The Theory and Practice of Teaching Construction Sciences to Foreign Students

T Bilyushova¹, M Belokon¹
¹Far Eastern University (FEFU), 8, Sukhanov St., Vladivostok, 690950, Russia

E-mail: bilyushova.tp@dvfu.ru, belokon.ma@dvfu.ru

Abstract. This article deals with the problems of engineering thinking formation among foreign students and the proposed solutions of these problems based on the study of years-long cooperation between the universities of Russia and China and the practices of working with foreign students in various universities in the country.

We focus on the problem of interaction of Russian-born teachers and foreign (Chinese) students aimed at the professional training of construction specialists. This article reviews the teaching practices employed in training foreign students, Chinese in particular, in such basic construction disciplines as Construction Mechanics, Bases of Architecture and Building Structures, General Architecture. We analyze the works carried out within joint Russian-Chinese programs, by FEFU and HUST (PRC) and the preparedness of foreign students chasing engineering degrees to master technical disciplines. The article analyzes possible training methods that may improve the acquisition of professional knowledge taking into account the features of engineering thinking formation among foreign students and the professional lingo of each of the covered disciplines. We also present a conventional classification of disciplines based on the features of their professional lexicon.

1. Introduction

Higher education combines extensive character building, general education, and professional training. The key goal of education in a technical university is the development of professional thinking.

The joint education program for the Chinese students run by Heilongjiang University of Science and Technology (HUST), Harbin, China, and the Far Eastern Federal University (FEFU), Vladivostok, stipulates studying the key disciplines for degree class 08.03.01 Construction, specializing in Industrial and Housing Construction at the Engineering School of FEFU. Upon graduation, both Chinese and Russian students receive their bachelor’s diplomas entitling them to continue education and undertaking a master’s degree.

Throughout the training, students have problems with science subjects and professional disciplines that are primarily associated with not knowing the professional terms and the features of the education process in Russian universities like course works, projects, and the large amounts of independent work.

This article deals with particular problems associated with mastering specific disciplines. However, the complexity of the entire education process depends on generic adaptation problems foreign students have when they start living in another country and studying at the university.
2. Relevance
The State Program of the Russian Federation for the Development of Education in 2013-2020 requires increasing the number of foreign students in Russian universities from 2.3% in 2011 to 10% in 2020 [1]. The number of foreign students is a key indicator of a university's success and international recognition. New accreditation indicators for Russian universities include the number of foreign students across various attendance modes and the number of study programs taught in foreign languages.

The largest number of foreign students pursuing technical degrees study at the Engineering School of the Far Eastern Federal University. These are Chinese students specializing in Construction (degree code 08.03.01). According to the Chinese Center for Strategic Research, the citizens of the PRC will dominate the world education market for several decades to come [2]. The number of Chinese students specializing in Construction (08.03.01) per year of study is between 60 and 240 people. Over twenty years of the implementation of the joint program of Heilongjiang University of Science and Technology (HUST, Harbin, China) and the Far Eastern Federal University (FEFU) resulted in the accumulation of huge experience of working with Chinese students.

3. Research significance
This article analyzes the problems faced by foreign students when they master professional subjects. These students have somewhat smaller knowledge of the Russian language, problems with simultaneous engineering thinking formation, and the acquisition of professional lingo and professional subjects, e.g. the Bases of Architecture and Building Structures, General Architecture, and Construction Mechanics.

Even though we review particular problems associated with mastering specific disciplines. However, the complexity of the entire education process depends on generic adaptation problems foreign students have when they start living in another country and studying at the university. Their adaptation depends on students’ age, social, psychological, physiological, national, and other parameters. This problem receives great attention from Russian and foreign academics and educators [2]. The principles of cooperative pedagogy in contemporary European (and Russian) education systems are unclear to Chinese students. The active interaction of teachers and students during lessons is almost impossible. Usually, Chinese students acquire knowledge by just memorizing the material. Besides, they are not eager to express their feelings and emotions. Research results show that students gradually accept and understand the principles of Russian pedagogy, which largely depends on the teacher [3].

The goals and objectives of education for Russian and Chinese students are normally the same. However, problem-solving and goal achievement depend on the efforts, talents, and experience of each teacher. We use the results of the analysis to develop lesson plan options for professional subjects so that the students could better understand the content of courses and were actively involved in the study process.

4. Statement of problem
To achieve this goal, it is necessary to:
- structurize the accumulated material on a given subject;
- analyze the teaching methods for foreign students;
- develop teaching techniques for specific subjects taking into consideration the features identified during analysis.

