

## Acquisition of key practical skills in the field of environmental engineering

Hrvoje Meaški

Faculty of Geotechnical Engineering, University of Zagreb, Croatia  
e-mail: [hrvoje.measki@gfv.unizg.hr](mailto:hrvoje.measki@gfv.unizg.hr)

Nikola Kranjčić\*

Faculty of Geotechnical Engineering, University of Zagreb, Croatia  
e-mail: [nikola.kranjcic@gfv.unizg.hr](mailto:nikola.kranjcic@gfv.unizg.hr)

Sanja Kovač

Faculty of Geotechnical Engineering, University of Zagreb, Croatia  
e-mail: [sanja.kovac@gfv.unizg.hr](mailto:sanja.kovac@gfv.unizg.hr)

Ranko Biondić

Faculty of Geotechnical Engineering, University of Zagreb, Croatia  
e-mail: [ranko.biondic@gfv.unizg.hr](mailto:ranko.biondic@gfv.unizg.hr)

Jelena Loborec

Faculty of Geotechnical Engineering, University of Zagreb, Croatia  
e-mail: [jelena.loborec@gfv.unizg.hr](mailto:jelena.loborec@gfv.unizg.hr)

Dragana Dogančić

Faculty of Geotechnical Engineering, University of Zagreb, Croatia  
e-mail: [ddogan@gfv.unizg.hr](mailto:ddogan@gfv.unizg.hr)

Ana Rosan

Faculty of Geotechnical Engineering, University of Zagreb, Croatia  
e-mail: [ana.rosan@gfv.unizg.hr](mailto:ana.rosan@gfv.unizg.hr)

## **ABSTRACT**

In the year 2012 Faculty of Geotechnical Engineering introduced a new university program – Environmental Engineering. Despite the good recognition and establishment of this profession in Europe and the world, when entering the labour market in Croatia, graduate students encountered several problems, most of them connected too low recognition of the occupation. To gain better visibility of the program and enhance competences of students a project was designed and implemented. The purpose of the project is to develop key practical skills through the development, improvement, and implementation of professional practice in the undergraduate and graduate study program of Environmental Engineering at the Faculty of Geotechnical Engineering.

A network of professional partnerships with institutions and the private sector has been established to enable students to apply the knowledge acquired during higher education in practice and to expand the theoretical knowledge by working in the real sector. This experience aims to facilitate the later employment of students. Also, goal is to establish a Career Development Centre and strengthen social cohesion in Croatia and therefore increase the number of students in STEM area.

Main users of this project are divided into three categories, teaching and non-teaching staff; undergraduate and graduate students; private and public sector. Teaching and non-teaching staff use this project to implement new systems of professional practice, to participate in additional competences workshops and to improve professional development programs and workshops for the education of professional practice mentors. Private and public sector will also benefit from outcomes of the project since the new generations of engineers will be trained and included in new internship programs over the years in the field of Environmental Engineering.

The transfer of knowledge and experience within the proposed project addresses all target groups with long-term positive effects on end users. This paper aims to present novel methods of professional practice as well presentation of project outcomes.

## **KEYWORDS**

Professional practice; Environmental Engineering, Undergraduate study, Graduate study, Faculty of Geotechnical Engineering

## **INTRODUCTION**

Enrolling professional practice as key part of undergraduate and graduate study programmes has become indispensable part at different faculties at different universities. Faculties and universities are more aware of key benefits that professional practice offers to their students. To support that claim, search on Google Scholar database was performed on 17<sup>th</sup> January 2022. Keyword “professional practice” gives over 4 million results and over 1.5 million in last 5 years. Faculty of Geotechnical Engineering, University of Zagreb since 2012 teaches undergraduate study, since 2015 graduate study and since 2019 doctoral study on Environmental Engineering. Since 2020 Faculty of Geotechnical Engineering enables students to enrol in course Professional practice at undergraduate and graduate level. Due to everything mentioned, this paper will be structured as it follows: after this short introduction, literature review is presented, then status of professional practice in Croatia and status of professional practice at Faculty of Geotechnical Engineering. Conclusion and Literature are at the end of paper.

