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THESES OF THE DOCTORAL DISSERTATION

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The development of the "Z" Generation identity

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Abstract

Computer engineering students' dropout rate is a crucial issue in higher education in the last two decades. Attrition has serious consequences on an individual, economic and educational level. As a worldwide phenomenon, it calls the attention of policy-makers, stake-holders and academics that solutions have to be found. The dropout crisis requires complex interventions for encouraging students in order to complete their studies. Addressing such a dropout crisis requires actionable interdisciplinary movement based on a foundation of partnership among stake-holders and academics.

Given the extensive work on how universities can support students to meaningfully address those sustainability challenges, the question is how can we further help students' adaptation process to university challenges? Our aim is to summarise the results which were conducted in students' data and highlight the points in the education system about what kind of further improvements can be made in the institutions.

According to Vision 2030 European Union studies, education is vital for economic development because it has a direct influence on entrepreneurship, productivity growth and then increases employment opportunities and women empowerment. Education helps in reducing unemployment, enhancing students' ability and skills. Due to computer engineering students' high attrition the economy also has to pay the cost because computer science experts with a degree usually earn more GDP than without (Whittle & Rampton, 2020).

Comparative analysis of past studies has been conducted in order to find out various causes of students' dropout.

Students' performance after the first academic year is a topic of significant interest: the lack of students' engagement in the academic life and their unpreparedness are mainly responsible for dropout after the first highly crucial period. Diverse authors have made grand calls for change in academic institutions to support computer engineering students. Various higher education institutions developed prevention and promotion programs. The program can be held by psychologists or peer counsellors for a group of students. The following topics can be covered:

time-management, study techniques and various soft skills. Developing concentration helps students stay on track and be able to achieve successful test scores. In the literature there are several concepts and such programs for all first-year students. These programs are usually voluntarily attended. However, a prevention and promotion program was introduced at a large public university in Europe for every freshman obligatorily (Takács et al., 2017).

Introduction

In the last decades, higher education institutions (HE) have been under pressure to reduce the rates of students 'dropping out', and develop methods that encourage students to continue their studies (Berens et al., 2019; Bound et al., 2010; Bowen et al., 2009). The aim of our research is to analyse students' academic success and to find subjects related characteristics of retention in the field of computer science (CS).

Universities around the world have made significant progress towards establishing study promotion interventions to prevent computer engineering students from dropout. Our studies aimed to investigate to what extent will an education reform affect the attrition of students by analysing the pattern of grades of computer engineering students' academic achievement. According to our results, after the education reform most subjects became accomplishable, and students with lower levels of ability also tried to take exams. Analysing students' results could help administrators develop new programs in order to increase retention. However, further improvements are necessary to maintain the career development of junior scholars.

Higher education studies open a new chapter in the development of adult identity. Individual decisions are needed, meeting new challenges requires a new adaptation from the individual, so this period becomes a critical period. The dissertation explored the factors behind dropout and transformed the results into intervention practices. We compared the main personality characteristics of the "Z" generation and the "Y" generation in the university population in order to develop more effective methods to support them.

The intervention program proved to be successful as part of a complex package of measures introduced by the Faculty of Informatics. This sequence of interventions ultimately reduced dropout by 33% among computer engineer students.

In the first survey, we examined the data from the student tracking system of computer engineer students. We were able to identify intervention points that play a role in dropout (e.g., most students leave the university by the end of the first two years), and we explored typical patterns of dropout. In the second study of the dissertation, we studied the psychological characteristics that could be related to retention (e.g. self-efficacy, psychological immune competence). The correlations of students with dropout and psychological dimensions were examined using cluster analysis. Students with uncertain or diffuse career identities are also at risk of dropping out and therefore need support in their university careers. People with low coping skills might have difficulties in stressful situations in the university, which can also lead to dropout. The second part of the study compared the "Z" and "Y" generations at the beginning of their university studies. This study confirmed the need to promote mental health programs for university students, especially to strengthen their resilience in times of crisis, such as the COVID-19 pandemic. Interventions that support students' self-regulatory abilities could be designed to help eliminate the negative effects of stress in the educational environment and thus lead to better academic performance.

