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The Role of Student Employment in Persistence and Efficiency in STEM Higher Education

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Abstract

The high dropout ratios that characterize STEM fields can be explained by several factors, one of which is the employment of students during their studies. Our research aims to explore the impact of student employment on persistence and academic performance in STEM fields. During our research, we used the data of the Hungarian subsample of the PERSIST 2019 database (N=1045). According to our results, IT trainings are more resistant to the negative effects of employment than other trainings, as students working in this field did not differ from their non-employed peers in terms of either persistence or academic progress. Concerning the science, engineering, and non-STEM training, employment had a significant negative effect on academic performance, but it was primarily compensated by being employed in study-related jobs in science training, which also had a favorable effect in non-STEM training courses. However, in the field of engineering, employment in the profession reinforced this adverse effect too. In the field of informatics, study-related work also had a negative impact. Based on our results, we think it is worth considering the broader spread of dual training courses in higher education, during which students can complete an internship at a company or partner organization in addition to theoretical training.

Introduction

The higher educational system and its institutions have diverse functional structures with different meanings and significance for different actors. In the 1990s, due to expansion and technological development, higher education institutions faced new challenges. Universities had to impart not only theoretical and academic knowledge but also had to implement the transfer of practical knowledge, concerning which the knowledge of the needs of the labor market is an essential condition (Castro & Levy, 2001; Hurtado, 2007; Teichler, 2011). Since then, exploring the needs of the labor market has become essential in preparing students for work, which has become a new task of higher education (Castro & Levy, 2001). The changes are well reflected in policy decisions and reports, as governments are constantly calling on institutions to adapt their curricula and training offerings to meet the needs of the knowledge-based economy (Elliott, 2017). This approach can contribute to higher labor market returns for students, and with the spread of market operations, higher education appears as a service that is significantly influenced by labor market needs, and training must be marketable (Fitzgerald, 2012). All of this can erode the classical, intelligentsia-educating functions of higher education, and the proliferation of company-funded research or collaborative training between companies and universities can reduce the independence of higher educational institutions. Post-expansion, market-oriented higher education is also characterized by the fact that some more marketable training courses come to the fore and others are pushed into the background, leading to a weakening of intelligentsia formation functions (Castro & Levy, 2001; Bocsi, 2019). The expansion is also accompanied by a heterogeneous student base and significantly higher dropout ratios, accompanied by a severe loss of resources for both students and institutions (Bocsi et al., 2019; Markos et al., 2019; Kocsis & Pusztai, 2020; Pusztai et al., 2019).

STEM, i. e. science, technology, engineering, and mathematics training, has been given a prominent role in market-oriented higher education, emphasizing the labor market's needs. The examination and promotion of STEM courses is a relatively new trend in educational research. This is also indicated by the fact that the first version of the acronym STEM (SMET), first used by the US National Science Foundation (NSF), can be dated to 1998 (Li et al., 2020). The growing scientific interest in STEM courses is well illustrated by the continuously increasing number of publications on the subject. The results of Li, Wang, Xiao and Froyd's (2020) review of STEM research over the last 20 years also showed that we could talk about a dynamically growing research field that is gradually becoming independent. Almost 30% of the 798 STEM-themed publications they examined were born in 2018, and it can also be seen that the number of publications started to grow exponentially in 2010. The gradual and current strengthening of the professional identity of journals dealing with STEM fields is indicated by the fact that the number of papers published in them has increased exponentially in the last few years, as well as the inclusion of the first STEM (International Journal of STEM Education) in SSCI (Social Sciences Citation Index) recently, in 2019 (Li, 2019).

As the importance of research in STEM areas has emerged in higher education, which has a stronger relationship with labor market needs than before and is characterized by higher dropout rates due to expansion, our study examines the relationship between dropout, student employment, and academic progress in STEM courses. The sheepskin effect is the added value of certificates and diplomas, which, in addition to the return on time spent in education, is obtained by the student after receiving the degree (National Research Council, 2012: 83). Based on the research of Kun (2014), it can be said that in Hungary, graduates can rely on higher earnings on average in all types of higher education than those with a secondary level school-leaving certificate, but the mechanism and influencing factors have not been explored. Kun (2015) later found a positive correlation between graduation, the length of time between graduation, and the development of full-time salary.

Our research aims to explore the applicability of traditional theories on the dropout and the impact of student employment on persistence in STEM fields. This is a superdisciplinary field that is significantly more closely intertwined with labor market needs and whose primary goal is to educate not classical intelligentsia but also experts with specific knowledge who are most likely to meet the needs of the labor market. It is also a question whether unemployment and the interruption of studies lead to a career break as serious in STEM courses as in other careers, where the criterion for employment is having a degree (e. g. in medical and legal courses (Lee &

Ferrare, 2019).

STEM Courses in the Focus of Educational Research and Policy

The development of STEM training at all levels of education and the promotion of STEM higher education are gaining more and more emphasis on the communication between educational institutions, business communities and governments. Economic arguments typically justify the increasing scientific interest as most authors say that the demand for skilled workers in STEM fields is constantly increasing, so the extraction of qualified professionals appears as a key to the competitiveness of the Western world (e.g. Koehler et al., 2016). In addition to changes in the labor market, solving some of the global challenges that can be interpreted as a typical challenge of the 21st century (e. g. climate change, the emergence of the information society, typical problems of ageing societies) can also be an important factor in increasing the number of STEM graduates.

