





www.ijemst.net

Participation in Bridging Courses and Dropouts among Cooperative Education Students in Engineering

Steffen Wild 
TU Dortmund University, Germany

Sebastian Rahn 
HTW University of Applied Sciences in Saarbrücken,
Germany

Thomas Meyer 
Baden-Wuerttemberg Cooperative State University,
Germany

To cite this article:

Wild, S., Rahn, S., & Meyer, T. (2024). Participation in bridging courses and dropouts among cooperative education students in engineering. *International Journal of Education in Mathematics, Science, and Technology (IJEMST)*, 12(2), 297-317. <https://doi.org/10.46328/ijemst.3270>

The International Journal of Education in Mathematics, Science, and Technology (IJEMST) is a peer-reviewed scholarly online journal. This article may be used for research, teaching, and private study purposes. Authors alone are responsible for the contents of their articles. The journal owns the copyright of the articles. The publisher shall not be liable for any loss, actions, claims, proceedings, demand, or costs or damages whatsoever or howsoever caused arising directly or indirectly in connection with or arising out of the use of the research material. All authors are requested to disclose any actual or potential conflict of interest including any financial, personal or other relationships with other people or organizations regarding the submitted work.



This work is licensed under a Creative Commons Attribution-NonCommercial-ShareAlike 4.0 International License.

Participation in Bridging Courses and Dropouts among Cooperative Education Students in Engineering

Steffen Wild, Sebastian Rahn, Thomas Meyer

Article Info

Article History

Received:

14 February 2023

Accepted:

19 August 2023

Keywords

Bridging courses

Dropouts

Propensity score matching

Entropy balancing

Engineering

Abstract

Dropout rates in engineering degree programmes at universities are high, and skilled workers are needed. Universities try to prevent dropouts with different offers one of which is attending bridging courses. Research on the effects of these programmes is rare, especially in subject-specific programmes and study formats like cooperative education. Furthermore, the results are contradictory. We focus our research on Germany and use data from the project “Study Process – Crossroads, Determinants of Success and Barriers While Studying at the Baden-Wuerttemberg Cooperative State University”, which included 963 participants from the first academic year and matched data from a survey with university administration data on dropouts two years after enrolment. Different propensity score matching algorithms and entropy balancing show small, non-significant negative effects. Results are reflected and embedded in the current state of the research. New research questions are discussed and practical implications are considered.

Introduction

Dropouts and success rates in higher education are important issues for universities, industry and society (Fokkens-Bruinsma et al., 2020; Nagy & Molontay, 2021). Neugebauer et al. (2019) emphasize education policy and industry because of unprofitable investments and a shortage of skilled workers. Dropping out leads to difficulties finding a job and lower occupational status (Scholten & Tieben, 2017). Researchers highlight the importance of the first academic year and the experiences there, like learning environmental, in the along with students' consequent future behavior academic performances (Trautwein & Bosse, 2016).

The completion rate in tertiary education varies according to country and is in the average at 70 percent (OECD, 2019, p. 208). The STEM subjects are facing major challenges, like math skills or combining theoretical and practical elements. Current figures show consistent dropout rates of around 40 percent in recent years (Heublein et al., 2020). Another challenge related to this topic is the heterogeneity of both traditional and non-traditional student populations and their associated dropout rates (Thomsen, 2021; Tieben, 2020; Yastrebov et al., 2018).

Universities make numerous offers to students to reduce dropout rates (Neugebauer et al., 2019). This is done in

a variety of ways, such as special time points (before or at the beginning of a study programme), like aptitude tests of study-related skills, or for special aims (better academic/social integration), like mentoring programs. Tieben (2019) argues that little is known about participants and their reasons for accepting such offers. Moreover, there is little research on the correlation between participation in bridging courses and student dropout rates.

Existing research shows varying relationships between participation in bridging courses and subsequent dropouts, depending on the study format (Tieben, 2019). Therefore, research should analyse different student formats, such as cooperative education programmes. Cooperative education is an accepted and widely spread study format (Coll & Zegwaard, 2011). Companies and students heavily invest in this study format and are greatly interested in the success of the programme (Graf et al., 2014). The German cooperative education study programme is exported to Brazil, France, Qatar, Mexico and the US (Graf et al., 2014), and the special model from Baden-Wuerttemberg Cooperative State University (DHBW) is exported to countries, such as Thailand and China (Reinhard & Gerloff, 2020). The increasing number of students, cooperative partners and higher education institutions participating in such programmes underlines the importance of this educational format in countries like Germany (Ansmann et al., 2020). Our research focuses on bachelor programmes and has two aims. The first aim is to explore what kind of persons participate in bridging courses. The second aim is to test the effect of participation in bridging courses on dropout rates. In our study, we focus primarily on cooperative education in the engineering programme in Germany.

Theoretical Framework and Empirical Results

Student Dropout as a Complex Multicausal Process

Consensus on two central aspects of dropout rates is growing in the scientific community. First, dropouts are not considered as a result of spontaneous or short-term decisions. They are seen as a prolonged decision-making and consideration process (Bäulke et al., 2021). Second, there are several reasons for dropping out, which vary in importance and reinforce each other (Mouton et al., 2020). Klein and Stocké (2016) also identified evidence that university dropout factors are time-variant, contrasting specifically between the early and late stages of studies.

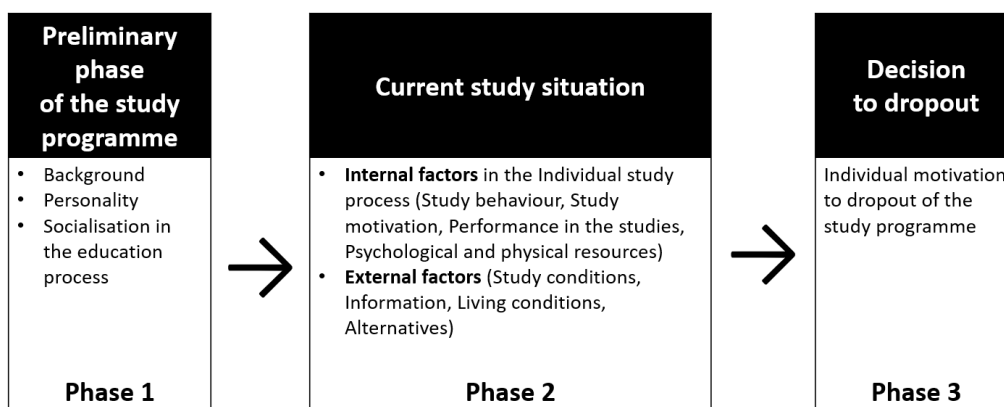


Figure 1. Dropout Process from Higher Education Institutions (adapted from Heublein, 2014)

According to the theoretical framework of Heublein (2014), there are three phases (cf. figure 1): the pre-study

phase (Phase 1), the study phase (Phase 2) and the decision to drop out (Phase 3). Every phase has different influencing factors. Next, we go into each of these phases in detail and present empirical findings. Some determinants influence the dropout process even before the beginning of the study programme (Phase 1). Three factors are fundamental: origin, personality and socialization in the education process. Empirical results support the importance of these factors. Social origin, migration background, age and gender affect dropout rates. Students from highly-educated families are less likely to drop out than those from less-educated families (Araque et al., 2009; Argentin & Triventi, 2011; Müller & Schneider, 2013). Researchers have found that there is a higher risk of dropping out for those with a migration background (Ebert & Heublein, 2017; Isphording & Wozny, 2018; Neugebauer et al. 2019). Some research results show that men (Berka & Marek, 2021; Van Bragt et al., 2011) and older students (Lassibille & Navarro Gómez, 2009; Müller & Schneider, 2013) are more likely to drop out, although this effect is relatively small and partially insignificant. In addition to these socio-demographic characteristics, personality traits are also related to the probability of dropping out. However, consistent negative effects exist only for conscientiousness (Isphording & Wozny, 2018; Van Bragt et al., 2011), and results for other personality traits vary. For example, openness has a positive effect (Isphording & Wozny, 2018; Neugebauer et al. 2019). We discuss socialization in the education process and analyse the impact of pre-tertiary educational pathways and educational choices. Those with vocational training are at a higher risk of dropping out of university than of a university of applied science (Müller & Schneider, 2013; Neugebauer et al. 2019). Further results show that students outside the standard path or academic track (Abitur) have higher dropout rates (Isphording & Wozny, 2018; Müller & Schneider, 2013; Neugebauer et al. 2019). Furthermore, high performance before enrollment, such as high university entrance scores (Lassibille & Navarro Gómez, 2009; Müller & Schneider, 2013), reduce dropout rates. Motivational input characteristics in this phase, like education aspiration (Isphording & Wozny, 2018) or subject interest (Heublein et al., 2017), decrease the likelihood of dropping out (Neugebauer et al. 2019).