In the third part of the research, we measured the effectiveness of the intervention program. The IRT model helped to investigate how each subject changed as a result of the intervention program. We found that students after 2016 were more likely to perform well than students who started their studies before the interventions. The results help to reinforce the importance of intervention programs in strengthening students' identities and social relationships. It is also important to encourage students to look for challenges and opportunities for further development at the university. After the intervention, a higher percentage of students with different abilities could successfully meet the university requirements and we succeeded in retaining 33% of our students.

Theoretical background

Tinto (1975) introduced an interactional theory of student persistence in academic life. This theory emphasized the importance of the students' personal characteristics, traits, experiences, and commitments. Furthermore, Tinto (1982) highlighted the interactions between the student and the institution regarding how integrated ("fitted" academically and socially) the student is. Pascarella and Terenzini (1983) also associated the importance of social and academic integration, such as peer relationships and faculty member relationships with persistence. Interactional theories suggest that students should be connected to one another and their institutions. Braxton et al. (2004) emphasized the need for community on campus as a help of social integration to develop relationships between peers. Terenzini and Reason (1983) and Reason (2005) suggest that the students' pre-college characteristics and experiences interact with internal structures, policies, and practices of the university. It will not turn out whether the student persists and continues their studies or not until the end of the interactional circle (Reason & Terenzini, 2005; Reason, 2005).

However, according to Braxton et al (2004), there is a missing evidence that these characteristics and motivations can provide a successful predictive model of student engagement. It remains a question why some students successfully "fit" while others do not at the university, although they often have similar academic backgrounds and socioeconomic demographics. Because of the remaining questions and the lack of explanation it is considerable to analyse the reasons behind CS dropout because this field has a large number of students dropping out.

Analysing the reasons behind CS dropout

In line with the growing attention paid to dropout, models explaining CS students' dropout have been presented in the literature. Unfortunately, most students drop out already in the first year of their studies. Every year many students around the world enter higher education enrolling for CS but after 3 years only a few will receive a degree. It means that we have to understand which characteristics of the subjects should be taken into account in order to avoid dropout. While one direction of the attrition analysis of dropout is investigating the core subjects which students tend to fail, the other direction is conducting research into students' psychological characteristics. In the following section some of the research will be discussed in detail.

During the first academic year, CS students have basic subjects, such as mathematics and programming, which provide important basic knowledge for their further academic studies. Most studies claim (Borzovs et al., 2005) that most of the students fail in mathematics courses; however, programming courses also cause problems for students (e.g.: Beaubouef & Mason, 2005; Lasserre & Szostak, 2011).

According to students' characteristics investigations, there is a hypothesis that being a successful student in engineering depends on being successful in math during high school. Giannakos et al. (2017) conducted an eight-predictor model explaining 39% of student retention. The model contained the following variables: usefulness of the degree, cognitive gains and supportive environment. Other researchers suggest restructuring the education system; Kalmar (2013) claims that the two important pedagogical factors behind attrition rates are the lack of feedback and practice.

Although the above studies dealt with a huge range of reasons behind attrition, further studies are needed for a deeper understanding of the phenomenon.

The "Z" generation

Higher education is full of challenges and it is essential to analyse coping mechanisms to understand generations in order to retain them at the university. A generation is a group of people of the same age in a similar social location experiencing similar social events.

The generation which was born 1995-2012 is called Generation Z (McCrindle and Wolfinger, 2014), and is an interesting crossover from the previous Generation Y (or Millennials). The birth period of Generation Y is 1981-1995. They are called Millennials because they were raised in the digital age, a sign of the upcoming new millennium (Prensky, 2001). We can also call Generation Z as iGeneration because they always had access to the internet, iPods, and iPhones. This immediate ability to retrieve and transmit information could have a strong influence on their thinking and learning methods. Given the size of this group of people, it is perhaps not surprising that much effort has been devoted to understanding them and seeking to improve their skills as students.

