An Investigation of the Effectiveness of Dual Learning Students, Majoring in Information Technology Engineering

Ildikó Holik*, Monika Pogátsnik **
* Óbuda University/TMPK, Budapest, Hungary
** Óbuda University/AMK, Székesfehérvár, Hungary, ELTE Faculty of Education and Psychology, PhD program on Educational Sciences, Budapest, Hungary
e-mail: holik.ildiko@tmpk.uni-obuda.hu, pogatsnik.monika@amk.uni-obuda.hu

***Abstract* — This study presents empirical research, which compares the effectiveness of students participating in dual trainings and those who study in the traditional way. This new model was introduced recently in the Hungarian higher education and is a focus of interest. The dual education students perform during the study period together with the normal full-time students in their respective higher education institute. During their employed (Corporate) period, students gain specific professional knowledge and practical working practice.**

***Keywords*—higher education, dual study, effectiveness, motivation, career orientation**

I. INTRODUCTION

The dual study model was introduced in Hungarian Universities based on German experiences. The Hungarian Higher Education Act [1] was amended in 2014 and it defined the role and place of this new form of training in higher education.

The dual education students perform during the study period together with the normal full-time students in their higher education institute (academic period). After this period they participate in the practical training at a company which has a contract with the University (corporate period). During the Corporate period the student gains specific professional knowledge and practical working practice. [2]

Domestic and International experience highlight the effectiveness of dual training [3] [4] [5]. Dual training increases the professional competences and the knowledge base in the company environment, by using curriculum content, structure, the number of hours spent at the companies and the practical experience for professionally qualified companies [6]. This allows students exiting higher education, to enter the workforce, without years of extra training and additional financial expense.

The dual form of training can be beneficial for both students and companies. The students can gain practical knowledge despite the overhead during their studies, which helps in getting a position after the training, and parallel the income from work can be used to more easily finance the training. However, it is important to note that participation in this type of training requires a certain degree of maturity, high level of motivation, because the coordination of work and study is difficult. For companies, this form of training allows in fulfilling their need for labor, the transfer of knowledge ensures professional recruitment. [7] In our study we try to verify the advantage of dual trainings for Universities, as they gain more effective and more motivated students.

An investigation of the International company, IBM, in Germany, suggested that cooperative education graduates show rapid career advancements. An interesting aspect of this observation is the fact that, Berufsakademie students at IBM, have higher salaries and hold higher positions over similar students from traditional Universities. [8]

II. RESEARCH ABOUT THE EFFECTIVENESS OF THE DUAL STUDY STUDENTS

In our empirical research we examined the special features of dual training compared to traditional training. The examined student's effectiveness is a complex expression, the pedagogical literature highlights and analyzes the different dimensions [9] [10]. The objective indicators may be, for example, the study results: grades obtained, semester or school year averages, contest results, language exams and/or number of failures. The subjective indicators include the commitment to school, the learning goals, further study plans, the interest in the area of study, the positive attitude toward the studies or learning motivation. [11] [12] [13] [14]

We considered as the specific feature indicating effectiveness, attrition rate, the obtained credits in the first semester, the obtained credit index and the grades obtained in the different subject areas.

We carried out our investigations along the following research lines:

- What differences can be observed in the effectiveness between the students participating in the dual training and the normal full time students, concerning the learning outcomes?
- In the case there are any differences, what are the reasons?

To answer the first research question, 252 first term students' learning outcomes were examined at Obuda University, Alba Regia Technical Faculty, majoring in Information Technology Engineering. These students

started their studies between 2011 and 2015 September. Our study only covered the first semester performance; we obtained the results from the Neptun system, the Unified Education System of Hungarian higher education.

Typical indicators of the students' success considered in this study are the drop-out rates, the number of credits earned in the first semester, the absolved credit index and the grades obtained in each subject.

The distribution of the participants in the examinations are listed in Table 1.

The dual training started in September 2015 at the University of Óbuda, Alba Regia Technical Faculty. 19 students majoring Information Technology Engineering started their study as dual students in this semester. Therefore, in our research we analyze the results of the first experience of the training.

The engineering education experiences a high level of attrition as a major problem, which arises within the first years. Therefore, we first investigated whether there was any difference in the drop-out rates between the dual and the traditional students during their first semester. We examined the number of students enrolled in the second semester.

