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Procedia - Social and Behavioral Sciences 215 (2015) 202 – 206

Procedia Social and Behavioral Sciences

International Conference for International Education and Cross-cultural Communication. Problems and Solutions (IECC-2015), 09-11 June 2015, Tomsk Polytechnic University, Tomsk, Russia

Improving the Organization of the Learning Process in Mathematics for International Students of Technical Universities

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Abstract

The article is devoted to the problem of teaching Mathematics to international students at technical universities. The study reveals the main educational difficulties of international learners enrolled in groups with Russian native speakers. The experience of giving lectures with presentations at Tomsk Polytechnic University is described. The study proves that the quality of mathematical education in a non-native language depends on the methods of delivering the lecture. It is found that delivering lectures in Mathematics with presentation slides enables international students to overcome educational difficulties.

Peer-review under responsibility of the organizing committee of IECC 2015.

Keywords: Higher education; international students; Mathematics; personal website; lecture; presentation slides.

1. Introduction

The population migration is common in the modern world. For various reasons people move from one country to another. In connection with the experience exchange in various fields many countries send their representatives to study in other countries. All this leads to the fact that big universities are becoming multinational. Students from different countries study there. The increase in the number of students coming from other countries to get higher education has also become characteristic at Russian universities. This trend has also affected the National Research Tomsk Polytechnic University. Students from Asian countries (Vietnam, Indonesia, China, Mongolia) and Africa

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Peer-review under responsibility of the organizing committee of IECC 2015.
doi:10.1016/j.sbspro.2015.11.621

(Zimbabwe, Nigeria) come to study at TPU. Some international students can speak Russian fluently. But for the majority of international students the education in Russian causes language difficulties. In this regard the main task of the teacher is to introduce new methods of teaching technical students in a non-native language (Ryan, 2015; Shafaei, Nejati, Quazi et al., 2015).

In this article we describe the experience in solving problems of training specialists in a non-native language at Tomsk Polytechnic University (TPU) on the example of teaching Mathematics.

At TPU there is Preparatory Department for the adaptation of international students to study at Russian universities. Students are trained there in small groups of 10, and Russian is a non-native language for all of them. The education at this department lasts one year. During this period international students prepare for further study at the university (Glazyrina, Efremov, & Nguyen, 2014; Ephraim, Glazyrina, & Podberezin, 2014). The ways to improve subject competences of international students at this department have been considered in the works of Sherstnev, Yanuschik, Pakhomov (2013).

It should be noted that one year of study at the Preparatory Department can not completely solve the future educational problems of foreign learners, caused by the language barrier. Later they enter their first year of study and begin to learn together with Russian native speakers. Thus, the number of foreign learners in a group of 25 students is no more than 2-4. Therefore, the pace of teaching is usually focused on native speakers. In this situation it is very difficult for international students to study the discipline, and they begin to fall behind. Thus, it becomes apparent that the organization of the learning process should be planned so that the teacher could pay more attention to learners studying in a non-native language.

2. Methods

The traditional educational activity at Russian universities includes lectures and practical lessons. The lecture has been one of the main components of the educational process at the universities for many centuries. The modern technological advances are increasingly penetrating into higher education and have an impact on the ways and forms of information delivery (Turner, 2015; Barton, Oates, & Patersonet al., 2015). Today, in addition to the traditional lectures there are filmstrips, slides, electronic presentations, training videos, interactive tutorials and online courses (Turner, 2015; Barton, Oateset al., 2015; Spence & McKenzie, 2015; Brinton et al., 2015; Kinnari-Korpela, 2015). But nevertheless, the main association arising at the word "lecture" is the image of a classroom filled with students and the teacher standing at the lecturing desk. This association is dictated by the traditional educational forms. Technologies change, but the essence of the process remains the same: at the lecture teachers should convey new knowledge to students in oral form.

As a rule, at the Russian universities the teacher has the leading role at the lecture. Besides, half of all the educational time is given to lectures. Today the question of the teacher's leading role is actively disputed, particularly in connection with the rapid development of Information and Communication Technologies and new educational models (Kablan, 2014) but in our view the lecture is one of the most effective educational means (Yoon, Oates, Sneddon, 2014; Alzhanova-Ericsson, Bergman et al., 2015).