The first of the Generation Z cohort started graduating from high school in 2013, and college in 2017 or are still studying. Generation Z is a kind of generation growing up with a culture of overprotective parents, a generation that has not received the opportunity to develop proper life management skills. Becoming a self-conscious individual involves making decisions and taking responsibilities for actions in uncertain situations and under unknown circumstances. Having overprotective parents hindered them in their proper social, emotional and intellectual development, which serves as an obstacle to be able to explore challenges of life and navigate in different working environments such as universities and colleges. There is little information about how Generation Z is going to be influenced by COVID-19.

Education reform:

Program description: Intervention

Based on information gathered in the literature review of issues surrounding attrition among CS students and analysing various intervention programs and their effectiveness, the following education reform has been performed.

Mentor program: first-year students are organized in fixed composition groups of 20 students in order to promote community building. Peer mentors serve to support and encourage new first-year students to succeed at the university. Peer mentors together with a mentor teacher lead a group meeting weekly and help new students throughout the academic year. In this buddy program, students share their problems with their teachers and fellow students, who then help them to cope with issues in university life. Peer mentors are knowledgeable guides for new students, thoughtful facilitators who provide access to people and resources, ultimately role models. Peer mentors coordinate and facilitate social and educational programs as desired or needed. there is an emphasis on fostering extra-curricular activities and peer interactions. The aim is to develop close student-student relations and student-teacher relations in order to closely monitor academic performance. It could result in satisfaction in basic psychological needs for competence, autonomy, relatedness and higher level of intrinsic motivation.

We started our education reform with non-compulsory mentoring classes and fixed groups and contemporary tutoring in 2006, but the program itself did not bring a breakthrough in reducing

dropout. However, a pilot program with 70 students was successful in 2015. During this period of time (between 2006 and 2015) the CS bachelor's degree programme did not change significantly; the subjects and outcome requirements were not modified and mostly the teachers as well remained the same. The legal background of higher education did not change either. So there was no substantive change that could have helped reduce dropout.

In the pilot program in 2015, we invited first-year students who performed badly during the semester. Students who participated in the study methods course performed better than those who did not (Takács, Horváth, 2017). After the pilot we extended the intervention to every first-year student to prevent them from dropping-out.

Promotion and prevention program: Achieving Student Success:

2016: A special course entitled "Preparation course for university studies and developing learning skills" became obligatory for all first-year students. The course consists of two main parts: an intensive training program and a special mentoring program. The training program is held by psychologists and peer counsellors for a group of 20 students. It is a combination of motivation, organisation, time management, and concentration that helps students stay on track and be able to achieve successful test scores. It is to develop and maintain 1) relationships with and support first-year students' acclimation, and a sense of belonging. 2) to motivate students to find out what they are passionate about and use their interests to connect with their university tasks, and to strengthen their Computer Science identity. 3) to help students stay organised, including labeling all materials and notebooks and keeping a checklist of essential tasks. 4) to help them prioritize and manage their time, keep track of assignments and tasks. 5) to develop soft skills to help concentration and preparation for exams to keep their minds on the task. Topics discussed are the difficulties in the transition from secondary school to university, how families can support students' academic life, general information about the university, the evaluation system used at the courses, general activities of student life etc. There are many benefits of the program: familiarisation with the university, developing teacher-student and peer relations, getting to know classmates before the academic year starts.

