Soils and Rocks
An International Journal of Geotechnical and Geoenvironmental Engineering
www.soilsandrocks.com
ISSN 1980-9743
ISSN-e 2675-5475

Discussion of "The development and evaluation of an educational board game on basic geotechnical characterization"*

Marina Pantazidou[1#]

Discussion

Efforts leading to heightened student motivation, such as the game developed by the authors, are commendable. Even more so if they also promote the métier of the teacher, seen from a content-related angle, which is the viewpoint of this discussion. All question-based educational games can potentially belong in this category that combines the two goals of increasing the engagement of students *and* the awareness of instructors of how students perceive key concepts. Even the teachers who are not interested in incorporating a game in their teaching can use the questions. Multiple-choice questions such as those presented in Table 3, belong in the broader category of retrieval exercises, which have been shown to result in learning gains by the students (Karpicke & Grimaldi, 2012). A multiple-choice question consists of a problem, known as the stem, and a list of suggested solutions, known as alternatives, which include typically one correct answer and a few wrong answers. Ideally, wrong answers are chosen to reflect alternative understandings of students, some of which are misconceptions. Such questions admitting answers that can detect nuances in student understanding are useful for the instructor for both diagnostic and summative assessment. A detailed discussion of the benefits of well-phrased multiple-choice questions is understandably beyond the scope of the paper by Chrusciak et al. However, since the questions are the educational heart of the game, the authors should have referenced geotechnical engineering education papers highlighting the role of questions in teaching and learning (Donohue, 2014; Fellin & Medicus, 2015; Pantazidou, 2022), including the one written by authors from the same team (Cardoso et al., 2023). Raising awareness about all the publications related to questions will balance the attention of the geotechnical engineering education community between the questions themselves, i.e. the main educational tool, and the various implementation alternatives (online, use of response systems, gaming). Then an in-depth discussion on the questions can begin.

References

Cardoso, G.A.F., Chrusciak, M.R., Cordao-Neto, M.P., & Lopes, B.C.F.L. (2023). UnSaLuDo: the development of an educational board game on unsaturated soil mechanics. In *Proceedings of the 8th International Conference on Unsaturated Soils (UNSAT 2023)*, Milos, Greece. http://doi.org/10.1051/e3sconf/202338224008.

Chrusciak, M.R., Luz, H.K.M., Souza, R.D., & Lopes, B.C.F.L. (2024). The development and evaluation of an educational board game on basic geotechnical soil characterization. *Soils and Rocks*, 47(2), e2024003723. http://doi.org/10.28927/SR.2024.003723.

Donohue, S. (2014). Supporting active learning in an undergraduate geotechnical engineering course using group-based audience response systems quizzes. *European Journal of Engineering Education*, 39(1), 45-54. http://doi.org/10.1080/03043797.2013.833169.

Fellin, W., & Medicus, G. (2015). Multiple-choice tests: more than a time saver for teachers. *Int. J. of Engineering Pedagogy*, 5(3), 15-24. http://doi.org/10.3991/ijep.v5i3.4376.

Karpicke, J.D., & Grimaldi, P.J. (2012). Retrieval-based learning: A perspective for enhancing meaningful learning. *Educational Psychology Review*, 24(3), 401-418. http://doi.org/10.1007/s10648-012-9202-2.

Pantazidou, M. (2022). Recall questions for soil compression: Potential learning gains for students and instructors. In *Proceedings of the Geo-Congress 2022*, Charlotte, NC, USA. http://doi.org/10.1061/9780784484067.051.

#Corresponding author. E-mail address: mpanta@central.ntua.gr
[1]National Technical University of Athens, School of Civil Engineering, Zografou, Greece.
*Appears in Chrusciak et al. (2024). Soils and Rocks, 47(2), e2024003723.

Submitted on August 21, 2024; Final Acceptance on November 25, 2024.
Editor: Renato P. Cunha
https://doi.org/10.28927/SR.2025.006724

Author's reply

Mariana Ramos Chrusciak, Hingred Karoline Magalhães da Luz, Rebeca Dias de Souza, Bruna de Carvalho Faria Lima Lopes

The authors thank Dr. Pantazidou for her valuable comments on this paper. We appreciate her recognition of the approach proposed for implementing multiple-choice questions through a game-based methodology and her emphasis on the critical role of well-constructed questions as a fundamental point in geotechnical engineering education.

Donohue (2014), Fellin & Medicus (2015), and Pantazidou (2022) provide valuable insights into the educational benefits of multiple-choice questions, emphasizing their relevance for future discussions aimed at enhancing geotechnical engineering education. These studies also highlight the critical role of well-designed questions in fostering deeper understanding among students. While our study primarily focused on exploring the conception and use of educational games within academic settings, a detailed analysis of question design and its pedagogical implications was beyond its scope. Nonetheless, the importance of such discussions is acknowledged as essential for advancing educational practices in geotechnical engineering.

