Suggestions for Improving Geotechnical and Infrastructure Courses Teaching on Higher Education

Nikolaos Alamanis, Grigorios Papageorgiou, Ioannis Chouliaras, Spyridon Kotsopoulos, and Nikolaos Xafoulis
University of Thessaly, General Department of Larissa, Larissa, Greece
Email: {alam, gpapageor, xouliar, kotsopoulos, nikoxafo}@uth.gr

Evangelia Farsirotou
University of Thessaly, Department of Ichthyology & Aquatic Environment, School of Agricultural Sciences, Volos, Greece
Email: efars@uth.gr

***Abstract*—The purpose of this paper is to prepare questionnaire-based research proposals by undergraduate students for the Soil Mechanics course of the Dept. Civil Infrastructure Engineering, as well as postgraduate students for the course of Environmental Geotechnics of the Postgraduate Programme "Advanced Environmental Management Technologies in Engineering Works" of the General Department of Larissa of the University of Thessaly, with the ultimate goal being the upgrade of the classes. It is noted that the lecturers of the course participated in the evaluation of the Environmental Geotechnics course through a relevant questionnaire. The research strategy concerns the design of the questionnaire in conjunction with the objectives of the course. According to the curriculum, geotechnical courses aim to enable students to apply the methodologies for calculating the physical characteristics and mechanical properties of the soil, which functions either as a superstructure load recipient or as a structural material for the construction of geotechnical works. The questionnaires took into account the content of each lesson, students' preferences in the learning process, the ability to self-evaluate, evaluate and develop collaborations, the desired number of teaching hours available to cover the subject and the adequacy of the knowledge acquired in each module of the course. Finally, the students' responses were evaluated, and useful conclusions were drawn which could contribute positively to the qualitative improvement of the teaching of the above courses**

***Index Terms*—Improvement, learning process, road infrastructure, soil-asphalt laboratory, upgrading.**

I. Introduction

The general purpose of teaching geotechnical courses is for students to acquire knowledge necessary for the design and construction of projects, in an interdisciplinary approach with other civil engineering specialties e.g. structural engineers, transportation planners, hydraulic engineers. Since geotechnical engineering is the connecting branch of all Civil Engineering specialties, it is easily understood that upgrading the teaching of the respective courses leads to a far-reaching upgrade of the entire Civil Engineering scientific field, positioning the whole field favourably in order for it to address the relatively new environmental challenges due to climate change and the global increase in population [1].

Geotechnical courses, in addition to the learning process of calculating the physical and mechanical properties of the soil as well as the study of geotechnical projects, are designed to enable students to develop social skills that include cooperation, communication, mutual assistance, organisation and responsibility [2]. This paper aims at activating the student and integrating them into a constantly changing scientific-social field. Thus, the sociality of teaching is reflected in the cultivation of those skills that promote science and the practice of daily life [3], At the same time, considering that teaching is and should be a collective venture in order to achieve improvements in education and taking into account the results of research on teaching and learning [4], the present paper concludes with possible conclusions which could be of interest to the broader educational community.

The purpose of the research process was to involve as many students as possible in the educational process so that there would be a reliable sample of responses to better classify and evaluate the responses.

II. Evaluation of Responses

The method selected for the collection of responses for this purpose was the use of closed question questionnaires, as these tend to allow researchers to collect in-depth data that can be interpreted easily, both quickly and economically. Moreover, information collected can be easily converted into quantitative data, in order to statistically analyze the data [5].

A. Soil Mechanics (Undergraduate Programme)

As regards the formulation of the questionnaires, various types of questions were used, and several factors

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were considered to improve the teaching of geotechnical courses. This section presents in pie charts the answers to the questionnaires for the undergraduate / Soil Mechanics courses at undergraduate level from a total of 76 students. Fig. 1 shows the degree, up to which, students are satisfied with the content of the soil mechanics / geotechnical engineering courses.