Although the study and promotion of STEM areas first came to the attention of researchers and policymakers in the United States, the question of their economic significance has become increasingly common across Europe over the past decade. According to the Europe 2020 strategy published in 2010, the proportion of people having a higher educational degree is low. According to forecasts, the demand for graduate labor in Hungary will increase to a greater extent than the average of the European Union. For this reason, the proportion of people entering higher education needs to be increased, and the share of STEM courses needs to be increased in particular. As part of the strategy, it was the responsibility of the Member States to 'provide a sufficient number of young people with a degree in mathematics, engineering or other science and to place creativity, innovation and entrepreneurship in the middle of curricula' (p. 15). The European Recovery Plan to address the crisis caused by the COVID-19 pandemic, including the Next Generation EU, has re-emphasized the importance of education policy decisions on STEM education. However, according to STEM research, not only the promotion of STEM courses, i. e. increasing the proportion of applicants, but also reducing dropout is an important goal. According to the literature, a specific problem typical for STEM training courses is significantly higher than the average dropout ratio, which significantly hinders the increase in the number of skilled workers (Chen, 2013).

STEM Training Courses and Dropout

The literature highlighted high dropout ratios and low persistence of students as a common feature of STEM courses (OECD 2019). Persistence is often defined as the opposite of dropout, which means students' commitment to study, perseverance, and effort invested in learning (Astin, 1975; Pusztai, 2015). The dropout of STEM students has been addressed in several studies (Belloc et al., 2011; Duque, 2014; Kori et al., 2015; Xenos et al., 2002). According to research, student dropout is influenced on the one hand by demographic characteristics such as students' gender, age, place of residence, marital status, and whether they started their higher educational studies immediately after secondary education (Belloc et al. 2011, Kori et al. 2015). Another important predictor of dropout, which can be identified in all disciplines, is a lack of motivation. The higher the motivation of the students is, the higher their academic achievement is. Thus, this can be a protective factor against dropping out (Bruinsma, 2004; Kinnunen & Malmi, 2006).

According to Tinto (1975), graduation and student performance are significantly influenced by individual characteristics and the institutional environment and their interactions (Tinto, 1975, 1993). Thus, institutions can support student development and performance (Pusztai, 2011). The time spent at the university, active participation in various university and student organizations, and interactions within the faculty can be regarded as protective factors as several studies have shown that they significantly reduce the risk of dropout (Duque, 2014; Kori et al., 2015). Interactions between students have also proven to be an effective predictor of persistence in STEM courses, as they are important conditions for students to remain in higher education even after introductory courses (Barker et al., 2009). Some empirical results suggest that the role of institutional factors in STEM courses may be more significant than in other courses. At the same time, curriculum difficulties, teaching standards, lack of student knowledge and self-confidence, and lack of counselling with educators in these areas can be identified as more common predictors of dropout (Marra et al., 2013; Xenos et al., 2002; Bocsi et al., 2019; Pusztai, 2019). From the point of view of our research, students' income deserves special attention, which also has an impact on the interruption of studies (Kori et al., 2015). If students do not receive a scholarship or other financial support, one of the most obvious ways to earn an income, especially in the case of prolonged studies, is reached by student employment. The impact of paid work during the studies on dropout is presented later in details.

According to the dropout results of Ódor and Huszárik (2020), in Hungary, 36-39% of higher education students interrupt their studies before graduating. Concerning the classic STEM fields, the dropout ratio is the highest in IT courses which is 49-55%. Following the field of IT, the highest dropout ratios can be detected in science courses (47-50%) and the field of engineering by a dropout ratio of 40-44% (Ódor & Huszárik, 2020). The STEM-Hungary secondary analysis, examining STEM-specific challenges, highlighted that institutional factors might also significantly explain the low number of graduates, such as insufficient adaptation of higher education to labor market needs, lack of appropriate science and mathematics-related competences, and selective subjects. Others draw attention to the possible effects of the disorganization and shortcomings of the Hungarian career guidance system, as a result of which secondary school students do not receive sufficient information regarding career guidance and the outcome of training courses on the labor market, which may also contribute to dropout. Our previous results also showed that in the STEM and non-STEM training areas, student employment also plays a significant role in the interruption of studies (Kovács et al., 2019a).

Relationships between Student Employment and Dropout

Although several factors can explain the high dropout ratio in STEM courses, our previous research suggests that student employment alongside studies can also have a significant explanatory factor concerning dropout ratios (Kocsis & Pusztai, 2020; Kovács et al., 2019a; Kovács et al., 2019b). The changes affecting the economic situation and the labor market processes can be explained by the fact that students have started to find a job during their studies, even if for different reasons, they have become active participants in the labor market processes in recent decades. Thus, it can be said that in the age of the massification of higher education, the date of employment no longer coincides with the date of obtaining a degree (Bocsi, 2013).

Working alongside learning reduces the time spent on studies and keeps students from embedding in institutional culture, integrating their academic experience, thus increasing the risk of dropout (Riggert et al., 2006; Darmody & Smyth, 2008; Perna, 2010; Kovács et al., 2019a). In countries participating in the EUROSTUDENT VI research, on average, 7% of students dropped out of their studies and a quarter named work-related reasons (Masevičiūtė et al., 2018). Examining the student employment ratio in Europe, we can see that 35% of higher educational students regularly work during the semester, while 16% has part-tome or occasional jobs. Also, employment is the most widespread in the field of education and business and social sciences and humanities. The lowest ratio besides higher educational studies appears in health and science training courses (Masevičiūtė et al., 2018).

Focusing on STEM courses, according to the Hungarian data of EUROSTUDENT, at least a quarter of students in technical and IT courses are employed in more than 20 hours per week. This is higher than in other fields, but almost half of the students have a job related to their studies. 70% of IT students typically work for gaining experience and regard themselves as employees rather than students. It is common among them that the attractive effect of the labor market prevails already during their studies (Hámori, 2018). Although a significant part of the research focuses on the sheepskin effect, according to which obtaining a degree and education results in an increase of the income (Kun, 2014, 2015) and in which interpretative framework, the main adverse effect of employment is when a student interrupts his/her studies without obtaining a degree, some results suggest that employment may in some cases bring positive returns to students.

