

# The Effect of Language of Instruction on Course Results for Civil Engineering Students in Estonia

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## Abstract

Education globalisation is a reality today. Students from different countries can participate in exchange programmes in universities worldwide. However, this makes sense only if students understand the language of instruction. For large and industrialised nations there is no problem, they teach in their native language and there are always foreign students who can understand the course content. Developing countries and small nations face a more complicated situation: they can choose to teach in an internationally recognised language or in their native language. Both solutions have their advantages and disadvantages and in both cases a large number of students pursue their university education in a foreign language. The research is intended to examine whether language proficiency represents a significant disadvantage for engineering students who do not learn in their mother-tongue. This paper describes research into the performance of Russian-speaking civil engineering students relative to their Estonian-speaking counterparts at the Tallinn University of Technology. Results over eight years for a course taught in the Estonian language are compared to determine whether any trends in the relative performance of students from the two main language-cultural groups and also genders are perceptible. In addition, comparison is made with students' results for a course taught in English in the 2006/7 academic year to provide an indication of the effect of Estonian language knowledge on course results.

Keywords: Engineering education; education globalisation, influence of language; influence of gender

## 1. Introduction

### 1.1 The Wider Research Context

In today's globalised market for higher education, students have the possibility of studying at universities in almost any country worldwide. However, this makes sense only if they understand the language of instruction. For large and industrialised nations the choice of language of instruction at universities is obvious - they teach in their official state languages (English, Russian, French, German, Chinese, etc.) and there are always foreign students who

can understand the course content. Developing countries and small nations, on the other hand, face a more complicated situation: they can choose to teach in an internationally recognised language (as universities in Sri Lanka do), in their native language (as in Estonia) or some combination of the two. In all cases, issues relating to language proficiency amongst students and institutional capacities to provide suitably qualified staff and course material in all requisite subject areas to teach in the elected language (or languages) arise.

While a considerable body of literature examines the role of language-cultural groups in education in Estonia generally, to the authors' knowledge this is the first time that an attempt has been made to compare the advantages and disadvantages deriving from language-cultural group membership in the education of engineers in Estonia. As such it represents original research.

## **1.2 Historical Background to the Linguistic Environment in Estonia's Universities**

Largely as a consequence of Soviet era settlement of ethnic Russians, Ukrainians and Belorussians in Estonia, a Russian-speaking minority comprises approximately 30% of Estonia's population. Throughout the Soviet era, education was provided separately in both Estonian and Russian languages, the majority of schools being either monolingual Russian or monolingual Estonian schools. At university-level, students were taught separately in Estonian and Russian groups with both groups following the same programme but each in their native language.

Since the restoration of independence in 1991, one of the most significant government policy changes in Estonia has been the adoption of Estonian as the only official state language. In order to integrate the Russian-speaking minority, the Estonian Government has elaborated a State Programme for Integration [10]. Among the comprehensive measures planned are different methods for the teaching of Estonian language. However, most schools remain as either Estonian schools or Russian schools and a considerable proportion of Russian-speaking children complete secondary school with limited Estonian-language proficiency. As the language of instruction at state-funded universities is mainly Estonian, this constitutes a potential disadvantage in pursuing further academic studies (Leino et al [9]; Brown [4]).

With an Estonian-speaking population in the order of only 1 million people, it is debatable whether it is possible to provide universities with high quality professors in all the necessary fields. Consequently, universities are faced with a choice between two working language directions for the future:

- to maintain the requirement that academic staff be able to teach in Estonian and thereby effectively preclude foreign staff with the risk that quality might be compromised; or,
- to drop the demand for teaching in Estonian and thus increase the pool of eligible academics. However, this involves risks associated with the quality of engineering knowledge transfer if students are not fluent in the language of instruction and the negative effects that this will have on Estonian engineering and scientific language.

Having avoided it during 50 years of Soviet occupation, voluntarily accepting the demise of Estonian language through changing the language of instruction in universities at a time of national independence would be unthinkable.

There is a need to find a reasonable compromise to this problem by deciding which disciplines, at what levels, etc. might be taught in other languages in such a way so as to complement the core, Estonian language, university courses. The current study's investigation into the influence of language of instruction on course results offers empirical input to this debate by providing insight into the effectiveness of knowledge transfer where issues of language proficiency exist.