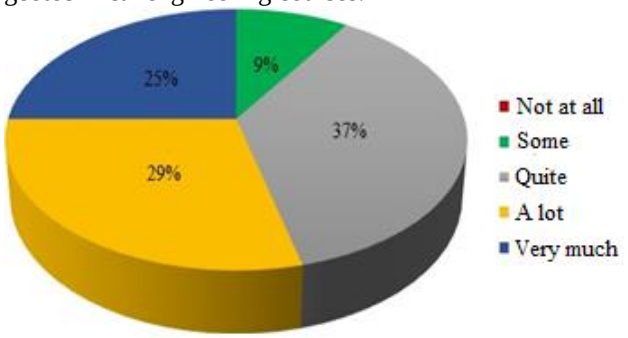

Figure 1. Student satisfaction with course contents.

According to the students' answers, the vast majority are satisfied with the content of the courses, while only 9% seem to be unsatisfied. The following pie-diagrams show the results of student assessment questions. Fig. 2 shows that students are largely eager to self-evaluate their progress, while Fig. 3 shows that the majority of students do not want to be evaluated by their peers.

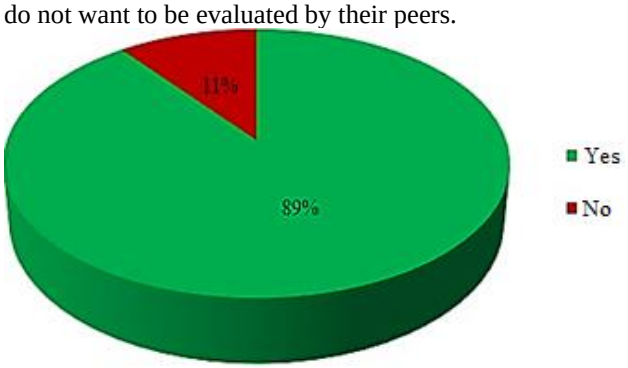

Figure 2. Self-assessment capability.

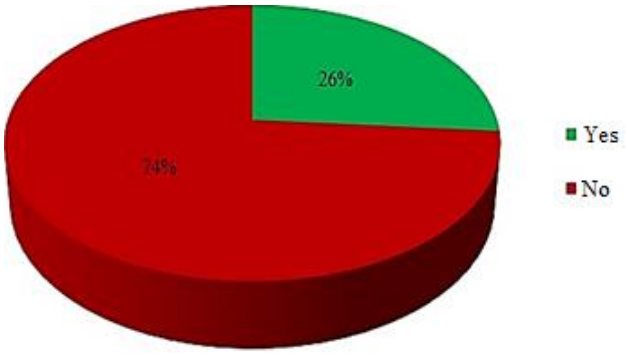

Figure 3. Peer-assessment capability.

According to the results presented in Fig. 4, the overwhelming majority of students (80%) believe that they understand geotechnical lessons better, by the teaching of Practical Exercises (PE) as well as laboratory exercises.

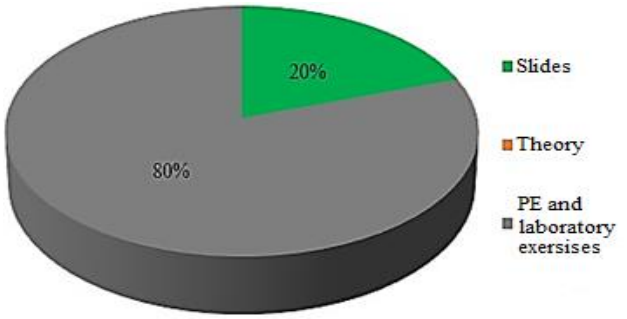

Figure 4. Preferences in the teaching of geotechnical lessons.

Students' preferences for the type of exercises they prefer vary as illustrated by Fig. 5. Teamwork is preferred to individual and partner work, while the combination of the above tasks seems to be the number one priority for students.

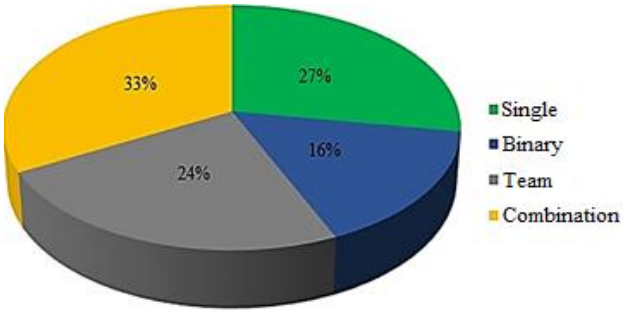

Figure 5. Preferences regarding the type of exercises.