In addition to teaching them general studying and time-management techniques so that they will avoid procrastination, psychologists also develop students' soft skills and develop a strong study

group. Besides psychologists, a circle of peer counsellors was formed, who serve as a positive social and academic role-model. Peer counsellors hold a special workshop about learning techniques on how to study mathematics and programming subjects efficiently. They last 30 hours. The prevention course lasts 18 lessons, which are held one week before the semester starts, whereas the 12-hour-long second part is held during the semester (Figure 1).
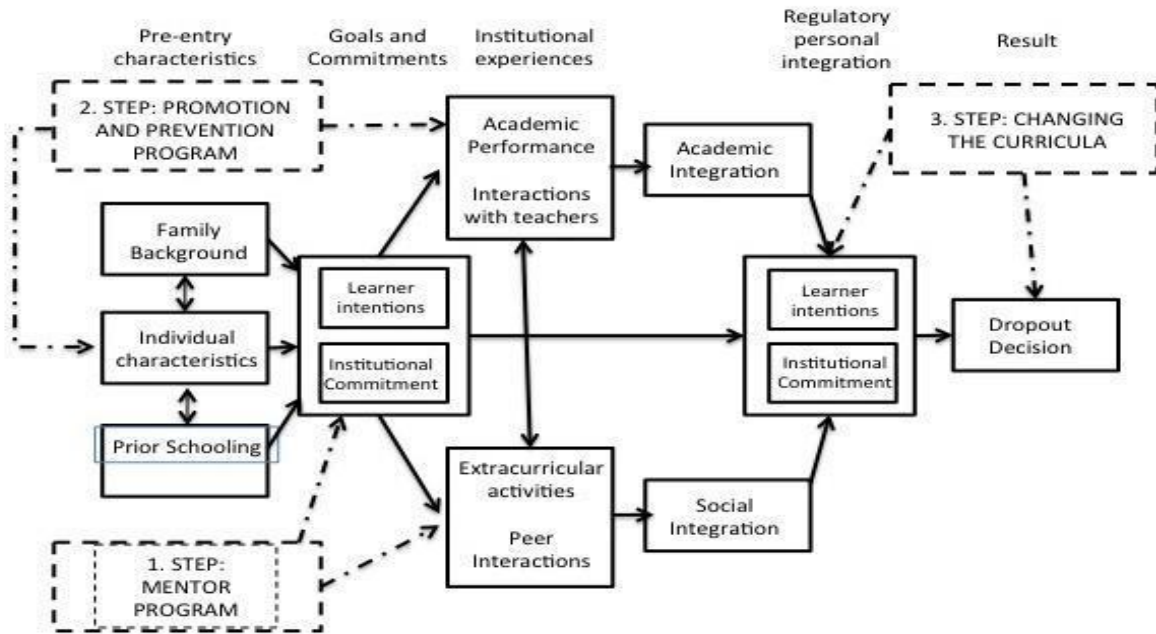

Figure 1: the steps of the intervention program along the intervention points using the diagram of Tinto's theoretical model

Method

Questionnaires:

GRIT

Psychological Immunocompetence Questionnaire

Lay- Procastionnaire questionnaire

Strengths and Virtues Questionnaire (Values in action (VIA))

Melgosa identity scale

EPQR-A

TIPI

Studies

1. study: Examination of dropout rates along the demographic data of the Faculty of Informatics

At a large public university in Europe (over 30,000 students) the overall dropout rate is 30%, and the worst among the departments is in Informatics, where the average rate of attrition was 60% between 2010 and 2016. The attrition rates are similar in other countries in Europe, as well (Borzovs et al., 2015), but it seems to be a worldwide issue, which can present a significant problem in the job market. Today more than 800,000 computer scientists would be needed, which makes this problem not only an educational but an economic one, as well. Most students in the first year of college fail the Introductory Mathematics course more often than any other courses. After the first semester, on average 30% of students leave the field of Computer Science, and this number increases to 60 % by the end of the first year (Borzovs et al., 2015). Therefore, it is worthwhile to analyse the curriculum of CS in order to find solutions for dropout.

A general CS program is based on various areas of mathematics, as well. For instance, discrete mathematics is essential for higher levels of CS. Every CS curriculum contains mathematics for at least 12 compulsory credits. However, at the departments of Informatics of a large public university in Europe half of the students (51 %) had problems with subjects related to mathematics. In the following the description of some theories behind the phenomenon of dropping-out clarifies the reasons and research directions in order to retain students.