TABLE 1.
IT ENGINEERING STUDENTS (N=252)

Year of entrance	Non-dual students	Dual study students
2011/2012. 1. semester	70	0
2012/2013. 1. semester	49	0
2013/2014. 1. semester	37	0
2014/2015. 1. semester	46	0
2015/2016. 1. semester	31	19
Total	233	19

Important differences can be observed in this regard. Everyone participating in the dual training all the 19 students are enrolled in the second semester. However, among the normal students the dropout rate is 19.35% in the school year of 2015/2016, which is a significant difference. In previous years, several students dropped out of the traditional training: from 8.11 to 30% until the beginning of the second semester. (Table 2)

TABLE 2.
ATTRITION IN THE FIRST SEMESTER AMONG NON-DUAL STUDENTS (N=233)

	Active student		Dismissed student		Passive student		Total attrition		Total student
Year of entrance	pers.	%	pers.	%	pers.	%	pers.	%	pers.
2011/2012. 1. semester	49	70.00	2	2.86	19	27.14	21	30.00	70
2012/2013. 1. semester	41	83.67	1	2.04	7	14.29	8	16.33	49
2013/2014. 1. semester	34	91.89	0	0.00	3	8.11	3	8.11	37
2014/2015. 1. semester	34	73.91	3	6.52	9	19.57	12	26.09	46
2015/2016. 1. semester	25	80.65	2	6.45	4	12.90	6	19.35	31
Total	*183*	*78.54*	*8*	*3.43*	*42*	*18.03*	*50*	*21.46*	*233*

TABLE 3.
STUDENT PERFORMANCE IN THE FIRST SEMESTER (N=252)

	Performed credit (average)	Credit index (average)	**N**umber of students
Dual student 2015/2016 1st semester	26.1579	2.5484	19
Non-dual student 2015/2016 1st semester	19.4194	1.7787	31
Non-dual student 2011/2012 – 2015/2016 1st semester	19.7124	1.9051	233

TABLE 4.
UNFULFILLED SUBJECTS IN THE FIRST SEMESTER (% AMONG ALL THE PARTICIPATING STUDENTS IN THE COURSES) (N=252)

	Calculus I.		Introduction to Computing Theory I.		Theoretical Foundations of Computer Science		Physics		Economics		Programming I.	
	fail	no award	fail	no award	fail	no award	fail	no award	fail	no award	fail	no award
Dual student 2015/2016 1st semester	5.3	0	5.3	0	0	0	5.3	21.1	10.5	0	15.8	5.3
Non-dual student 2015/2016 1st semester	9.7	22.6	9.7	16.1	3.2	3.2	3.2	36.5	9.7	3.2	22.6	16.2
Non-dual student 2011/2012 – 2015/2016 1st semester	11.2	21.4	4.3	18.9	2.1	10.7	10.3	23.1	5.6	12.9	9.4	25.7