### **1.3 Languages of Instruction in the Faculty of Civil Engineering at Tallinn University of Technology**

Tallinn University of Technology (TUT) was founded in 1918 as an engineering college and it was granted university status in 1936. Today TUT is one of the largest public universities in Estonia and has over 10,000 students. In the Faculty of Civil Engineering there are approximately 800 students. The faculty currently offers Master of Science in Engineering and PhD study programmes with nominal study durations of 5 years and 4 years respectively. At TUT civil engineering students are taught separately in Estonian and Russian for the first two years during which time non-Estonian-speaking students can take the Estonian language course offered by the university. Starting from the third year the language of instruction is primarily Estonian. From this point, Russian-speaking students are taught in a combined group with their Estonian-speaking counterparts in the Estonian language.

Since Estonia's accession to the European Union in 2004, the effects of education globalisation have begun to be felt. With increasing international mobility of both students and staff, the university hosts more foreign professors, lecturers and students and, as a consequence, the use of English at TUT is growing. As more courses taught in foreign languages (particularly English) are developed, Estonian-speaking and Russian-speaking students are increasingly being called upon to undertake some of their studies in a foreign language (refer to Altbach [2] on the predominance of English as an international academic language).

## **2. Problem Definition**

In this way, language issues are central to TUT's ability to successfully maintain the quality of technical education and thus fulfil its national obligations to develop and transfer knowledge as well as to compete in the global market for education and research. Two specific language-related questions arise from recent developments and anticipated future trends:

- How has the change to Estonian language tuition affected students whose home-language is not Estonian – particularly the large minority of Russian-speakers?
- How might the increasing tendency to provide modules in English or other foreign languages impact on the performance of students?

### 3. Basis of Research Approach

The importance of proficiency in the language of tuition and testing has been investigated by many researchers covering a variety of taught subjects, e.g. Cuevas [5], and, unsurprisingly, an inadequate understanding of the language of instruction is found to be a major source of underachievement. Similarly, a considerable collection of factors have been variously found to be correlated with academic performance including:

- Alfán, E. and Othman, M.N. [1]: secondary school academic performance, admission qualifications, gender, attendance (full-time / part-time), linguistic capacity, ethnicity, culture, age;
- Eskew, R.K. and Faley, R.H. [6]: academic aptitude, past performance; effort / motivation, previous experience of subject matter, exposure to more generally related subject matter areas;

Some have considered these in the context of ethnic groups, e.g. Hofman, A. and van den Berg, M. [7], – ethnic specific differences: prior education, financial considerations (minorities need to earn more to afford university), effort.

The influence of language of instruction has been widely investigated at the level of primary and secondary schools in Estonia. Leino *et al* [9], based on empirical studies, stated that young non-Estonians put greater emphasis on their acquiring education and obtained better results than the local Estonian majority. The same authors also found that differences exist in students' performance at schools in Estonia between both the Estonian and Russian language-cultural groups as well as on the basis of gender so that the subgroups may be ranked by school results achieved as follows (from best to worst): (1) Girls whose language of instruction is Russian; (2) Girls whose language of instruction is Estonian; (3) Boys whose language of instruction is Russian; (4) Boys whose language of instruction is Estonian.

R. Kallas [8] has observed the performance of students of non-Estonian origin learning in Estonian secondary schools and indicated that there is no significant difference in their results by nationality.

In this paper an attempt has been made to compare the advantages / disadvantages deriving from language-cultural group membership in civil engineering education at university level.

### 4. Methodology

The research described here is essentially a comparative before and after study. It compares the performance of two populations of undergraduate students one of which is Estonian-speaking and the other Russian-speaking. The results obtained by these students in a Building Technology course are compared:

- for the years when the two groups received separate instruction in Estonian and Russian languages, i.e. before the change to all students receiving the course in Estonian; and,

- for some years after the change to all students being taught the course in Estonian.

Since it is a comparison, the influence of factors such as prior education, past performance, age, previous experience, culture and financial considerations are assumed to be insignificant in that they are considered to remain relatively constant. The effect of gender, however, must be taken into account as the changing proportions of males and females within the language-cultural groups may affect differences in course results between the groups given that gender differences in academic performance have already been observed at school level (Leino *et al* [9]).

