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Some Explanatory Variables of Dropout in Technical Higher Education Institutional and Social Loss

SUMMARY

The focus of my research is the added value model of technical higher education. I approached the question from several aspects, in this paper I present some of the key results of the study conducted among students who interrupted or terminated their studies without a degree. I am looking for answers to the research questions of how dropouts can be categorized, i.e. from whose point of view it appears as a loss, and which background factors causing learning difficulties are crucial from the point of view of the loss. By turning the further education situation variable into a binary one, an institutional loss and a social loss group became distinguishable. I chose the logistic regression study to investigate which educational background factors can affect the probability of this type of dropout. Among the results, in addition to the critical subject(s), the interest in other training areas and the emergence of "alone with the problem" appeared as a novelty.

Journal of Economic Literature (JEL)

codes: I23

Keywords: technical higher education, dropout, explanatory variables, institutional loss, social loss

INTRODUCTORY THOUGHTS

My research focuses on the question of what the determinants of the added value of technical¹ higher education are and how they can be transformed into a model with an educational aspect, which can be used to identify the development potential of the added value of technical higher education. During the research, I will focus on the value creation process of higher education itself with a specific approach, the aim is to map the value creation elements of the higher education process and their interrelationships, and to model the value creation processes. I do not approach value added from a metric point of view, but I model it. I define the value added² higher education as the social value embodied through the values transferred through the higher education process, including individual benefits that support sustainable development (for more details see Mészáros, 2021). In my interpretation, quality does not equate to excellence based on the positive deviation of certain indicators from the mean (Brusoni et al., 2014). However, parallels can easily be drawn with the results of the educational theoretical work of Bábosik-Borosán-Budainé Csepela (2021), who studied the role of value awareness in pedagogy. The creators specifically mention constructive (both socially

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and individually valuable) life management targeted at the community-developing and individual-developing function of pedagogical activity as the value of pedagogy. In the context of higher education, I call this social and individual (stakeholder) value, which together represent the quality and added value of higher education. I narrowed the focus of the research to the added value of technical higher education, because on the one hand, the responsibility and role of technical higher education is prominent from the point of view of sustainable development, on the other hand, the danger of innovation/technological competition and the distancing of education is most evident, and technical higher education is especially affected by those who leave without a degree also regarding. I approached the value-added research from several angles, and in this paper, I present some of the key findings from a survey questionnaire of students who had dropped out or left education without qualifications.

As a first step, I will describe the research background that had the greatest impact on the present sub-research. I will then describe the research framework, the research questions and the main characteristics of the questionnaire and the sample used in the research. After presenting the research methodology used, I will present the results and conclude the paper with a summary of the conclusions.

RESEARCH BACKGROUND

Technical higher education is highly relevant and has a major responsibility in setting the sustainable direction of technological development (WEF, 2019). The real-world “mindset” required for STEM education, which has become more valued in our world due to accelerated technological development, and the openness of thinking that is a major determinant of success (Kun et al., 2002; Brandenburg, 2013), as well as the interdisciplinary approaches that are essential across disciplines and fields, represent new challenges of quality for sustainable social development. This can be linked to the

fact that the lack of skills and abilities is the biggest barrier to technological adaptation, according to the Future of Jobs Report published in October 2020³. From the point of view of the research, it is of great importance how the Hungarian technical higher education responds to these needs. Simply put, how to train “shock-resistant”⁴ technical citizens?

When researching higher education added value models, two main directions seemed to emerge: learning results and competence (Harvey, 2004; Chingos, 2016; Joniada-Ernesto, 2015) and individual or social advantage (Cunha-Millehr, 2014; Tomlinson, 2018; McMahan, 2017) based model. Domestic practice aims to implement an outcomes-based model (A shift in Higher Education, 2014). Similar to my own approach, researchers approach increasing added value by reducing attrition. More information on the implementation of this action plan can be found in the study booklet published in 2020 by the Education Authority, Hungarian Equivalence and Information Centre, edited by Ms Goldfárthné Veres⁵, which describes the planned system and operation of the higher education competency assessment. One of the results of the research, according to which “we succeeded in identifying two generic, short-term competences that are related to early dropouts: time management and learning strategy” (Goldfárthné Veres, 2020:7) was incorporated into my research, albeit with a slightly different name⁶.