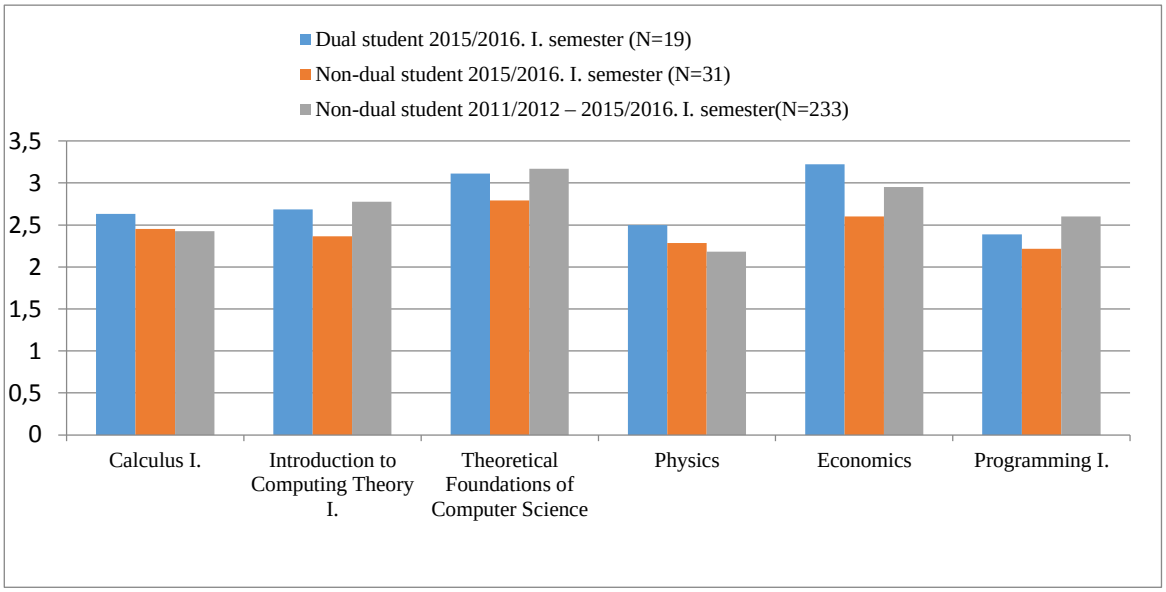

Figure 1. The first semester results of the subjects on the basis of the marks obtained (N=252)

According to the Neptun system we realized that the dual students performed significantly higher, than the non-dual traditional students. The dual students gained more credits and obtained a higher credit index, than their non-dual schoolmates. (Table 3) Among the completed credits and the credit index a close correlation was observed, based on the Pearson correlation r = 0.915; p = 0.000; N = 233.

Table 4 shows that the rate of the unfulfilled subjects is significantly lower among the dual students, compared to the traditional students. The most significant difference is in two subjects within the field of mathematics: Calculus and Introduction to Computing Theory. The most difficult subjects in the first semester seem to be the Physics and the Programming for both dual and non-dual students, but the dual students perform here also better.

In the Physics study area we found a significant correlation between the form of training and subject grades, based on data made Chi-square test p = 0.024.

In the first semester of the school year of 2015/2016, the dual students earned from five of the six subjects, better grades (in proportion to the number of students) compared to the traditional students (except Calculus where the dual students had a lower grade). Looking at the past five years, there are four subjects where the dual students gained better grades (they reached less excellent grades in Calculus and in Introduction to Computing Theory)

We also examined what averages the students achieved in each subject (Figure 1). If the results of those involved in the dual training is compared to grade peers, we can conclude they have better results in all the subject areas.

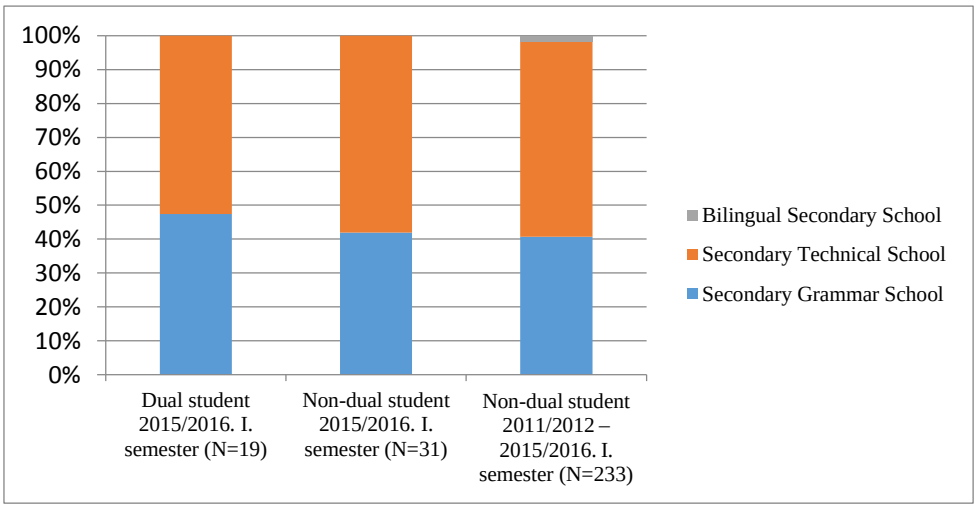

Figure 2. The secondary school type students come from (N=252)

Looking at the results over the past five years, however, we can observe only three subjects where the dual students achieved better results than those involved in traditional training.

However, the above interpretation of the results cannot overlook the fact that here we have only taken into account the grades obtained. We did not calculate those students who were refused an evaluation (no award: disabled or denied), which we mentioned in Table 4, this occurred in much greater numbers among non-dual students.