## **LITERATURE REVIEW**

Professional practice benefits are highly recognized in scientific and professional community. Menges (1975) [1] assessed readiness for professional practice. He provided four key questions that should be discussed before professional practice. These questions indicated readiness to attend professional practice, desired characteristics of the person attending professional practice and how and by whom are they measured. [1] concluded that effective practice should be derived from analysis of the responsibilities and obligations of the professionals. Dall’Alba (2004) [2] performs investigations before and after an educational program. Her focus was on professional practice in medical sector, and she offers different approach to traditional measures of knowledge and skills for investigating the professional skills obtained during professional education programmes. Green (2009) [3] focuses on concept of professional practice with two main concerns. First is how to understand and research practice to generate rich account of practice and second is how to address what, why and how is complex professional practice implemented. Environmental engineering is a engineering discipline that unites broad scientific topics like ecology, biology, geology, chemistry, hydraulics (and similar) to provide solutions in order to protect and improve quality of the environment and the health of living beings [4]. Butkus and Kelly (2004) [5] investigated the approach for integrating professional practice into undergraduate environmental engineering design project. In their project students communicated with a client and craftsmen during the project. This way of communication was novel to students and based on results, students appear to have grown in skill from the iterative process. Authors [6–9] agree on benefits of thinking out of the box when it comes to higher education and authors realize benefits of professional practice which reflects in higher employment of students.

## PROFESSIONAL PRACTICE AT FACULTY OF GEOTECHNICAL ENGINEERING

As mentioned in introduction, at Faculty of Geotechnical Engineering study of Environmental Engineering is taught. For better understanding of professional practice in Croatia in Table 1,2 and 3 an overview of professional practice is provided. Data presented in table 1,2 and 3 is modified from [10] and the data available is produced based on input from different faculties and universities. All data is from 2015 so today the data can be slightly changed. Table 1 presents professional practice representation according to the levels of study program.

Table 1. Professional practice representation according to the levels of study program

| Study program level                   | Number of programs | Professional practice / program representation (%) | Number of students | Professional practice / number of students (%) |
|---------------------------------------|--------------------|--|--------------------|--|
| Undergraduate                         | 319                | 42   | 63 506             | 42   |
| Graduate                              | 366                | 57   | 30 831             | 52   |
| Integrated undergraduate and graduate | 354                | 85   | 23 146             | 66   |

Table 2. Professional practice representation according to scientific areas

| Scientific area           | Number of programs | Professional practice / program representation (%) | Number of students | Professional practice / number of students (%) |
|---------------------------|--------------------|--|--------------------|--|
| Natural                   | 76                 | 54   | 6682               | 45   |
| Technical                 | 105                | 50   | 25 624             | 52   |
| Biomedicine and health    | 36                 | 86   | 8673               | 96   |
| Biotechnical              | 56                 | 79   | 6491               | 83   |
| Social                    | 153                | 49   | 46 721             | 37   |
| Humanistic                | 202                | 36   | 18 477             | 36   |
| Art                       | 90                 | 67   | 2017               | 59   |
| Interdisciplinary science | 18                 | 61   | 2573               | 64   |

Table 3. Professional practice as separate course/mandatory course based on study level program

| Study program level                   | Number of students | % Separate course | % Mandatory courses | % Provided ECTS points |
|---------------------------------------|--------------------|-------------------|---------------------|------------------------|
| Undergraduate                         | 57 088             | 67                | 78                  | 90                     |
| Graduate                              | 26 519             | 56                | 74                  | 96                     |
| Integrated undergraduate and graduate | 15 271             | 75                | 83                  | 92                     |

As tables 1, 2 and 3 indicate, benefits of professional practice as a mandatory course in Croatia are highly recognized and are represented throughout different sciences and scientific areas. Since the beginning of Environmental Engineering study program in 2012, Professional practice is mandatory for all graduate students. However, in 2020 fully funded project was established to enhance and improve student practice and enhance employment of graduate students.

The aim of the project is to acquire key knowledge and competencies of students during their studies through the development of professional practice in the field of environmental engineering, which includes improving the competencies of teaching and non-teaching staff of higher education institutions and developing partnerships with employers. The result of the project is a developed institutional system of professional practice with the corresponding online system of planning and monitoring its quality and a positive impact on increasing employability in the field of environmental protection, with emphasis on the application of innovative solutions in the economy. The purpose of the project is to develop key practical skills through the development, improvement, and implementation of professional practice in the undergraduate and graduate study program Environmental Engineering at the Faculty of Geotechnical Engineering. The goal is to facilitate the employment of students through the development of partnerships with institutions that will enable them to apply acquired theoretical knowledge in practice, to establish a Centre for Career Development and to strengthen social cohesion in Croatia and to increase the number of students in STEM. Through various forms of cooperation with external stakeholders, the teaching process will be improved so that employers also participate in teaching through professional practice. The project enables the strengthening of the capacity of the Applicant's institution through networking with partners and employers in the labour market. Special attention will be paid to the long-term continuous implementation of the program, monitoring the needs of target groups and end users and the needs at the level of the applicant and partner institutions.

