

Support for Elite Engineering Education: Student Creative Workshops

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The paper considers elite engineering education provided at the higher education institution of architecture and civil engineering. The elements of the educational process have been described. The regional employers are supposed to play an important role in setting learning outcomes, therefore, the questionnaires filled out by the representatives of civil engineering enterprises have been analyzed. The paper also describes the results of the poll held among the institution graduates. The authors of the paper have analyzed the poll data with due regard to the fact whether the respondent participated in the student creative workshop for designing and developing e-learning resources on geodetics engineering at Novosibirsk State University of Architecture and Civil Engineering (Sibstrin). The authors suggest that student professional creative workshops play a significant part in providing elite engineering education at the higher education institution of architecture and civil engineering.

Key words: engineering training, architecture and civil engineering education, student workshops, student projects, e-learning resources.

Technology-intensive manufacturing has lately led to the demand for “elite” engineers experienced in cutting-edge research and technologies, in other words, “the leaders in engineering”, who are capable of systemic, creative, and critical thinking and have “the skills necessary to make a team and manage a project” [1, p. 188].

There are different approaches to providing elite engineering education within the framework of modern education system [2]. The leading national and international higher education institutions design and implement original elite educational programmes [1]. For example, in compliance with the Regulations on elite education at Rostov State University of Civil Engineering to be found on the official website, the aim of the elite engineering education is to train highly-qualified professionals possessing fundamental knowledge, profound foreign language

skills, with additional education in the spheres of economics and IT, who can work in team, conduct research, perform entrepreneurial and innovative activities under the changing conditions.

In article [1] the authors analyze the notion of elite technical education in detail based on the system of engineering education developed at Tomsk Polytechnic University (TPU). The basic attributes of elite engineering education provided at TPU are fundamental education with profound knowledge of natural sciences, mathematics, economics, and foreign languages, professionalism in intense research, creative, and project activities performed by the students, innovations based on student’s critical thinking and initiative, entrepreneurial and leadership skills [1, p. 201-202].

The system of elite architecture and civil engineering education is a pilot project implemented within the framework of

complex development programme [3] by Novosibirsk State University of Architecture and Civil Engineering (Sibstrin). There will be particular student groups trained in compliance with demands specified by the employers, for example, a constructing engineer with profound knowledge of economics or a geodesist trained for road construction.

Therefore, elite engineering education can include:

- intensive engineering training courses starting from the first year of study with an emphasis on fundamental and professional disciplines;
- educational programme designed in compliance with two specializations or profiles;
- team work to perform project and innovative activities simulating production process;
- intensive foreign language study (as a rule, English as it is the language of international business communication);
- additional training in the spheres of IT, economics, and entrepreneurship.

It is impossible to train a professional in demand for civil engineering industry without continuous monitoring of employers’ needs. According to the results of deep analysis of Russian engineering education modernization [2], to develop elite engineering education, “it is necessary for the governmental and regional education programmes to be balanced” [2, p. 18].

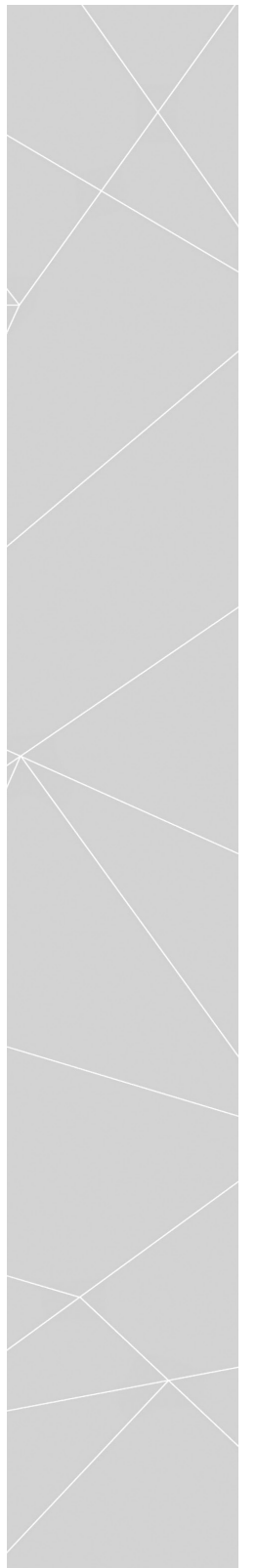
There are data of 15 interviews conducted over the period of January-March, 2015 with the heads of civil engineering enterprises located in Novosibirsk and Novosibirsk Oblast. There were also eight other interviews conducted via e-mail and video communication with the representatives of civil engineering enterprises in Tomsk (two interviews), Moscow (two interviews), Berdsk (three interviews), Sochi (one interview). The limitations in student training identified as a result of the interviews analysis are as follows:

- incapacity of working with a large number of engineering documents, which may involve IC technologies application;
- lack of experience in submitting documents in electronic version (reports, verification letters, etc.) to the organizations providing for municipal and federal control;
- poor skills of analyzing the structure of databases and interrelation between different documents;
- lack of negotiating and business writing skills, as well as business communication skills in general, including those for international communication;
- inability to present work outcomes and successfully defend professional projects.