In case the 2015/2016 first semester considered (N = 42), the closest relationship can be found between the results of Physics and Theoretical Foundations of Computer Science (Pearson correlation performed the following values on the data: r = 0.716; p = 0.000), but there is also a close tie between Physics and Introduction to Computing Theory I (r = 0.702; p = 0.000) and between the results of Calculus and Introduction to Computing Theory I (r = 0.707; p = 0.000). In the last five years (N = 205) the closest connection can be observed among the results of Calculus and Introduction to Computing Theory I (r = 0.674; p = 0.000).

The differences between the study results may have more possible causes. The four factors are emphasized in our study.

1. The previous studies and learning conditions
2. The attitude toward the engineer training
3. The learning motivation
4. The differences in career concepts

A. The previous studies and learning conditions

In Figure 2, it can be observed, that there is a difference between students in previous secondary schools. Among the dual training students there is a higher proportion of students from secondary grammar schools (47%) compared to the non-dual students (40-42%).

Another difference is that the dual students were admitted to the University with higher entrance scores compared to the non-dual students (Table 5).

TABLE 5.
AVERAGE ENTRANCE SCORES (N=252)

	Average entrance scores	N
Dual student 2015/2016 1st semester	327.11	19
Non-dual student 2015/2016 1st semester	321.32	31
Non-dual student 2011/2012 – 2015/2016 1st semester	308.61	231

TABLE 6.
LIVING ENVIRONMENT (N=252)

	Students living in a hostel		Students not living in a hostel		Total students
	n	**%**	**n**	**%**	
Dual student 2015/2016 1st semester	6	31.6	13	68.4	19
Non-dual student 2015/2016 1st semester	14	45.2	17	54.8	31
Non-dual student 2011/2012 – 2015/2016 1st semester	73	33.9	154	66.1	233

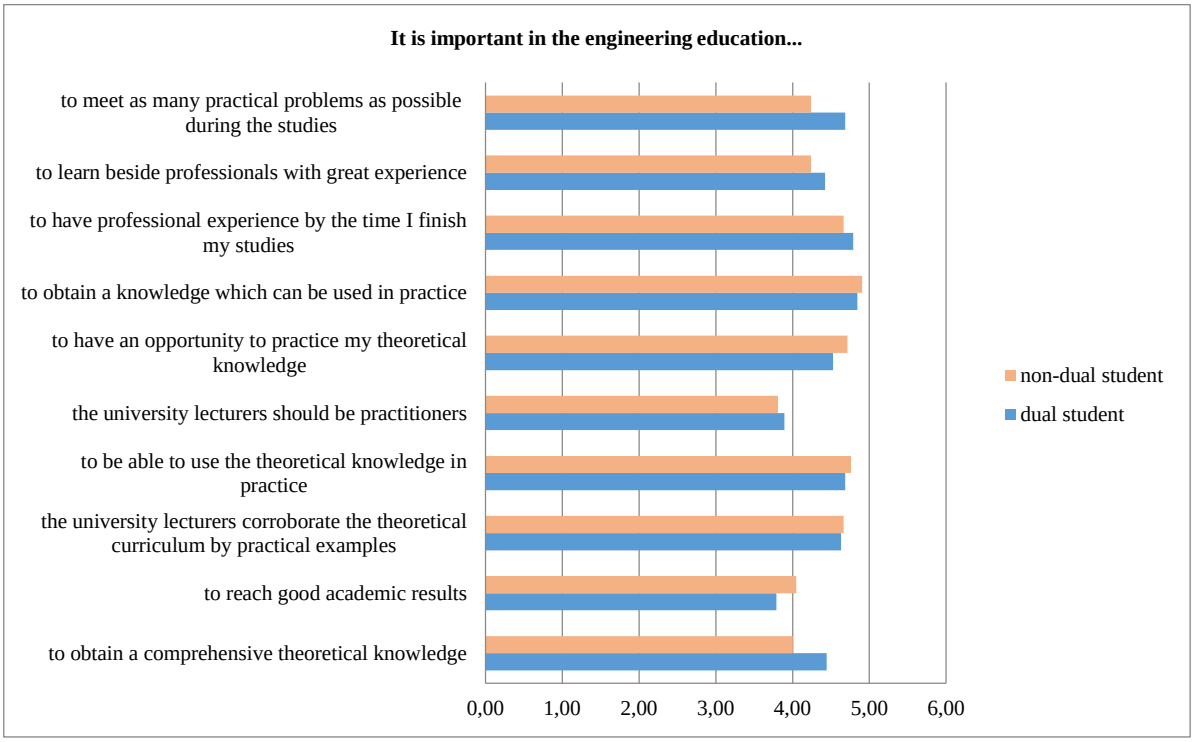

Figure 3. The attitude toward the engineer training (average scores, rating a 5-point scale, N = 40)