The traditional lectures in Mathematics usually consist of theoretical material sometimes including practical examples. Usually it is the monologue of the teacher who writes the basic information on the board. During the first semester all the technical students learn Mathematics which consists of two parts: the first is "Linear algebra and analytical geometry" (LAAG), the second is "Differential calculus of functions of one and several variables" (DC). These parts are studied in sequence, each of them lasts during two months and ends with a small exam.

In our research we set the aim to compare the traditional way of giving lectures in Higher Mathematics and delivering a lecture with the use of visual presentations. The study was carried out at Tomsk Polytechnic University (TPU) in mixed groups (where Russian native speakers and foreign learners study together).

At the first stage of our study we gave traditional lectures in LAAG not using any multimedia equipment. At the second stage of our research we gave lectures in DC using the visual aids (presentation slides). As each stage ended with an exam in the studied subject, we could compare the final results and therefore assess the proposed techniques efficiency.

Besides, at the end of the first stage (after studying LAAG), in order to evaluate the efficiency of the traditional educational form for international students we proposed them a survey. It covered 26 international students (for which Russian is a foreign language) enrolled at the technical specialties of TPU. The students were asked to note what difficulties they met at the lectures using the list of 10 possible educational problems. According to the answers, the following difficulties have been found.

1. Complexity of making notes because of the rapid speech (85% of students).
2. Perception of speech in the teacher's monologue (73%).
3. Lack of speaking practice in Russian, which leads to difficulties in communication with the teacher (67%).
4. Perception and understanding of mathematical terminology in Russian (73%).
5. Reading educational literature in Russian (87%).
6. Organizational form of education (54%).
7. Lack of visual illustrations (many abstract concepts that can't be visualized) (38%).
8. Lack of knowledge necessary for further study of mathematics (44%).
9. Insufficient analysis of examples illustrating the theoretical material (67%).
10. No difficulties (0%).

Having analyzed the results of the survey we identified three main problems of students enrolled in a foreign language at a technical university.

First, only a small number of international students (15%) speak Russian fluently. The majority of international students (85%) can understand only simple sentences spoken by the teacher at a slow pace, ask simple questions and read texts using Russian translators. They translate the text into their native language and only then understand it. Thus, learning in the total flow, international students can hardly understand words of the lecturer.

Second, the educational forms and methods are not identical in different countries. It is also a problem affecting the quality of teaching. It was noted by 54% of international students. In each country the educational process is based on their traditions and way of life. So in many Asian countries the attendance at high school is not compulsory, homework and projects are not limited in time. In all Russian universities it is strictly regulated.

Third, the discrepancy between school programs of different countries leads to the mismatch of knowledge and skills that students have previously received at schools and the knowledge required at the university in a particular discipline.

Thus, we can conclude that it is difficult for international students to understand the traditional lecture because of the following reasons.

1. The main part of the traditional lecture is understood by ear. If a student understands the language poorly, at a certain moment he loses the awareness of what was just said, and the information perception stops.
2. When the teacher recites certain facts and records them on the board at the same time he turns his back to the audience, and thus his speech becomes less clear and loud.
3. Teachers often use abbreviations which are natural for Russian students, as they can always guess the meaning from the context. For international students it is a difficult task.
4. When submitting material in the form of a traditional lecture the teacher has not enough time to analyse examples illustrating the theoretical material.

It should be noted that if the foreign learners study the theoretical material from textbooks and online courses, as a rule, they translate all the text into their native language and only then understand it. In Russian there are linking words such as "however", "note that", "shows that", which do not carry much information themselves. It is difficult for a foreign student to separate them from the main text and understand them in context.

For these reasons, we suggested that it is possible to improve the perception and memorizing of the theoretical material with the use of presentation slides at the traditional lecture. First, we should identify the characteristics of lectures with slide presentations.

1. Slides contain brief definitions and theorems without redundant linking words or complex grammatical constructions which is more understandable to international students. The teacher has an opportunity to give the lecture at a slow pace and make all the necessary comments not being distracted by the need to make records on the board.

