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INTERDISCIPLINARY, MULTIDISCIPLINARY, AND MONODISCIPLINARY STUDY PROGRAMS IN GERMANY: A CLASSIFICATION SCHEME

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Interdisciplinary, Multidisciplinary, and Monodisciplinary Study Programs in Germany: A classification scheme

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Interdisciplinary, Multidisciplinary, and Monodisciplinary Study Programs in Germany: A Classification Scheme

Abstract

In this paper, we propose a classification scheme for study programs. The classification scheme makes it possible to classify study programs in respect of their interdisciplinary design. Interdisciplinary study programs do not fit particularly well into existing classification systems. The proposed classification scheme differentiates between interdisciplinary, multidisciplinary and monodisciplinary programs. It has been applied to the open responses of first-year students of starting cohort 5. The resulting classification is available in NEPS Scientific-Use-Files 13-0-0. We present the classification scheme, the coding process, and an overview of the results.

Keywords

interdisciplinarity, interdisciplinary study programs, first-year students

1. Introduction

In recent decades, the number of undergraduate study programs in Germany has increased significantly (Hachmeister et al., 2016). In addition to the introduction of bachelor's and master's study programs in the course of the Bologna reforms, an increase in interdisciplinary study programs can also be attested. In interdisciplinary study programs, content from two or more disciplines is combined. There are great differences in the design of interdisciplinary study programs.

So far, there is a lack of reliable information about these study programs and the students enrolled in them. In German higher education statistics, interdisciplinary study programs are not recorded as such, but are mostly categorized in residual categories. This neglect in higher education statistics makes research on interdisciplinary programs and their students difficult. At the same time, research suggests that interdisciplinary study programs come with special requirements and challenges for the students (Repko et al., 2017).

Information on study programs in NEPS starting cohort 5 data (NEPS Network, 2022) has already been classified according to two classification schemes, (1) the DeStatis (2015) subject classification scheme and (2) ISCED 1997 (UNESCO, 2006). (1) The DeStatis (2015) classification distinguishes between different subjects (e.g., history or engineering) and subject groups. Although very thorough, interdisciplinary study programs do not fit particularly well into the classification system. This is due to the fact, that one subject has to be chosen and not several subjects at once (as interdisciplinary programs would often require). The DeStatis (2015) scheme recognizes interdisciplinary study programs (e.g., 004 - interdisciplinary studies with a focus in linguistic and cultural studies), however, those codes are then subsumed under broader categories and can therefore not be analyzed separately (e.g., 004 is subsumed under linguistic and cultural studies in general). Study programs spanning different disciplinary groups cannot be identified using this scheme, either. (2) The ISCED classification scheme aims at providing a framework for describing both levels of education (e.g., tertiary education) and broad fields of education (e.g., literacy and numeracy, but also engineering, manufacturing and construction). Here, NEPS employs different degrees of details (1-digit codes, 2-digit codes, 3-digit codes). But even on the most detailed level, interdisciplinary study programs cannot be recognized. Therefore, the existing classification schemes do not support analyses and research on interdisciplinary study programs in Germany.

Interdisciplinary study programs in Germany are very diverse. Therefore, an analysis of these differences is also necessary for the systematic recording and research of these study programs. In this paper, we present a classification scheme that makes it possible to classify study programs with respect to their interdisciplinary design. We first present a short theoretical background of interdisciplinary study programs (Chapter 2), before we outline the classification scheme in Chapter 3. Chapter 4 introduces the data basis of the NEPS starting cohort 5. Information regarding the classification process can be found in Chapter 5. The results of the classification procedure are described in Chapter 6 and discussed in Chapter 7.