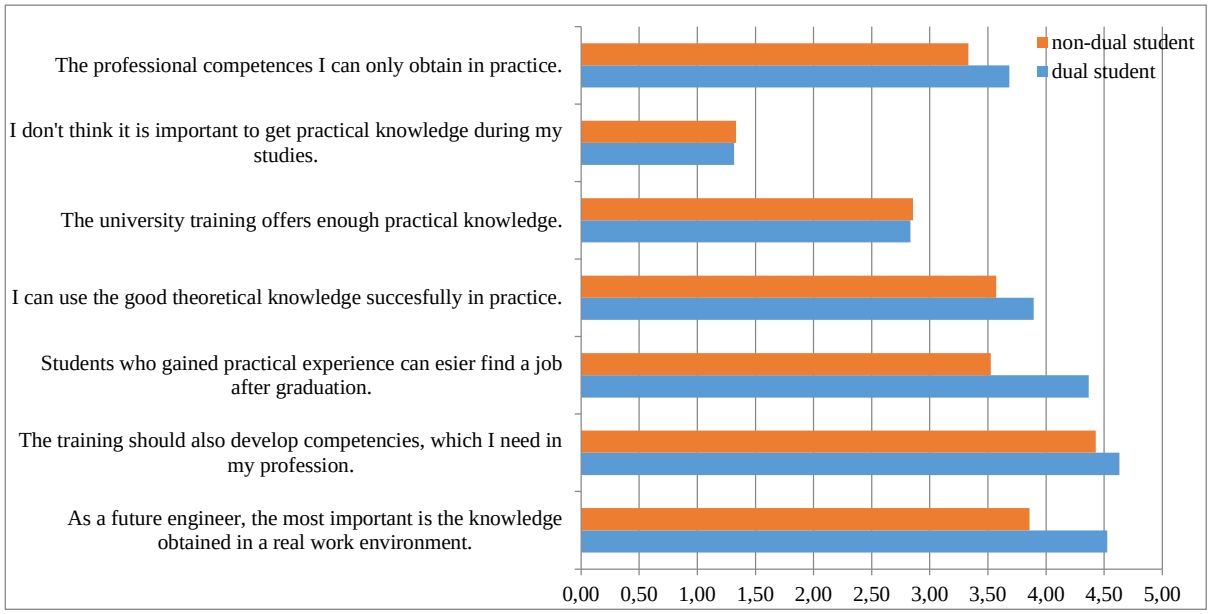

Figure 4. The attitude toward the practical training (average scores, rating a 5-point scale, N = 40)

The conditions and the learning environment are likely to have an impact on the study results. There are less dual training students living in the dormitory than traditional students. (Table 6)

B. The attitude toward the engineer training

To examine the factors 2-4, a survey was carried out among the 40 first-year engineering students who started the second semester of the school year of 2015/2016 at Obuda University Alba Regia Technical Faculty in Székesfehérvár, Hungary. 19 of the 40 students were involved in dual training. The survey was done at the beginning of the second semester of the school year 2015/16, so the students had a semester of experience in the training.

We examined how the students relate to their engineering education. We received very interesting results (Figure 3). Participants in the dual training had a more positive attitude to meet more practical problems, to gain more professional experience before completing their studies. At the same time they also seek a wide theoretical knowledge, they emphasize it more than the traditional students. It is less important for the dual students to achieve good academic results, however, they are performing better than the non-dual students.

The next question draws attention to the fact that dual students have a more positive attitude to practical education than their non-dual peers (Figure 4). They believe that professional competence can be acquired only in practice, and in their view, a prospective engineer needs to acquire their knowledge in a real work environment (between these two variables is the closest relationship based on Pearson's correlation, $r = 0.619$; $p = 0.000$; $n = 40$). They also expected to develop competencies in training which they will need later on in the labor market. This question clearly shows that those involved in the dual training - despite the fact that practical training is very important for them - give a priority to the theoretical knowledge, and they hope that the well-learned theoretical knowledge can be applied successfully in practice.