Phase 2 in this process is the study situation itself. It is a complex, ongoing, dynamic interplay between internal and external factors. While internal aspects are a central theme of concrete actions of individual students in the study context, external factors relate to conditions determined by the institutions. The four internal influence factors in this framework are study behaviour (Klein, 2019), study motivation (Schnettler et al., 2019), performance (Araque et al., 2009) and psychological and physical resources (Berndt & Felix, 2020). In addition to these internal influence factors, there are external factors of studying conditions, like the quality of teaching (Georg, 2009), financing of studies and accommodation (Belloc et al., 2010; Chen & DesJardins, 2010), existing alternatives (Hadjar & Becker, 2004) and supply of information (Heublein, 2014). These four factors are based on several subdimensions and characteristics that influence one another. The coherence between internal and external factors as they change and develop is indispensable for academic success. As a result, students must be able to match their motivations and actions with external conditions. Therefore, the study process factors have to develop in line with, and in correspondence to, the study and living conditions as far as the information and alternative from the study programs. However, this model does not integrate the corporate partners into the cooperative education system. For example, Wild and Schulze Heuling (2020) show that affective commitment to the companies affects dropout rates. The third and last phase in this process is the decision for or against dropping out. If internal and external factors are too mismatched, students become motivated to drop out of the study programme.

This dropout model is complex. However, it is very flexible because it can address different problems and integrate different interdisciplinary and theoretical aspects (Heublein, 2014). With this background, it is possible to design and conduct different empirical research. Concerning the present research subject, the model shows that bridging courses can also be relevant to dropping out, as they influence the change from the pre-study phase to the study phase.

Bridging Courses in Higher Education

Dropping out does not necessarily result in negative consequences for the individual, but it is in the interest of higher education institutions to decrease dropout rates due to programme accreditation procedures and financial support (Klein & Stocké, 2016). As described in the previous chapter, the reasons for dropping out vary, and therefore interventions are different. However, higher education institutions cannot influence all factors that correlate with dropping out, like university entrance scores or social backgrounds. Therefore, we look only at bridging courses in detail.

Regarding study programmes with an emphasis on math, Wood (2001, p. 89) suggests; "Bridging courses prepare students for the academic concepts, skills and attitudes of their degree programmes as opposed to orientation programmes that prepare students for university life". Kürten (2020) states that in German-speaking countries, there is a break between a programme and before (usually a few weeks) and after the university starts (up to some semesters), which does not occur in English-speaking areas.

In the literature, there are different views on the goals of bridging courses. Wood (2001, p. 90) formulates three aims depending on the target group: (1) fill gaps in knowledge, (2) prepare students for math proofs during the first academic year and (3) develop the attitudes and language of students who are new to the higher education system or are from non-academic backgrounds. Greefrath et al. (2017, S. 147 f.) argue that these courses should not introduce the content of the basic lectures at university, but rather address school knowledge (mathematics in this case) in more depth, offer an impression of the later degree programme, teach problem-solving strategies and adopt speaking, writing and arguing lessons at university in a more abstract way compared to school. According to Kürten (2020), increasing students' commitment to their higher education institutions is another goal. By contrast, the university's interest is to reduce dropouts, which is a reason for the investment of resources (Tieben, 2019).

Bridging courses in the USA and Germany are different. While bridging courses are highly accepted in Germany, they are controversial in the United States (Büchle, 2020a). In the USA, the courses are required for students with less education, and large resources are needed. In contrast, in Germany bridging courses are voluntary and depend on the knowledge of the offer for the freshmen, their motivation and anticipated benefit (Tieben, 2019). Falk and Marschall (2021) present the results of the National Educational Panel Study (NEPS, SC5) for Germany, which show that 39 percent of students do not participate in bridging courses. In the academic fields of science, technology, engineering and mathematics (STEM), 75 percent participate, and students at universities of applied science (88 percent) participating more than those in university (72 percent). However, the bridging courses differ

between universities depending on the interests and resources of the faculties (Tieben, 2019).

Xu and Dadgar (2018) discuss two important theoretical frameworks for understanding the results of bridging courses: the assistance and hindrance model. The assistance model's aim is to analyse the development of long-term academic skills and knowledge to college-ready standards for students with inadequate preparation. Three principles must be taken into account: (1) well-defined criteria that students need to know, (2) correct identification of students and (3) benefits of acquiring the relevant knowledge and skills outweigh the additional financial burden on students. In contrast, the hindrance model assumes that the benefit of skills and knowledge development in bridging courses exceeds the following costs to students: (1) participation in additional courses, (2) a higher investment of time and (3) psychological cost of feeling stigmatized for not meeting university standards.

A lower risk of dropping out of bridging courses is possibly associated with participants' characteristics (selection bias). However, there is less knowledge about the characteristics of the participants (Gerdes et al., 2021). Falk and Marschall (2021) argue that people with less prior knowledge of math and lower university entrance performance are less likely to participate in bridging courses. Their research suggests that higher performance in math at school, the desired subject to study and type of university (preferring universities over universities of applied science) increase participation in bridging courses. According to Büchele (2020b), the probability of participation bridging courses increases when the self-perception of mathematical ability is higher.

The effect of bridging courses on dropout rates varies by country. While Xu and Dadgar (2018) do not find any effect in the USA in their research, Bettinger and Long (2009) and Bahr (2008) demonstrate a reduction of dropouts against the background of taking bridging courses. In Germany, there are contradictory findings. Falk and Marschall (2021) find no effect, but the data analysis of Gerdes et al. (2021) as well as Büchele (2020b) show empirically that participation in bridging courses causes decreasing dropout rates. Furthermore, Tieben (2019) is only able to demonstrate an effect at universities and not at universities of applied sciences. These contradictory findings postulate a need for further research, particularly at different types of higher education institutions and in different countries. One challenge of this research is analysing long-term effects. This is the starting point for new research in response to a research desideratum (Tieben, 2019; Büchele, 2020b; Gerdes et al., 2021) related specifically to cooperative education programmes.

Cooperative Education Programme in This Research

Interest in cooperative education has risen over the past two decades (Coll & Zegwaard, 2011). One reason for this development is that companies need skilled workers with both practical experience and a university degree (Reinhard et al., 2020). This need is underlined by an increase in cooperative students in Germany—growing from 40,000 in 2004 to over 100,000 in 2019 (Ansmann et al., 2020). Another reason is the rapidly changing world of work, which influences cooperative education (Govender & Våland, 2021).

Cooperative education characteristically combines three elements: vocational education, higher education, and

on-the-job training (Graf et al., 2014). In this approach, companies and higher education create learning environments together. Students gain theoretical knowledge at the university as well as practical experience in the company environment. As a consequence, students in this educational format are trained by academic faculty as well as company experts, which is seen as a benefit for student's development. The resulting synergy of these aspects generates a learning environment that is productive for applying theoretical knowledge to a practical, work-related setting (Reinhard & Pogrzeba, 2016).

The model of cooperative education varies among and within countries (Graf, 2013). Reinhard et al. (2016) show results for Germany, South Africa and Namibia. However, in all countries, there is a minimum system requirement to combine theoretical elements from higher education institutions with practical experience in partner companies, so that the benefits for industry and the economy will not be cut short.