According to Harkányi's (2020) results focusing on IT in Hungary, students who work during their studies but drop out are in a better position and can become more successful in the labor market than those who have dropped without working alongside their studies. An additional positive effect of working alongside studies may be the development of students' soft skills and the expansion of their network gained in the labor market (Beerkens et al., 2011; Pollard et al., 2013; Sanchez-Gelabert et al., 2017). Nevertheless, the educational methods prevailing in higher education in Hungary are theory-centered. There is no possibility to apply experiential and classroom knowledge and to solve problems (Kovács, 2016). A significant problem is that labor market needs do not appear in the curriculum, and as a result, the development of key competencies is not solved either, as the experience gained in education is far from problem-solving and work situations. According to employers, IT graduates are looking for quality communication and presentation skills and teamwork. Students can acquire these abilities and skills during a traditional university education less or not at all.

Research Questions and Hypotheses

In the theoretical review, we could have seen that, compared to classical, more theoretical courses, STEM courses are declared to meet the needs of the labor market in most countries, to prepare them for shortages, so they presumably promise a stable labor market situation, yet high dropout ratios. According to our hypothesis, due to the characteristics of the STEM fields, it is conceivable that classical theories describing the impact of student employment on dropout and persistence cannot be used for some courses in Hungarian STEM higher education. In some STEM areas, working students may not drop out, so we cannot see any negative impact of employment in their case. Based on these facts, we formulated two main hypotheses:

H1: As students need to prepare for labor market positions requiring specific skills in STEM courses, we assume that working alongside theoretical higher education has a less negative effect on persistence and progression in their case.

H2: We hypothesize that employment in STEM courses weakens the commitment to studies and has a negative effect on student progress if it does not fit the students' studies.

Method

The data are collected in the large sample PERSIST 2019 student database recorded in the academic year of 2018/19 (N=2199). The data collection was carried out in one of the easternmost higher educational regions of the European Higher Education Area. The research was carried out in higher education institutions in the eastern region of Hungary. In the present analysis, we used the data of the Hungarian sample (N=1045), which is a representative sample for the faculties, field of studies, and the form of finance (state-financed/self-financed). The sample included full-time second-year BA/BSc students and second- or third-year full-time students in undivided training courses. Data were analyzed with SPSS 22.0 statistical program. The distribution of the sample by relevant training areas is presented in Table 1.

Table 1. The Distribution of the Sample according to the Training Field

Training field	N	%
Natural sciences	50	4.8
Informatics	61	5.8
Engineering	119	11.4
Other training	815	78

In our research, students were divided into two groups according to work (0: do not work/ works once a year; 1: works weekly/monthly). The horizontal fit of work and studies was also coded along with two categories (0: the work does not fit the student's studies, 1: the work mostly/always fits the studies). As an indicator of the risk for dropout, we examined persistence, the low level of which may indicate a lack of commitment to studies. Persistence was measured using the following statements:

1. The studies I pursue will be useful to me throughout my professional career;
2. I am very determined to complete my studies;
3. I want to achieve the best possible academic achievement;
4. I will do my best to participate in lectures, seminars, and practical classes.

Students indicated their agreement with the statements on a four-point Likert scale (1-4) (Cronbach $\alpha = 0.74$). Based on four indicators of persistence, principal component analysis was performed on the entire sample. We obtained one principal component with an eigenvalue higher than one, and a total explained standard deviation of 56.7% (Pusztai & Szigeti, 2020). Later, analyzing the Hungarian sample, we used the values of the principal component obtained in the whole sample.

Academic progress was examined by pathways. This variable was created by cluster analysis based on the number of passive semesters, the number of reimbursable semesters, running out of time, change of the institution/profession (Pusztai & Szigeti, 2020). According to the results obtained, the participants were divided into three groups: those who follow a traditional standard path (we cannot talk about running out of time, passivation or change of faculty/institution and study in a state-funded form), postponing-passivating students and fee-paying, institution and/or faculty changing students.

32.8% (343 participants) of the examined sample work monthly or weekly, while 65.5% (684 participants) do not work or work only once per year. 27.1% (93 people) of the employed students answered that their work always or mostly fit their studies, while the rest of the employed students noticed that their work does not fit their studies. Regarding the academic pathway of the examined sample, it can be said that the majority (58.1%) follow the traditional, standard path, 18.9% belong to the fee-paying, institution and/or faculty changing group, and 23% belong to the postponing-passivating group. The mean value of persistence of the sample was -0.08 (SD = 0.03).

Results

Employment and Persistence in STEM and Non-STEM Training Courses

The main effect and intersection of the training area and employment on persistence were examined by multivariate analysis of variance. According to the obtained results, the training area has a significant main effect ($F(3, 985) = 4.81$, $MSE = 1.02$, $p = 0.002$), but the main effect of work was not significant ($F(1, 985) = 1.46$, $MSE = 1.02$, $p = 0.23$). The intersection of the two variables was trend-level ($F(3, 985) = 2.33$, $MSE = 1.02$, $p = 0.07$). The means and standard deviations of the students of each training area are shown in Figure 1, and the intersection of the two variables is shown in Figure 2.