For the years 1999 to 2006 inclusive, the results for all students participating in the Building Technology course were collated. The student group for each year was disaggregated by language-cultural group membership and by gender into four sub-groups: (1) Estonian-speaking females; (2) Estonian-speaking males; (3) Russian-speaking females and (4) Russian-speaking males. The course results obtained by students in each sub-group were compared in order to determine:

- whether the course results achieved by Estonian-speaking students in each year are significantly better than those achieved by Russian-speaking students; and,
- whether the course results obtained by Estonian-speaking males differ significantly from those obtained by Estonian-speaking females and whether the results obtained by Russian-speaking males differ from those obtained by Russian-speaking females.

In addition, comparison was made between students' results in the Building Technology course (taught in Estonian) and those in the Project Management in Construction course (taught in English).

## **5. Description of the Study Group and Results**

### **5.1 The Building Technology Course 1999-2006**

The course of Building Technology is taught during 2 semesters in the third year of engineering studies. It involves 120 academic hours of lectures and a course project. Students must pass 8 tests, 2 written exams and defend their course project, which involves considerable independent work. In return, they receive 6.5 credit points (3 for the first exam, 2.5 for the second and 1.0 for the course project).

In the years 1999 and 2000, Estonian and Russian students were taught in separate groups in their respective languages. Since 2001, the separate groups have been united and the language of instruction is Estonian. For the 8 years from 1999 to 2006, total student participation in the course varied from 44 to 130 with the proportions of Estonian-speaking and Russian-speaking students varying from 55% - 72% and 28% - 45% respectively. Between 16% and 27% of participating students were female.

## 5.2 The Project Management in Construction Course 2006

In 2006, for the first time, a course previously offered in Estonian language was delivered in English. The course, Project Management in Construction (60 academic hours and 2.5 credit points), was taught to fourth year civil engineering students. Students' performance was assessed by means of a coursework project and a written exam. A total of 74 students participated in the course of whom 55% were Estonian-speaking and 45% Russian-speaking. 38% of participating students were female.

## 5.3 Results

For the Building Technology and the Project Management in Construction courses, the student participation rates and average results achieved for the years under consideration are tabulated in Table 1 and Table 2 respectively.

Table 1: Student Participation in the Building Technology and Project Management Courses

Student Subgroup	Number of participating students							
	1999	2000	2001	2002	2003	2004	2005	2006
<b>a) Building Technology Course</b>								
Estonian-speaking Females	16	4	11	8	6	14	9	11
Estonian-speaking Males	71	60	30	26	18	48	57	49
Russian-speaking Females	15	12	5	4	4	12	13	17
Russian-speaking Males	28	25	14	9	16	21	29	32
<b>Total</b>	<b>130</b>	<b>101</b>	<b>60</b>	<b>47</b>	<b>44</b>	<b>95</b>	<b>108</b>	<b>109</b>
<b>b) Project Management in Construction Course</b>								
Estonian-speaking Females	-	-	-	-	-	-	-	<b>15</b>
Estonian-speaking Males	-	-	-	-	-	-	-	<b>26</b>
Russian-speaking Females	-	-	-	-	-	-	-	<b>13</b>
Russian-speaking Males	-	-	-	-	-	-	-	<b>20</b>
<b>Total</b>								<b>74</b>

Table 2: Average Results obtained for the Courses

Student Subgroup	Average results, %							
	1999	2000	2001	2002	2003	2004	2005	2006
<b>a) Building Technology Course</b>								
Estonian-speaking Females	78.6	81.3	88.7	59.1	69.3	84.9	71.8	76.6
Estonian-speaking Males	71.3	83.4	83.3	79.3	77.0	78.0	78.2	74.8
Russian-speaking Females	77.2	86.8	82.8	72.8	66.0	58.6	68.8	57.5
Russian-speaking Males	72.5	79.5	69.6	60.1	66.8	58.3	64.5	61.6
<b>b) Project Management in Construction Course</b>								
Estonian-speaking Females	-	-	-	-	-	-	-	74.2
Estonian-speaking Males	-	-	-	-	-	-	-	76.1
Russian-speaking Females	-	-	-	-	-	-	-	65.4
Russian-speaking Males	-	-	-	-	-	-	-	57.8

## 6. Analysis and Interpretation of Results

By analysing the results obtained by individual students comprising each language-cultural and gender subgroup, the statistical significance of the relationships under investigation were tested.