The cooperative education programme in Germany is of special interest to the international community. Two developments are particularly important (Graf et al., 2014). First, Germany has been robust, particularly in terms of youth employment, in past decades despite the financial and economic crisis. Dual vocational education has played a major role in this success (Graf et al., 2014, p. 71). Second, there is a link between initial vocational training and higher education. Consequently, this kind of education contributes to the development of professional competencies in the new century, especially competencies of skilled workers of which a shortage is predicted (Graf et al., 2014).

In three study areas (Business School, School of Engineering and School of Social Work) the Duale Hochschule Baden-Württemberg (Baden-Wuerttemberg Cooperative State University; DHBW) has one of Germany's largest cooperative education programmes. It has an enrollment of nearly 34,000 cooperative students and over 9,000 partner companies. The university has nine locations and three campuses, and it offers both bachelor's and master's degree programmes (Reichardt, 2021). Cooperative student programmes at DHBW are different from traditional university tracks (Wild & Alvarez, 2020). Before beginning their studies, students must have an employment contract and appropriate university entrance qualification (Figure 2). The students are selected by the partner companies, not the university. The university, therefore, does not influence the selection of suitable students. Under a study contract with the partner companies, only the higher education entrance qualification is required for admission to the university. Thus, students do not necessarily meet all requirements of the university, like unique math skills. Bridging courses could be a good way to fill this gap.

In a cooperative education programme, students benefit from a monthly salary (including theoretical semesters) and a regular employee status. The programmes that offer bachelor's degrees are constructed for 210 European Credit Transfer System (ECTS) credits in six semesters, instead of the 180 credits offered by standard bachelor programmes at university. Students rotate every three months between academic training at the university and workplace training at the company. After earning a degree, nearly 90 percent of the students obtain a permanent employment contract, usually with their corporate partner (State Statistical Office Baden-Württemberg, 2018). Employers benefit from this system because students work on company tasks during workplace training. Furthermore, after graduation, the companies can hire skilled workers who are already trained to meet specific

company needs. Consequently, recruitment costs and miscast risks are lower, and graduates need less training to become productive employees after starting work for cooperative partners (e.g., Braunstein et al., 2011; Reinhard & Pogrzeba, 2016). Research on this study programme shows differences between academic fields regarding students' development of affective commitment, dropout rates and motivation (Wild et al., 2020; Wild & Schulze Heuling, 2020; Wild & Neef, 2019). Derr (2018) reports a learning programme that effectively assists students beginning engineering studies at DHBW.



Figure 2. Curriculum of Baden-Wuerttemberg Cooperative State University (adapted from Wild & Alvarez, 2020)

Research Question

Heublein's (2014) theoretical framework provides empirical evidence that the postulated factors in the pre-study (Phase 1) and study (Phase 2) phases influence dropout decisions. As mentioned above, dropping out is a prolonged decision-making process for many, mutually-reinforcing reasons. We argue that an intention to drop out is a result of an accumulation of doubt rooted in the factors in Phase 1 and Phase 2 described above. In line with this argument, we assume that the bridging courses have an important function as components in the transition phase in academic and social integration in higher education institutions. In addition, these courses are often the first point of contact between students and universities that influence students' behaviors and future actions. This shows that research requires detailed and comprehensive information about the variables and differences in motivation between participants and non-participants in bridging courses. We can use these findings to analyse the process and predict dropouts. In this study, we ask two research questions: (1) How do participants differ from non-participants? (2) To what extent do participants differ from non-participants with regard to study dropouts?

Method

Participants and Design

To analyse our research questions, we use data from the panel study "Study Process – Crossroads, Determinants

of Success and Barriers during a Study at the DHBW” (Deuer et al., 2020) on participants in the first academic year and the third wave from July 2018. All 963 respondents are enrolled in the bachelor’s programme at the School of Engineering at DHBW. Members of the research group invited the university students to participate in the survey by sending them two emails with a link to an online questionnaire within a two-week interval. Contact with the participants followed a privacy policy, and participation was voluntary. Every fiftieth student who answered more than one question received an incentive worth 10 euros. The average age in the sample was $M = 21.52$ years ($SD = 2.38$). We collected data from 693 male (72 percent) and 270 female (28 percent) students. 21 percent of students finished vocational training before their studies. After participants’ second academic year (September 30, 2019), we matched data from the survey with university administration data to integrate dropout and demographic information in our analysis. In the following chapter, we explain the measurement instruments that we used. In the first step, we describe the independent variable bridging course and dependent variable dropout. Subsequently, we discuss the covariates. We also present the different types of data collection in our study.

Measures

Bridging Courses

The information on participation in bridging courses is obtained by one item. The dichotomous values for this variable are 0 (= not participate) and 1 (= participate). In our sample, 481 persons (50 percent) participated in bridging courses in the school of engineering. This item is only integrated into the third wave of the panel study.

Dropout

We integrate data from the university administration with the dropout information from our dataset two years after enrollment (deadline: September 30, 2019). The dichotomous values for this variable are 0 (= no dropout) and 1 (= drop out). According to our data, 12 percent (113 persons) dropped out.

Subject Interest

The subject interest is measured with an instrument from Fellenberg and Hannover (2006). Reliability of nine items on a 5-point Likert scale with values ranging from 1 (strongly disagree) to 5 (strongly agree) is seen as good ($\omega = .85$; item example: My field of study is just right for me).

Conscientiousness

Conscientiousness, which is one of the Big Five personality traits, is measured on a short scale with two items from the instrument Big Five Inventory and with ten items (BFI-10) developed by Rammstedt et al. (2013) based on the BFI established by John et al. (1991). We use a 5-point Likert scale with values ranging from 1 (strongly disagree) to 5 (strongly agree). In our sample, the measured reliability for conscientiousness is low ($\omega = .53$; item example: I do tasks thoroughly).

University Entrance Score

German university entrance scores vary between 1 (equivalent to A in Great Britain and the United States of America) and 4 (equivalent to E in Great Britain and D in the US) in the survey. The data is recoded with 4 as the best score and 1 as the lowest score for better interpretation. Data for the university entrance scores was provided by the university administration.

Social Origin

In this research, social origin is measured by parental education. This study distinguishes between two groups: “high” if at least one parent has a degree in higher education and “low,” which includes all other combinations. According to survey data, 451 (47 percent) have “high” social backgrounds.

Age

Student birth years were provided by the university administration. We calculated the age of respondents using this data. The ages of respondents vary between a minimum of 18.5 and a maximum of 38.5 years.

Gender

The university administration provided gender data for the study, which included 693 males (72 percent) and 270 females (28 percent). We did not receive any data for gender-diverse persons. The study matches this data with the collected data from the survey.

Migration

Adjusted by the index of Middendorff et al. (2013), we measured migration background. We used 4 items for the index (Deuer & Wild, 2018). The data was collected in panel wave 3. The dichotomous values for this variable are 0 (= no migration background) and 1 (= migration background). In our sample, 160 persons (17 percent) have a migration background.

Standard Academic Track

We used data from the university administration to analyse pathways to university. The dichotomous values for this variable are 0 (= no standard academic track) and 1 (= standard academic track). In our data, 865 persons (90 percent) had a standard academic track to a higher education institution.

Education Aspiration

To measure the educational aspiration of the students, we used a proxy variable. The item text is ‘The subject I

am studying has been my “desired subject” from the very beginning’. A 5-point Likert scale with values ranging from 1 (strongly disagree) to 5 (strongly agree) is used.

Vocational Training

We use a dichotomous variable for measuring degrees in vocational training before entering the cooperative education programme at DHBW. The values for this variable are 0 (= no degree in vocational training) and 1 (= a degree in vocational training). This data was collected in the survey.

Affective Commitment

We use an instrument created by Felfe et al. (2014) to measure affective commitment. Participants rated themselves on a 5-point Likert scale from 1 (strongly disagree) to 5 (strongly agree). The reliability of the scale is seen as good ($\omega = .89$; 4 Items; item example: I feel a strong sense of belonging to my organization).