Each of the above-mentioned limitations can be overcome through the application of the appropriate pedagogical techniques. For example, to improve the communicative skills of civil engineering students [4], business games and project work can be used. In case of elite engineering education there should be a complex of measures to prevent all the limitations throughout fundamental professional training.

To train elite engineering staff specialized in two profiles and capable of solving multiple tasks, it is important to use the educational potential of general professional disciplines. As for NSUACE (Sibstrin), one of the general professional disciplines taught for all civil engineering students is geodesics engineering followed by internship. Therefore, in terms of pedagogy, geodesics engineering is of great potential to improve elite engineering education.

Due to the rapid pace of technology advancement, educational and methodological support for engineering students, as a rule, lag behind and fail to meet the ever-changing requirements. Therefore, the adequate form for educational resource development is e-learning resources. Development of robust e-learning



resources is labour-consuming, however, the use of e-learning resources in the education is time-saving for both students and teachers and allows releasing hours for new educational purposes, such as elite education.

To simulate work with high-tech geodetic equipment, the Department of Geodesics Engineering, NSUACE (Sibstrin), steps up efforts to develop various e-learning resources. To increase the number of developed resources, the student creative workshop "Geo-S" was established, which has been efficiently working over the past ten years. In 2014, NSUACE (Sibstrin) summarized interim outcomes of the pedagogic research on e-learning resource conducted together with Armavir State Pedagogical University to improve the quality of civil engineering education. The research revealed high efficiency of e-learning resources developed by students in cooperation with teachers at the student creative workshops [5].

The e-learning resources developed at "Geo-S" are "Electronic Notes on Geodesics Engineering", "Electronic Geodesic Glossary", animated educational resources "Setting out Levels at Pit Bottom", "Measuring Line Length", "Setting out Design Level", etc. The resources are available at geo-s.sibstrin.ru and some of them are in English.

Students involved in the creative workshop participate in exhibitions and conferences becoming laureates and winners. Recently we have had an opportunity to compare careers of alumni who, when students, participated in the creative workshop "Geo-S" with those who did not. We developed a questionnaire and held a survey, which involved 42 respondents, 27 of whom live and work in Novosibirsk, 9 – in Novosibirsk Oblast, 6 – in other areas.

The questions were as follows:

- Do you work in the sphere you have a university degree in?
- What was the position you occupied at first and what position do you

occupy now (please, specify how many years have passed since you graduated the university)?

- When at university, did you participate in any student unions and activities (workshops, conferences, etc.)? If yes, please, specify what you did.
- Were the skills and abilities developed through the above-mentioned student activities contributive to your career and professional activities?
- Are you going to take any continuing professional development course?

Let us summarize the answers. As for the former participants of the "Geo-S" workshop, 100% of respondents answered "Yes" for the first question (note: one of the answers was "including site engineer"). Among those who did not use to participate in the student workshop, 68% do work in the sphere they specialize in, 7% are on decree or maternity leave, 15% completely changed their specialty, and 10% work in the sphere related to their specialty (for example, he or she has got a degree in Industrial and Civil Engineering and works as a head of the laboratory for construction material production; or has a degree in Economics and works as a cost engineer at a civil engineering enterprise; etc.).