### 6.1 Do Russian-speaking Students Perform Worse than their Estonian-speaking Counterparts?

The research hypothesis may be framed as follows: The change from instruction in separate languages to instruction in Estonian negatively affected the performance of Russian-speaking students. A corresponding null hypothesis enables the testing of our hypothesis:

- Null Hypothesis 1: (For each year) Estonian-speaking students did not perform significantly better than Russian-speaking students,

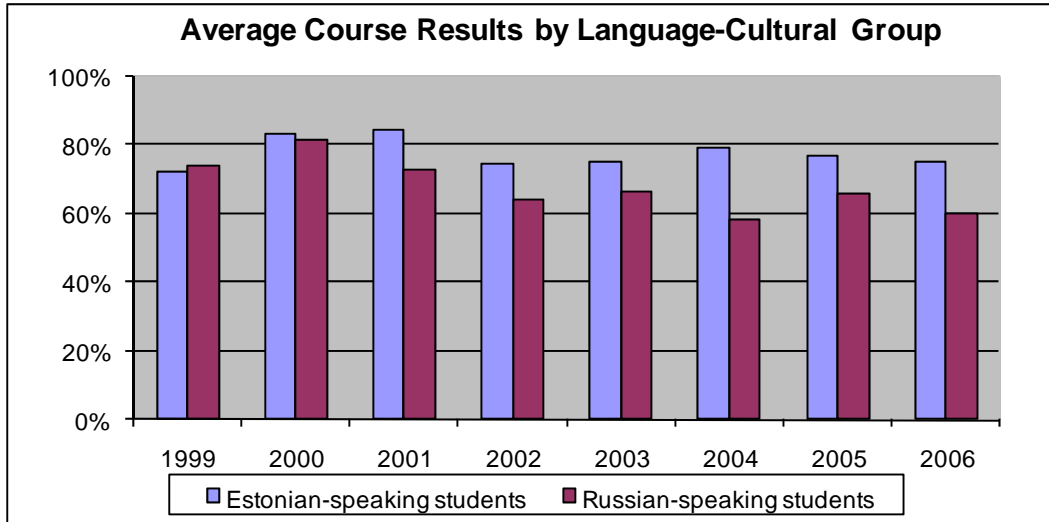
An unpaired, one-tailed Student's  $t$ -test was applied. The values of  $p$  calculated show the probability of these results assuming the null hypothesis. The results of this analysis are shown in Table 3 below.

Table 3: Probability of the Observed Results assuming Null Hypothesis 1

Student's $t$ -test (unpaired, 1-tailed)	Test results							
	1999	2000	2001	2002	2003	2004	2005	2006
<b>a) Building Technology Course</b>								
Degrees of freedom	128	99	58	45	42	93	106	107
Probability, $p$ (assuming null hypothesis)	0.356	0.357	0.015	0.056	0.051	1E-06	8E-05	2E-06
<b>b) Project Management in Construction Course</b>								
Degrees of freedom	-	-	-	-	-	-	-	72
Probability, $p$ (assuming null hypothesis)	-	-	-	-	-	-	-	1E-05

Assuming an alpha level of  $P = 0.05$ , we may reject the null hypothesis at values of  $P < 0.05$ . In the years 1999 and 2000, prior to the change from separate tuition in Russian and Estonian to all students being taught in Estonian, Estonian-speaking students did not perform significantly better than Russian-speaking students. Whereas, in the years 2001, 2004, 2005 and 2006 the null hypothesis may certainly be rejected, the values of  $P$  yielded for the years 2002 and 2003 (0.056 and 0.051 respectively) are marginal. However, it should be noted that these results are influenced by the lower number of students participating in the Building Technology course in these two years and, in consideration of this, the better performance of Estonian-speaking students in these years may be interpreted as being significant.

Thus, Estonian-speaking students performed significantly better in all years after the change to Estonian language tuition only (2001-2006) and we may accept our research hypothesis that the change from instruction in separate languages to instruction in Estonian negatively affected the performance of Russian-speaking students. This is clearly visible from a plot of the average course results achieved by the two language cultural groups as shown below in Figure 1.