C. The examination of the learning motivation

More empirical research also drew attention to the impact on the learning motivation in school grades, but the obtained grades also shaped the students' motives. [15][16] In other words, learning motivation and academic performance are interrelated [17] and the motivation to learn, is incontestable, in terms of success at school [18]. Exploration of the adult learning motivation is less extensive than the lower school students'. [19] Therefore, it was important to examine the students' motivations. In motivation research, we used a measurement, which has been developed within the framework of a research in Budapest. [20]

The learning motivation of adults is divided into two large groups. The internal motives include interest, curiosity, and the desire for learning. The external motivations are for example better job, a higher salary, or other incentives coming from the environment. [21]

In our research, among the internal motives, the interest appears the most significant among the dual students. They will learn a curriculum, if they are interested in it (an average of 4.61, while non-dual students 4.43). Other motivating factors for them, is to see the practical utility of the knowledge (an average of 4.56, while non-dual students: 4.43). Among the external motivations, personality of the teacher is the most deterministic, they prefer learning from a teacher who explains well (dual students average points: 4.5, non-dual students: 4.00). The expectations of the parents as an external motivation, however, is less important for the dual students (average of 2.28, while conventional training: 2.95). In addition, there are two areas they are less motivated in than the non-dual students: future careers and learning the curriculum word for word does not motivate them.

It is interesting to note that there is a strong correlation between the sense of achievement gained from learning and the positive feedback from the teachers (Pearson correlation r = 0.707; p = 0.000). It is important that education should give a positive feedback for the students to have more sense of achievement therefore to be more motivated to learn and therefore to achieve a better performance.

D. The examination of the carreer orientation

There are also interesting differences in terms of how the first-year students imagine their professional future (Figure 5). One question group of the Lent questionnaire was used in this part of the study [22]. The dual-students agreed more with the statements, which focused on relations with colleagues and the situation of the profession in the labor market. They believe that if they acquire a degree, it allows them to build proper relationships with people, to work in an area, where there is a high demand for work force, to do a work that can "make a difference" in people's lives, to receive a good job offer. These considerations were given higher scores by dual-students than by traditional students. The traditional non-dual students, however believe mainly, that if they acquire a degree, it allows them to do exciting work, to do work that they would find satisfying (between these two variables is the closest correlation, Pearson correlation (r = 0.643; p = 0.000; n = 40), to have a career that is valued by their family, to increase their sense of self-worth, to do work that they would find satisfying and to get respect from other people, that means, human factors come first for them. In addition, they hope a better salary than the dual education students.

III. CONCLUSION

In our research we tried to capture the characteristics of dual education compared to "traditional" education. We examined the differences that can be observed in the learning results among dual and non-dual students, and we were looking for the reasons for these differences.

We examined the results of 252 first term IT students of Óbuda University Alba Regia Technical Faculty, who started their studies between 2011 and 2015 September.

Our first research question focused on the differences in the effectiveness between the students participating in the dual training and the normal full time students concerning the learning outcomes. Based on the Neptun system data we detected, that while there is a high attrition among first term students, there is were no drop-outs among dual students. The dual training participants performed significantly better in credit indicators compared to the students participating in non-duel training. This can be observed in the number of credits obtained or credit index reached. In addition, the proportion of unfinished courses is significantly lower among the dual students than among the non-dual students.

If we look at the results obtained in each of the six subjects first semester IT engineer students take, we can also state, that the dual students performed significantly higher.