2. Theoretical Background

Interdisciplinarity is defined as "the process of answering a question, solving a problem, or addressing a topic that is too broad or complex to be dealt with adequately by a single discipline or profession. […] Interdisciplinary studies draws on disciplinary perspectives and integrates their insights through construction of a more comprehensive perspective" (Klein & Newell, 1996, p. 3). This definition highlights the special role of integration for interdisciplinarity, which is also emphasized by other authors (e.g., Repko et al., 2017). According to this definition, interdisciplinarity should be more than the sum of the individual disciplines and enable innovation by combining these different perspectives (Sung et al., 2003). Multidisciplinarity as a term is used to describe a mode of collaboration in which different disciplines contribute their perspectives but do not seek comprehensive integration (Repko et al., 2017). Multidisciplinary study programs have been established, for example, as "Magister" study programs before the Bologna reforms (Hachmeister et al., 2016).The classification scheme takes this distinction and applies it to study programs. The interplay between interdisciplinary study experiences and interdisciplinarity in the work context has not been conclusively established. The hypothesis that interdisciplinarity in studies promotes later interdisciplinarity in research is already put forward by (Mittelstraß, 1987, p. 157): "Those who have not studied interdisciplinarily cannot do interdisciplinary research". The preparation of interdisciplinary thinking already in studies can be applied equally to non-university jobs. These considerations certainly contribute to the increase in interdisciplinary courses of study.

3. The Classification Scheme

The classification scheme distinguishes at the top level between interdisciplinary, multi-disciplinary and monodisciplinary programs (see Figure 1).

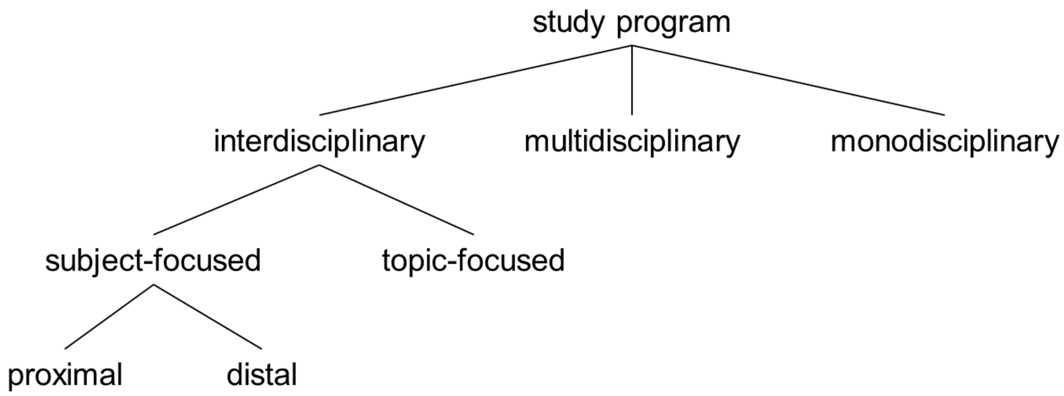

Figure 1. At the top level, the classification scheme distinguishes interdisciplinary, multidisciplinary, and monodisciplinary programs.

Monodisciplinary degree programs consist of one subject discipline. This discipline alone is studied or clearly stands in the foreground of the study program. The category of monodisciplinary degree programs includes classic degree programs such as law, human medicine or economics, but also newer degree programs in which only one discipline is taught. Following Hachmeister et al. (2016), for example, this includes new degree programs from previously non-academic professions, such as nursing or physical therapy. Study programs that include a minor subject of a maximum of 60 ECTS credits are also classified as monodisciplinary in this scheme.

Multidisciplinary degree programs are those in which, for the most part, two subject disciplines are studied side by side without the integration of the subjects involved being in the foreground or even addressed. This category includes, for example, 2-subject bachelor's degree programs that are in the tradition of Magister study programs, for example, a 2-subject bachelor's degree programs in political science and sociology. Often, students in these programs can choose their two majors independently, so from an organizational perspective there is no integration at all. Teacher education programs are also classified as multidisciplinary. In addition to a pedagogical education, most teacher education programs provide for the independent study of two subject disciplines representing the later teaching subjects. In the subject didactics, references between these subjects and educational science are addressed, but an integration of the two subjects (for example, mathematics and religious studies) is not aimed at.