The following pie-charts illustrate the students' responses to the need to use examples - applications in geotechnical lessons (Fig. 6) and whether the course objective is achieved when students are familiar with a wide range of geotechnical applications (Fig. 7).

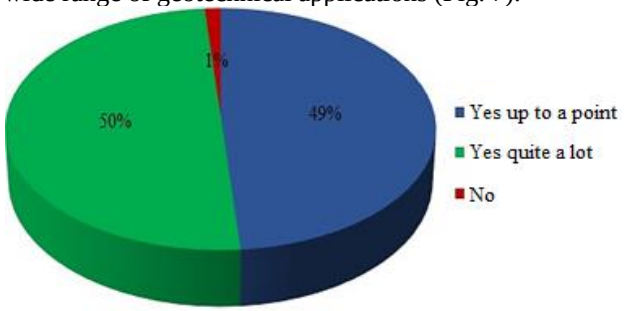

Figure 6. Necessity for the use of examples - applications.

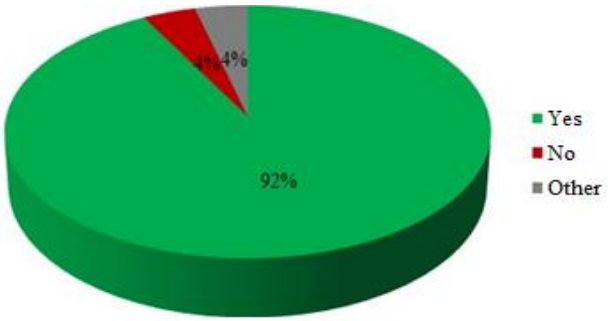

Figure 7. Familiarization of students with geotechnical applications.

The graphs above show that all students find it interesting to present examples of applications - failures in each module of the course, but then preferences vary in the frequency of presentation of the examples. At the same time, almost all the students (92%) consider that the purpose of the course is achieved when the course participants are familiar with a wide range of geotechnical applications.

In addition, student responses indicated that a large percentage (75%) wanted to describe the knowledge gained at the end of each module of the lesson as well as the degree of difficulty of the modules as shown in Fig. 8.

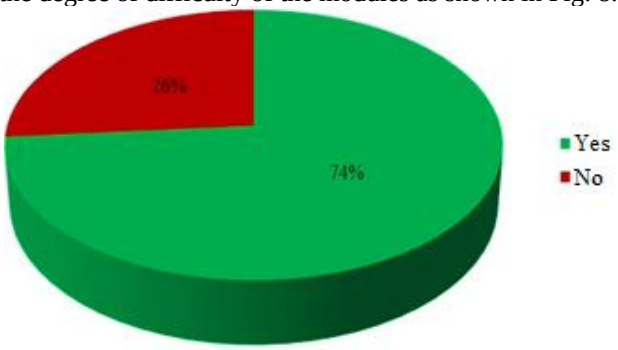

Figure 8. Description of knowledge and degree of difficulty of the modules.

The same percentage of students would be interested in making suggestions for improving the modules and the lesson in general (Fig. 9).

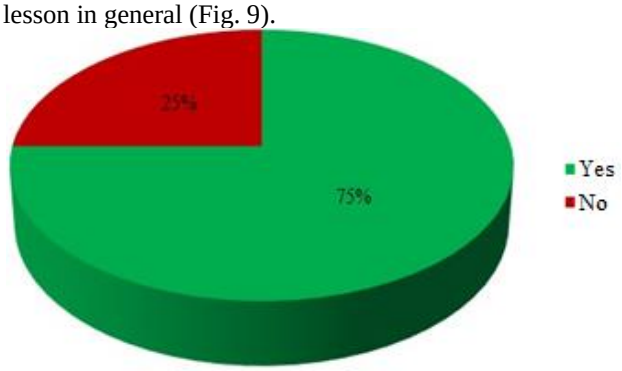

Figure 9. Suggestions for improving the modules.

Finally, the student evaluation criteria for each subject teacher are described. Most students, according to their answers, hold as evaluation criteria (both specific and general), the proper organization of the subject and lesson, the ability to arouse interest in the subject, the teacher behavior towards the students and the teacher's willingness to answer questions and solve their queries.