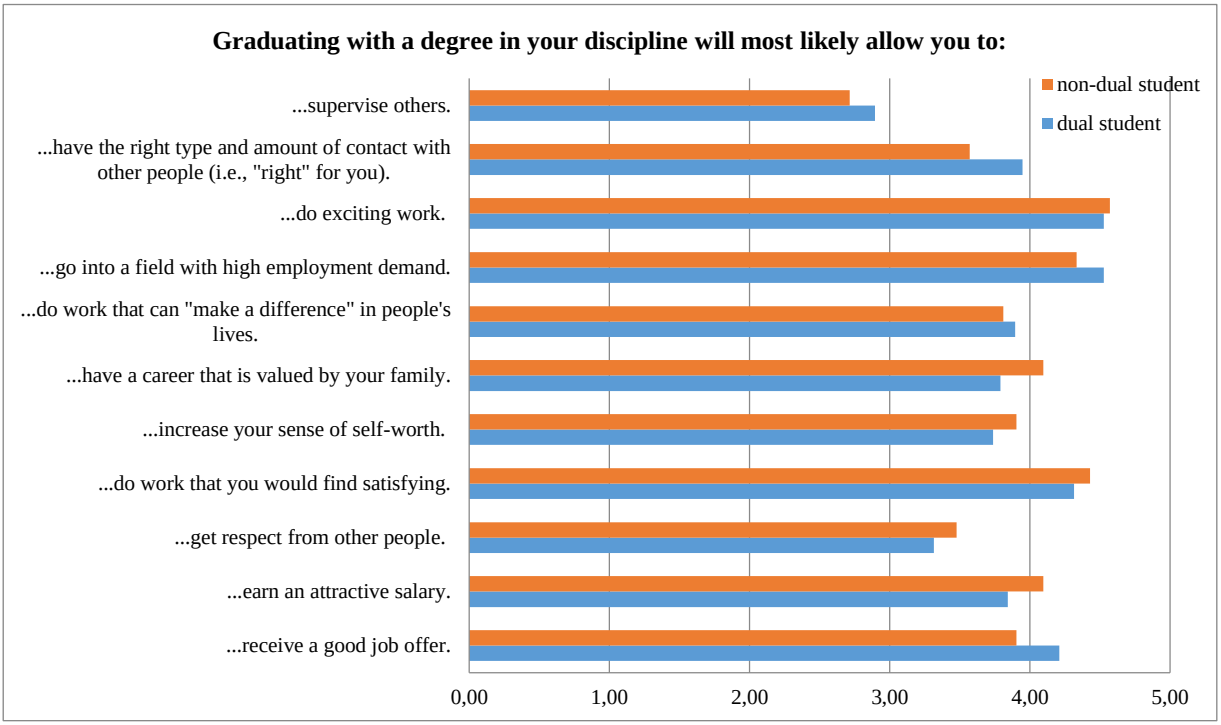

Figure 5. Examination of the career concepts (average scores, rating a 5-point scale, N = 40)

In all the six courses required in the first semester, there were less unfulfilled courses among the dual students in the school year of 2015/16. When we consider the first semester students in the last five years, there is only one subject, Physics, where the non-dual students were better. The reason is probably a deteriorating quality of Physics education in high schools and the new possibility to choose Informatics for entrance exam instead of Physics.

In our second research question we focused on the reasons for the differences in the learning outcomes. The differences between the study results, can be traced back to several factors, among which, we highlighted four factors: the earlier studies and the conditions for learning, the attitude toward the engineering training, the learning motivation and the differences in career concepts.

We could observe a difference among students in their secondary schools and their learning conditions. Participants in the dual training had a more positive attitude to both the theoretical and practical training and kept better, in mind, the needs of the labor market.

REFERENCES

[1] *2011. évi CCIV. törvény a nemzeti felsőoktatásról*. (2011 CCIV. Law on the National Higher Education) http://net.jogtar.hu/jr/gen/hjegy_doc.cgi?docid=A1100204.TV (retrieved: 2016. 01. 26.)

[2] P. Tóth: *A vállalati mentorképzés elméleti alapjai.* (Theoretical foundations of corporate mentor training) Óbudai Egyetem, Budapest, 2015.

[3] G. Melin, et al.: *Towards a future proof system for higher education and research in Finland.* Publications of the Ministry of Education and Culture, Finland, 2015. http://www.minedu.fi/OPM/Julkaisut/2015/liitteet/okm11.pdf [retrieved: 2016.07.14.]

[4] Zs. Kovács, E. Török: "Dual System for Renewing Hungarian Higher Education", *International Journal of Education and Learning Systems*, vol. 1, pp. 81-85, 2016.

[5] L. Yu: "Research On the Cooperative Education Model Cultivating In Higher Vocational Education", *Education and Management Engineering*, vol. 1, pp. 35-41, 2012.

[6] I. Simonics: Oktatásszervezés, gyakorlattervezés- és vezetés, (Seminar organization, planning and management) In: P. Tóth Péter (edit.): *A vállalati mentorképzés elméleti alapjai*, Óbudai Egyetem, Budapest, pp. 53-73, 2015.