Data Analyses and Missing Values

Propensity Score Matching is widely used for analysing the effects of bridging courses (Lesik et al., 2015; Voßkamp & Laging, 2014). To answer research questions, we used the procedure in 6 steps for propensity score analysis according to Lee & Little (2017) from Figure 3.

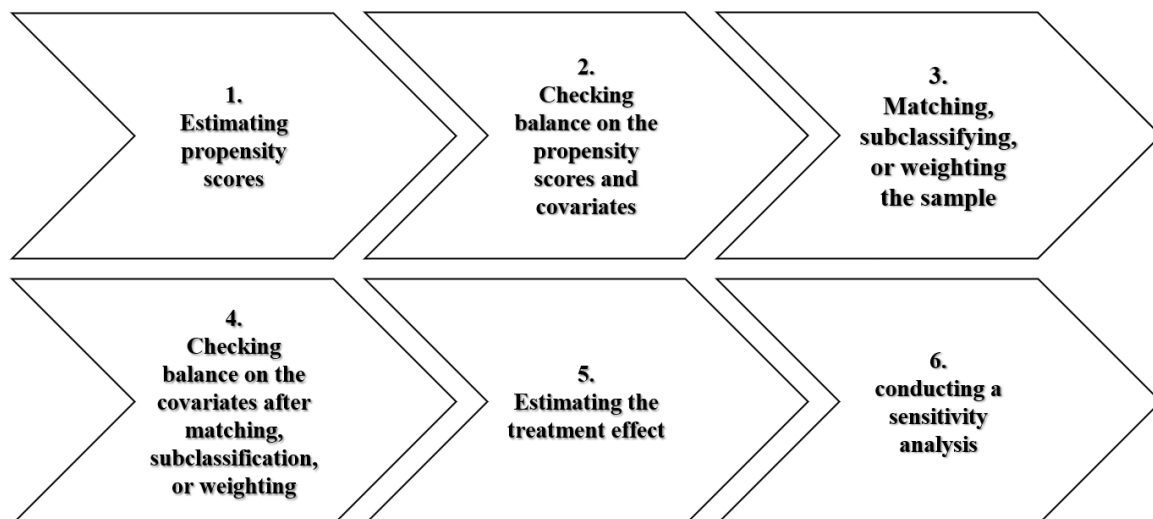


Figure 3. Steps of Propensity Score Analysis (Adapted from Lee & Little, 2017)

To answer the first research question, we used an estimated logistic regression model in the first step for “Estimating propensity scores”. To analyse the “Balance on the propensity scores” in the second step, we inspected a density plot for the distribution of the propensity scores in the variable “bridging courses”. Here, we checked the common support assumption. In the third step, “matching, sub classifying or weighting the sample”, we estimated five propensity score models: nearest neighbour matching (1:1 rotation with replacement), optimal matching, caliber matching (radius = .2), full matching and entropy balancing. We used the method of entropy

balancing because it better handles selection bias in our analysis and because of the criticism of the other propensity score matching methods (King & Nielsen, 2019). We estimated five models with different algorithms to check the robustness of the results. The fourth step, “checking the balance on the covariates after matching, subclassification, or weighting”, was done to test the covariates for statistical differences between the treatment and comparison groups. A standardized mean difference below 0.10 is seen as acceptable (Benedetto et al., 2018). In step five, “estimating the treatment effect”, we estimated an “average treatment effect on the treated” (*ATT*). Finally, in step six, we did a sensitivity analysis. We estimated the Average Marginal Effect (*AME*) in our logistic regression (Mood, 2010).

There are a few missing values in our data. Missing values range between 0 percent and 28.75 percent ($M = 9.05$; $SD = 8.21$). In 630 cases there are no missing values. We replaced the missing data using Multiple Imputation by Chained Equations of the R package “mice” with 20 imputations (van Buuren & Groothuis-Oudshoorn, 2011). We used the software R (Version 4.1.1, R Core Team 2019) to analyse the data. The packages “MatchIt” (Version 4.3.1, Ho et al., 2011), “twang” (Version 2.5, Ridgeway et al., 2016) and “rbounds” (Version 4.9-11, Keele, 2014) were used for propensity score matching. The analysis by entropy balancing was done with the packages “ebal” (Version 0.1-6, Hainmueller, 2014) and “WeightIt” (Version 0.9.0, Greifer, 2020).

Results

The propensity scores were estimated in the first step. We analyzed the first research question, “How do participants differ from non-participant?”. This was done using logistic regression analysis. Table 1 presents the result. Women ($AME = .07$; $p = .06$) and students with a degree in vocational training ($AME = .23$; $p < .001$) participate more often in bridging courses. The results suggest that we should work only with these two variables in further analyses. However, given the current state of research, we assume that all variables are related to dropout rates (Schafer & Kang, 2008). Consequently, we integrate all variables in further analysis.

Table 1. Logistic Regression for Participation in Bridging Courses ($N = 963$)

	<i>AME</i>	<i>SE</i>	
Affective Commitment	.03	.02	
Education Aspiration	-.01	.02	
Standard Academic Track	.04	.07	
Migration	-.06	.04	
Gender (Ref. = male)	.07	.04	†
Age	-.01	.01	
Social Origin	-.04	.03	
University Entrance Score	.03	.03	
Conscientiousness	.03	.02	
Subject Interest	.01	.03	
Vocational Training	.23	.06	***

Note. *AME* = Average Marginal Effect; † $p < .1$; * $p < .05$; ** $p < .01$; *** $p < .001$.

In the second step, we analyzed the distribution of the estimated propensity scores. Figure 4 shows a substantial propensity score overlap between no participation and participation in bridging courses (“common support”). The values are concentrated in the interval between .50 and .55. However, the propensity scores below .25 and above .75 seem to have little overlap with the other group. This analysis suggests that the assumptions for further analyses are met. In step 3, we estimated the following five models: nearest-neighbour matching, optimal matching, caliber matching, full match and entropy balancing.