The research team of the Education Authority, Hungarian Equivalence and Information Centre regularly publishes its findings in the Higher Education Analysis Reports, the results of which in issue II.3 (2018) are mostly published in the field of technical education. It has been found that the technical field is considered to be more at risk than the non-technical field in terms of the proportion of students interrupting their studies without graduation i.e. dropouts (Harkányi, 2018). In the same volume of studies, Hámori (2018) analysed the social characteristics of students in the field of engineering, analysing the satisfaction of en-

gineering and non-engineering students with certain aspects of their education. According to the study, students in the technical field were the least satisfied with two factors: the inspirational power of the lecturers and the lecturers' attention to the students' career path. In my research, I included these factors among the background factors of learning difficulties and examined whether these background variables also occupy such a "prominent" place among the reasons for drop-out. Szigeti et al. (2021) in their study *Types and Characteristics of Student Progression* also observed the "diversity" of students in the STEM field. The aim of the research is to identify objective and subjective predictors of dropout and to identify groups of students who continue their studies. An interesting finding, also in relation to my own research, is that one of the three identified clusters (corrective, sliding-postponing, standard), the corrective experimental one has a characteristic feature of changing specialisation or institution. This further reinforces my own definition of drop-out; the phenomenon of re-engagement needs to be addressed. The other important finding for STEM higher education is that sliding-passing students are over-represented in computer science, engineering, medicine, and natural science courses. A key finding of the research is that the field of education has been shown to be the most important predictor of the higher education career path.

Molnár and his co-authors summarise the research of the University of Szeged related to competence measurement in an article in the volume of educational studies published in 2021. Among first-year students, the researchers examined which competencies or student background factors most predict student success. As a result of the longitudinal studies, the potential graduation was mostly predicted by the acquisition of the first 20 credits and the mother's education, while at the same time, reading literacy can be an important supporter or obstacle to university success. The authors found that, although problem-solving ability did not show a correlation with academic suc-

cess, it was strongly correlated with students' knowledge acquisition and application and research skills, which are essential components for a university degree attainment. As problem-solving skills are a key factor for 21st century labour market competences, the researchers argue that they need further development.

An interesting example is the volume of studies on STEM (practice-oriented project-based) education and STEM students, edited by Sahin in 2015, which focuses on the international literature specifically relevant to technical higher education. It holistically presents an approach to "addressing" the challenges of 21st century competencies – critical thinking and application, interdisciplinary linking to industrial needs – through a Project Based Learning (PBL) methodology. The work presents a highly complex presentation of the "STEM SOS" model, which was created in the USA with the aim of providing engaging, fun, and effective teaching of difficult subjects. The model emphasises the interdisciplinary nature of STEM education and devotes a separate chapter to researching the achievement gap in mathematics and science. Avoiding a presentation of the PBL method at this stage, I would like to underline that the volume of studies contains valuable approaches to the pedagogical aspects of STEM education, the success of which is based on teacher-initiated and student-led instruction and lesson completion on the one hand, and on projects that are sustained throughout the year on the other. Representing research-based and socially and economically connected education, Hasanefendic and colleagues' publication (2015), examining German and Dutch examples, draws the attention of Portuguese technical higher education to the integration of short-term, project-oriented research into short-cycle education.

Searching among the international publications of the last two years, I found interesting articles with a focus on technical higher education. Through a technical university project in Kazakhstan, Jantassova (2021) shows how the internationalisation of technical higher educa-

tion could be connected with the development of competence-oriented and market-responsive educational programmes and methods, thus representing a means to increase competitiveness. The study by Eshpulatovich (2022), a professor at the Tashkent University of Textile and Light Industry, provides recommendations for the use of software tools in relation to the development of professional competences. The features and advantages of some software tools have been compared along the goal-content-method-form-assistance concept. Nematov (2022), also representing Uzbek higher education in his article on improving teaching methods of the subject “Electrical engineering and electronics”, draws attention to the importance of problem-based teaching and the complexity of the choice of teaching method.

I also find it important to mention two scientific works that represent two Western countries, Finland and Ireland. Routaharju’s (2022) research explores how content and key sustainability competences that support the transition to sustainable development are reflected in the curricula and subject content and teaching activities at the South-Eastern Finland University of Applied Sciences, School of Technology. The results show that there is scope for enhancing both the content of sustainable development and sustainability competences, as well as more structured educational organisation and systematic guidance on how to integrate them into curriculum development and teaching could support the transition to sustainable development.