[7] *Kutatási-fejlesztési tevékenység megvalósítása jó gyakorlatként azonosított magyarországi és külföldi duális képzési programok elemzése és a kutatáshoz kapcsolódó fejlesztések kapcsán. Esettanulmányok*, (Research and development related to the implementation of the dual training programs, analysis of Hungarian and foreign practices as a good examples. Case studies) Educatio Nonprofit Kft, Budapest, 2014.

[8] A. Göhringer: "University of Cooperative Education – Karlsruhe: The Dual System of Higher Education in Germany", *Asia-Pacific Journal of Cooperative Education*, vol. 3 (2), pp. 53–58, 2002.

[9] B.P.M. Creemers: "Development of a Theory on Educational Effectiveness: Testing a Multilevel, Multifactor, Contextual Theory about Education", *Educational Research Journal*, vol. 8. pp. 1-11, 2013.

[10] J. Scheerens: "Review of school and instructional effectiveness research", Background paper prepared for the *Education for All Global Monitoring Report*, UNESCO, 2004. http://www.mecd.gob.es/dctm/cee/encuentros/effectiveteachingscheerens.pdf?documentId=0901e72b815f9784 [retrieved: 2016.07.14.]

[11] B.P.M. Creemers, L. Kyriakides, P. Sammons: *Methodological Advances in Educational Effectiveness Research*, Routledge, Taylor & Francis, London and New York, 2010. https://rufiismada.files.wordpress.com/2012/02/methodological_advances_in_educational_effectiveness_research__quantitative_methodology_series_.pdf [retrieved: 2016.07.10.]

[12] J. Pásku: "Az iskolai teljesítményt befolyásoló pszichológiai sajátosságok és összefüggésük a munkára vonatkozó értékekkel", (Psychological features influencing school performance and their correlation to values of work), *Életpálya-tanácsadás*, vol. II, pp. 52–60, 2013.

[13] G. Sáska: „Mit osztályoztak a matematikatanárok 2011-ben?" (What was evaluated by mathematics teachers in 2011?) *Educatio*, vol. 4, pp. 565–577, 2012.

[14] M. Szemerszki: "A tanulói eredményesség dimenziói és háttértényezői", (The dimensions of students' effectiveness and background factors) In: M. Szemerszki (edit.): *Eredményesség az oktatásban. Dimenziók és megközelítések*, Oktatáskutató és Fejlesztő Intézet, Budapest, pp. 52-91, 2015.

[15] B. Csapó: "Az iskolai tudás felszíni rétegei: mit tükröznek az osztályzatok?" (The surface layers of school knowledge: what is reflected by the scool grades) In: B. Csapó (edit.): *Az iskolai tudás*. Osiris Kiadó, Budapest, 2002.

[16] K. Józsa: "Tanulási motiváció és humán műveltség", (Learning motivation and human culture) In: B. Csapó (edit.): *Az iskolai műveltség*, Osiris Kiadó, Budapest, 2002.

[17] E. Ceglédi, J. Máth: "Az iskolai teljesítményt befolyásoló tényezők vizsgálata", (Factors affecting school performance), *Alkalmazott pszichológia*, vol. 13 (4), pp. 23-46, 2013.

[18] K. Józsa: *Az elsajátítási motiváció*, (The learning motivation) Műszaki Kiadó, Budapest, 2007.

[19] M. Kocsis: "Felnőttek tanulási motivációi", (Adults' learning motivations) In: D. Koltai, L. Lada (edit.): *Az Andragógia korszerű eszközeiről és módszereiről*, Nemzeti Felnőttképzési Intézet, Budapest, pp. 113-142, 2006.

[20] P. Tóth: *Egyéni különbségek szerepe a tanulásban. Tanulási stratégiák.* (The role of individual differences in learning. Learning strategies.) DSGI Kiadó, Székesfehérvár, pp. 51-55, 2012.

[21] Á. Engler: "Tanulási döntések és tanulási motívumok regionális vizsgálatok alapján", (Learning decisions and motives based on regional studies) *Educatio*, vol. 22 (1), pp. 81-89, 2013.

[22] R. W. Lent, A. M. Lopez, F. G. Lopez, H. B. Sheu: "Social cognitive career theory and the prediction of interests and choice goals in the computing disciplines", *Journal of Vocational Behavior*, vol. 73, pp. 52-62, 2008.