5. Theory
The experience of teaching professional subjects shows that the main differences between teaching Russian and foreign students are to be found in *the content of the course*. It can be produced as texts, images, as well as formulae, and charts.
The structure of the pedagogic (teaching) process according to S. I. Samygin can be used to determine the algorithms of teachers’ interactions with students, especially the foreign ones. Teachers’ activities are determined by the goal of the discipline covered, the content of works, as well as means and forms of study material presentation and acquisition. Thus, the informational support of teachers is crucial because they must know and understand their students’ needs. As a rule, experienced educators can evaluate or characterize their students after one or two lectures. The Chinese traditions of educational interactions are based on the hierarchic principle (teachers govern the students), saving students face, emotional restraint, students’ independence [4].

The Chinese students studying in FEFU specialize in Construction (degree code 08.03.01) and they have to cover the subjects within the respective syllabus. The study process participants create the portion of the syllabus that provides the graduates with the knowledge necessary in their future jobs. These subjects can be divided into three groups: calculations where the texts are complemented by extensive calculations, texts that mostly contain reading materials, and images represented by rough drafts and their descriptions (Table 1).

Table 1. Conventional subject groups.

| No. | Year | Number of subjects covered during the school year |
|-----|------|--------------------------------------------------|
|     |      | texts | calculations | images | calculations and images | texts and images |
| 1.  | Year 1 | 7     | 6            | 2     | 9                      |
| 2.  | Year 2 | 8     | 2            |        | 2                      |
| 3.  | Year 3 | 9     | 1            | 4     | 2                      |
| 4.  | Year 4 | 5     |              | 6     | 1                      |
| 5.  | Total  | 29    | 9            | 12    | 12                     |

The calculation subjects include Construction Mechanics, Metal Structures, Reinforced Concrete, and Masonry Structures, Foundation Engineering, and other disciplines that mostly consist of formulae for structural calculations, design diagrams, and charts.

The text subjects include Work Processes in Construction, Construction Emergencies, Construction Planning, Organization, and Management, as well as some others. Their contents mostly comprise texts.

The image subjects include Descriptive Geometry and Engineering Drawing, General Architecture, Bases of Architecture and Building Structures, whose contents comprise building and structure blueprints and their descriptions, as well as small amounts of mathematical calculations, apart from texts.

For instance, Construction Mechanics, as a calculation subject, has a lot of formulae, mathematical derivations, diagrams, and charts apart from the texts. If students have a professional dictionary with specific words and notations for this discipline, they understand the study material quite quickly. Besides, prior to this calculation subject, the students have to master such basic disciplines and Theoretical Mechanics and Material Resistance. When Chinese students come to study in Russia, they usually have a good understanding of mathematics from their schools. They can count quickly and correctly and know how to use mathematical methods. The imperfect command of the Russian language, however, complicated the acquisition of the theoretical component of the subject.

It is recommended that in this subject the majority of practical sessions should be dedicated to calculations, and the tests and exams must be in the form of problem solution works. Therefore, within the Construction Mechanics course, students are asked to independently carry out a course work based on their lecture notes and specialized dictionaries.
Work Processes in Construction as a text subject is based on verbal instruction. It features a few formulae and there are no preliminary subjects for this discipline. Thus, the students must understand the contents of lectures well and efficiently use study materials like textbooks, notes, and other sources. During the practical sessions within such disciplines, there must be time for student polls on the content of lectures delivered to identify the acquired knowledge and improve them through analyzing visual aids, such as posters, diagrams, and educational videos.

The Bases of Architecture and Building Structures, as well as General Architecture, belong to general professional disciplines and thus form the basis for all other specialized subjects. Within the Construction syllabus, they essentially begin the professional training of students and consolidate the knowledge obtained by students in other subjects, both previous and simultaneous.

The program of the Bases of Architecture and Building Structures and the General Architecture courses traditionally consists of lectures, practical sessions, and two coursework projects. Foreign students, Chinese in particular, have to cover the subjects within the same time frame as the Russian students who have a better understanding of some professional terms. The level of the Russian language of the majority of the Chinese students does not allow them to understand well and analyze the information at the early stages of engineering disciplines. Our years-long working experience shows that 30% of foreign students who speak and understand Russian quite well, excluding professional lingo. Another third of the students have a limited command of the Russian language but they are trying to improve. The last third of the students do not know or understand the language for various reasons, so it is unlikely that they will master the professional lingo within the program terms.

6. Applicability

Up until recently, lectures were accompanied by the full representation of the content on the blackboard (chalk talks). This method requires a lot more time than the simple presentation of the material to Russian students and foreigners knowing the Russian language. Normally, first lectures, practical sessions, and course work project sessions are among the most complicated lessons for students. Foreign students are simply not ready to comprehend the material in Russian. The lesson plans for foreign students significantly differ from those for Russian students, while the syllabus remains the same. Teachers’ experience, talents, and skills are very important and teaching aids like models, posters, blueprints, presentations, and the tutorial stock are very useful in such situations.