Results:

In the first group of hypotheses, we analysed socio-demographic indicators of how students' data correlated with dropout. Students with higher enrollment scores are more likely to continue a university career in computer engineering. So those with higher enrollment scores are more likely to continue their studies. The GPA (grade point average) averages of the first semesters play a decisive role in the dropping out. There is a significant difference in GPA of the first two semesters between students who drop out and those who continue their studies.

In the next question, we examined the parents' educational attainment in terms of assuming that if the parents have a computer engineering or mathematical background This hypothesis was confirmed in the case of mothers, i.e., if the mother graduated in mathematics, computer science, or engineering, there was a greater chance that student would actually graduate from university (Lannert, 2004).

2. study: Profiling computer science students through their performance and psychological characteristics using cluster analysis

This study investigated a comprehensive model to help administrators and decision makers in planning interventions to address students who drop out from CS programs. The model is the consequence of a broad investigation, union of research and hypothetical examinations. It is adaptable and contains various factors related to student dropout at various levels: institutional, departmental or program. The complexity of this program shows that not only do we have to fix one factor behind attrition but we have to deal with it as a general phenomenon, as a process. These interventions can contain a wide range of actions on the part of the institutions. Maintaining students in such an area of CS has become a world-wide phenomenon and ageless worry for educators.

Results:

One of the main findings of this study was that psychological characteristics such as grit, occupational identity, or coping strategies can allow us to examine a student's behaviour. This study confirms the results that low levels of Consciousness can predict dropout. However, students with procrastination do not necessarily drop out. Students with low Extraversion and Emotional

stability are less open-minded to challenges and because of focusing on themselves, they become isolated from others and might drop out. The lack of strong ties and identity augment the probability of students' attrition. A Six-Cluster Solution was found in this study. The clusters are described as follows: Cluster 1 as "Almost dropping out"; Cluster 2 as "High probability of dropping out with Bravery virtue"; Cluster 3 as "Good achievers"; Cluster 4 as "Low Overall scores"; Cluster 5 as "High identity" and Cluster 6 as "Non-identifiers". The largest cluster was Cluster 3 (n= 585), which one third of the participants fell into. However, the low scores that were revealed in several areas on the instruments used attest to the need to provide appropriate university counselling services for these students. In this study, two main clusters were described as ones where there is a high probability of students leaving university/dropping out (26% in Cluster 2 and 35% in Cluster 4). They had the lowest GPA as well. It draws the attention to the fact that early interference could prevent these students from dropping out. We can conclude that participants in Cluster 2 are interested in computers, but they do not have enough information about what it means to study CS at university level. They do not have an IT attitude, which the previous educational institutions should have developed in them. By the time they start their university studies, they are supposed to know, for instance, what exactly CS means, and why it is important to have a deeper understanding of mathematics in this field. They probably come because IT jobs are among the highest-paying ones and they are brave enough to take the first step and enroll at a university. So, it would be important for the university, to visit high schools as a first step, and talk about real career identity, what IT learning means. As for the participants in Cluster 4, they had low general Occupational Identity, which meant that we could provide sufficient information and professional guidance for them about their chosen career. They also had low csores in PICI, which means low coping strategies might prevent them from taking the challenges of the university correctly. The gap between high school and university learning is too wide, so there is a need for catch-up programs that promote their abilities and skills in order to gain success in university life. A promotion and prevention training program might also be useful at the beginning of the academic year to strengthen their learning skills, such as time-management and communication skills. Low coping skills also means that they might have difficulties in stressful situations, and university life has many assignments and duties. A good life management course as an additional factor could help students to cope with stressful situations in a purposeful way. The clusters that emerged in this study helped to understand the dimensions of these students.

b) Generation Z

 This study examines the coping skills of today's generation of students in order to provide new perspectives on how different staff members of the university can support Generation Z in their academic success. The result of this discussion is significant because the results could be a remedy for the concerns of administrators, faculty members, teachers and practitioners on how to apply intervention strategies.