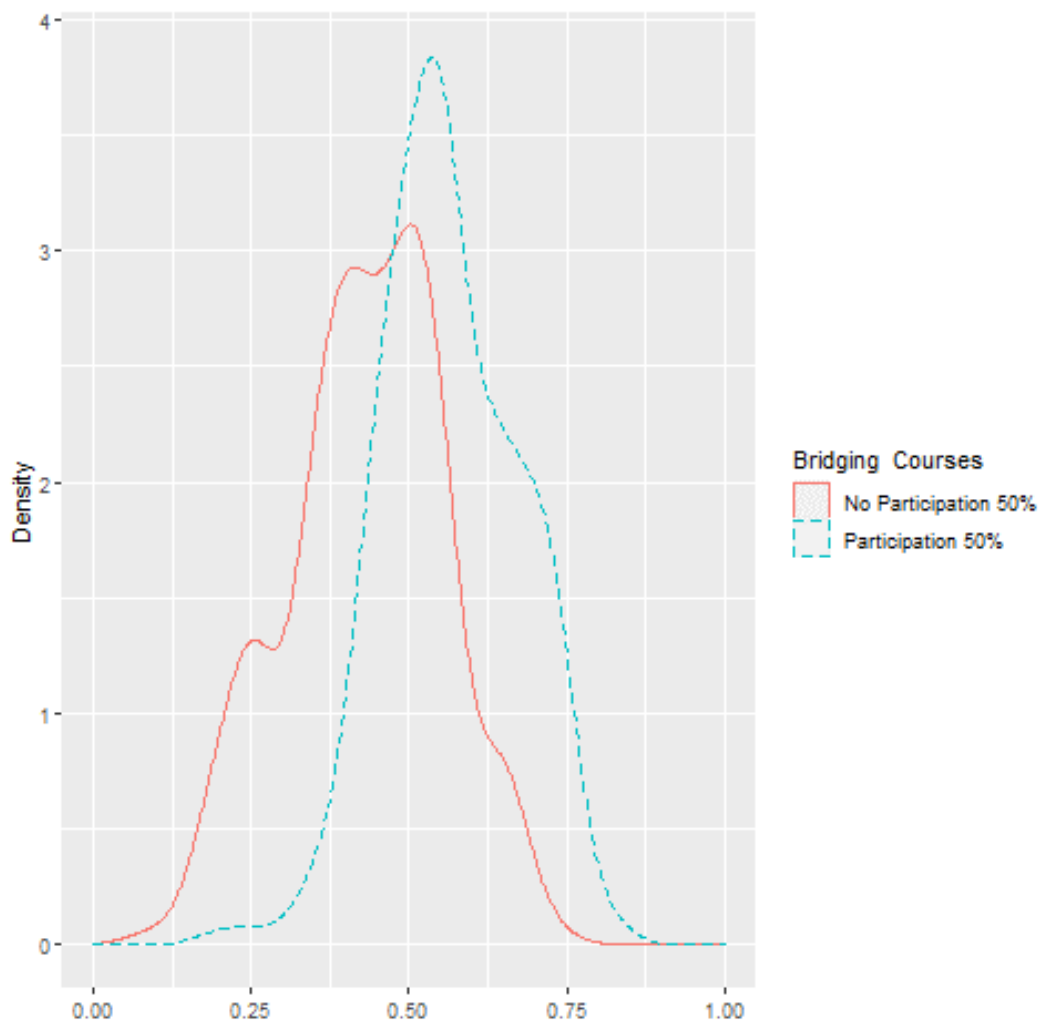


Figure 4. Propensity Score Distribution ($N = 963$)

In the fourth step, we checked the balance of the covariates before and after matching. Figure 5 presents the results of the standardized mean differences. In general, the standardized mean differences are lower after matching than before. The variables university entrance score, educational aspiration and subject interest have values below .10 in the standardized bias. The differences in social origin, migration and gender are higher. Values for affective commitment, age, standard academic track and conscientiousness are even higher. The highest difference value was analyzed for vocational training, which is seen as problematic. The matching algorithm varies depending on the standardized mean differences of the covariates. A trend is identified: caliper matching, nearest-neighbor matching and entropy balancing produce smaller standardized mean differences than other matching algorithms.

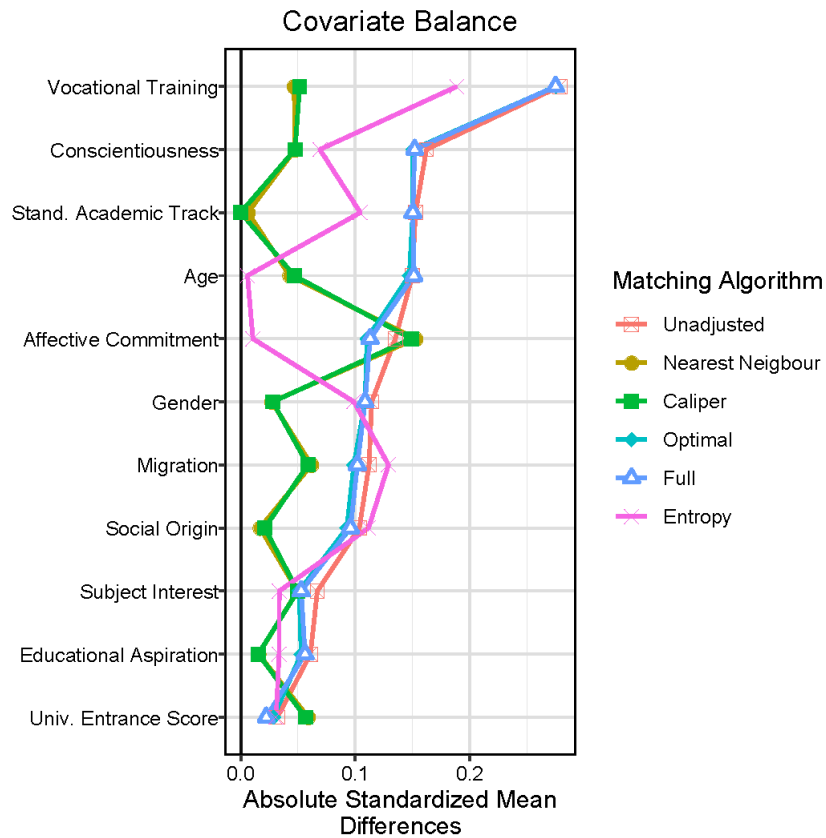


Figure 5. Standardized Differences Before and After Propensity Score Matching Comparing Covariate Values for Cooperative Students With and Without Participation in Bridging Courses ($N = 963$)

In step 5, we estimated the effect of bridging courses on dropout rates with different matching algorithms. Results are presented in Table 2. The effects are all negative (between $AME = -.01$ and $AME = -.02$), which means that the likelihood of dropping out decreases with participation in bridging courses. However, the results are not significant in the models ($p > .05$).

Table 2. Results of Logistic Regression for Participation in Bridging Courses on Dropout with Different Matching Algorithm ($N = 963$)

		<i>AME</i>	<i>SE</i>	<i>p</i>
Bridging Courses	Nearest Neighbor Matching	-.02	.02	.46
	Optimal Matching	-.01	.02	.64
	Caliber Matching	-.02	.02	.46
	Full Matching	-.01	.02	.62
	Entropy Balancing	-.01	.02	.50

Note. *AME* = Average Marginal Effect

In step 6, sensitivity analysis follows for the matching algorithm nearest to neighbor matching, optimal matching, caliber matching and full matching (Rosenbaum, 1991). There are significant results ($p < .05$) between $\Gamma = 1$ and $\Gamma = 5.4$. In other words, the effect of participation in bridging courses on dropout is in our analysis robust to hidden

bias from unmeasured covariates up to $\Gamma = 5.4$. These analyses seem to integrate important characteristics as background variables.

Discussion and Conclusion

Overall, our findings suggest that bridging courses are no guarantee for decreasing dropout rates. The empirical results from our sample show a non-significant negative effect of bridging courses on dropout rates. Bridge courses therefore do no harm, but also do not show a hoped effect on reducing dropout. Further analysis of the research question, “who participates in a bridging course”, showed that primarily women and people with a degree in vocational training participate in these courses.

We use Heinlein’s (2014) dropout model as a theoretical framework in our analyses. However, this model is not exactly matched with the cooperative education approach. We therefore modified the model by integrating the effect of the cooperative partners on student dropout rates. This procedure allowed us to use a solid theoretical framework to explore a population—a topic on which few research results currently exist. Our analysis integrates the increasingly important aspect of motivation research (Bäulke et al., 2021, Schnettler et al., 2019) by using the variable of subject interest in our analyses. However, it would be helpful for further analyses to combine the two theoretical models mentioned above to understand the dropout process better, especially when modelling the effect of contextual factors on individuals and estimating its consequence on the decision-making process. It would be great, if approaches and empirical analyses could close these gaps in the future and integrate the effects of bridging courses.

Our conclusion of the small and insignificant effect is that the content of bridging courses in cooperative study programmes either requires a different focus or other factors have to be taken more into account to prevent dropouts. Therefore, we suggest the following practical implications. It is a central concern for us to propose how the bridging courses could be improved. In this context, it is important to mention that learning content from secondary school and university could be better coordinated, or in other words: the curricula of the two institutions must be better aligned with each other. The integration of new students into the new learning environment at university could be improved by helping students improve their organizational skills, emphasizing a reflective learning process, and increasing self-motivation by helping students manage work time in their workload. Bridging courses could help students in the transition phase during the start of the study programme. This particularly applies to students with a degree in vocational training who participate more frequently in bridging courses. For these participants, a bridging course could not only enable social integration but make academic learning easier for them.

Our contribution raises new research questions. From our point of view, an important research question is how participation in a bridging course influences the short-term study situation, such as the motivation of first-year students in a study programme. Furthermore, the analyses in this study should be done in other subject areas. Further analyses should differentiate between early and late dropouts. In addition, it would be worth investigating whether different types of bridging courses have different effects. It would be conceivable, for example, to

distinguish between courses that focus on a specific subject (e.g., mathematics, chemistry) and courses that teach basic study skills (e.g., learning strategies, propaedeutics).