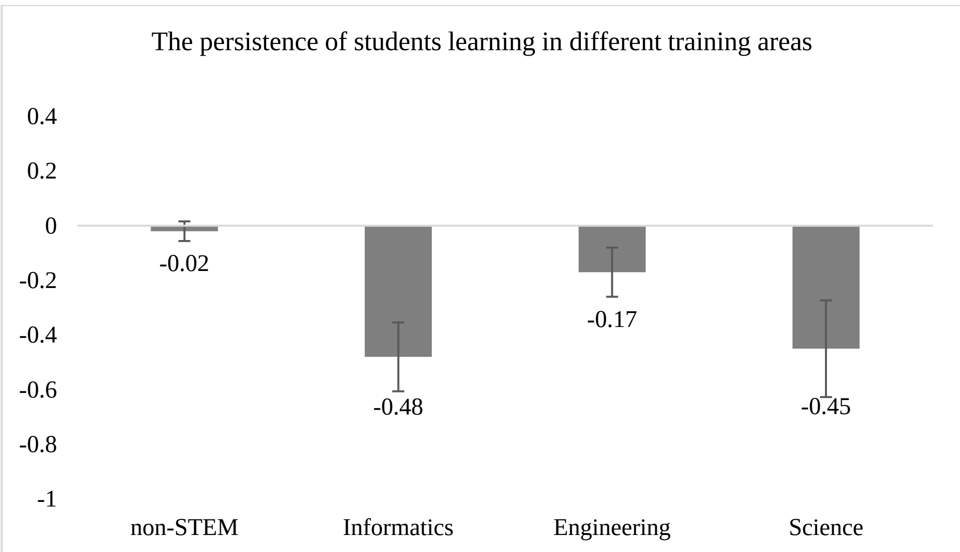

Figure 1. The Relationship between Training Area and Persistence (N = 1045)

Based on the data of Figure 1, it can be seen that there was a significant difference in the persistence of students concerning the training areas. According to the results, the persistence of students in all STEM courses was lower than that of students in non-STEM courses. However, the situation of students in engineering fields was more favorable in this respect than students in informatics and science courses.

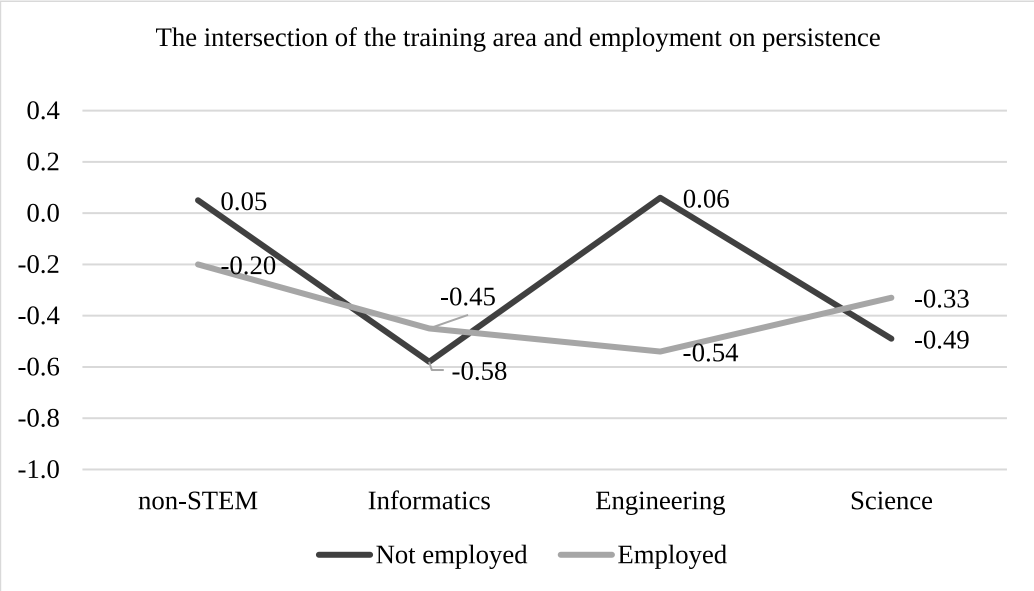

Figure 2. The Intersection of the Training Area and Employment on Persistence (N = 1045)

As shown in Figure 2, student employment does not have the same effect on persistence in all training areas. While non-STEM and engineering courses showed mechanisms following the literature, i. e. the persistence of working students was lower than those who did not work alongside their studies, the persistence of employed and non-employed students showed similar trends in the case of students learning informatics and science.

The Relationship between the Horizontal Suitability of Work and Studies and Persistence in STEM and Non-STEM Courses

The effect of work-study suitability on persistence was examined exclusively among working students (N = 343). To test our hypothesis, multivariate analysis of variance was used, where the independent variables were the training area and the suitability of work and study (yes/no). According to the obtained results, the main effect of the training field proved to be trend-level among the employed students ($F(3, 316) = 2.32$, $MSE = 1.06$, $p = 0.075$), but the horizontal fit of work and studies had a significant main effect ($F(1, 316) = 5.07$, $MSE = 1.06$, $p = 0.025$). The intersection of the two variables was not significant ($F(3, 316) = 0.03$, $MSE = 1.06$, $p = 0.99$). The main effect of the training area and the suitability of work and studies are introduced in Figure 3 and 4.

As shown in Figure 3, examining only the employed students, we can see that the persistence of those in the engineering field is the lowest in contrast to the total sample. Thus, in their case, employment is presumably more negatively affected than in other training courses. Based on Figure 4, which shows the main effect of the horizontal suitability of work and studies, we can see that students who are employed in a job related to their studies have a significantly higher persistence, regardless of the field of study than those whose job is not related to their studies.