B. *Environmental Geotechnics (Postgraduate Studies Programme)*

Every environmental problem has far-reaching social repercussions, stemming from some application of contemporary technology. Deeper understanding of scientific data, based on which such technology functions, puts it in layman terms and demystifies it, allowing it to create new correlations in the social framework and, conclusively, offer solutions. Resolving to action on the specific environmental issue will consider all the available data and different parameters [6].

This section presents the questionnaire response results from both a total of 17 postgraduate students attending the Postgraduate Programme in "Advanced Environmental Management Technologies in Engineering Works" of the Larissa General Department of the University of Thessaly and their lecturers.

C. *Postgraduate Student Responses*

The following pie chart (Fig. 10) shows the students' view on the necessity of having an environmental geotechnical course in postgraduate studies in civil engineering. All postgraduate students consider the teaching of the course in the above programme necessary. They also believe that teaching this course will give them a better understanding of other subjects that are related to the specialty of civil engineering. Therefore, it can be inferred that environmental geotechnics is one of the basic lessons that should be taught in such programme.

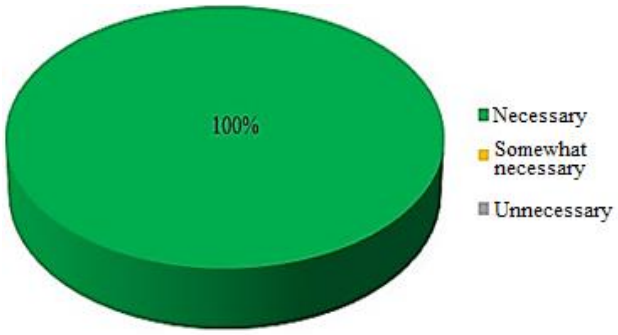

Figure 10. Teaching environmental geotechnics in postgraduate studies.

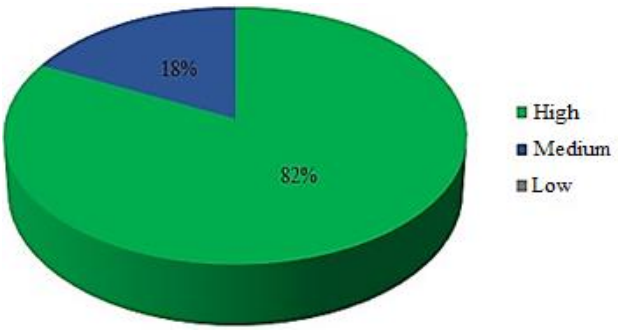

Figure 11. Students' satisfaction with the lesson timetable.

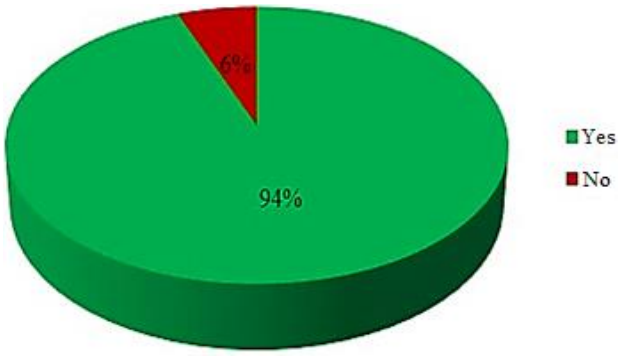

Figure 12. Oral and written final exams.

In a question regarding the level of satisfaction the students have with the class hours, 82% of the students seem to be satisfied with the class hours (3 hours per week), while 18% think it is appropriate to increase the class hours. as shown in Fig. 11. Also, regarding the final exams of the course, the overwhelming majority thinks that besides the written final exam, there should be an oral exam (Fig. 12).

Finally, a significant percentage of students (88%) believe that both the lesson and the teacher should be assessed at the end of each semester, while they would not make any changes to the course as they believe that the existing chapters cover a wide spectrum of knowledge. However, some students believe that a laboratory lesson or some field test should be provided in the course.

D. Involvement of Tutors

The tutors of the University consider Environmental Geotechnics as a whole, to be absolutely necessary for the M.Sc. level of study, along with other specialized programme related to that of civil engineering, despite the difficulties encountered by tutors in its implementation in the context of general environmental education. Tutors' assessment is that environmental education is a relatively new scientific field, it constitutes a knowledge of many subjects, thus, requires an interdisciplinary approach.