One strength of our study is that we were able to use university administrative data. Furthermore, our research uses good measurement instruments. We were also able to analyze data on an increasingly popular type of study programme. This is countered by the following weaknesses of our research. We only have data from one university in one country. Unfortunately, our data set does not integrate any information on students who graduated at the end of the standard period of study when contracts with cooperative partners end. The current study situation from the model of Heublein (2014) is not integrated enough in our statistical model. Moreover, we have not sufficiently integrate the work-integrated period at the company into our research or control for it in the statistical model, because well-supervised work-integrated period could be like bridging courses.

This study can be seen as a starting point for further research on the effects of bridging courses on dropout rates in cooperative study programmes. In our opinion, there is a need to revise the curriculum in the analyzed bridging courses to reduce dropout rates. This should be done together by students, higher education institutions and companies. We hope that our research can help to achieve this goal.

References

- Ansmann, M., Hemkes, B., Hofmann, S., König, M., Kutzner, P., & Joyce, S. L. (2020). *AusbildungPlus. Duales Studium in Zahlen 2019. Trends und Analysen [AusbildungPlus. Cooperative Education in figures 2019. Trends and Analysis]*. Federal Institute for Vocational Educational and Training.
- Araque, F., Róldan, C., & Salguero, A. (2009). Factors influencing university drop out rates. *Computers & Education, 53*, 563–574. <https://doi.org/10.1016/j.compedu.2009.03.013>
- Argentin, G., & Triventin, M. (2011). Social inequality in higher education and labour market in a period of institutional reforms: Italy, 1992–2007. *Higher Education, 61*, 309–323. <https://doi.org/10.1007/s10734-010-9379-6>
- Bahr, P.R. (2008) Does Mathematics Remediation Work?: A Comparative Analysis of Academic Attainment among Community College Students. *Research in Higher Education, 49*, 420–450. <https://doi.org/10.1007/s11162-008-9089-4>
- Bäulke, L., Grunschel, C., & Dresel, M. (2021). Student dropout at university: a phase-orientated view on quitting studies and changing majors. *European Journal of Psychology of Education, 37*, 853–876. <https://doi.org/10.1007/s10212-021-00557-x>
- Belloc, F., Maruotti, A., & Petrella, L. (2010). University drop-out: an Italian experience. *Higher Education, 60*, 127–138. <https://doi.org/10.1007/s10734-009-9290-1>
- Benedetto, U., Head, S. J., Angelini, G. D., & Blackstone, E. H. (2018). Statistical primer: propensity score matching and its alternatives. *European Journal of Cardio-Thoracic Surgery, 53*, 1112–1117. <https://doi.org/10.1093/ejcts/ezy167>
- Berka, P., & Marek, L. (2021). Bachelor's degree student dropouts: Who tend to stay and who tend to leave? *Studies in Educational Evaluation, 70*, 100999. <https://doi.org/10.1016/j.stueduc.2021.100999>

- Berndt, S., & Felix, A. (2020). Resilienz und der Übergang in die Hochschule – Eine empirische Untersuchung der Bedeutung von Resilienz für den Studienerfolg und -abbruch in der Studieneingangsphase [Resilience and the transition to higher education institution – An empirical study of the meaning of resilience for academic success and dropout in the starting phase of study program]. *Beiträge zur Hochschulforschung*, 42, 36–55.
- Bettinger, E., & Long, B. (2009). Addressing the needs of under-prepared college students: Does college remediation work? *Journal of Human Resources*, 44(3), 736–771. <https://doi.org/10.3368/jhr.44.3.736>
- Braunstein, L.A., Takei, H., Wang, F., & Loken, M. K. (2011). Benefits of Cooperative and Work-Integrated Education for Employers. In R. Coll & K. E. Zegeard (Eds.), *International Handbook for Cooperative and Work-Integrated Education: International Perspectives of Theory, Research and Practice* (2nd ed., pp. 277–286). World Association for Cooperative Education (WACE).
- Büchtele, S. (2020a). Should we trust math preparatory courses? An empirical analysis on the impact of students' participation and attendance on short- and medium-term effects. *Economic Analysis and Policy*, 66, 154–167. <https://doi.org/10.1016/j.eap.2020.04.002>
- Büchtele, S. (2020b). Bridging the gap—How effective are remedial math courses in Germany? *Studies in Educational Evaluation*, 64, 100832. <https://doi.org/10.1016/j.stueduc.2019.100832>
- Chen, R., & DesJardins, S. L. (2010). Investigating the Impact of Financial Aid on Student Dropout Risks: Racial and Ethnic Differences. *The Journal of Higher Education*, 81(2), 179–208. <https://www.jstor.org/stable/40606850>
- Coll, R., & Zegwaard, K. E. (Eds.). (2011). *International handbook for cooperative and work-integrated education: International perspectives of theory, research and practice* (2nd ed.). World Association for Cooperative Education (WACE).
- Derr, K. S. (2018). *Mathematics for engineering students in the 'Dual System': Assistance in study start-up and conduct* (Doctoral thesis, University of Plymouth). <http://hdl.handle.net/10026.1/13323>
- Deuer, E., & Wild, S. (2018). *Studierende mit Migrationshintergrund im Kontext des dualen Studiums – empirische Analysen [Students with a migration background in the cooperative education – empirical analyses.]*. Baden-Wuerttemberg Cooperative State University. <https://www.dhbw.de/studie>
- Deuer, E., Meyer, T., Walkmann, R., & Rahn, S. (2020). Das Studienverlaufspanel an der DHBW (2015–2019) [The Panel Study of DHBW (2015–2019)]. In E. Deuer & T. Meyer (Eds.), *Studienverlauf und Studienerfolg im Kontext des dualen Studiums [Study Process and Academic Success in the Cooperative Education]* (pp. 5–20). WBV.
- Ebert, J., & Heublein, U. (2017). *Ursachen des Studienabbruchs bei Studierenden mit Migrationshintergrund [Reasons for dropout among students with migration background]*. German Centre for Higher Education Research and Science Studies (DZHW).
- Falk, S., & Marschall, M. (2021). Abbruch des Erststudiums bei MINT-Studierenden: Welche Rolle spielen Informations- und Unterstützungsangebote bei Studienbeginn? [Dropout among Students in the Field of STEM for first degree: What role do information and support services play before the start of the study programme?]. In M. Neugebauer, H. D. Daniel, & A. Wolter (Eds.) *Studienerfolg und Studienabbruch [Study Success and Dropout]* (pp. 345–368). Springer VS. <https://doi.org/10.1007/978-3-658-32892->