Gallery’s (2021) PhD thesis highlights the impact of the labour market in shaping engineering education. It examines the impact of outcomes-based education on engineering teachers and engineering education in the Irish engineering higher education sector. Gallery’s suggestion as an engineering teacher is that rather than assessment and compliance with the different ISCED levels, a focus on the process of engineering identity formation is in place in the education of the next generation of engineers, alongside a well-structured sys-

tem of ‘who, what and how to teach’ questions to train engineers appropriately for the labour market.

A review of the identified and selected literature reveals that there are many prominent researchers, both domestic and foreign, working in the field of quality and added value in higher education, and that there is a rich, diverse, and multifaceted conceptualisation.

The research unit, which is the focus of this paper, will be described in more detail by outlining the research objective, framework, and research questions.

THE AIM AND SCOPE OF THE RESEARCH, RESEARCH QUESTIONS

The results presented in this paper fall under the umbrella of the sub-research that, deriving the value-added approach from the lean⁷ management philosophy, considers dropouts in higher education as a loss element of the value-added model, and thus the elements of the value-added model are inversely approximated by examining dropouts. In this sub-study, I will conduct a questionnaire survey among students who have dropped out of university, to find the reasons and characteristics of failure along the lines of student, teacher, institution, and support networks. It should be stressed that I consider all students who leave their studies without having completed their studies as dropouts. At the same time, a significant proportion of such dropouts involve a resumption of studies within the institution or at another institution. This is why the question of how to categorise early school leaving, i.e. from whose point of view it is a loss, has become a priority for research. Furthermore, it was a research question which background factors that cause learning difficulties are determinants of loss.

In response to the relevant research questions, in my paper I present the categorization of drop outs as an element of loss, as well as the exploration of defining explanatory variables, through which we can better understand the reasons and factors behind dropping out, and

thus approximate the components of the value-added model and identify preventive actions.

I narrowed the research to the three dominant institutions in the 5 clusters of higher education in Hungary (broad profile, but different professional composition from the classical, large student population), classified by Hrubos (2012), but with different technical priorities in terms of location and operational potential.

In order to present my research methods and results, it is necessary to describe certain characteristics of the survey questionnaire and the sample, which I will do in the next chapter.

THE QUESTIONNAIRE AND THE SAMPLE

Using the results of previous research, I conceptualised and operationalised (Babbie, 2001) a possible approach to the added value of technical higher education. I approached the causes of academic difficulties along four dimensions - student, teacher, institution, and support networks. In a questionnaire survey conducted among students who dropped out, I asked the target group about the personal and official reasons for the termination of their legal student status, the number of semesters spent at the institution in connection with the relevant training, the background factors of possible academic difficulties, their further education situation, housing during the training and some characteristics describing the relevant training. For the personal reasons for the termination of the legal student status and the background factors of academic difficulties, I edited a four-item Likert scale questionnaire (full, critical, uncharacteristic, no scale at all), with the aim of eliminating the middle scale value. I left it possible to give individual explanatory answers to several questions of the survey questionnaire, and the non-Likert scale variables - where this could be interpreted and were equipped with optional answer types.

The questionnaire was sent via the Neptun study system in the form of a UNIPOLL⁸ questionnaire to students who terminated their student status at their own request due to other

compulsory circumstances, with a 5-year time-frame selected, and the questionnaire was sent to students affected from 1 January 2015, in the first semester of 2020. After a few months of filling out the survey questionnaire, the number of respondents remained unchanged, so I asked for the survey questionnaires to be closed in July and November of 2020.

Importantly, the background factors of learning difficulty cannot be considered comprehensive; the study focused on the elements that were easy to assess and define, following the main dimensions of the model. Consequently, students' social, cultural characteristics, competences and motivations are not included in the study structure. To mitigate this circumstance, several questions in the survey questionnaire were marked 'other' and were given the option of a free text response. The analysis of these questions helps us to go beyond the framework of our prepared survey structure; it nuances and enriches it, which I have given space to in a separate study (Mészáros, 2021a).