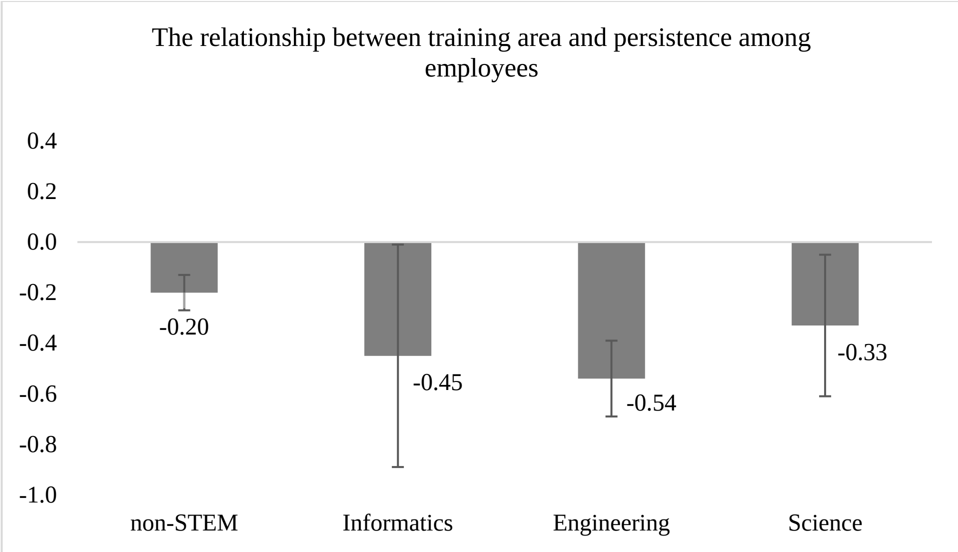

Figure 3. The Main Effect of the Training Area on Persistence in the Case of Employed Students (N = 343)

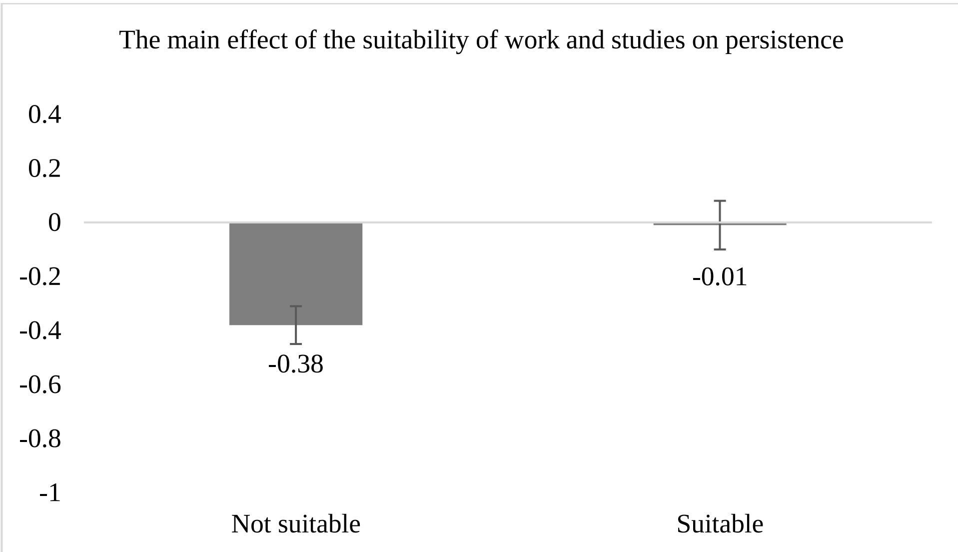

Figure 4. The effect of the suitability of work and studies on persistence (N = 343)

Student Employment and Academic Progress in STEM and Non-STEM Courses

The relationship between student employment and academic pathways (standard, postponing-passivating, fee-paying, institution and/or faculty changing) was examined in STEM and non-STEM courses using three-dimensional cross-tabulation analysis and chi-square tests. According to the obtained results, the field of study and the academic pathway showed a significant effect in the group of both non-employed ($\chi^2(6) = 25.06$, $p < 0.001$) and employed ($\chi^2(6) = 29.35$, $p < 0.001$) students. Figure 5 and 6 illustrate the proportions of students per training area in the two groups.

As shown in Figure 5, among non-employed students, the ratio of those following the standard path is the highest in science courses at the highest rate, and there are no fee-paying, institution and/or faculty changing students can be found among them. In the engineering field, similarly to non-STEM courses, the proportion of those following the traditional standard path is relatively high compared to the field of informatics. However, a higher ratio of fee-paying, institution and/or faculty changing students can be found. Only half of the students follow the traditional, standard path concerning IT training, while a remarkably high proportion of postponing-passivating students can be seen. In non-STEM courses, almost a quarter of the students belong to the fee-paying, institution and/or faculty changing group. Based on the adjusted standardized residuals, the overrepresented groups are marked with bold while the underrepresented groups are marked with italic.