Results:

The monitoring-creating-executing subsystem is responsible for understanding and preparing actions to control the environment. Being open to positivity helps the enactment of positive coping strategies and discovering new solutions. The monitoring-creating-executing subsystem can activate the access to the person's resources and problem-solving capacity. Since the approach-belief subsystem consists of competences that are open to improvement, with appropriate interventions- like strengthening creativity, facilitating to discover alternative solutions- students can be facilitated to change whether their attitudes, or map their possibilities whether they can make changes in the environment. The components which are part of the auto-regulating subsystem are the following: emotional control, perseverance, impulse control, irritability control, help in handling the tensions that arise due to stress, and also help coping by controlling feelings. The self-regulating subsystem is in control of the process of accomplishing goals, and helps to control emotional states after failure. The self-regulating subsystem score was lower for the younger generations, pre- and post- Covid generations (Generation Z). However, lower scores in the self-regulating subsystem allows us to see that they have difficulties in shutting out the discomfort evoked by negative feelings. They can be identified as a risk population as they are less capable of mobilizing social resources or effective stress management tools. The lower resilience can lead to insufficiency in adapting to the changing demands of the environment. It means that the younger generation (Z) could have adjustment problems, they can have difficulties adapting to academic challenges. One of the conclusions could be that the younger generation needs

prevention programs in order to strengthen their auto-regulating subsystem, their resilience and flexibility. There is a need to develop these competences of the psychological immune system that help the individual to experience more successful adaptation even in more demanding life situations like COVID-19.

3. Study : **Applying the Rasch model to analyse the effectiveness of education reform in order to decrease computer science students' dropout**

In the present study, we introduce different steps of education reforms attempting to help our students be engaged in their university studies. The intervention program can have an effect and benefits on the retention of students such as influencing their goals and commitments, their institutional experience and their integration into the academic environments. Information is available about the benefits and outcomes of university intervention programs, but – unlike our intervention program – most of them are voluntary to attend. The research question is, '1. To what extent will an education reform at a large public university affect the attrition of students? 2. Can we have evidence of it regarding the subjects by analysing the pattern of grades?'

Results:

The most reasonable result from recent research is the effect it has had on the rate of retention. The 28% lower attrition rate among the students following the education reform suggests that interventions might help to reduce attrition. This reduced attrition – as a result of our reform – gave students the ability to continue their university education. The drop-out rate was minimized from 48% to an impressive 20%. However, we know that in CS programs we might lose these students later, as well (for example, because they start working), but retention still has great economic and social consequences. In order to answer to the first hypothesis (i.e. To what extent

will an education reform at a large public university affect the attrition of students?), it could be claimed that education reform might have a substantial part in reducing dropout.

Education reform is still in progress. Each semester we analyse the effectiveness of our education reform and we introduce different challenges in order to reduce further dropout. Annual statistical measurements throughout the program support the effort to help the reform develop along with its students. However, a program which involves every freshman student is not yet to be found. Our education reform involved all first-year students, and participation was obligatory in order to prevent students from dropout, so every student participated in the learning methods course. Both the research and the feedback by students are positive and encouraging.

Tinto (1975) introduced an interactional theory of student persistence in academic life. Our education reform has a developing impact on every factor that according to Tinto (2012) could be important for student retention. This theory emphasized the importance of the students' personal characteristics, traits, experiences, and commitment. The study course develops interactions between the student and the institution and help students to become more integrated, "fitted" academically and socially. The course supports these students in their efforts to become academically successful. The small groups provide a support system and strong relationships for the students. The structure of course addresses many of the relevant academic skills affecting dropout including time management skills and effective study skills. The ongoing, reflective, and responsive nature of the course allows mentor teachers to treat students as individuals within the groups. The education reform allows us to give students positive and proven guidance about how to become successful college students. The education reform facilitates members of the university to be involved in retention and student success in a meaningful way. The investment by the institute is huge, but we can experience the results immediately by conducting longitudinal research and find new opportunities to invest in order to develop student retention by the university. All in all, the education reform appears to be a win-win program that could be used by other institutions, as well, to increase the retention of their students.