The questions of the survey questionnaire are relevant to the current study and ask about the situation *in further education and the background factors* that make it difficult to study. Two of the three technical institutions selected produced a sample of universities that could be evaluated (n=863), of which the sample for the present sub-survey is 691 and 625 for the relevant questions (the number of answers to the first and second questions now relevant). Observing the stratification of the basic sample based on the variable of the reason for termination of the legal student status:⁹, the following main findings can be made: a non-representative sample is a good representation of the basic sample, but the analytical aspects to follow are the multifaceted approach and cautious and careful inferences. *The phenomenon of readmission draws attention to itself.*

I adapted the applied research methods to the research goal, the questions to be answered and the possibilities offered by the questionnaire survey, which are the subject of the next chapter.

RESEARCH METHODS

In examining the relationship between dropout and educational background factors, the question arose whether the background factors that predict dropout can be identified as causes of learning difficulties. Since this requires the investigation of causal relationships, I chose the method of logistic regression (hereafter: logit). As a result of the logistic regression analysis, I aimed to examine which explanatory variables significantly increase the probability of dropping out.

As a preparatory step of the logit and for the purpose of categorising dropouts, the further education status¹⁰ was converted into a binary variable¹¹, allowing to distinguish between a group of students who stay in or leave an institution (institutional loss) and a group that remains in higher education or leaves higher education (social loss¹²). This made our study two-dimensional in the sense that we researched the explanatory variables for institutional and social dropout separately. Our aim is to identify the determinants of learning difficulties in these groups, which could be useful for the value-added model.

The logistic regression analysis was performed in the R program. In order to perform the logistic regression analysis (Hastie et al., 2009), I selected the most independent and relevant background factors for both dimensions/groups (institutional, social) based on the correlation between 17 background factors describing learning difficulties and preliminary cluster analysis results (Mészáros-Takács, 2022¹³). I examined the correlations using the Pearson's correlation. I considered correlations greater than 0.55, but correlations above 0.6 and 0.7 formed a separate category. My basic principles were to place the important factors of the cluster study, and to highlight one of the factors that are strongly correlated - based on the research background.

For the logistic regression analysis, I used the previously determined factors of the institution-

al and social analysis as explanatory variables. The target variable was institutional and social dropout (binary indicator; with a value of 0 if no loss occurred, with a value of 1 if dropout occurred). In the logit study, the institutional and social (higher education) studies were conducted along three main lines: (1) The values of the variables (according to the four-point Likert scale) were treated together. (2) Treating the values of the variables as separate categories (according to the scale values). Thus, we could separately examine the relationship between the Likert scale attributes of each variable and the target variable. (3) In the third approach, the values of the variables were “completely” and “of decisive importance”, i.e. 1 or 2 of the Likert scale (“important” group), as well as “not typical” and “not at all”, i.e. values of 3 or 4 were also treated in a (“not important”) group. These refinements ensured the understanding of the results.

Interestingly, due to the categorical variables included in the study (Likert scale), I was not able to numerically/percentage-wise determine the strength of the explanatory variables (to what extent they increase the likelihood of dropping out) as reported in Hastie (et al., 2009)¹⁴. However, the results provide statistically significant evidence for the explanatory variables of institutional and social dropout based on the sample examined, which are presented in detail in the next chapter.

RESULTS

As a preparatory activity for the causal investigation (the frequency distribution of the variables of learning difficulties, treated together with the responses “completely” and “of crucial importance”, is presented in Annex 2), I examined correlation coefficients between the factors chosen as important based on the research history (which I will not discuss in this paper due to focus and scope limitations) for the institutional and social investigation. This was necessary because it is a prerequisite of logit analysis that there should be no correla-

Table 1: Explanatory variables of the logistic regression

Institutional analysis	code	Social analysis	code
learning methods	2	schedual	1
other field of training	4	other field of training	4
critical subject(s)	7	assessment - requirements	6
assessment system	8	critical subject(s)	7
the teacher was not inspiring	10	assessment system	8
supporting curriculum	12	the teacher was not inspiring	10
I felt alone with my problem	16	supporting curriculum	12
		I felt alone with my problem	16

Source: own editing

tion between factors (Hastie et al., 2009). Using Pearson's correlation (Appendix 1), only two factors appeared to be completely independent: 'I became interested in another field of education' and 'I felt alone with my problem'. The other factor was also independent, but I approximated it with a separate analysis (Mészáros, 2021a).

By visualising correlation chains, which revealed connections similar to those of the background factors, I tried to extract from these correlation chains those elements that were both important in the preliminary cluster analysis and most defining for each dimension. As a result, Table 1 shows the explanatory variables found to be suitable for logit analysis. The "code" column contains the research codes for the background factors that cause learning difficulties, while the first columns contain short descriptions of the background factors associated with the codes.