Interdisciplinary study programs combine two or more subject disciplines and integrate their specific perspectives. Following Hachmeister et al. (2016), we distinguish between subject-focused and topic-focused study programs. Subject-focused study programs are also referred to as "hybrid study programs" and integratively combine two separate subject disciplines. A further distinction is made between proximal and distal subject-focused study programs. In proximal subject-focused programs, the two disciplines come from the same subject family (e.g., biochemistry, computer engineering). To define the subject families, the subject classification of the Statistisches Bundesamt (DeStatis, 2015) was adapted so that law, economics, and social sciences are each considered as independent subject families (see Table 1). This allows for better differentiation in this area. Distal subject-focused study programs combine the content of two disciplines that come from different subject families. Accordingly, the content, methods and theories of these subjects are further apart. Industrial engineering, social economics and biotechnology, for example, fall into this category. Topic-focused study programs are not directly oriented toward traditional academic disciplines. These study programs are organized around an overarching theme and draw on content, methods, and theories from different disciplines that can be assigned to that topic (Hachmeister et al., 2016). Examples of topic-focused study programs include hydrology, environmental protection, and media conceptualization.

Table 1

Adaptation of the subject classification of the Statistisches Bundesamtes (DeStatis, 2015)

Code	**Subject Classification by DeStatis (2015)**	**Code**	**Adapted Subject Classification**
1	Humanities	0	Humanities
2	Sports	1	Sports
3	Law, economics and social sciences	2	Law
		3	Economics
		4	Social Sciences
4	Mathematics, natural sciences	5	Mathematics, natural sciences
5	Human medicine/ health sciences	6	Human medicine/ health sciences
6	(not awarded)		
7	Agricultural, forestry and nutritional sciences, veterinary sciences	7	Agricultural, forestry and nutritional sciences, veterinary sciences
8	Engineering sciences	8	Engineering sciences
9	Arts, art science	9	Arts, art science
10	Outside the subject classification	10	Outside the subject classification

Examples of the corresponding classifications can be found in Table 2.

Table 2

Examples of study programs and their classification

Classification	**Examples of Study Programs**
Monodisciplinary	• Civil Engineering • International Management Science • Agricultural Science • Nursing Science • Sociology
Multidisciplinary	• Elementary school teaching program • 2-subject Bachelor Political Science and Sociology • Teacher training with the subjects German and History
Interdisciplinary – subject-focused – proximal	• Biochemistry • Technical Computer Science • Cruise Industry Management • Historical Linguistics and Cultural Studies • Media Education: Visual Culture and Communication
Interdisciplinary – subject-focused – distal	• Media informatics • Medical Education • Business informatics • Political and administrative science
Interdisciplinary – topic-focused	• Regional Studies • Water Science • Media Design • Interactive Game Design • European Studies

4. Data Basis

We used data from the registration dataset (see field instruments; Leibniz Institute for Educational Trajectories (LIfBi), 2018) as the basis for classifying the study programs. Question 5 (f5) asks about the study program in an open text entry format ("What is the exact name of your study program?"). In addition, question 4 (f4_1, f4_2, f4_3) were used as additional sources of information (f4_1: "For which subject(s) are you enrolled (e.g., economics, bioinformatics, meteorology, social work, archaeology)?" f4_2: "In each case, please indicate whether the subject is a major/core subject or a minor/supplementary subject." f4_3: "If you are studying with the goal of becoming a teacher, please indicate the teaching subjects for which you are enrolled."). The combination of information provides the basis for the classification decisions made by the coders.

The classification results are available since data release SC5_13-0-0, in the data set pTargetCATI, Wave 1. The variables are tg04009_g1 “Type of course of study: mono-/interdisciplinarity” and tg04009_g2R “Type of course of study: subject group for interdisciplinarity”. tg04009_g1 represents the classification of courses into monodisciplinary, interdisciplinary (subject-focused proximal, subject-focused distal, topic-focused), and multidisciplinary courses using the classification scheme shown in Figure 1. The variable tg04009_g2R indicates the subject groups involved in the respective study programs according to the adapted subject system (see Table 1). Here, 1-3 subject groups are referenced (e.g., the code "38" stands for the involvement of economics [3] and engineering [8]).

