

# Thematic Mapping Practice and Explanation (THEMPE) as an Open Educational Resource for Classroom Teaching

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**Abstract:**

Education is essential for developing skills and deepening knowledge. The website of The ICA Commission on Education and Training states the range of educational resources, including literature, online tutorials, and tools for those interested in learning cartography. Recently, Open Educational Resources (OERs) have emerged as a promising tool for teaching. In Marcus-Quinn and Diggins, 2013, the authors describe OER as learning, teaching, and research resources made publicly available under specific intellectual property licenses.

Thematic mapping involves creating maps representing geographic phenomena, locations and attribute information simultaneously (Kraak et al., 2020). Thematic mapping can be taught using online OERs. There are numerous existing OERs. For instance, the "GIS&T Body of Knowledge" by UCGIS, "Cartography Playground" by Moritz Brunnengräber, and "Thematic Map Tutor" by Köbben, 2018.

This research aims to assess the significance of Thematic Mapping Practice and Explanation (THEMPE) as an OER in classroom settings and its impact on thematic cartography teaching. A previous online study by Afifah, 2020 during the COVID-19 pandemic involved 48 participants. This earlier study affirmed THEMPE's relevance and potential in teaching thematic cartography. Consequently, we made refinements to improve its content, including an introduction to ten thematic map types.

To evaluate THEMPE's efficacy, we conducted the user study in a classroom environment at the University of Augsburg. Thirty-two students participated anonymously in the user study. The students come from different study programs, i.e. Lehramt Gymnasium Geographie (Teaching qualification for high school geography) and Geography BSc. They were in various semesters, from the second to the ninth semester. The observation was supported by a central computer that could monitor the student's activities, and a tutor also helped to observe them. This user study was undertaken in the course "Geographic Information Systems and Cartography II", which has ten exercises. In the weeks before, the students had finished six tutorials on using ArcGIS and QGIS. Hence, the user study included the rest of the four exercises we did each following week.

The user study started from "Exercise 7: Introduction to Thematic Mapping". The task in this exercise consists of five steps (see figure 1). On average, students spent 1 hour and 24 minutes completing the task. Also, we gave extra points to encourage them to join the study until the last exercise. The students did the task in this exercise independently without interruptions from the lecturer or tutors and were not allowed to talk to each other. This setup was meant to make the students focus on their tasks.

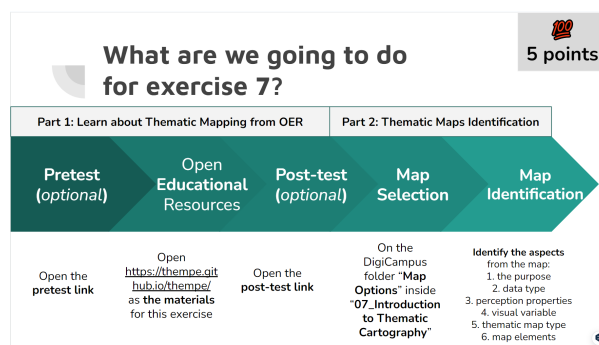


Figure 1. User study steps in the class' presentation

The pretest and post-test comprised seven identical questions. They aim to assess various aspects of thematic mapping, map quality recognition, understanding of visual variables, and data visualisation techniques. Then, we compared students' answers in the pretest and post-test to see whether they gave different answers after the learning process. For instance, the question "What visual variable is suitable for representing Population Density data on a thematic map?" is where most students answered correctly in the post-test only by 43.8%. It shows how much THEMPE helped them answer the question about data and its visualisation.

On the other hand, the question where 53.1% of students answered wrongly in both the pretest and post-test was, "Which visual variables can be used to visualize data with a Flow Map?". Most students answered that "orientation" is one of the visual variables for a flow map. It reveals how the difference between orientation as a visual variable and the flow direction should be explained further in THEMPE. The comparison of these two questions is shown in 2 below:

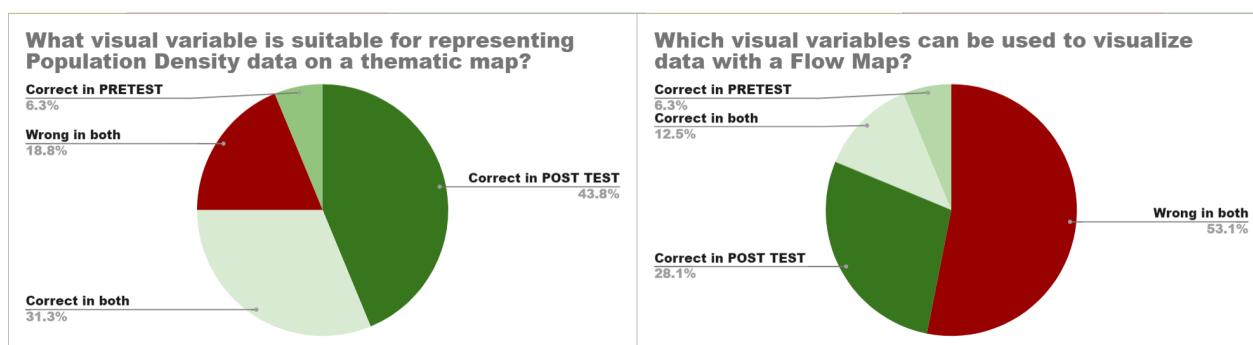


Figure 2. Pie charts of the two questions' answers comparison  
Source: Own works from the users' study

As mentioned, this user study involved four exercises. Each exercise is assigned a maximum grade of 10 points. Meanwhile, the success rate indicates the student's achievement in obtaining these points, ranging from 0.0 to 1.0. In exercise 7, after the students finished the post-test, they were asked to choose one map showing good qualities, as shown in figure 1. We provided three good maps from a selection of five, and all students chose the correct ones. Then, they needed to identify the purpose, data type, perception properties, visual variables, thematic map type and elements on the map they chose. Unfortunately, three-fourths of the students did not answer accurately, so the success rate of exercise 7 was 0.77.

In the following weeks, we conducted "Exercise 8: Map Types." We asked the students to use statistical data, which consists of qualitative and quantitative data. Then, they needed to create three maps using ArcGIS in the first week and another three in QGIS the following week. Some students did not make suitable map types for their data and skipped labelling them. Thus, the success rate was 0.77.

Furthermore, we performed "Exercise 9: Map Elements and Layout," reaching a success rate of 0.68. The success rate is the lowest because we graded all aspects of creating maps, from the labelling and base map selection to the aesthetic. Lastly, "Exercise 10: Map Creation" demonstrated a success rate 0.76. It emphasises proficiency in map design and understanding of thematic mapping.

In conclusion, THEMPE demonstrates its excellence as a valuable OER, specifically in enriching thematic cartography education within classroom environments. As an adaptable tool, THEMPE complements traditional teaching, encouraging both independent learning and innovative approaches in educational cartography. To enhance user experience and understanding, THEMPE will continuously improve based on feedback.

Access THEMPE here: <https://thempe.github.io/thempe/>

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