4_15

- Felfe, J., Six, B., Schmook, R., & Knorz, C. (2014). Commitment Organisation, Beruf und Beschäftigungsform (COBB) [Organizational Commitment, Occupation and form of employment (COBB)]. In D. Danner & A. Glöckner-Rist (Eds.), *Zusammenstellung sozialwissenschaftlicher Items und Skalen (ZIS) [Compilation of social science items and scales]*. GESIS. <https://doi.org/10.6102/zis9>
- Fellenberg, F., & Hannover, B. (2006). Easy come, easy go? Psychological causes of students' drop out of university or changing the subject at the beginning of their study. *Empirische Pädagogik*, 20(4), 381–99.
- Fokkens-Bruinsma, M., Vermue, C., Deinum, J.-F., & von Rooij, E. (2020). First-year academic achievement: the role of academic self-efficacy, self-regulated learning and beyond classroom engagement. *Assessment & Evaluation in Higher Education*, 46(7), 1115–1126. <https://doi.org/10.1080/02602938.2020.1845606>
- Georg, W. (2009). Individual and institutional factors in the tendency to drop out of higher education: a multilevel analysis using data from the Konstanz Student Survey. *Studies in Higher Education*, 34(6), 647–661. <https://doi.org/10.1080/03075070802592730>
- Gerdes, A., Halverscheid, S., & Schneider, S. (2021). Teilnahme an mathematischen Vorkursen und langfristiger Studienerfolg. Eine empirische Untersuchung [Participation in mathematics pre-courses and long-term academic success. An empirical study.]. *Journal für Mathematik-Didaktik*, 43, 377–403. <https://doi.org/10.1007/s13138-021-00194-3>
- Govender, C. M., & Våland, T. I. (2021). *Work Integrated Learning for Students: Challenges and Solutions for Enhancing Employability*. Cambridge Scholars Publishing.
- Graf, L. (2013). *The hybridization of vocational training and higher education in Austria, Germany, and Switzerland*. Budrich UniPress Ltd.
- Graf, L., Powell, J. J. W., Fortwengel, J., & Bernhard, N. (2014). *Dual study programmes in global context: Internationalisation in Germany and transfer to Brazil, France, Qatar, Mexico and the US*. DAAD.
- Greefrath, G., Koepf, W., & Neugebauer, C. (2017). Is there a link between Preparatory Course Attendance and Academic Success? A Case Study of Degree Programmes in Electrical Engineering and Computer Science. *International Journal of Research in Undergraduate Mathematics Education*, 3, 143–167. <https://doi.org/10.1007/s40753-016-0047-9>
- Greifer, N. (2020). WeightIt: Weighting for Covariate Balance in Observational Studies. R package version 0.9.0. <https://CRAN.R-project.org/package=WeightIt>
- Hadjar, A., & Becker, R. (2004) Warum einige Studierende ihr Soziologie-Studium abbrechen wollen. Studienwahlmotive, Informationsdefizite und wahrgenommene Berufsaussichten als Determinanten der Abbruchneigung [Why some students want to abandon their sociology studies. Motives for the choice of studies, information deficits and perceived occupational prospects as determinants for the abandonment inclination]. *Soziologie*, 33(3), 47–65.
- Hainmueller, J. (2014). ebal: Entropy reweighting to create balanced samples. R package version 0.1-6. <https://CRAN.R-project.org/package=ebal>
- Heublein, U. (2014). Student Drop-out from German Higher Education Institutions. *European Journal of Education*, 49(4), 497–513. <https://doi.org/10.1111/ejed.12097>
- Heublein, U., Ebert, J., Hutzsch, C., Isleib, S., König, R., Richter, J., & Woisch, A. (2017). *Zwischen Studienerwartungen und Studienwirklichkeit: Ursachen des Studienabbruchs, beruflicher Verbleib der*

- Studienabbrecherinnen und Studienabbrecher und Entwicklung der Studienabbruchquote an deutschen Hochschulen [Between Expectations and Reality in study program: Reasons of Dropout, Career Retention of Dropouts and Development of the Dropout Rate at German Universities]* (Forum Hochschule, 1/2017). German Centre for Higher Education Research and Science Studies (DZHW).
- Heublein, U., Richter, J., & Schmelzer, R. (2020). *Die Entwicklung der Studienabbruchquoten in Deutschland [Development of dropout rates in Germany]*. (DZHW Brief 3|2020). DZHW. https://doi.org/10.34878/2020.03.dzhw_brief
- Ho, D., Imai, K., King, G., & Stuart, E. A. (2011). MatchIt: Nonparametric Preprocessing for Parametric Causal Inference. *Journal of Statistical Software*, 42(8), 1–28. <https://doi.org/10.18637/jss.v042.i08>
- Isphording, I., & Wozny, F. (2018). *Ursachen des Studienabbruchs – eine Analyse des Nationalen Bildungspanels [Reasons for dropout - an analysis of the National Educational Panel Study]* (IZA Research Report No. 82). Institute of Labor Economics.
- John, O. P., Donahue, E. M., & Kentle, R. L. (1991). *The Big Five Inventory--Versions 4a and 54*. University of California, Berkeley, Institute of Personality and Social Research.
- Keele, L. J. (2014). rbounds: Perform Rosenbaum bounds sensitivity tests for matched and unmatched data. <https://cran.r-project.org/web/packages/rbounds/index.html>
- King, G., & Nielsen, R. (2019). Why propensity scores should not be used for matching. *Political Analysis*, 27(4), 435–454. <https://doi.org/10.1017/pan.2019.11>
- Klein, D. (2019). Das Zusammenspiel zwischen akademischer und sozialer Integration bei der Erklärung von Studienabbruchintentionen. Eine empirische Anwendung von Tintos Integrationsmodell im deutschen Kontext [The interplay between academic and social integration in explaining higher education dropout intentions. An empirical application of Tinto's integration model in the German context]. *Zeitschrift für Erziehungswissenschaft*, 22, 301–323. <https://doi.org/10.1007/s11618-018-0852-9>
- Klein, D., & Stocké, V. (2016). Studienabbruchquoten als Evaluationskriterium und Steuerungsinstrument der Qualitätssicherung im Hochschulbereich [Dropout rates as evaluation criteria and control tool of quality management in higher education]. In D. Großmann & T. Wolbring (Eds.), *Evaluation von Studium und Lehre: Grundlagen, methodische Herausforderungen und Lösungsansätze [Evaluation in study programmes and teaching. Basics, methodological challenges and approaches to solutions]* (pp. 323–365). Springer. https://doi.org/10.1007/978-3-658-10886-1_10
- Kürten, R. (2020). *Mathematische Unterstützungsangebote für Erstsemesterstudierende. Entwicklung und Erforschung von Vorkurs und begleitenden Maßnahmen für die Ingenieurwissenschaften [Support services in Math for freshman. Development and research of pre-course and supporting methods for engineering sciences.]* Springer.
- Lassibille, G., & Navarro Gómez, M. L. (2009). Tracking students' progress through the Spanish university school sector. *Higher Education*, 58, 821–839. <https://doi.org/10.1007/s10734-009-9227-8>
- Lee, J., & Little, T. D. (2017). A practical guide to propensity score analysis for applied clinical research. *Behaviour Research and Therapy*, 98, 76–90. <https://doi.org/10.1016/j.brat.2017.01.005>
- Lesik, S. A., Santoro, K. G., & DePeau, E. A. (2015). Evaluating the effectiveness of a mathematics bridge program using propensity scores. *Journal of Applied Research in Higher Education*, 7, 331–345. <https://doi.org/10.1108/JARHE-01-2014-0010>

- Middendorff, E., Apolinarski, B., Poskowsky, J., & Kandulla, M., & Netz, N. (2013). *Die wirtschaftliche und soziale Lage der Studierenden in Deutschland 2012. 20. Sozialerhebung des Deutschen Studentenwerks durchgeführt durch das HIS-Institut für Hochschulforschung [The Economic and Social Situation of Students in Germany 2012. 20th Social Survey of the German Student Union conducted by the HIS Institute for Higher Education Research.]*. Federal Ministry of Education and research.
- Mood, C. (2010). Logistic Regression: Why We Cannot Do What We Think We Can Do, and What We Can Do About It. *European Sociological Review*, 26(1), 67–82. <https://doi.org/10.1093/esr/jcp006>
- Mouton, D., Zhang, H., & Ertl, B. (2020). German university student's reasons for dropout: Identifying latent classes. *Journal for Educational Research Online*, 12(2), 190–224. <https://doi.org/10.25656/01:20977>
- Müller, S., & Schneider, T. (2013). Educational pathways and dropout from higher education in Germany. *Longitudinal and Life Course Studies* 2013, 4(3), 218–241. <http://dx.doi.org/10.14301/llcs.v4i3.251>
- Nagy, M., & Molontay, R. (2021). Comprehensive analysis of the predictive validity of the university entrance score in Hungary. *Assessment & Evaluation in Higher Education*, 46(8), 1235–1253. <https://doi.org/10.1080/02602938.2021.1871725>
- Neugebauer, M., Heublein, U., & Daniel, A. (2019) Studienabbruch in Deutschland: Ausmaß, Ursachen, Folgen, Präventionsmöglichkeiten [Higher education dropout in Germany: extent, causes, consequences, prevention]. *Zeitschrift für Erziehungswissenschaft*, 22, 1025–1046. <https://doi.org/10.1007/s11618-019-00904-1>
- OECD (2019). *Education at a Glance 2019: OECD Indicators*. OECD Publishing. <https://doi.org/10.1787/f8d7880d-e>
- R Core Team (2019). *R: a language and environment for statistical computing*. R Foundation for Statistical Computing.
- Rammstedt, B., Kemper, C. J., Klein, M. C., Beierlein, C., & Kovaleva, A. (2013). A Short Scale for Assessing the Big Five Dimensions of Personality: 10 Item Big Five Inventory (BFI-10). *Methods, data, analysis*, 7(2), 233–249. <https://doi.org/10.12758/mda.2013.013>
- Reichardt, D. (2021). Contributions of Character Computing to AI Based Adaptive Learning Environments – A Discussion. In F. De La Prieta, A. El Bolock, D. Durães, J. Carneiro, F. Lopes & V. Julian (Eds.), *Highlights in Practical Applications of Agents, Multi-Agent Systems, and Social Good. The PAAMS Collection. PAAMS Workshops 2021. Communications in Computer and Information Science, vol 1472* (pp. 40–47). Springer. https://doi.org/10.1007/978-3-030-85710-3_4
- Reinhard, K., & Gerloff, A. (2020). Internationalizing cooperative education: Implementing the German DHBW model in Thailand and China. *International Journal of Work-Integrated Learning*, 21(3), 289–301.
- Reinhard, K., & Pogrzeba, A. (2016). Comparative cooperative education: Evaluating Thai models on work-integrated learning, using the German Duale Hochschule Baden-Wuerttemberg model as a benchmark. *Asia-Pacific Journal of Cooperative Education*, 17(3), 227–247.
- Reinhard, K., Pogrzeba, A., Townsend, R., & Pop, A. P. (2016). A comparative study of cooperative education and workintegrated learning in Germany, South Africa, and Namibia. *Asia-Pacific Journal of Cooperative Education*, 17(3), 249–263.
- Reinhard, K., Wynder, M., & Kim, W.-S. (2020). Developing best practice for cooperative and work-integrated education: Lessons from Germany, Australia and South Korea. *International Journal of Work-Integrated*