5. Classification Process

The following paragraphs describe the classification process, including the training of coders, the technical solution, and handling of disputed cases.

A total of seven psychology students participated as coders in the classification of the claims. Each coded entry was also validated by the first author.

5.1 Training of the coders

The coders were familiarized with the coding tool (see 5.2) and the classification scheme in a half-day training session by the first and second authors. Together, a random sample of 100 open text entries was classified to practice the system and to discuss unclear cases. Subsequently, the coders each coded an additional 300 entries individually with the opportunity to discuss questions together. This approach was intended to ensure a common understanding of the classification scheme and to provide consistency in coding.

5.2 Coding

For the coding of open text entries, the Leibniz Institute for Educational Trajectories (LIfBi) has a specially developed coding tool (CODI) that allows flexible handling of different requirements.

For the coding of the study programs, a standardized setting could be offered in which the coders could assign one or more open entries to a value of the previously defined classification scheme by mouse click. The coders were supported in this by a suggestion algorithm, which sorted the categories of the classification in a ranking order on the basis of a text and similarity search.

The basis of this ranking is the full text search of an SQL server (SQL Server technical documentation, 2020), on which the data was stored and accessed by the CODI tool.

Two functions have been crucial for this coding. First, text matches between the categories of the classification and the open entry are searched for. Open entries that are identical to the title of a category are considered as a match. This function could be used for the variable tg05009_g2, because parts of the value labels of the categories occurred in the answers of the respondents (e.g. sports, mathematics). For the classification to distinguish between inter-, multi- and monodisciplinary study programs (with a differentiation of the different interdisciplinary study programs into subject-focused proximal, subject-focused distal and topic-focused) it could not be used meaningfully, because the titles of these categories are not a direct part of the study program names.

As a second function, the stock of already coded open entries for the text search was used for both variables. If an open entries is processed that is in parts identical or similar to one or more already validated entries, the classification value assigned in the past moves up in the ranking. In this way, the dataset that had already been created and the decisions associated with it were used on an ongoing basis.

In addition to the open entry on the study program in question 5 (f5), the coders were also shown the study subjects (f4_1-f4_3), so that they could include all information at one glance for decision-making.

If further research was necessary in addition to the displayed information, the coders had the opportunity to leave sources, references, or other remarks as comments for later reference. Thus, specific comments could be attached by the coder to each open entry that received a code.

For entries that were coded only under some uncertainty, the status "proposal" could be set for the decision as an additional note. This status helps to identify uncertain decisions more quickly during later validation and to check them again intensively.

5.3 Multiple Codings

Since different coders were used for the coding of the study programs, it was possible to draw a sample of 1000 cases and to have each of these coded a second time by a different coder. Using the CODI tool, the working environment could be kept constant. The suggestions of the algorithm were frozen at the level of knowledge that the first coder had available, in order to prevent any influence on the results. This procedure was applied to the coding of the variable tg05009_g1.

We found a pure agreement of 84.90% between the two codings of the 1000 cases. This result is also reflected in the intercoder reliability, which was 0.77 according to Cohens/Congers Kappa and Krippendorff's alpha. Consideration of other calculation methods also shows that the coders largely agreed in their assignments (Table 3).