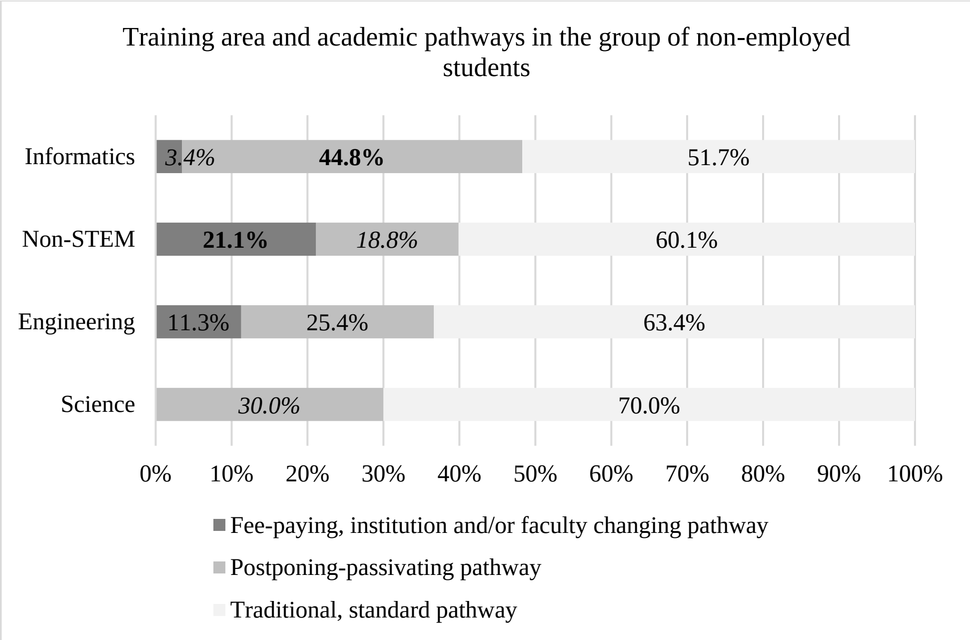

Figure 5. The Relationship between the Training Area and the Academic Pathways in the Group of Non-employed Students (N = 684)

Figure 6 shows that in the group of employees, the proportion of students following the standard pathway is lower than in the case of non-employees in all training areas except informatics. In the case of employees, another difference is that postponing-passivating students are over-represented among engineering students, who also can be seen in a higher proportion in non-STEM courses compared to non-employees. In contrast, we obtained the same proportions in the group of employees and non-employees concerning informatics training courses, so in their case, employment presumably has little effect on academic progress. Based on the adjusted standardized residuals, the overrepresented groups are marked with bold while the underrepresented groups are marked with italic.

The relationship between employment and academic progress was also examined in terms of the horizontal suitability of work and studies among employed students (N = 343) by performing three-dimensional cross-tabulation analysis with chi-square tests. The relationship between the field of study and the pathways proved to be significant in case of employment suitable to the studies ($\chi^2(6) = 20.94$, $p = 0.002$) and in case of the lack of suitability as well ($\chi^2(6) = 12.75$, $p = 0.05$). Figures 7 and 8 illustrate the proportions of students concerning the training areas in the two groups. As shown in Figure 7, the proportion of those who have a job not related to their studies is between 56-64%, which is the highest in informatics and the lowest in non-STEM training courses. Regarding both the informatics and engineering fields, the proportion of postponing-passivating students is almost 40%, while in non-STEM training, the ratio of fee-paying, institution and/or faculty changing students was high. Based on the adjusted standardized residuals, the overrepresented groups are marked with bold while the underrepresented groups are marked with italic.

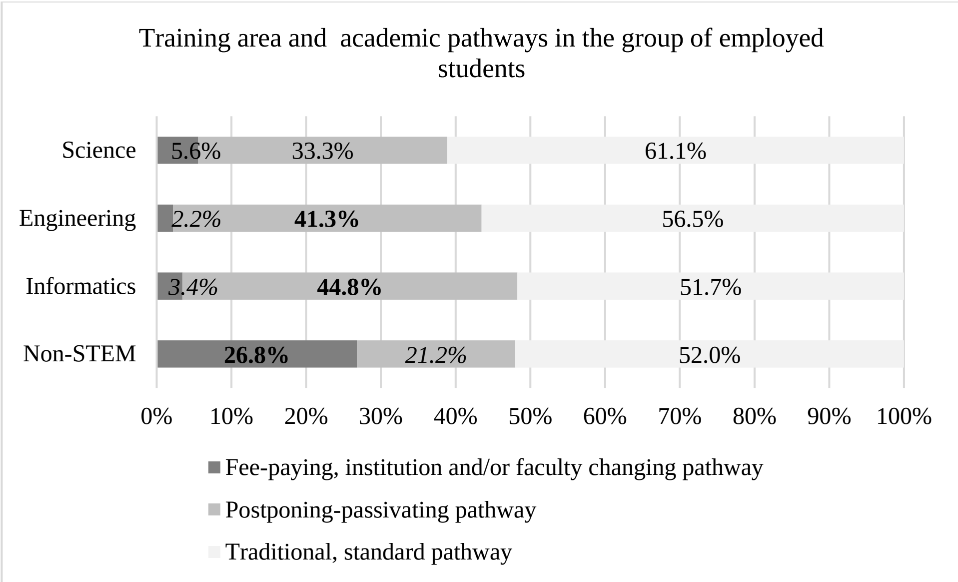

Figure 6. The Relationship between the Training Area and the Academic Pathways in the Group of Employed Students (N = 343)