Finally, environmental literacy and sensitivity are not equally developed in all citizens of a country, leading to familiarization with environmental issues taking place at a slower pace than the ideal case.

III. Conclusion

After analysing the questionnaire results for undergraduate and postgraduate students as well as for tutors of the department, the following conclusions emerged, that are useful towards upgrading geotechnical courses, at a time when the profession of Civil/Geotechnical Engineer has been deeply affected by the economic recession:

1) The vast majority of students are satisfied with the content of the courses and find that they understand geotechnical lessons better by being taught both practical exercises and laboratory exercises. For the implementation of the exercises, they find it preferable to divide into groups as it is necessary to present examples of applications-failures of technical projects at a sparser frequency, nonetheless.
2) The majority of the research participants, at the end of each module of the course, wish to describe the benefits of the acquired knowledge and propose any improvements that will help to upgrade it, while it was found that the students wish to self-evaluate rather than be evaluated by their peers.
3) All undergraduate and postgraduate students interviewed are favourable to participating in an educational excursion in the framework of geotechnical course teaching, as they believe that in this way the examples studied in the theoretical and laboratory areas would be more easily understood.
4) Postgraduate students believe that the course in Environmental Geotechnics can help students understand the rest of the courses and is therefore essential to the teaching of the MSc. Students are also satisfied with the teaching hours of the course, consider the final oral examination necessary and believe in the usefulness of evaluating tutors and courses at the end of the semester.
5) Finally, the above research with the use of questionnaires led to useful and interesting points regarding the improvement of Geotechnical engineering courses and the educational process in general.

IV. Suggestions-Discussions

Considering the conclusions of the survey analysis, the authors of this paper believe that several suggestions can be put forth, in order to improve the overall quality of Geotechnics curriculum and to prepare it to meet future demands. These suggestions are as follows:

1) Provide students with the flexibility to self-organize as they deem necessary, in order to tackle class work requirements, such as papers, experiments, etc, as this will provide the class with a higher quality, diversified results set, compared to work done individually.
2) Hold regular class assessment meetings with the participation of the teaching staff and a delegation of the student body, in order to gain insight into the overall reception of the curriculum by the students and be prepared to take under consideration for evaluation and future assimilation into the teaching module any suggestions made during these meetings.
3) Provide students attending the Soil Mechanics curriculum with the opportunity to participate in field trips organized by the school, for them to experience in vita reali and in context the theoretical knowledge they gained in class [7].
4) Provide all students with the opportunity to give feedback anonymously on both the quality of the lesson as delivered by teachers and the material delivered, at the end of the semester.

Conflict of Interest

The authors declare no conflict of interest.

Author Contributions

Nikolaos Alamanis and Nikolaos Xafoulis wrote the full text and edited the figures and the questionnaires. The rest of the authors analyzed the results of the questionnaire responses, while they also participated in the writing of the text. All authors, during the university lectures, distributed the questionnaires to the students. Finally, all authors had approved the final version.

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Dr. Nikolaos Alamanis, Assistant Professor PhD in Stability of Slopes (University of Thessaly, Dept. of Civil Engineering), D.E.A (MSc) Mecanique des Sols-Structures (Ecole Centrale Paris), MEng, BEng in Civil Engineering (integrated master from National Technical University of Athens, School of Civil Engineering). Member of Technical Chamber of Greece, Member of Hellenic Association of Civil Engineers, Member of American Society of Civil Engineering. He has published papers in international peer-reviewed journals and conferences at the field of Geotechnical Engineering and Infrastructure Works. Research interests: stability of slopes, spatial variability of soil properties, autocorrelation and cross correlation of soil strength parameters.

Dr. Grigorios Papageorgiou, Assistant Professor, University of Thessaly, Larissa, Greece.
PhD in Transport Infrastructure Management (University of Thessaly, Dept. of Civil Engineering), MSc in Environmental Design of Infrastructure Works (Hellenic Open University, School of Science and Technology), MSc in Environmental Design of Cities and Buildings (Hellenic Open University, School of Science and Technology), Member of Technical Chamber of Greece, Hellenic Association of Civil Engineers, Hellenic Institute of Transportation Engineers. He has published papers in international peer-reviewed journals and conferences at the field of Transport Infrastructure Management.
Research interests: smart roads, pavement management, environmental road design, highway infrastructure optimization.