- Learning*, 21(2), 177–191.
- Ridgeway, G., McCaffrey, D., Morral, A., Griffin, B. A., & Burgette, L. (2016). twang: Toolkit for Weighting and Analysis of Nonequivalent Groups. <https://cran.r-project.org/web/packages/twang/index.html>
- Rosenbaum, P. R. (1991). Sensitivity analysis for matched case-control studies. *Biometrics*, 47, 87–100. <https://doi.org/10.2307/2532498>
- Schafer, J. L., & Kang, J. (2008). Average causal effects from nonrandomized studies: a practical guide and simulated example. *Psychological methods*, 13(4), 279–313. <https://doi.org/10.1037/a0014268>
- Schnettler, T., Bobe, J., Scheunemann, A., Fries, S., & Grunschel, C. (2020). Is it still worth it? Applying expectancy-value theory to investigate the intraindividual motivational process of forming intentions to drop out from university. *Motivation and Emotion*, 44, 491–507. <https://doi.org/10.1007/s11031-020-09822-w>
- Scholten, M., & Tieben, N. (2017). Vocational qualification as safety-net? Education-to-work transitions of higher education dropouts in Germany. *Empirical Research in Vocational Education and Training*, 9(7), 1–17. <https://doi.org/10.1186/s40461-017-0050-7>
- State Statistical Office Baden-Württemberg (2018). *Ergebnisse der Absolventenbefragung 2017 an der Dualen Hochschule Baden-Württemberg [Results of the Graduates survey 2017 at Baden-Wuerttemberg Cooperative State University]*. State Statistical Office Baden-Württemberg.
- Thomsen, J. P. (2021). The social class gap in bachelor's and master's completion: university dropout in times of educational expansion. *Higher Education*, 83, 1021–1038. <https://doi.org/10.1007/s10734-021-00726-3>
- Tieben, N. (2019). Brückenkursteilnahme und Studienabbruch in Ingenieurwissenschaftlichen Studiengängen [Remedy Mathematics Course Participation and Dropout among Higher Education Students of Engineering]. *Zeitschrift für Erziehungswissenschaft*, 22, 1175–1202. <https://doi.org/10.1007/s11618-019-00906-z>
- Tieben, N. (2020). Non-completion, Transfer, and Dropout of Traditional and Non-traditional Students in Germany. *Research in Higher Education*, 61, 117–141. <https://doi.org/10.1007/s11162-019-09553-z>
- Trautwein, C., & Bosse, E. (2017). The first year in higher education—critical requirements from the student perspective. *Higher Education*, 73, 371–387. <https://doi.org/10.1007/s10734-016-0098-5>.
- Van Bragt, C. A. C., Bakx, A. W. E. A., Bergen, T. C. M., & Croon, M. A. (2011). Looking for students' personal characteristics predicting study outcome. *Higher Education*, 61, 59–75. <https://doi.org/10.1007/s10734-010-9325-7>
- van Buuren, S., & Groothuis-Oudshoorn, K. (2011). mice: Multivariate Imputation by Chained Equations in R. *Journal of Statistical Software*, 45(3), 1–67. <https://doi.org/10.18637/jss.v045.i03>
- Voßkamp, R., & Laging, A. (2014). Teilnahmeentscheidungen und Erfolg [Participation decisions and success]. In I. Bausch, R. Biehler, R. Bruder, P. R. Fischer, R. Hochmuth, W. Koepf, S. Schreiber & T. Wassong (Eds.), *Mathematische Vor- und Brückenkurse [Mathematics Pre- and Bridge Courses]* (pp. 67–83). Springer Spektrum. https://doi.org/10.1007/978-3-658-03065-0_6
- Wild, S., & Alvarez, S. (2020). Cooperative education in the higher education system and Big Five personality traits in Germany. *International Journal of Work-Integrated Learning*, 21(1), 37–49.
- Wild, S., & Neef, C. (2019). The role of academic major and academic year for self-determined motivation in cooperative education. *Industry and Higher Education*, 33(5), 327–339.

<https://doi.org/10.1177/0950422219843261>

- Wild, S., & Schulze Heuling, L. (2020, online first). Student Dropout and Retention: An Event History Analysis among Students in Cooperative Higher Education. *International Journal of Educational Research*, 104, 101687. <https://doi.org/10.1016/j.ijer.2020.101687>
- Wild, S., Rahn, S., & Meyer, T. (2020). Gut gebunden oder Loslösung auf Zeit? Zur Entwicklung des affektiven Commitments von dual Studierenden unter längsschnittlicher Betrachtung [Close ties or detachment over time? A long-term perspective on the development of affective organizational commitment of cooperative students]. *Zeitschrift für Soziologie der Erziehung und Sozialisation*, 40(4), 312–334.
- Wood, L. (2001). The secondary-tertiary interface. In D. A. Holton (Eds.), *The teaching and learning of mathematics at university level* (pp. 87–98). Kluwer Academic.
- Xu, D., & Dadgar, M. (2018). How Effective Are Community College Remedial Math Courses for Students With the Lowest Math Skills? *Community College Review*, 46(1), 62–81. <https://doi.org/10.1177/0091552117743789>
- Yastrebov, G., Kosyakova, Y., & Kurakin, D. (2018). Slipping Past the Test: Heterogeneous Effects of Social Background in the Context of Inconsistent Selection Mechanisms in Higher Education. *Sociology of Education*, 91(3), 224–241. <https://doi.org/10.1177/0038040718779087>

Author Information

Steffen Wild

 <https://orcid.org/0000-0003-3290-8761>


TU Dortmund University

Emil-Figge-Str. 50, D-44227 Dortmund

Germany

Contact e-mail: steffen.wild@tu-dortmund.de

Sebastian Rahn


 <https://orcid.org/0000-0001-6754-0085>

HTW University of Applied Sciences in Saarbrücken

Malstatter Straße 17, D-66117 Saarbrücken

Germany

Thomas Meyer

 <https://orcid.org/0000-0002-8357-9980>

Baden-Wuerttemberg Cooperative State University

(DHBW)

Rotebühlstraße 131, D-70197 Stuttgart

Germany