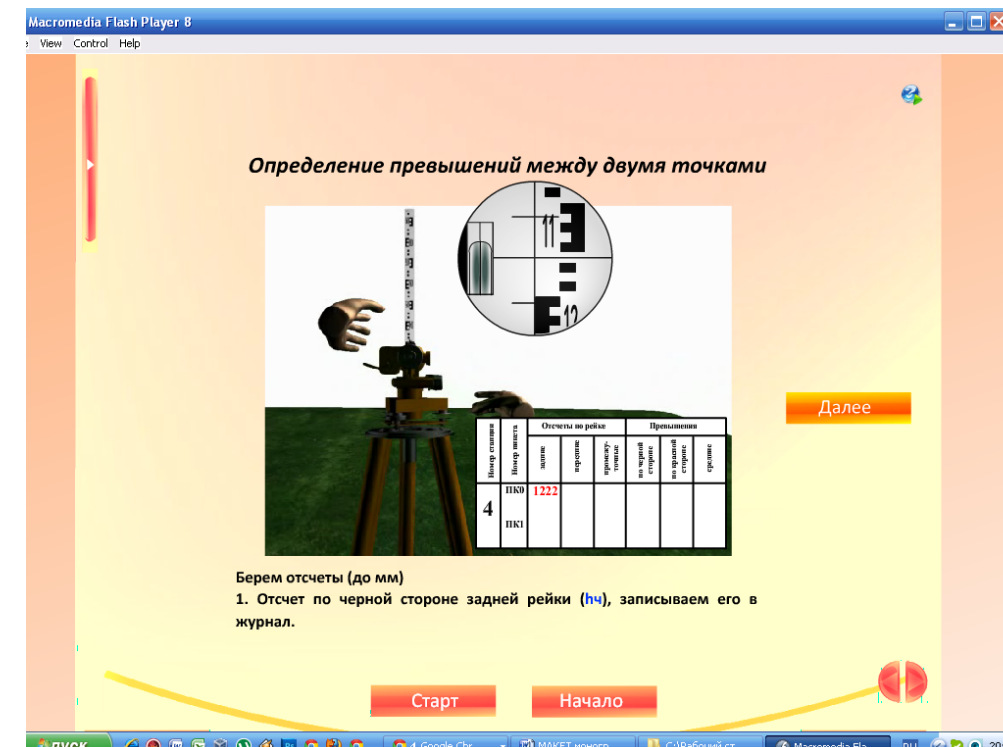
As for the second question, the former participants of the "Geo-S" workshop answered in the following ways: "master hand, site engineer in four years", "software programmer, entrepreneur in two years", "design engineer, lead professional in five years", "architectural assistant, project architect in three years", "software programmer, head of IT department in four years", "section supervisor, head of production department in five years". The answers of those who did not use to participate in the student workshop were as follows: "master hand, site engineer in five years" (12% of respondents), "master hand, the same position after five years of work", "master hand, senior master hand in five years".

Answering the third question, the former participants of the "Geo-S"

Fig. 1. E-learning resources developed at student creative workshop:
a) "Setting out levels at Pit Bottom"



b) "Engineering Levelling: Filing Order"



workshop mentioned the roles of coordinator, software programmer, project web-designer of e-learning resources and the activities as follows: creating animation illustrating work with geodetic equipment, flash programming for geodetic activities, animating equipment in 3D Max, recording audio for animation and video recording, developing tests for Geodesic Glossary, designing Geodesy website, and other activities connected with e-learning resource development and implementation into professional education. Those who did not use to participate in the student workshop, as a rule, answered "No" or mentioned educational activities only.

Answering question four, more than half of respondents who used to participate in "Geo-S" workshop (55%) emphasized a significant role of the workshop for further career development, 20% said that the workshop played a minor part, 25% said that the workshop did play a certain role, 0% defined the workshop activities as irrelevant. The other respondents did not give any full answers illustrating the effects of participating in university activities on further career development. The former participants of "Geo-S" workshop also mentioned that designing e-learning resources for geodetics engineering allowed them to acquire knowledge of IC-technologies applicable for their professional activities, improve business communication skills, and develop hand-on projects, which is particularly important for further employment even without real work experience.

As for question five, the majority of "Geo-S" workshop participants (72%) said that they would take a continuous professional development course within the next three years, 21% would like to take a course but after a certain event (for instance, project completion), 6% would take a continuous professional development course within the next five years, 1% could not say precisely, 0% would not like to take a course. The alumni who did

not participate in the student workshop but worked in their degree field gave the following answers: 95% would take a continuous professional development course if the supervisor orders, 5% would like to acquire another specialty with higher salary. It is noteworthy that in both cases extrinsic motivation for professional development predominates over the inner one.

It should be noted that the activities performed at "Geo-S" workshop are supposed to fill education gaps identified by the employers in the course of the survey. For example, the workshop activities performed to improve business communication skills are expressing one's ideas using professional terminology; project discussion and group decision making; preparing supporting documentation to present or revise a project; keeping project record; presenting a project for potential customer; business communication at different levels; explaining the issue or task briefly; delegating the subordinate to present the work results for the supervisor [6, p. 194].

"Geo-S" workshop implements the components of elite engineering education: acquiring knowledge of geodetic equipment and technologies for further numerical modelling, developing and defending projects delegating responsibilities and generating efficient communication at all levels, designing e-learning resources with video- and audio-recording using IT, including those available in English.

Today, employees should meet stiff professional requirements, however, all the alumni who as students participated in "Geo-S" creative workshop are currently employed. This fact leads us to the conclusion that student creative workshop of fundamental discipline profile can provide the necessary support to efficiently implement the component of elite engineering education at civil engineering institutions and universities.

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