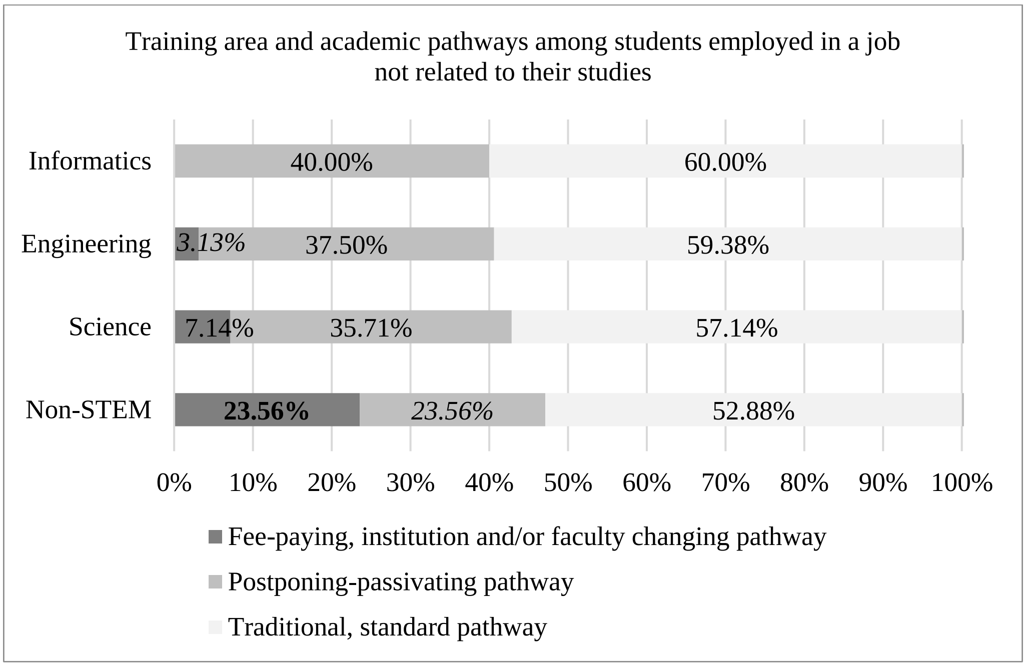

Figure 7. The Relationship between the Training Area and the Academic Pathways among Students Employed in a Job not related to their Studies (N = 247)

Figure 8 shows that slightly different trends can be observed among those employed in a job related to their studies. According to the results, employment related to the profession can be a significant advantage in science training courses, as the proportion of those who follow the standard path was 75%. In other training areas, this positive effect no longer appeared. Half of the employed students who have a job related to their studies belong to the postponing-passivating group in the engineering field, while the other half follows the traditional, standard path. Co IT, the proportion of postponing-passivating students is still outstanding (47%), while almost 40% of those in non-STEM courses belong to the fee-paying, institution and/or faculty changing group in this group. Based on the adjusted standardized residuals, the overrepresented groups are marked with bold while the underrepresented groups are marked with italic.

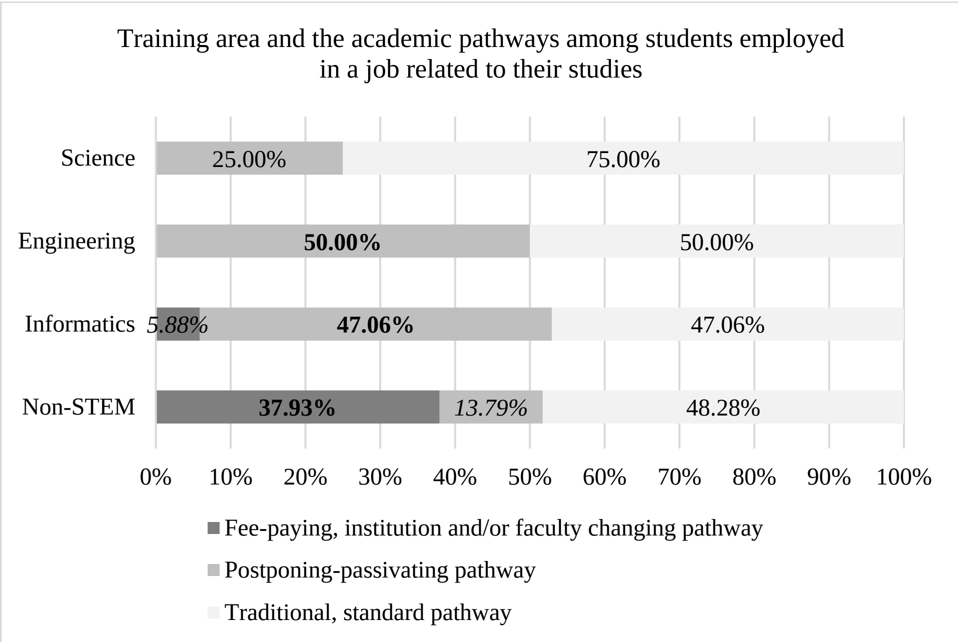

Figure 8. The Relationship between the Training Area and the Academic Pathways among Students Employed in a Job related to their Studies (N = 93)

Discussion

Our research examined the relationship between employment and studies, particularly in STEM areas that show a strong intertwining with the labor market. In the case of the mentioned training areas, the emphasis is on the new functions of higher education that come to the fore with the expansion, i. e. the knowledge transfer and market approach that can be utilized in the labor market has become a significant part of the training. Based on these, we hypothesized that traditional theories concerning the relationship between employment and academic progress would be less valid for STEM courses. According to the literature, some STEM courses have a proportion of student employment above the average (Hámori, 2018; Masevičiūtė et al., 2018), and these courses often aim to acquire more practical and specific skills than non-STEM courses. Thus, we expected that students' employment in contrast to the average observed trends (Kocsis & Pusztai, 2020; Markos et al., 2019) does not hinder students' academic progress.

In the case of students of informatics training courses, we found no significant difference between employed and non-employed students concerning persistence or academic pathways. These data were refined by the results obtained for those employed in a job related and not related to their studies. Concerning informatics training courses, the proportion of students following the traditional, standard route was higher among those employed in a job not related to the studies than those employed in a job related to their training. In this case, we can assume that the distracting power of the labor market prevails (Hámori, 2018). As this negative effect on persistence did not occur, it is conceivable that intra-professional employment may require a more significant investment of time and/or energy on the part of students than not training-related student work, thus negatively affecting students on academic progress. According to Hámori (2020), as students in informatics training in Hungary are dissatisfied with the quality of their training or experience less support and inspiration from their teachers and are insecure concerning their studies, it is conceivable that these students are driven by disillusionment with less practical higher education towards gaining experience in the labor market, which may act as a 'pull' mechanism to pull them out of higher education (Doll et al., 2013).

