedure.

1. **Relevance of the topic and justification of the need for the research. Accuracy of the formulated object, subject, goals, and objectives of the study**

The relevance of the research topic is presented in the introduction to the dissertation. The PhD candidate provides a convincing justification for the study, emphasizing the rapid development of web cartography and the increasingly widespread use of geoportals and interactive cartographic products. Particular attention is given to the influence of visual variables, legend structure, and navigation and interface design on users' perception of spatial information. The author correctly points out that, to date, there have been no comprehensive studies simultaneously examining the symbol systems, legends, and interactive elements of web maps, nor any systematic analyses of Bulgarian geoportals.

The topic is of clear scientific and practical significance, as the findings may contribute to the development of more effective cartographic products intended for both the general public and specialized institutions.

The subject of the research is formulated in accordance with the dissertation topic; however, it is not sufficiently distinguished from the research object. A clearer definition of the research subject, limited exclusively to the characteristics and relationships under investigation, would enhance the methodological rigour of the dissertation.

The research aim and objectives are consistent with the dissertation topic but are not formulated with sufficient clarity. The stated aim is descriptive rather than research-oriented (i.e., "to provide a better understanding"), while the objectives are presented in overly general terms and do not clearly outline the sequential stages of the research. A more precise formulation and structuring of the aim and objectives would contribute to greater methodological clarity and logical coherence.

2. Theoretical background. Research approach and research methods.

The theoretical part of the dissertation demonstrates an in-depth knowledge of the scientific literature in the fields of cartography, cartographic semiotics, WEB cartography, user interfaces, and methods for evaluating the usability of WEB applications.

To achieve the stated objective, a comprehensive research approach has been applied, including comparative analysis, cartographic methods, experimental studies, analysis of user behavior using eye-tracking technology, statistical processing, and interpretation of the obtained results. The methods used have been appropriately selected and correspond to the nature of the investigated problems.

A particularly positive impression is made by the use of an experimental approach for evaluating the perception of different variants of cartographic symbols and legends. The application of eye-tracking technology enables an objective assessment of the effectiveness of various design solutions for WEB maps and contributes to increasing the scientific reliability of the obtained results.

3. Analysis and interpretation of the results. Correctness and validity of the results

The research is based on a substantial amount of theoretical and experimental material. An analysis of the semiotic system, content, and functional characteristics of WEB maps has been carried out, using both classical cartographic approaches and modern methods for studying user behavior. A major part of the dissertation consists of experimental studies conducted using Eye Tracking technology, through which the perception of different variants of cartographic symbols and legends has been evaluated. The applied indicators enable an objective assessment of the effectiveness of various design solutions for WEB maps and enhance the reliability of the conclusions drawn.

The analysis of existing WEB cartographic products and geoportals deserves a positive evaluation. The author does not limit the study to a description of their functionality but performs a critical assessment of the semiotic systems, legends, and interactive elements, on the basis of which recommendations are formulated for improving cartographic communication and the usability of WEB maps.

The results are presented through appropriate tables, figures, and graphical materials, which facilitate their interpretation and demonstrate the doctoral candidate's ability to analyze and interpret a substantial volume of experimental data.

4. Scientific contributions

The doctoral candidate Nikoleta Nikolova identifies a total of 10 contributions, grouping them into three categories: scientific, scientific-applied, and applied contributions. The contributions are formulated based on the conducted research and demonstrate the author's ability to develop and apply contemporary methods for the analysis of WEB cartographic products.

I would make one recommendation regarding the formulation of the scientific and scientific-applied contributions. They are presented in too much detail, and some of them have the character of specific results or practical applications. In my opinion, it would be more appropriate for the contributions to be summarized into several main directions, which would allow the scientific achievements of the dissertation to be highlighted more clearly.

The results of the dissertation have both scientific and practical value, as they contribute to a better understanding of the factors determining the effectiveness of cartographic communication in a web environment. The formulated recommendations can be applied in the design and improvement of web maps and geoportals, contributing to enhancing their usability and quality.

5. Basic concepts, scientific style, and structure of the dissertation

The dissertation is written in a good scientific style. The presentation is consistent and logical, while the individual chapters are well structured and interconnected. The illustrative material is extensive and of high quality. The figures, tables, and diagrams used support the understanding of the text and clearly present the results of the conducted analyses and experiments.

The abstract accurately presents the methods used, the results obtained, and the contributions of the dissertation. The publications presented are relevant to the topic of the dissertation and reflect the main results of the conducted scientific research.

6. Remarks and Questions for the Doctoral Candidate

The presented dissertation is a thorough and independent scientific study. Despite its high scientific value, some recommendations can be made.

1. In Chapter 4, dedicated to methods for the analysis and evaluation of WEB maps, an in-depth review of existing approaches is provided, and an original methodology has been proposed. It would be useful to include, at the end of the chapter, a summary comparative table comparing the methodology developed by the doctoral candidate with existing approaches. This would more clearly highlight her original contribution and the place of the proposed methodology among established methods.
2. In Chapter 8, practical recommendations for WEB map design are formulated based on the conducted experimental studies. I believe that their practical value would be enhanced if they were structured according to the main types of WEB cartographic products (geoportals, thematic WEB maps, mobile applications, etc.) or compared with established international recommendations and standards in the field of geographic information and cartography. This would facilitate their future application in practice.

Questions for the Doctoral Candidate:

1. The dissertation analyzes the state of various WEB cartographic applications and geoportals. Which of the analyzed components, in your opinion, has the most significant

impact on the effectiveness of cartographic communication – the semiotic system, the organization of the legend, the map content, or the tools for user interaction?

2. The conducted Eye Tracking studies demonstrate the advantages of certain variants of cartographic symbols and legends. To what extent can the developed methodology be applied for the evaluation of three-dimensional WEB maps and applications using virtual and augmented reality?

Conclusion:

The dissertation of Eng. Nikoleta Nikolova represents a completed, independent, and relevant scientific study dedicated to a problem of scientific and practical significance for the development of modern cartography and geoinformation technologies. The research methods used are appropriate to the objectives set and ensure the reliability of the results obtained. The doctoral candidate demonstrates in-depth theoretical knowledge, skills for independently conducting scientific research, and the ability to critically analyze the obtained results.

The remarks made are of a recommendatory nature and do not diminish my positive evaluation of the presented dissertation.

Based on the above, I consider that the dissertation of Eng. Nikoleta Nikolova entitled "Analysis of the Semiotic System and Content of WEB Maps" meets the requirements of the Law on the Development of Academic Staff in the Republic of Bulgaria and the Regulations for its implementation. I give my positive evaluation and propose that the respected scientific jury award Eng. Nikoleta Nikolova the educational and scientific degree "PhD" in the professional field 5.7. "Architecture, Construction and Geodesy", doctoral program "Cartography and GIS."

24.07.2026 Signature: .....

prof. Nina Nikolova, PhD