Contemporary lecturing methods do not require extra time for drawing anything on black- or whiteboards because it is possible to just show the relevant images. The teachers need to talk and show visual aids, and students need to understand and record the material somehow. Nowadays, most students use their phones to save any information. This requires independent work skills to process the material obtained during lectures and, most importantly, the command of the professional lingo. Students rely on translating this information, again, using their phones but their translation apps usually do not recognize professional terms.

The next lecture scenario for special subjects stipulates that all and almost all materials are presented in the presentation. The teacher delivers a talk and visualizes examples on the black- or whiteboard. Thus, we have two information transmission options. The data on the screen and the black or whiteboards are photographed by students. This information may get lost. Those of the students who know Russian, however, mostly rely on copying the information by hand. In this case, they have their notes which can help during tests, practical sessions, and possibly in coursework projects when they need to solve some problems. When preparing for lectures, teachers must consider the level of Russian language command among foreign students and present the material so that it would be accessible and clear for students with varying knowledge of professional lingo. The education result analysis shows that the volume of study material acquired per time unit drops by 40-50%, while the study process is still governed by the Russian student-oriented syllabus.

The insufficient command of the Russian language or its complete absence prevents students from taking notes, using professional terms properly, filtering the unnecessary, and recording only the
essential information. When mastering an ‘image’ subject, it is important to be prepared to acquire the material using graphic representation skills, proper spatial thinking, and graphic software.

Learning for an engineering degree, especially in construction, is impossible without coursework projects. General Architecture alone stipulates two coursework projects. The practical activity aimed at preparing a design documentation package for buildings of any type requires huge efforts from both students and teachers. It also requires significant amounts of individual work from them. Consulting foreign students takes a lot more time. One of the causes of this is the specific features of professional lingo: foreign students do not know it sufficiently well despite the efforts of engineering teachers. Acquisition and understanding the lingo of each of the engineering subjects requires extra time. Apart from professional training, teachers have to help their students master the Russian language, both its professional and everyday aspects that are used in engineering education.

7. Conclusions
1. To create a proper psychological climate in groups of foreign students and the year in general, it is necessary to consider the restoration of academic curatorship.
2. Students must be accommodated in the same building or on the same floor (floors) to improve their psychological comfort and promote collaboration.
3. Class schedule should be created taking into consideration the study mode of each of the professional subjects (text, images, calculations). The technical disciplines set on the same day must have as few differences in study mode and content as possible. This can help reduce stress levels from the changing of study modes and professional lingos from class to class.
4. With a view to the abovesaid, it is necessary to change the methods of teaching Russian to foreign students specializing in engineering. Russian language and engineering subject teachers should cooperate on the study process management level, rather than on a personal level.
5. It is necessary to conduct education-and-methodology seminars for all teachers working with foreign students and invite colleagues from Russian and foreign universities to them.
6. It is also necessary to develop learning and teaching aids for foreign students. This, however, must not eliminate the possibility of using methodologies developed for Russian students.
7. The wider involvement of foreign engineering students with conferences, exhibitions, and competitions of a various level will result in greater time inputs, which creates extra loads on teachers and the readjustment of afternoon tasks.
8. Foreign student training must be accounted for when calculating the teaching loads.

8. References
[1] The concept of long-term socio-economic development of the Russian Federation for the period up to 2020: approved By order of the Government of the Russian Federation of November 17, 2008 No 1662-r Collected Legislation of the Russian Federation 2008 No 47 Art.5489 http://www.consultant.ru/document/cons_doc_LAW_82134/
[2] Center for Strategic Studies of China. National resource center for support of Russian-Chinese educational cooperation Consolidated analytical review (2009) www.chinacenter.ru
[3] Rakhimov T R 2010 Features of the organization of training for foreign students in a Russian university and the direction of its development Language and culture 4(12) pp 123-136
[4] Balykhina T M, Zhao Yujiang 2010 From methodology to ethnomethodology Teaching the Chinese to the Russian language: problems and ways to overcome them (M. : RUDN) 344 p
[5] Tan Ya 2017 Ethnopsychological features of teaching Chinese students Young scientist 17 pp 288-291 URL https://moluch.ru/archive/151/42833/ (date of access: 04/04/2020)
[6] Kuznetsova T E, Perfilova I L, Sokolova T V, Perfilova S V, Yumasheva L V 2010 Features of teaching Chinese students in universities of the Russian Federation Preparation of foreign applicants to universities in the Russian Federation (SPb. : Ed. Polytechnic University) pp 238-236
[7] Balykhina T M, Zhao Yujiang What are they like, Chinese? Ethnomethodical aspects of teaching Russian to the Chinese *Higher education today*