In our research we analysed students' achievement from a new perspective: we applied IRT, based on the Rasch-model. We found different achievement patterns before and after the education reform. One of the most mentionable results is that experience has proven that reaching passing

grades has become easier after the education reform, which means that students are more willing to take the exam. It means that we could stop dropout which begins with students not attempting exams and ends with their leaving the university during the semester. In addition to this, there is another notable result: after the education reform the structure of subjects has changed, as well. Mathematics-related subjects became achievable at lower levels of difficulty, thus students with lower levels of ability also took exams. Programming or professional subjects became harder, more serious subjects, and retained their differentiating ability.

As we can see from the literature, most students drop out already in the first year of their studies. Our education reform can be one of the answers for this issue, because our program has been introduced for every freshman student, not just for students at risk. This way, with support from the mentors and developing study skills, we can prevent our students from drop-out. According to our findings we could retain 33 % of our students.

Discussion

Students' lives have been supported from many perspectives. A different approach can be highlighted from an educational organization perspective. For example supporting teachers by developing pedagogical strategies aimed at ensuring that students could get passing grades easier in examinations. According to industrial proposals every position requires soft skills so prevention and promotion programs are useful for universities and companies as well. It would be also vital for those who wish to interrupt their studies that a list of their completed subjects should be given so that by the time they wish to come back to the university they can continue their studies. Switching to evening courses can also be a solution because when the life circumstances are changing an evening course can be more achievable.

Re-enrolling to the university is also a crucial phenomenon. It means that after dropping out from the university, 20% of these students in a large public university re-enroll to the same course. Financial questions can be raised because it takes the instructor's working time. It is worthy to prevent these students from further failure and help them to automatically accept their previously completed subjects. The system should be adjusted to them, the university grade tracking system should be developed in order to follow their progress. A unified grade tracking system should also

help to follow the students' result even if they change to another institution the new university could easily access to their result.

It is important to see that subjects where it was more difficult to get better grades were mainly theoretical ones. In this respect, the teacher's explanations, illuminating lectures, for example, could lead to very serious shortcomings in case of knowledge transfer as well as the transfer of the same levels of the previous examination systems. This could result in lower achievement in areas where teacher's explanations would have been necessary. Students had a harder time bridging their knowledge gap.

In the future it is suggested to measure students' level of knowledge before entering the university in order to adjust the system better to their knowledge. Moreover, this type of analysis can generate ideas for instructors (e.g. to introduce more study supporting mechanisms) and course managers (e.g. to improve retention, scholarship system).

Questions/hypotheses of the dissertation	confirmed/disproved
1. **Study** **H1: There is a significant difference in the number of years spent in higher education among students who dropped out and those who continued their studies.**	confirmed
H2: Prior maths knowledge predicts a student's success at university, so it is assumed that those with an advanced maths qualification are less likely to drop out.	confirmed
H3: The dropout rate in Hungarian higher education is around 40% in bachelor programmes (Varga, 2010), but much higher in computer programming (Czakó, 2017; Fenyves et al., 2017; Varga, 2015).	confirmed

