International Cartographic Association
Association Cartographique Internationale

How do geography students read and interpret contour lines? An empirical study of their misconceptions

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Keywords: hypsography, contour lines, conceptual test, misconception, user study, geography education

Abstract:

The 3D relief of terrain is represented in two dimensions on maps, with contour lines being one of the most widely used methods for depicting it. Contour lines allow interpretation of landforms and mathematical operations related to the measurement of slope, angle of elevation and other terrain-related analysis.

Developing the ability to read and interpret contour lines in a map is an indispensable part of school education (Cockrell, Petcovic 2022). Students are taught to read a map and interpret landforms presented by contour lines early in school. However, the process of interpreting a hypsography map can be challenging even for undergraduate students of related scientific fields. By analyzing various cases, one can attempt to identify the most common misconceptions hindering successful map use (Clark et al. 2008).

The paper will present research conducted in two European universities: Charles University (Czechia) and University of Warsaw (Poland). A total of 236 students took part in the study. The participants were first-year bachelor students of geography and other field studies connected with geography. To evaluate students' understanding of contour lines a paper-form conceptual test consisting of 15 tasks was used (Krajňáková et al. 2024). The time spent to complete all tasks was approximately 30 minutes.

The study indicated the level of geography students' ability to read and interpret contour lines on the hypsography maps. The average success rate in the test was 69.24%. The lowest result was 26.67% (6 participants), and the highest was a complete list of correct answers (9 participants). Users were also asked to rate the certainty of their answers in each task on a scale from 0 (just guessing) to 3 (absolutely certain). The average certainty of all answers given was 1.99 (Figure 1).

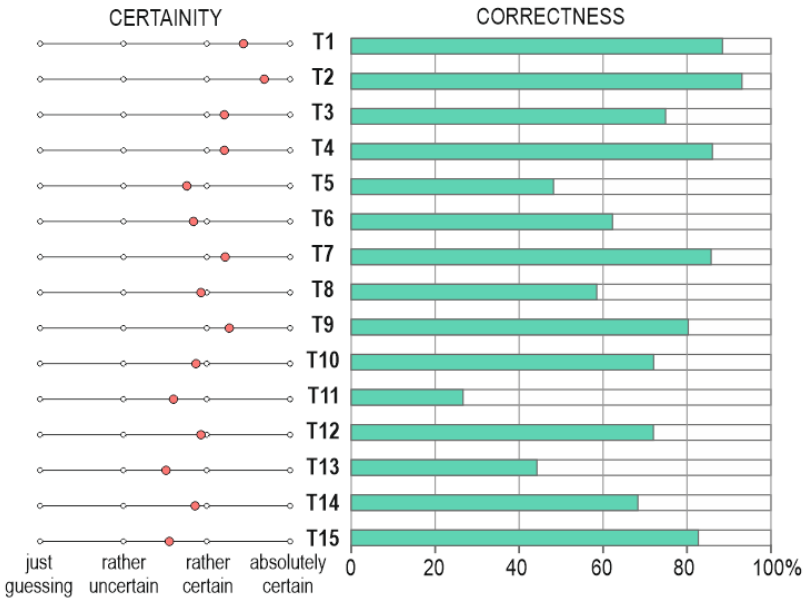

Figure 1 The average certainty and correctness of answers in individual tasks. Source: own elaboration.

When analyzing the results for the individual tasks, it is worth looking at whether the high certainty of the answers given was accompanied by a high rate of their correctness. Based on the answers' correctness and certainty in them, four types of participants were distinguished for each task [Table 1: participants with scientific knowledge (SK), participants lacking confidence or lucky guessers (LC), participants lacking knowledge (LK), participants holding misconception(s) (MC)].

Category	Answer correctness	Certainty of answer
Scientific knowledge (SK)	Correct	Absolutely certain, rather certain
Lucky guess / Lack of confidence (LC)	Correct	Rather uncertain, just guessing
Lack of knowledge (LK)	Incorrect	Rather uncertain, just guessing
Misconception (MC)	Incorrect	Absolutely certain, rather certain

Table 1. The categorisation of possible responses. Source: own elaboration.

The characteristics and distribution of these participants' types will be the key part of the presented conference contribution together with specific misconceptions identified. These findings have substantial implications for improving undergraduate geography education, as the ability to read and interpret contour lines is essential for the work of a geographer (climatologist, hydrologist, geomorphologist, cartographer, urban planner, etc.).

References

Cockrell, J & Petcovic, HL 2022, 'Teaching topography using 3D printed terrain in an introductory earth science course: A pilot study', *Journal of Geoscience Education*, vol. 70, no. 1, pp. 2–12.

Clark, D, Reynolds, S, Lemanowski, V, Stiles, T, Yasar, S, Proctor, S, Lewis, E, Stromfors, C, & Corkins, J, 2008, 'University Students' Conceptualization and Interpretation of Topographic Maps', International Journal of Science Education, vol. 30, no. 3, pp. 377–408.

Krajňáková, L, Hanus, M, Trahorsch, P, 2024, 'Pre-service geography teachers' conceptual understanding of contours on maps: implications for teacher training in cartography', Journal of Geography in Higher Education, pp. 1–19.

Abstracts of the International Cartographic Association, 10, 152, 2025
32nd International Cartographic Conference (ICC 2025), 17–22 August 2025, Vancouver, Canada.
https://doi.org/10.5194/ica-abs-10-152-2025