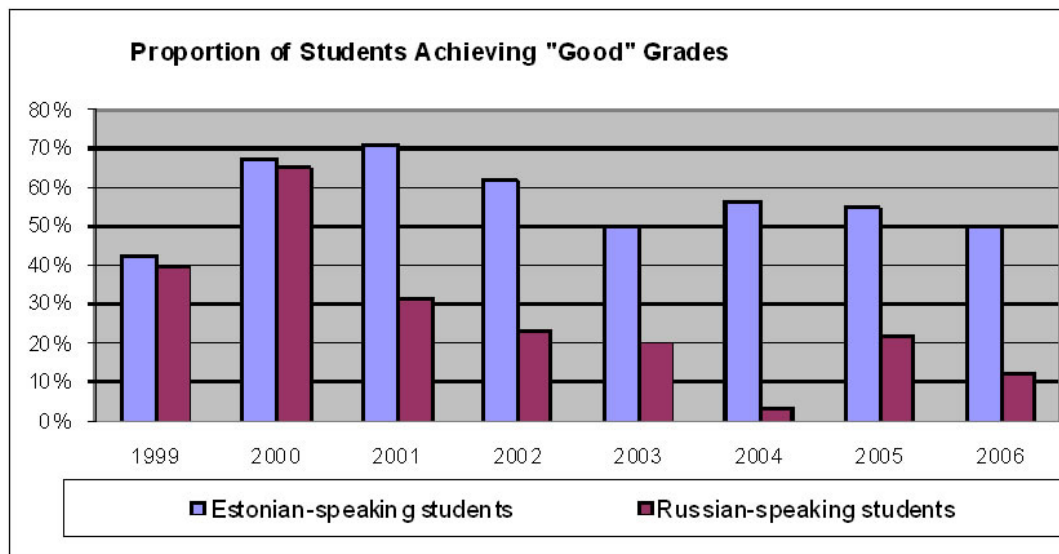


*Figure 1: Average Course Results by Language-Cultural Group*

In the years 1999 and 2000, when the Building Technology course was taught in two separate languages, the average results obtained by the Russian-speaking students were similar to those of the Estonian-speaking students. In the years 2001 through 2006, when all students were taught in Estonian, a noticeable gap is apparent between the average results of the two groups.

A further illustration of the effect of the change on Russian-speaking students may be seen from a plot comparing the proportion of students in each of the two language-cultural groups who achieved 'good' grades (i.e. grades of 4 and 5 in the TUT grading system, corresponding to results of > 80%) as shown in Figure 2 below.





*Figure 2: Proportion of Students Achieving "Good" Grades*

The same analysis of results achieved by the two language-cultural groups in the Project Management in Construction course (which was conducted in English) reveals that Estonian-speaking students performed significantly better than their Russian-speaking counterparts. This may indicate a similar gap between the groups in both Estonian language and English language proficiency but could as well be influenced by other factors. In contrast to the results for the Building Technology course which allow for comparison before and after the change in the language of tuition, the Project Management in Construction course results are available for only 2006 when instruction in English started. Beyond serving to confirm that a performance gap between Russian-speaking and Estonian-speaking students exists in other courses besides the Building Technology course, they do not provide additional insight into the nature of this gap.

## 6.2 Is there Evidence of a Gender Difference in Student Outcomes?

Since a difference in the performance of Estonian-speaking and Russian-speaking students (following the change to Estonian language tuition) has already been established, the existence or otherwise of significant gender differences in performance must be investigated within the language-cultural groups rather than considering the entire student group.

Research Hypothesis: Within the Russian-speaking and Estonian-speaking groups, differences between course results obtained by males and females exist.

- Null Hypothesis 2: (For each year) Estonian-speaking males did not perform significantly differently to Estonian-speaking females.
- Null Hypothesis 3: (For each year) Russian-speaking males did not perform significantly differently to Russian-speaking females.

An unpaired, two-tailed Student's  $t$ -test was applied. The values of  $p$  calculated show the probability of these results assuming the null hypothesis. The results of this analysis are shown in Table 4 below.

*Table 4: Probability of the Observed Results assuming Null Hypotheses 2 & 3*

Student's $t$ -test (unpaired, 2-tailed)	Test results							
	1999	2000	2001	2002	2003	2004	2005	2006
<b>a) Building Technology Course</b>								
Degrees of freedom	85	62	39	32	22	60	65	58
Probability, $p$ (null hypothesis 2)	0.218	0.737	0.082	0.067	0.600	0.062	0.101	0.695
Degrees of freedom	41	35	17	11	18	31	40	47
Probability, $p$ (null hypothesis 3)	0.486	0.264	0.159	0.253	0.913	0.968	0.463	0.487
<b>b) Project Management in Construction Course</b>								
Degrees of freedom	-	-	-	-	-	-	-	39
Probability, $p$ (null hypothesis 2)	-	-	-	-	-	-	-	0.450
Degrees of freedom	-	-	-	-	-	-	-	31
Probability, $p$ (null hypothesis 3)	-	-	-	-	-	-	-	0.165

Assuming an alpha level of  $p=0.05$  again, in no year within the study may either null hypothesis 2 or 3 be rejected as all calculated  $p$  values exceed this threshold. Thus, there is no evidence of statistically significant differences between the course results obtained by males and females in either language-cultural group. This may well be influenced by the small sample sizes.