2. All the new terms should be highlighted in color, which helps the international students to be concentrated on them.
3. Some of the mathematical concepts are presented as symbols, e.g. "if and only if" is replaced by «□». Lecturer makes special comments to introduce these symbols. It contributes to the understanding of mathematical terminology.
4. Since the number of slides does not exceed 10-14, the lecture does not become too complex. If the lecture provides large amounts of information, international students lose the thread of narration, begin to lag behind and as a result, lose interest to the subject.
5. When using slides the teacher saves much time. It gives the opportunity to present examples supporting the theory and also to communicate with the audience. It should be noted that the students can have various knowledge gaps. They can forget or not know this or that thing. And the teacher is ready to guide them: what is necessary to be revised or studied further. There is a possibility to remove questions and to reveal misinterpretations of the studied material, thereby preventing its further improper use in practice. The described approach was used during the second period of studying Higher Mathematics (at the DC lectures).

To increase the lectures efficiency we also used the so-called "Personal site of the teacher." This page is at the Internet portal of TPU where the teacher can post the necessary information related to the disciplines. The Personal site generally comprises several tabs, and some of them are actively used by international students. Firstly, it is the tab "News", which contains all the information related to the educational process organization: teacher's consultations schedule, information about exams, etc. The second tab, "Educational work" includes lecture notes in the form of slides; plans of practical lessons with examples analyzed at the lesson; tasks to memorize the material after each topic; variants of control works (with precise instructions for international students to understand the tasks that need to be done); individual assignments; questions for the exam; list of necessary literature. Thus, with the help of this site international students can get acquainted with the following lecture and take notes in advance. During the lecture, they should listen carefully and ask questions, if necessary. If students do not understand the lecture or do not have time to perform tasks in the classroom, they can revise the material independently at a slower pace, using material on the personal page of the teacher.

3. Results

At the end of our study two approaches to the lecture delivering were compared: the traditional lecture and the involvement of slide show. The following diagram (Fig. 1) shows the final average scores of international students at the exams in LAAG and DC taken after two months of studying each of these disciplines.

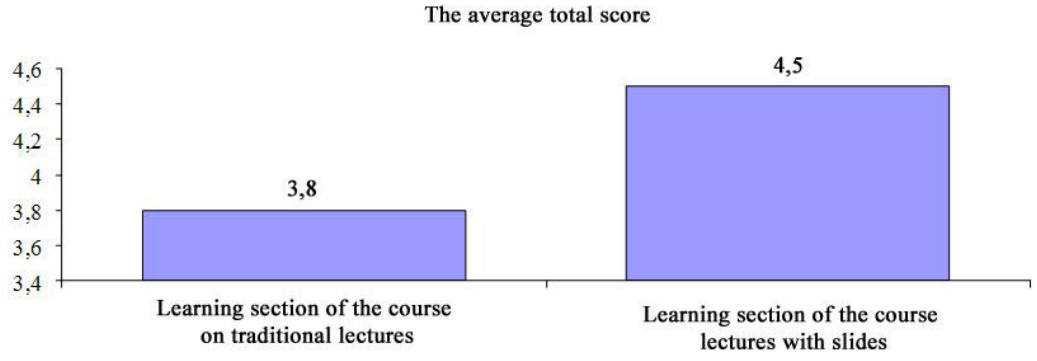

Fig. 1. The average total score for LAAG and DC.

As it can be seen from the diagram, the average performance in DC is higher than in LAAG. The data presented in Fig. 1 show that international students remember and perceive information better at the lectures with visual presentations. There has been progress in the results of the development of mathematical disciplines. The dependence of the mathematical education quality of international students on the methods of delivering the lecture is clearly revealed.

4. Conclusions

Each lecture hall of Tomsk Polytechnic University is equipped with multimedia facilities, so lectures with slide-show can become one of the efficient educational means. It is particularly actual for international students who experience language difficulties when sitting lectures with Russian native speakers. Our research has shown that the use of slides at the lectures in Mathematics can significantly improve their learning outcomes.

First, slide-shows contribute to a better perception of information at the lecture. It also solves the problem of note-taking which is particularly actual for international students at the lecture in Russian.

Second, the text on the screen allows the lecturer not to dictate everything but to involve students into dialog communication, answer their questions and explain difficult material.

Third, the lectures posted at the teacher's Personal site allow the international students to organize their way of study: prepare to the following lecture and then be ready to ask questions there and fix the received knowledge, or listen to the lecture and then revise and understand the new material. We should mention that the slides include all the basic formulas necessary to solve the tasks at the practical lessons.

Thus, the presence of visual content allows to build a relationship between the teacher and students, which is based on collaboration and cooperation. In this coordination the quality of students' progress increases.

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