Dr. Ioannis Chouliaras. Professor, University of Thessaly, Larissa, Greece. Civil Engineer (Democritus University of Thrace, 1980). He obtained his Master's degree in Construction Management and Economics from ASTON University in Birmingham in1982. He holds his Ph. D degree from Aristotle University of Thessaloniki in 2000 with doctoral thesis "Hydraulic erosion. Study of the erodibility of cohesive geomaterials". He has professional experience of 39 years as an engineer, 34 years in teaching graduate and postgraduate civil engineering subjects and 22 years in positions of responsibility in the TEI of Thessaly. He participated in 6 research and in 9 EPEAEK programmes, published 27 scientific articles and wrote a textbook. He supervised 15 postgraduate and 51 graduate students' theses. His research interests include Soil Mechanics, Environmental Geotechnics, Project Management, Reinforced Concrete and Research Methodology.

Dr. Spyridon Kotsopoulos is currently Professor in water resources management at the General Department of Larissa (University of Thessaly). His teaching activity includes lecturing and dissertation supervising on the subjects: hydrology, hydraulics, river regulation, water supply, harbour and land reclamation engineering.
Until March 2008, he was working as researcher at the Institute of Soil Classification and Mapping (I.S.C.M.) of the National Agricultural Research Foundation (N.AG.RE.F.).
He received his first degree in 1984 from the National Technical University of Athens (N.T.U.A.), Dept. of Civil Engineering and his PhD in 1989 in Water Resources Management from the Southampton University, UK. Dr. Kotsopoulos is the author of monographs and numerous articles in scientific journals and proceedings of national and international symposia related to water resources management. He has also participated in several national and international research projects and is currently member of the advisory committee for the scientific journals: "Hydrotechnika" of the Hellenic Hydrotechnical Association, "Geotechnical Scientific Issues" of the Geotechnical Chamber of Greece, "European Water" of the European Water Resources Association (EWRA) and "Water Resources Management" of the Kluwer Academic Publishers.

Nikolaos Xafoulis G. Civil Infrastructure Engineer, M.Sc. in Advanced Environmental Management Technologies in Engineering Works (Technological Educational Institute of Larissa).
Academic Scholar at P.S. of Civil Engineering T.E., University of Thessaly. He teaches "Computer Aided Applications on Hydraulic Works".
Research assistant in the laboratory of "Flooding Protection Hydraulic Works & Water Resources Management Technology" at General Department of Larissa, University of Thessaly. He has published several papers in international peer-reviewed journals and conferences.
Research interests: hydraulics of open channels, sediment transport in natural rivers, river flood protection works, hydrology and water resources management.

Dr. Evangelia Farsirotou. Professor at the Department of Ichthyology & Aquatic Environment, School of Agricultural Sciences, laboratory of "Ecohydraulics & Inland Water Management" at the University of Thessaly. Her scientific area is in ¨Hydrodynamic and Flood Prevention Works¨. She has a diploma in Civil Engineering, Ph.D. at the Aristotle University of Thessaloniki, Department of Civil Engineering in the Division of Hydraulics & Environmental Engineering and Master of Science in Hydraulic Engineering. She is director of the Master of Science in ¨Advanced Environmental Management Technologies in Engineering Works¨ (General Department of Larissa, University of Thessaly). She teaches ¨Hydraulics¨, ¨Regulations of Rivers and Streams-Flood Prevention Works¨, ¨Hydrodynamic Works-Dams¨, ¨Computer Aided Applications on Hydraulic Works¨, ¨Environmental Management of Natural Rivers¨ and ¨Flood Protection and Sustainable Development¨. She is active in research in hydraulics of open channels, riverbed morphology and sediment transport, degradation, aggradation and scour simulation in alluvial channels and river flood protection works. She has published several papers in international peer-reviewed journals and conferences. Moreover, she has participated in the research projects titled: ¨Water Resources Management of coastal Agricultural Environments-Resilience of climate change impacts (Agroclima)¨and ¨Investigation of the impact of the climate change on river deltas. Case study: the delta of river Pinios (Thessaly, Greece) ¨.