INSTITUTIONAL LOGISTIC REGRESSION ANALYSES

The results of the logistic regression analysis are presented in Annex 3. The logit test was first performed by treating the variables together, based on the results of which, in the institutional test, the "critical subject(s)" and "the teacher was not inspiring" factors were found to be decisive at the 0.001 significance level, be-

cause the absolute value of their "z" value was 2- was greater than (Hastie et al., 2009:119-124). Interpreted differently, I decided with a 99.9% probability that the corresponding coefficient was not zero, i.e. that these variables had a decisive explanatory power in terms of increasing the probability of dropping out. The "supportive curriculum" was found to be a determinant of institutional dropouts with a probability of 95%.

As an alternative approach, we have separated the attributes of the variables. Thus, we identified the attributes "completely true" (Likert scale 1) of the variable "the teacher was not inspiring" as a significant explanatory variable for dropout with a probability of 99% (0.01 significance level). The "critical subject(s)" attribute "of crucial importance", i.e. Likert scale 2, showed an explanatory power of 0.05 at the significance level for institutional dropout, i.e. a statistically significant increase in the probability of dropping out. Furthermore, it cannot be omitted that the attributes of the Likert scale "critical subject(s)" with a value of 1 also showed explanatory power at 0.1 level of significance.

When we treated the "completely" and "crucially important" attributes together, we obtained interesting results. On the one hand (which was not unexpected based on the antecedents), for both the "critical subject(s)" and "instructor was not inspiring" factors, I decided

with 99% probability that they had explanatory power for the increase in the dropout probability. At the same time, a new explanatory variable, the variable “learning methods”, appeared, with Likert scale values of 1 and 2 at a confidence level of 0.95, which could increase the probability of institutional dropout.

SOCIAL LOGISTIC REGRESSION ANALYSES

Similar to the previous logic, when the variables were treated together in the social investigation, based on the results of the logit study, I decided on the explanatory power of the “time allocation” factor (i.e. that the target variable is not zero) with 99% probability based on the results of the logit test.

When we examined the explanatory power of the attributes of the variables, the attributes “I felt alone with my problem” marked “completely” and “I became interested in another field” marked “of crucial importance” as well as the attributes “time management” with a probability of 95% were shown to be a factor increasing the probability of social loss. Noteworthy is the attributes “I became interested in another field” and “to a full extent” (Likert scale 1), for which I decided with 99% probability that the social dropout coefficient is not zero, i.e. the variable increases the probability of dropping out of higher education.

When we combined the “important” attributes (“completely true” and “of crucial importance”), a new variable appeared, “critical subject(s), which shows an explanatory effect with a significance of 0.1, i.e. with a probability of 90% strength in relation to social dropout.

In summary, the following were identified as explanatory variables in the institutional analysis: “*the critical subject(s)*”, “*the instructor was not inspiring*”, “*the supporting curriculum*”, and “*learning methods*” were identified as explanatory variables in the institutional investigation. In the logit analysis of social dropout, the study background factors “*time schedule*”, “*I felt alone with my problem*”, “*I became interested in another field*”

and “*critical subject(s)*” were identified as significant explanatory variables.

Based on the logistic regression analysis carried out within the presented framework, the following dimensions and factors represent the explanatory variables of the (institutional and social) loss of technical higher education based on the examined sample:

- Student dimension: “*time schedule*”, “*learning methods*”, “*someone else became interested*”.
- Teacher dimension: “the teacher was not inspiring”.
- Institutional dimension: “*critical subject(s)*”, “*supporting curriculum*”.
- Network dimension “*I felt alone with my problem*”.

It can be seen that all four dimensions may be involved in increasing the likelihood of dropout. However, I think it is important to point out that the likelihood of dropping out of higher education was not found to be influenced by the teacher dimension, while the same can be said for the network dimension in terms of institutional drop-out. This could be interpreted as a lack of teacher inspiration leading to dropout, whereas this is no longer an explanatory variable for drop-out. The network dimension, however, may lead to social loss, while the likelihood of dropping out of the institution is not found to increase. The results obtained can be approached in several ways, and I will summarise them in the concluding chapter of the paper, where I will also briefly touch on the next steps of the research.