In the case of science courses, we also found interesting results. Concerning this area, the data again showed that employment on its own does not have a significant effect on student persistence. In comparison, the results are somewhat contradictory in the case of pathways, according to which the proportion of employed students learning in science training and following the non-standard route is 9% higher compared to non-employed students. However, the proportion of students having a job related to their studies (75%) surpassed that of non-workers, so in this case, it can be said that the horizontal integration of work and studies can significantly compensate for the negative effects of employment. As science courses mean the theoretical components of the STEM discipline that are less clearly identifiable with specific jobs compared to the engineering and informatics fields, it is conceivable that labor market experience has a strengthening effect on career socialization and commitment in this field.

The examination of the engineering training field showed significantly different results compared to the other two STEM areas. In this area, we found that the persistence of working students lagged far behind that of non-working students. Regarding the pathways, it can be said that the percentage of those following the traditional, standard route was 7% lower in the employed group compared to the non-employed group, but the proportion of postponing-passivating students (who have the highest risk for dropout) was significantly (almost 20%) higher (41%). In the case of the horizontal suitability of work and studies, similarly to the field of informatics, we found patterns contrary to the expected trends. Among students having a job related and/or not related to the studies, the proportion of those following the standard path was the same (50%), but the proportion of postponing-passivating students was 13% higher among those having training-related jobs compared to those having a job not related to the studies. Thus, concerning this field, it can be assumed that employment related to the profession has a significant negative effect on studies. Based on the results of the recent research of Fresh Graduates (Frissdiplomások), according to which 65% of students who did not graduate in the field of engineering and 44% of those who did not graduate in the field of informatics felt the lack of the degree when entering the labor market (Keresztszeghy, 2018). Different reasons may explain similar trends in the horizontal suitability of work and study. Since the results of Keresztszeghy (2018) suggest that there is a stronger professionalization in the field of engineering, we can assume that the sheepskin effect is stronger here than in informatics. This means that the lack of the degree and working in the profession results in a more negative image of their chosen profession.

Employment also presumably reduces the time spent on university and courses and hinders student integration, further reinforcing the negative consequences of work.

In the case of non-STEM courses focusing on the more traditional higher education functions, we expected to find results following the facts introduced in the literature. In the case of persistence, this was confirmed by the data, as our results showed that the persistence of employed students attending non-STEM courses was significantly lower than that of not employed students. According to the results obtained in the case of the pathways, this negative effect is also reflected in the proportions of those belonging to the standard path, which is 8% lower among employees compared to non-employees. However, this is mainly due to the ratio of the fee-paying, institution and/or faculty changing students rather than a higher proportion of postponing-passivating students. The horizontal suitability of studies and work in non-STEM courses proved to be neutral concerning the proportion of those following the standard pathway. However, the proportion of fee-paying, institution and/or faculty changing membership was almost 15% higher among those having a job related to the studies, while significantly fewer postponing-passivating students can be found in this group. Based on the latter result, it can be said that employment related to studies can positively affect non-STEM training courses compared to not training-related work, but this is not reflected in the differences in the proportions of those on the standard routes, but those on non-standard pathways.

Conclusion

The results of our research can be interpreted with certain limitations. Although we pointed out important differences within the STEM discipline and between STEM and non-STEM courses, the effect of employment and its horizontal integration with studies could be most effectively examined in a longitudinal arrangement. Thus, for the same students, we could see the effect of working alongside their studies on their progress with a given persistence and ability. A further limitation of our research is that the number of items in each subgroup is small as the group of students having a job related to their studies consisted of 93 people, so the results obtained in their case cannot be generalized. Thus, we do not aim to conclude them, but it can be an appropriate basis for further investigations. The interpretation of the results is also limited by the fact that we did not have the opportunity to examine the motivations behind employment (e. g. gaining work experience, unfavorable financial situation) within the framework of the present research. However, based on the literature (Bocsi et al., 2019; Markos et al., 2019; Kocsis & Pusztai, 2020), these variables could also have significantly influenced our findings. The differences between the STEM fields indicated that in further research, it might be worthwhile to examine the non-STEM training courses separately as non-STEM courses have a different training structure and curriculum due to their diversity (humanities, law, economics, medical courses, etc.). However, due to the explicit STEM focus of the analysis, we did not have the opportunity to elaborate on this topic in our research.

Overall, our results are suitable for supporting education policy and institutional decision-making. Our data showed that student employment could influence academic progress through complex mechanisms in which we found significant differences concerning the training areas. While the study of informatics training courses showed that this field is resistant to the negative effects of employment concerning both persistence and academic progress, concerning science training courses, we found that employed students with similar persistence could be characterized by less favorable pathways compared to their peers. The negative effects of employment could have been seen in the engineering and non-STEM courses, as it also had a negative effect on the students' persistence and academic progress. Significant differences could have been detected in the training area in the compensatory effect of the horizontal suitability of work and studies. While informatics and engineering training can be expected to have an adverse effect on employment related to the profession, non-STEM and science training have shown that employment related to studies can significantly reduce the risk of dropout.

Our results are suitable for both identifying further research directions and supporting policy decision-making. Exploring variables explaining the different effects of employment and its relationship to studies on training courses can be an important area for further research on the topic. Such variables, which have not been examined in the framework of the present research, may be the professionalization of each discipline, the number of hours spent by students in each group, and the purpose of employment. As our results show that employment can have a wide range of effects. The best way to reduce the negative consequences is to increase the support of dual courses and to increase the availability of company collaborations and internships, as this would allow training places to ensure for students to work under conditions that do not significantly affect their academic progress through the investment of time and energy. In our opinion, it would also be important for students who are forced to become employed due to their unfavorable financial situation to receive an adequate amount of scholarships and student support. Also, they can provide an appropriate alternative to gain experience by the training places within the framework of their courses, and they enable the acquisition of practical knowledge.

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