In addition to the planned work on new projects and the application of the obtained results in real systems, continuous training of teaching and non-teaching staff is planned so that the programs contain relevant up-to-date knowledge. Institutional sustainability is guaranteed by the long-term experience of the Applicant in the implementation of the Environmental Engineering as a relevant profession in the organizational and educational structure of the University of Zagreb, but also in the legal regulations of the Republic of Croatia. The development of learning outcomes of professional practice and general improvement of professional practice in the study programs of Environmental Engineering at the Faculty of Geotechnical Engineering will significantly increase the output competencies of graduates, which will further connect VU with employers in the labour market.

During project several outcomes are already achieved. There was workshop for professional development of teaching and non-teaching staff entitled "Pedagogical aspects of online teaching and application of MS Teams and other MS tools". The Career Development Center was established. Also, three Career Days in Environmental Engineering were organized where students and companies presented their work to each other. Due to pandemic reasons most of the workshops were held online. Some pictures and screenshots are presented in Figure 1,2 and 3.



Figure 1. Education in the field of occupational safety

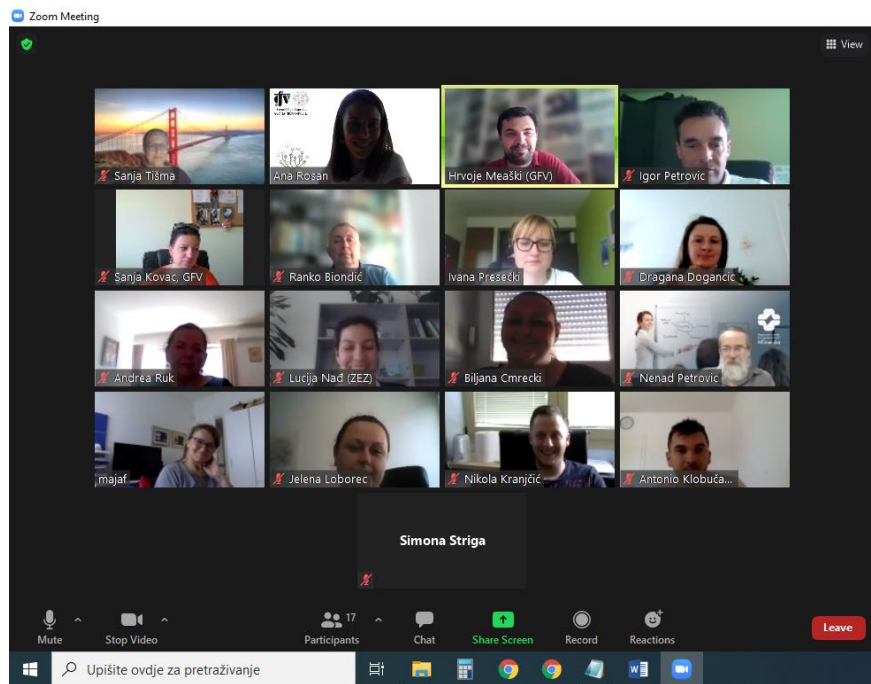


Figure 2. Workshop “Pedagogical aspect of online teaching and application of MS Teams and other MS tools”