FINAL THOUGHTS

To summarise the results, I think it is useful to start by highlighting a few correlations. It is striking that “*critical subject(s)*” is an important explanatory variable of both institutional and social loss. These suggest that the subject programme deserves a prominent place in the value-added model, and that there are numerous opportunities for a separate research topic on what we teach our students. It is noteworthy that this is

the only common point between the explanatory variables of institutional and social loss in the sample. The likelihood of *institutional drop-outs from the sample is further increased by the distinctive characteristics of the teaching-learning environment “the instructor was not inspiring”, and the inadequate quality or quantity of “supporting curriculum” and student “learning methods”*.

In other words, not higher education, but based on the investigation, students who are dissatisfied with the teachers' inspiring ability and the supporting curriculum can leave the institution more typically. Furthermore, the inadequacy of the student's learning methods can increase the likelihood of institutional dropout. I consider it an interesting question and part of my further research, which methods the institutions systematically use to obtain information about these important factors revealed by the research, as well as what they use this information for. *To what extent does awareness characterise technical higher education in terms of the teacher's ability to inspire and motivate, the quantity and/or quality adequacy of supporting curricula, and the effectiveness of student learning methods?* In addition to “time management” problems, the students who left higher education drew attention to two very interesting aspects: “I became interested in another field” and “I felt alone with my problem” background factors. Based on the research conducted on the sample, these factors can increase the probability of dropping out of the higher education system and social loss, so they are extremely important at the social level. *The emergence of “interest in other areas” and “loneliness” as predictors of social loss is a separate innovation. The importance of consciously dealing with students who are looking for a way in life, who have become uncertain in terms of their field of study, and helping these young people change professions or even institutions as a “positive dropout phenomenon” is a great responsibility. Similarly, the importance of strong communities came to the fore as a result of the research.* These factors can save a student based on the test performed on the sample.

It should be stressed that the value-added model, which is the crown of the research, should not forget the substitutes, as it would have been possible to highlight other factors in the case of strong correlations. The results extracted from the previous studies in the linked research series could have influenced the results of the present study, which is why I consider it important to have surrogates “at hand” during the validation of the value-added model. In my view, this way we do not lose important factors, including the focus, and we reduce the size of the model to a manageable size.

The results presented in this paper have made a significant contribution to the research synthesis necessary for the construction of a value-added model of higher technical education.

NOTES

- ¹ In the course of my research, I interpret higher education institutions providing training in the field of STEM (technical, natural science, mathematics, IT) degrees as technical higher education (and related institutions), which does not exclude the possibility that the higher education institution also provides courses in other fields of science.
- ² based on the value judgements of the evaluating stakeholders.
- ³ According to the report, some key competences will increase in importance by 2025: critical thinking-analysis, problem solving, self-management, teamwork, technology use and development.
- ⁴ „shock resistance” (Boros, Filipov, 2020, 295), a synonym for adaptability.
- ⁵ has been prepared under the Hungarian EFOP-3.4.5-VEKOP-17-2017-00001, Sectoral programmes for systemic improvements and accessibility in higher education. The results of the preparation of the Higher Education Competency Assessment were presented on 30 January 2020, at the final conference of the above-mentioned project by Ádám Hámori of the Education Authority, Hungarian Equivalence and Information Centre.
- ⁶ I have named these background factors time management and learning methods and they are included in the student dimension of the value added model (author's note).

⁷ Lean management, formalised by researchers at the Massachusetts Institute of Technology (MIT) in the US, is a value-added management and development approach that focuses on increasing the proportion of activities and resources that add value for customers and employees, while all resources, activities, that which does not produce value is unnecessary, and therefore considered a loss and strives to minimize them through continuous self-reflection.

⁸ provides full anonymity

⁹ there was a question about this in the questionnaire.

¹⁰ I transferred to another higher education institution (1), I am resuming my studies (2), I am not continuing my studies (3), I am continuing my studies abroad (4).

¹¹ With this research, I have created a value pair of graduates/interrupted studies, both from an institutional and a social point of view. According to Luhmann's theory, each social subsystem can be defined in terms of a binary code system (Luhmann, 1990). Interestingly, Béla Pokol (1991), in his study of professional institutional systems, writes that the educational subsystem has no internal central value dual, and therefore uses binary codes from external systems, e.g. the academic subsystem, to assess quality.

¹² it can also be called a higher education loss.

¹³ under editing in the Knowledge Management periodical, expected publication August 2022.