Table 3

Intercoder-reliability

	Coef.	Std. Err.	t	p>|t|	95% confidence interval	
Percentage Agreement	0,85	0,01	74,95	0,00	0,83	0,87
Brennan and Prediger	0,82	0,01	60,23	0,000	0,79	0,85
Cohens/Congers Kappa	0,77	0,02	47,36	0,00	0,74	0,81
Scotts/Fleiss' Pi	0,77	0,02	47,13	0,000	0,74	0,81
Gwets AC	0,83	0,01	62,73	0,00	0,80	0,85
Krippendorffs Alpha	0,77	0,02	47,14	0,00	0,74	0,81

Notes: *N* = 1000; Rating per person: 2; Number of Categories: 6; Source: kappaetc.ado; own illustration

5.4 Validation

Following the coding, the coded information was validated in the CODI tool. This was done by the first author, who used the same working environment and the same information. The coded value and the status of the coding, i.e. the distinction between "proposal" and "coded", were added to the information. In addition, the comments were inserted, if any were left. In this way, all information could be checked again and a second decision could be made beyond the double coding, without losing the results obtained first.

In multiple-coded cases, the validator was shown the results of all coding.

Validation of single-coded cases confirmed the coders' decisions 89.9% of the time. This result, together with the reliability analysis, indicates a largely reliable assignment of the study programs according to the specifications of the training.

5.5 Disputed Cases

Some of the information in the open text fields could not be immediately classified according to the classification scheme. This was due on the one hand to the use of unusual abbreviations for study programs (e.g. "Hannibal" for a model study program in human medicine) and on the other hand to the fact that the interdisciplinary orientation of the study program was not clear. In these cases, research on these study programs followed in order to better classify them. Since many interdisciplinary study programs are offered at several universities and can be designed differently there, the examination regulations of several universities were studied in order to gain an impression of the interdisciplinary design. In such cases, a uniform coding was then assigned to all information relating to these courses of study.

6. Results

We coded the data of N = 17,910 first-year students of NEPS Starting Cohort 5. This sample has an oversampling of students in teacher education programs, which is also relevant for the presentation of our coding results. Therefore, we report results for both the total sample and the subsample without teaching program oversampling (n = 14,993).

In the overall sample of 17,910 first-year students, the information of 725 persons (4.0%) was missing. We therefore refer below to 17,185 individuals from whom codable information was available. Of these, 8,343 individuals indicated that they were enrolled in a monodisciplinary study program (46.6%). Interdisciplinary study programs occupied 16.4% of first-year students (n = 2,942), with subject-focused distal programs being the most popular here with 2,122 first-year students (11.8%) (subject-focused proximal n = 542; 3.0% and topic-focused n = 278; 1.6%). Multidisciplinary study programs were reported by 5,899 first-year students (32.9%). Since teacher education study programs are among the multidisciplinary study programs, teacher education oversampling at this point works in favor of a higher number of first-year students in multidisciplinary programs. A comparison of the total sample with teacher education oversampling and the sample with a representative number of first-year students (without teacher education oversampling) can be found in Table 4.

The results for the disciplines involved in each interdisciplinary program (variable tg04009_g2R) show the diversity of interdisciplinary programs. The values refer exclusively to the study programs coded as interdisciplinary. Up to three subject groups could be selected from the adapted subject classification system (see Table 1), so that, in accordance with the interdisciplinary design, several subject groups can be involved in a study program. A large proportion of interdisciplinary students are enrolled in a program involving engineering (58.8%), followed by economics (49.7%) and the mathematics and natural sciences subject group (18.1%). By far the most common subject combination is the combination of economics and engineering (31.5%), which is present, for example, in the degree program in industrial engineering. This is followed by study programs in which only engineering sciences are involved (13.6%; for example, mechatronics) and study programs that combine engineering sciences and the subject group mathematics and natural sciences (11.2%, e.g., biotechnology). An overview of frequent subject combinations can be found in Figure 2.