### **6.3 Has the Performance Difference between Estonian-speaking and Russian-speaking students Increased over Time (since 2001)?**

Having established that there is a significant gap in performance since 2001 between the Russian-speaking and Estonian-speaking students and that this appears to be independent of gender differences, it is important to determine whether this gap is stable, narrowing or widening. Figure 3, below, plots the difference in results (how much better Estonian-speaking students have performed, expressed as a percentage of the Russian-speaking students' average results) for the Building Technology course against time.

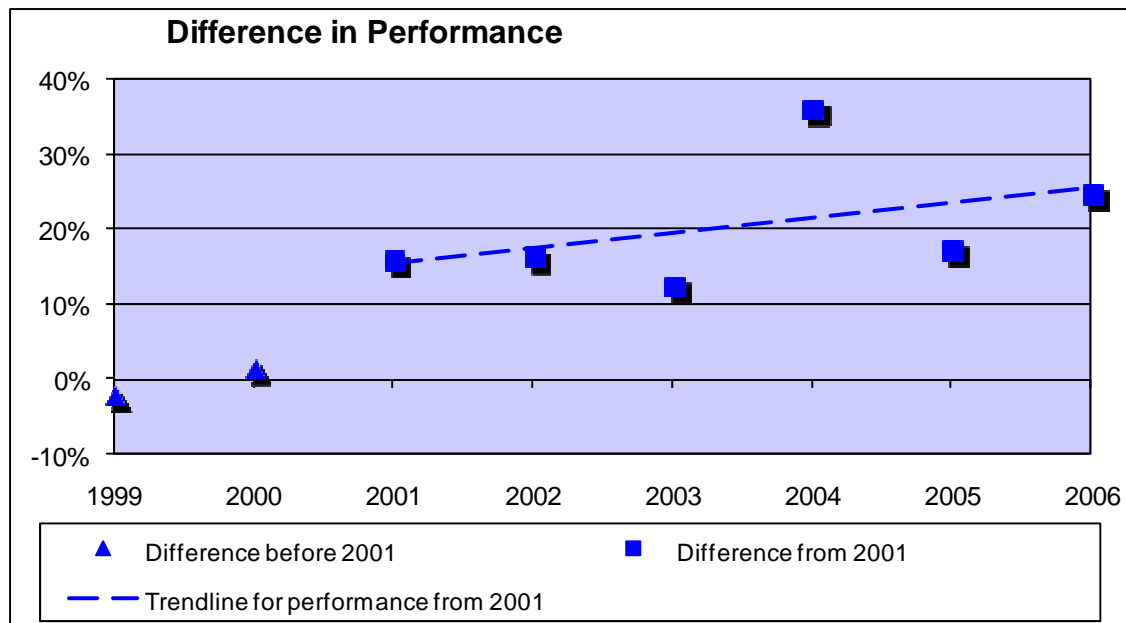


Figure 3: Difference in Performance

A linear trendline superimposed on the performance differences calculated for the years 2001 to 2006 would indicate that the performance difference has tended to increase over time. It is also evident that the performance differences between the groups which were negligible in 1999 (-2%) and 2000 (1.6%) are considerable from 2001 (the average results of the Estonian-speaking group having ranged between 12.7% and 36.2% better than the average results of Russian-speaking students). Interestingly, the performance difference calculated for the Project Management course results in 2006 is 24.1%, very similar to that shown below for the Building Technology course in the same year.

## 7. Conclusions

This research represents an initial and very limited investigation, but it does highlight the sensitivity of the language problem by showing that students' performances are dependant on their proficiency in the language of instruction:

- The difference in the results achieved by Russian-speaking students and those achieved by Estonian-speaking students since separate language tuition was stopped and the Building Technology course was taught in only the Estonian language indicates that the Russian-speaking students' Estonian language skills are insufficient and considerably compromise their course results. A direct relationship between language proficiency and course outcomes is apparent.
- As observed with the Project Management in Construction course, opting to teach in a foreign, international language may yield similarly large gaps between language-cultural groups' performances. In contrast to the case of the Building Technology course where at least the Estonian-speaking group's results were not adversely affected by the language proficiency factor, all students' results in the Project Management in Construction course may have been adversely affected by the choice of English as the language of instruction.