H4: Prior knowledge of programming predicts a student's success in university, so it is hypothesised that students with an advanced computer science degree are less likely to drop out (Borzovs et al., 2015; Zweben et al., 2015).	Partly confirmed
H5: Younger students are less likely to drop-out rates than older students (e.g. Carter et al., 2006; Horn, 1998)	confirmed
H6: There is no significant difference in dropout among those students who took two advanced final exams than those who did not.	confirmed
H7: Women have lower drop-out rates than men. (Rosson, 2011; Ceglédi, 2019)	confirmed
H8: The students' grade point average is the best predictor of dropping out. (Lannert, 2004; Kalmar, 2013)	confirmed
H9: Most students drop out after the first two semesters. There is a significant difference in the academic results of the first two semesters between students who drop out and those who retain.	confirmed
H10: Whether parents were educated in engineering, IT or mathematics plays a big role in the transmission of family patterns. (Lannert, 2004; Szemerszki, 2018; Pusztai, 2018, Czakó, 2017; Reay et al., 2009; OECD, 2014)	confirmed
H11: The academic performance of students, especially at an early stage, can depend heavily on the mother's education. (Lannert, 2004)	confirmed

2. **Study:** Psychological characteristics and dropout (Oláh, 2005; Richardson et al., 2012; Duckworth et al., 2007)	
H1.: Students who drop out score lower on psychological immunocompetence scales.	confirmed
H2.: Self-regulation and resilience show a positive correlation with retention (PIK scale)	confirmed
H3: A mature identity has a positive correlation with retention.	confirmed
H4: Moratorium and diffuse identity are associated with dropout.	confirmed
H5: A student with higher persistence (GRIT) has better academic results.	confirmed
H6: Students who drop out are more likely to procrastinate than those who retain.	disproved
H7: .Students in dropout groups scored low on the (Big5) scales of conscientiousness, openness and emotional stability.	confirmed
2. B) Z generation: H1: Generation Z has significantly stronger approach-belief subsystem than the Generation Y.	disproved
H2: Generation Z has significantly stronger creative-executive social and individual effectiveness (Monitoring- Creating- Executing	disproved

subsystem) than Generation Y (2004s).	
H3: Generation Y has significantly stronger self-regulation than Generation Z.	confirmed
H4: Generation Y has significantly stronger resilience than Generation Z.	confirmed
H5: There is no significant difference between pre- and post-COVID generations' psychological immune systems.	disproved
3. Study: **Impact evaluation of an intervention programme by the IRT model**	
H1: After the education reform mathematics became easier to complete.	confirmed
H2: It is assumed that the programming subjects will remain as passable after 2016 as before, i.e. they will be neither easier nor harder.	confirmed
H3: No change is expected in non-professional subjects, which can be completed in the same way as before.	confirmed

1. table: Hypothesis confirmation and refutation

The summary of this dissertation points to the fact that high dropout rates have various effects on the computer engineer education sector.

Despite the fact that this study presented interesting results, the authors believe that the conclusions derived from them should be interpreted carefully. Future research should be extended to additional variables. Further analyses could be considered, e.g., whether both examined groups can get until they receive a diploma or not.

We addressed some important issues of CS retention in this paper, and now we will discuss some further solutions to these problems here. It is hoped that by identifying some of the major reasons for high attrition rates among students, efforts can be made to reduce them. We should pay more attention to students.

Much research has investigated higher education dropout, but little attention has been paid to intervention programs that are not voluntary. Such intervention programs may affect students' engagement in university activities and can support them making their decision whether to retain or not. First time in the literature we have introduced an education reform for every freshman: all the theoretical classes have been made obligatory and an intervention program offering effective learning skills have been introduced to students who need it. Our results suggest we managed to improve student success. Introducing a new course as a compulsory item in the curriculum is a new phenomenon, through this we could reach those students who are not willing to participate in extra classes after school or not willing to reach for help but could be at risk of attrition. The implementation of the education reform could improve a further example of caring, and develop effective communication between students and mentor students.

Preventing students' attrition and gaining more information about students' needs might result in better understanding students' needs and developing more interventions to retain students at the faculty.

The summarised results of this comment open up new lines. It is hoped that other researchers will consider examining the potential impact of dropout on educational management issues and student gardes tracking systems. Our result could give a deeper understanding of the dropout phenomenon. Analysing students' results could help administrators develop new programs in order to increase retention.

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