¹⁴ the categorical variables of the Likert scale do not provide the same explanatory power as the discrete variables. For example, in the study described by Hastie et al (2009) (Hastie et al, 2009:122-124), a % increase in the incidence of heart disease was found for a unit increase in tobacco consumption. In my research, it is unclear what is meant by a unit increase – thus, I have refrained from showing a specific percentage explanatory power.

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Appendix 1: Pearson's correlation

Educational background factor	Code*	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17
scheduled	1																	
learning methods	2	0.57																
learning difficulties (I don't understand)	3	0.39	0.63															
other field of training	4	0.03	0.09	0.30														
unclear requirements	5	0.31	0.36	0.44	0.20													
assessment - requirements	6	0.31	0.34	0.42	0.12	0.71												
critical subject	7	0.42	0.56	0.63	0.10	0.52	0.63											
assessment system	8	0.35	0.31	0.36	0.12	0.58	0.67	0.58										
the teacher's professional competence	9	0.18	0.21	0.32	0.16	0.54	0.61	0.41	0.58									
the teacher was not inspiring	10	0.25	0.33	0.43	0.23	0.57	0.64	0.52	0.58	0.69								
the teacher did not follow my progress	11	0.28	0.35	0.43	0.14	0.57	0.60	0.50	0.56	0.61	0.69							
supporting curriculum	12	0.30	0.34	0.38	0.11	0.61	0.67	0.54	0.58	0.56	0.64	0.59						
learning auxiliaries	13	0.26	0.26	0.31	0.18	0.53	0.50	0.34	0.49	0.54	0.50	0.55	0.59					
modern ICT	14	0.24	0.28	0.29	0.18	0.51	0.51	0.38	0.53	0.51	0.53	0.54	0.60	0.73				
access to student services	15	0.30	0.31	0.35	0.18	0.50	0.50	0.37	0.49	0.45	0.49	0.52	0.52	0.61	0.67			
I felt alone with my problem	16	0.33	0.43	0.49	0.16	0.44	0.39	0.43	0.41	0.35	0.44	0.52	0.38	0.35	0.38	0.48		
other	17	0.15	0.11	0.11	0.07	0.18	0.14	0.07	0.17	0.14	0.14	0.17	0.08	0.20	0.14	0.26	0.21	1.00

* absence (this is the term in the database)

0.60>Pearson correlation>=0.55
 0.70>Pearson correlation>=0.60
 Pearson correlation >=0.70
 independent variables

Source: own editing based on the R program

Appendix 2: Frequency distribution of study difficulties variables by sample ('completely' and 'crucially important' answers together)

Variables of learning difficulties	Sample_1	Sample_2*
critical subject	61%	55%
schedule	44%	44%
the teacher was not inspiring	46%	40%
learning methods	37%	35%
became interested in a different field of training	43%	34%
assessment - consistency of requirements	42%	34%
I felt alone with my problem	33%	33%
learning difficulties (I do not understand)	38%	33%
assessment system	36%	32%
supporting curriculum	48%	30%
ambiguous requirements	32%	26%
the teacher did not follow my progress	28%	26%
the teacher's professional competence	19%	24%
modern ICT	23%	21%
learning auxiliaries	17%	18%
access to student services	15%	18%
other	14%	9%

*Sample_2 sorted, variables above 30% highlighted

Source: own editing

Appendix 3: R programme logistic regression main indicators

Institutional loss assessment	variables together		variables separately		"important" *		
	variable codes	sig.	z value	sig.	z value	sig.	z value
H7	0.01	2.897					
H7_2			0.05	-2.248			
H7_12					0.01	-3.171	
H10	0.01	- 2.652					
H10_1			0.05	2.066			
H10_12					0.01	2.796	
H12	0.05	-0.984					
H2_12					0.05	-1.968	
H4_12					0.1	-1.710	

* "to the fullest extent" and "of critical importance"

Source: own editing based on the R programme

Social loss assessment	variables together		variables separately		"important" *		
	variable codes	sig.	z value	sig.	z value	sig.	z value
H1	0.01	-2.730					
H1_2			0.05	-2.570			
H1_12					0.05	-2.454	
H4_1			0.001	-3.531			
H4_2			0.05	-2.025			
H4_12					0.001	-6.448	
H16							
H16_1			0.05	-2.215			
H16_12					0.1	-1.947	

* "to the fullest extent" and "of critical importance"

Source: own editing based on the R programme