Table 4

Comparison of number of first-year students by type of study program in the total sample and the sample without teacher education oversampling

	Total sample (including teacher education oversampling)		**Representative sample (without the teacher education oversampling)**	
	n	**%**	***N***	**%**
Monodisciplinary	8,343	46.6%	8,317	55.5%
Interdisciplinary	2,942	16.4%	2,924	19.5%
Of which				
Subject-focused	2,665	14.9%	2,647	17.7%
Proximal	542	3.0%	541	3.6%
Distal	2,122	11.8%	2,105	14.0%
Topic-focused	278	1.6%	277	1.9%
Multidisciplinary	5,899	32.9%	3,237	21.6%
Missing data	725	4.0%	515	3.4%
Total	17,910		14,993	

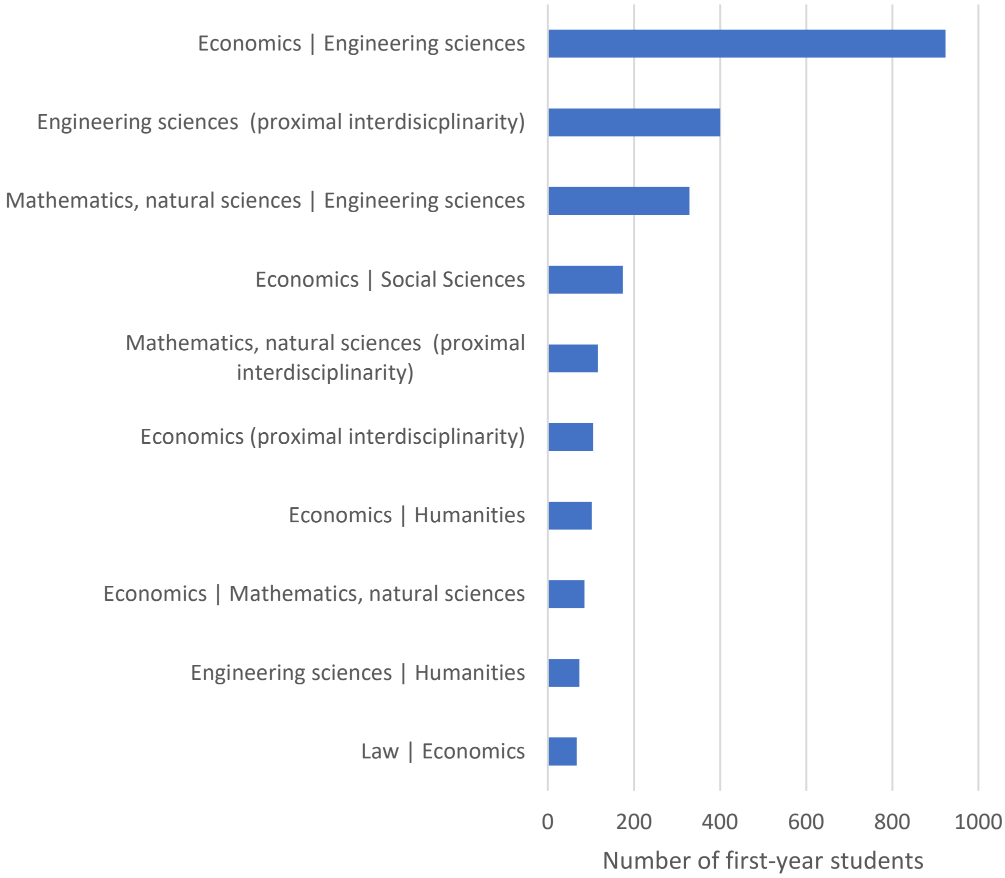

Figure 2. The ten most common combinations of subject groups involved in interdisciplinary study programs (representative sample without teacher education oversampling)

7. Conclusion

As interdisciplinary study programs are on the rise (Hachmeister & Grevers, 2019), the new classification within the NEPS starting cohort 5 data allows to estimate the extend of interdisciplinary study programs in a representative sample. Results show that every fifth first-year student in 2011 was enrolled in an interdisciplinary study program. Most of these interdisciplinary study programs are subject focused and span across different disciplinary groups, such as economics and engineering sciences.

The new classification scheme builds the basis for further research on students enrolled in interdisciplinary study programs. On the one hand, research questions regarding the selection of interdisciplinary study programs based on students' interests and abilities can be addressed. On the other hand, the longitudinal nature of the panel data allows to study how students manage with the demands and challenges of interdisciplinarity and to track their educational trajectories.

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