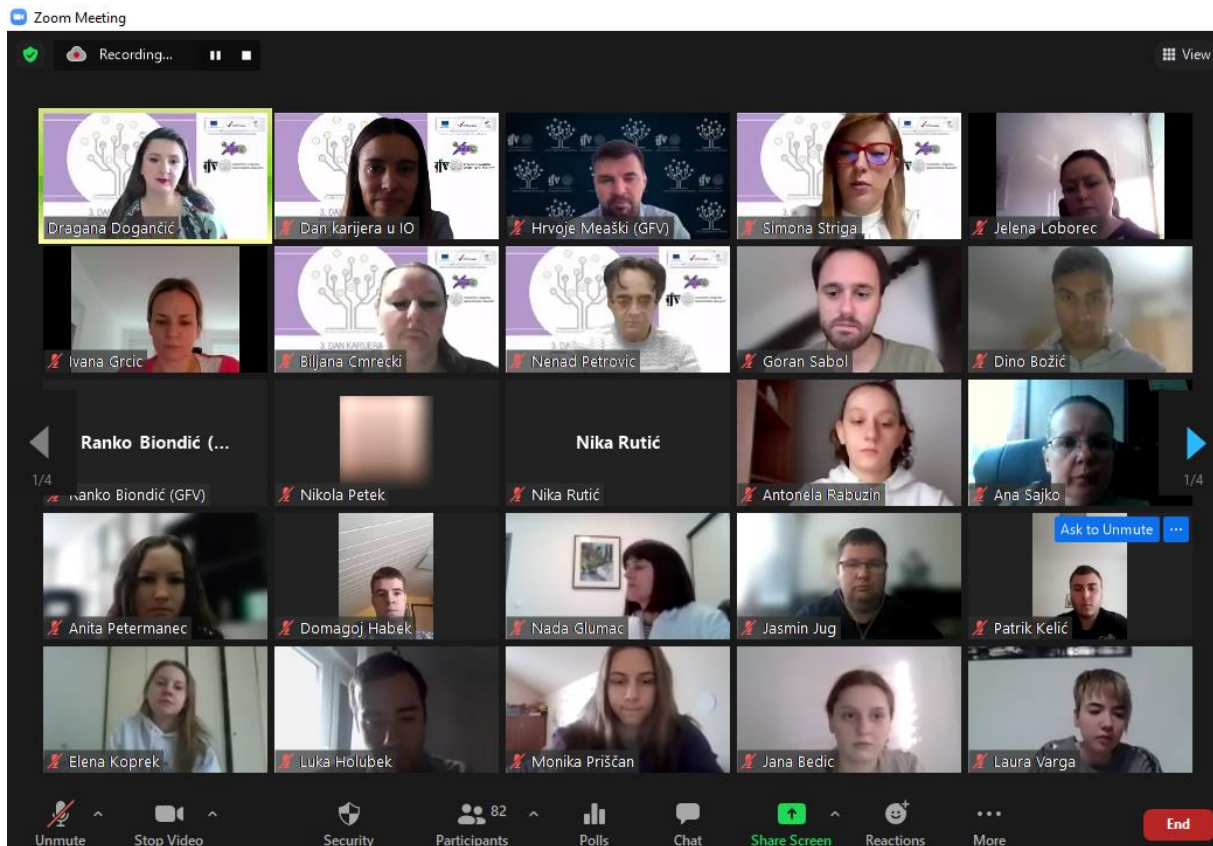


Figure 3. Third career day in Environmental Engineering

## CONCLUSION

The educational process and the transfer of new knowledge from science to education and textbooks sometimes takes several years. Through internships in companies and organizations, students encounter new, up-to-date, and interesting knowledge and situations, and at the same time get a much clearer view of the direction of development of knowledge and technology. Other than that, professional practice provides students with an insight into the situation on the labour market and the conditions prevailing in the real sector. Practice, in addition to the above, gives meaning to what has been learned, which is sometimes difficult for students to see during their time spent studying.

## ACKNOWLEDGMENT

Project: “*Acquisition of key practical skills in the field of environmental engineering*” is fully funded by European Social Funds with 527,858.06 €.

## REFERENCES

1. Menges, R.J. Assessing Readiness for Professional Practice. *Rev. Educ. Res.* **1975**, *45*, 173–207, doi:10.3102/00346543045002173.
2. Dall’Alba, G. Understanding professional practice: Investigations before and after an educational programme. *Stud. High. Educ.* **2004**, *29*, 679–692, doi:10.1080/0307507042000287195.
3. Green, B. Introduction: Understanding and Researching Professional Practice. In; Brill: Leiden, The Netherlands, 2009; pp. 1–18 ISBN 9789087907327.
4. Aitken, M.D.; Novak, J.T.; Characklis, G.W.; Jones, K.L.; Vikesland, P.J. The Evolution of Environmental Engineering as a Professional Discipline. *Environ. Eng. Sci.* **2004**, *21*, 117–123, doi:10.1089/109287504773087291.
5. Butkus, M.A.; Kelley, M.B. Approach for integrating professional practice issues into undergraduate environmental engineering design projects. *J. Prof. Issues Eng. Educ. Pract.* **2004**, *130*, 166–172, doi:10.1061/(ASCE)1052-3928(2004)130:3(166).
6. Magnell, M.; Geschwind, L. A seamless blend of research and professional practice: dual coupling in engineering education. *High. Educ. Res. Dev.* **2019**, *38*, 807–818, doi:10.1080/07294360.2019.1581141.
7. Harwood, J. Engineering Education between Science and Practice: Rethinking the Historiography. *Hist. Technol.* **2006**, *22*, 53–79.
8. Speight, S.; Lackovic, N.; Cooker, L. The Contested Curriculum: Academic learning and employability in higher education. *Tert. Educ. Manag.* **2013**, *19*, 112–126, doi:10.1080/13583883.2012.756058.
9. Robertson, J. Beyond the ‘research/teaching nexus’: exploring the complexity of academic experience. *Stud. High. Educ.* **2007**, *32*, 541–556, doi:10.1080/03075070701476043.
10. Education, M. of S. and *Studija o stručnoj praksi u visokom obrazovanju*; 2017;