Building on these foundation, Chrusciak & Lopes (2024) provided a detailed account of the development of six games within the GeoFUN project, four of which were co-created with undergraduate students, including the game focus of the current paper discussed here (Chrusciak et al., 2024) and the unsaturated soil mechanics game discussed in Cardoso et al. (2023). The co-creation process addressed a significant challenge in crafting multiple-choice questions - a topic often discussed during progress meetings. These deliberations frequently centered on ensuring the clarity of questions and the quality of available alternatives. By involving students in this process, the project offered them valuable insight into the educator's perspective, enabling a more critical and informed approach to assessment design. This participatory method not only enriched the educational tool but also aligned with established evidence highlighting the benefits of multiple-choice questions in fostering learning.

Additionally, Borges et al. (2024) investigated the use of active methodologies in geotechnical engineering education through faculty surveys. The study revealed that innovation in teaching is a significant concern for many educators, with 39% expressing high concern and 48% indicating moderate concern. However, the practical application of such methodologies remains inconsistent, as only 50% of respondents occasionally use active methodologies, while 34% incorporate them regularly, and 16% do not use them at all.

The study also shed light on the challenges faced by faculty in implementing these methods. The primary barriers identified were time constraints for adequate preparation (63%), lack of resources (39%), and resistance from students (38%). Despite these obstacles, 71% of respondents saw opportunities to improve or expand the use of active methodologies, while 29% did not perceive such potential. Resistance to adoption was largely attributed to a lack of knowledge about these methodologies (71%) and deficiencies in training and the sharing of experiences (54%). Additionally, 48% of faculty highlighted the difficulty of developing activities, and only 25% felt that educators' roles were appropriately recognized within the engineering academic environment.

These findings underline the importance of targeted initiatives to address these barriers, particularly through improved training and support for educators. In the context of multiple-choice questions, these challenges are especially relevant. Developing high-quality questions that effectively diagnose student understanding and misconceptions requires time and resources, as well as expertise that may currently be lacking among faculty. Furthermore, resistance from students to new approaches, including the integration of question-based active methodologies, highlights the need for strategies that engage students and demonstrate the value of these methods in enhancing their learning.

These observations suggest that while discussions on designing effective educational tools, such as multiple-choice questions, are essential, there is a broader need to first foster motivation, support, and encouragement for adopting innovative teaching methodologies. Overcoming barriers such as time constraints, resource limitations, and resistance from both educators and students is critical for creating an educational culture where these tools can thrive.

As multiple-choice questions are an integral component of active methodologies, addressing these foundational challenges would enable educators to fully leverage their potential—not only as tools for summative assessment but also as mechanisms for formative assessment and deeper engagement with key concepts. By cultivating a supportive environment that prioritizes training, resource allocation, and collaboration, multiple-choice questions can become central to fostering innovation and advancing geotechnical engineering education. In doing so, they will contribute to a broader transformation of teaching practices, positioning these methods as indispensable to the future of the field.

References

Borges, C.B., Chrusciak, M.R., & Lopes, B.C.F.L. (2024). A experiências de docentes no desenvolvimento e implementação de metodologias ativas no ensino de geotecnia. In *Anais do 21º Congresso Brasileiro de Mecânica dos Solos e Engenharia Geotécnica*, Balneário Camburiú. ABMS, CBMR, ISRM & SPG (in Portuguese). http://doi.org/10.47094/COBRAMSEG2024/122.

Cardoso, G.A.F., Chrusciak, M.R., Cordao-Neto, M.P., & Lopes, B.C.F.L. (2023). UnSaLuDo: the development of an educational board game on unsaturated soil mechanics.

In *Proceedings of the 8th International Conference on Unsaturated Soils (UNSAT 2023)*, Milos, Greece. http://doi.org/10.1051/e3sconf/202338224008.

Chrusciak, M.R., & Lopes, B.C.F.L. (2024). Considerações de educadores sobre inovação na educação de mecânica dos solos: um estudo de caso do Projeto Geofun. In *Anais do 10º Simpósio Brasileiro de Engenheiros Geotécnicos Jovens*, Balneário Camburiú. ABMS, CBMR, ISRM & SPG (in Portuguese).

Chrusciak, M.R., Luz, H.K.M., Souza, R.D., & Lopes, B.C.F.L. (2024). The development and evaluation of an educational board game on basic geotechnical soil characterization. *Soils and Rocks*, 47(2), e2024003723. http://doi.org/10.28927/SR.2024.003723.

Donohue, S. (2014). Supporting active learning in an undergraduate geotechnical engineering course using group-based audience response systems quizzes. *European Journal of Engineering Education*, 39(1), 45-54. http://doi.org/10.1080/03043797.2013.833169.

Fellin, W., & Medicus, G. (2015). Multiple-choice tests: more than a time saver for teachers. *Int. J. of Engineering Pedagogy*, 5(3), 15-24. http://doi.org/10.3991/ijep.v5i3.4376.

Pantazidou, M. (2022). Recall questions for soil compression: Potential learning gains for students and instructors. In *Proceedings of the Geo-Congress 2022*, Charlotte, NC, USA. http://doi.org/10.1061/9780784484067.051.