It follows that decisions concerning the language of tuition at universities have a profound effect on knowledge transfer to students and, ultimately, on national development.

## 8. Recommendations

The considerable magnitude of the performance gap observed and the possibility that it may be increasing is concerning not just from a narrow, effectiveness of university tuition point of view, but potentially for its wider socio-economic and political implications. It is therefore recommended that a further, wider investigation establish whether or not these performance differences are apparent in other courses taught within the Faculty of Civil Engineering and to define more precisely the factors influencing the differences with a view to proposing practical measures to close the gap. Additional factors affecting performance may include the extent of students' employment, lecture attendance rates, etc which need further investigation.

In the wider, international context, where both students and professors are increasingly mobile, questions are raised in terms of the effectiveness of learning in foreign languages – to what extent are engineering students throughout the world having their learning experience compromised by inadequate language skills? The influence of language of instruction must be given thorough consideration.

- It is important to ensure that students obtain solid fundamental knowledge and, therefore, that instruction in basic and core modules of the civil engineering curriculum should preferably be maintained in students' native languages. Where this is not possible, targeted language support should be provided. Similar was suggested also by Briguglio [3] in strategies for overcoming linguistic difficulties.
- At a higher level of education (Master, PhD) the need for knowledge of foreign languages is obvious and engaging international professors is highly recommended. The same applies to elective courses within the civil engineering curriculum. However, lecturers instructing in foreign language must give consideration to students' knowledge of the language of instruction.

## References

[1] Alfian, E. and Othman, M.N. (2005) Undergraduate students' performance: the case of University of Malaya, *Quality Assurance in Education*, Vol.13, No.4

[2] Altbach, P.G. (2007) *The Imperial Tongue: English as the Dominating Academic Language*, *International Higher Education*, Number 49 (available online [http://www.bc.edu/bc\\_org/avp/soe/cihe/newsletter/Number49/p2\\_Altbach.htm](http://www.bc.edu/bc_org/avp/soe/cihe/newsletter/Number49/p2_Altbach.htm) [accessed on 23/09/2007])

[3] Briguglio (2000) *Language and Cultural Issues for English-as-a-Second / Foreign Language Students in Transnational Educational Settings*, *Higher Education in Europe*, Volume XXV, No.3

- [4] Brown, K. (1997) Integration Through Education? The Russian-Speaking Minority and Estonian Society, ISRE Newsletter (Indiana University), Volume 6, No.2 (available online <http://www.indiana.edu/~isre/NEWSLETTER/vol6no2/brown.htm> [accessed on 23/09/2007])
- [5] Cuevas, G.J. (1984) Mathematics Learning in English as a Second Language, Journal for Research in Mathematics Education, Vol.15, No.2, Minorities and Mathematics, pp 134-144
- [6] Eskew, R.K. and Faley, R.H (1988) Some Determinants of Student Performance in the First College-Level Financial Accounting Course, The Accounting Review, Vol.63, No.1, pp 137-147
- [7] Hofman, A. and van den Berg, M. (2003) Ethnic Specific Achievements in Dutch Higher Education, Higher Education in Europe, Volume XXVIII, No.3
- [8] Kallas, R. (2004) Kultuuridevaheline haridus Eesti koolihariduses. (*Intercultural education in Estonian educational environment*), Rmt. Kasvatusteadused muutuste ajateljel, Tallinn, Tallinna Pedagoogikaülikool, lk. 77-86, (in Estonian)
- [9] Leino, M., Veisson, M., Ruus, V., Sarv, E., Ots, L. and Veisson, A. (2006) New Identity of Russian Speaking Children in Estonian Society, Social Work and Society, Volume 4, Issue 1 (available online [http://www.socwork.net/2006/1/countrynotes/leino\\_et\\_al/Leino.pdf](http://www.socwork.net/2006/1/countrynotes/leino_et_al/Leino.pdf) [accessed on 23/09/2007])
- [10] Riiklik programm "Integratsioon Eesti ühiskonnas 2000-2007" (State programme "Integration in Estonian Society in 2000 – 2007"), approved by the Government of the Republic of Estonia on 14.03.2000. (available online <http://www.riik.ee/saks/ikomisjon/programm.htm> , in Estonian [accessed on 20/09/2007])