

Doctoral Students in Germany 2010: How Many Are There and What They Study

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Abstract

Data on doctoral students in Germany are required for national and international educational reports. However, due to the provisions in the enrolment and doctoral degree regulations at institutions of higher education, undercoverage of the data on doctoral students is observed in the statistics of students. Doctoral students who are not enrolled at institutions of higher education are not covered there. Hence, the Federal Statistical Office had been asked by the Federal Ministry of Education and Research to conduct a survey on doctoral students in Germany. The purpose was to develop a concept which provides reliable information on doctoral students in Germany. The survey provides comprehensive results on doctoral students in Germany in winter semester 2010/2011. It shows that about 200 400 doctoral students were supervised by professors at German institutions of higher education in winter semester 2010/2011.

Keywords

Doctoral students, institutions of higher education, professors, students, Federal Statistical Office of Germany

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INTRODUCTION

The implementation of the consecutive study model as part of the Bologna process³ elevates the doctoral phase to a new, separate level. Data on doctoral students is needed not only nationally, e.g. for the Fed-

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³ In June 1999, the ministers of science from 29 European nations signed the Bologna Declaration (<www.bologna-berlin2003.de/pdf/bologna_deu.pdf>, accessed 19 June 2012) to create a uniform European higher-education zone. The primary objective of the reform process initiated in Bologna and at the follow-on conferences is to standardize the academic structures by introducing university degrees with different levels; see Willand, I.: "Bachelor und Master: Aktuelle Entwicklungen an deutschen Hochschulen" in *WiSta* 4/2005, pp. 372 ff.

eral Report on Promotion of Young Scientists (“Bundesbericht zur Förderung des wissenschaftlichen Nachwuchses”), but also for international education reporting.⁴

On account of the stipulations of the enrolment and doctoral programme regulations, the student statistics undercounts doctoral students. Doctoral students who are not enrolled at an institution of higher education are not counted here. As each institution of higher education, and sometimes even each faculty at such an institution, reports its doctoral students differently – due to different examination and doctoral regulations – it is currently impossible to determine the precise number of doctoral students in Germany on the basis of the student statistic. By contrast, the examination statistic of successful doctorates as well as the examination mark and the ages of the successful doctoral candidates is registered in great detail.

To this end, the German Federal Statistical Office conducted a survey of doctoral students in Germany on behalf of the Federal Ministry for Education and Research. The aim of this project was to develop a concept for providing reliable information on all doctoral students in Germany.

Article 7 (1) of the Federal Statistics Law formed the foundation for this survey.⁵ In addition to the Federal Statistical Office, the statistical offices of the federal states of Baden-Württemberg, Bavaria, Berlin-Brandenburg, Hesse, Western Pomerania and North Rhine-Westphalia were involved in conducting the survey.

1 SURVEY CONCEPT

The survey was based on a two-stage procedure. At the first stage, 20 000 professors at German institutions of higher education with the right to award doctorates were asked in a voluntary survey to indicate the number of doctoral students supervised at the beginning of winter semester 2010/2011 as well as their type of doctoral studies and sex. Doctoral students covered were those guided by the professor as a (primary) supervisor. Another item covered was the professor’s willingness to pass on the survey documents to their doctoral students at the second stage. This was crucial for the further process. The professors were either contacted directly or got the survey documents through an internal distribution procedure applied at the respective institution of higher education. In a second stage, a survey was conducted among 20 000 doctoral students. At this second survey stage, the professors were asked to pass on the survey documents to their doctoral students. The doctoral students were questioned on sociodemographic variables, on when they started their doctoral studies, on their employment status and on any financial aid programmes.

2 SAMPLING CONCEPT

As for the survey concept a two-stage procedure was applied in the sampling concept. The information obtained in the survey of professors at the first stage was needed for sampling in the survey of doctoral

⁴ In the European Union (EU), Regulation (EG) No. 452/2008 of the European Parliament and the Council dated 23 April 2008 on the preparation and development of statistics on education and life-long learning (Official Journal of the EU No. L 145, page 227) sets out the obligation to provide statistics on the systems of general and vocational education. Regulation (EU) No. 88/2011 of the Commission dated 2 February 2011 (Official Journal of the EU No. L 29 dated 3 February 2011, page 5) on execution of Regulation (EG) No. 452/2008 stipulated that members states had to provide information on their doctoral students in September 2012. In a decision of the Commission taken in December 2010, however, exceptions were granted to the implementation of the Regulation (resolution 2010/786/EU of the Commission dated 17 December 2010, Official Journal of the EU No. L 335 dated 18 December 2010, page 66). In one such exception, Germany was permitted to provide data on doctoral students one year later, in 2013.

⁵ “Gesetz über die Statistik für Bundeszwecke (Bundesstatistikgesetz – BStatG)” dated 22 January 1987 (BGBl. I page 462, 565), most recently amended by Art. 3 of the Law dated 7 September 2007 (BGBl. I page 2246). Art. 7 (1) BStatG: “In order to fulfil a data requirement arising on short notice for the purposes of preparing and justifying upcoming decisions of top-level federal agencies, federal statistics with no obligation to disclosure may be conducted when a top-level federal agency requires such a federal statistic.” An article 7 survey may not question more than 20 000 respondents, and the respondents’ participation is voluntary.

students (stage 2). At the first stage, 20 000 professors at German institutions of higher education with the right to award doctorates were sampled. For this purpose, a cluster sample was used with the institutions of higher education as clusters. For the participating institutions of higher education, a Bernoulli sampling procedure with an inclusion of probability proportionate to “doctorates per chair and year” was used. To avoid large design weights, the minimum inclusion probability was set to 1/10. However, large institutions of higher education were sampled with a probability of 1 to avoid excessive variations in the number of professors interviewed. A total of about 19 500 professors were actually interviewed at the first survey stage. In the sampling concept for the survey of professors, it was defined that not all institutions of higher education in Germany with a right to award doctorates had to be included in the survey. At the second stage, 20 000 doctoral students were sampled. These students were of those professors who had agreed to pass on the survey documents to their doctoral students at the first stage. Thus, the results of the first stage of the survey among professors were the sampling basis for the second stage, the survey among doctoral students. The professors who had agreed to participate in the second stage were stratified by federal state, institution of higher education, as well as teaching and research area or subject of the doctoral advisor. The sample size was distributed proportionately to the strata; when selecting the professors, care was taken that small groups, such as doctoral students with an external type of doctorate, were sufficiently represented in the sample. The total of 19 998 doctoral students was sampled at random from the sampling frame with the condition that all doctoral students of a specific professor are selected.

3 EXTRAPOLATION METHOD

In line with the study concept, the results of the two surveys were extrapolated in two stages, too. The general goal of extrapolation was to take the sample parameters (total value, mean value, proportion, variance) as a basis for making conclusions for the parameters of the population, using suitable estimators. An unbiased estimate of the unknown total value of a relevant variable Y is obtained through a generalised regression estimator (GREG). The regression estimator is a linear estimator and one of its characteristics is that the benchmarks are met during extrapolation from the sample. This methodological approach was applied for extrapolation in the surveys. Furthermore, the regression approach has the advantage that the approximate formula of the variance of the estimator has a closed representation. In turn, the variance can be estimated from the sample. Consequently, the estimation error can be quantified for any target group after every extrapolation. The relative standard error can be indicated as a measure of the random error. The standard error is calculated by means of the CLAN SAS macro of Statistics Sweden.

In the first stage of the survey, about 9 400 (48%) professors had responded and were available for extrapolation. About 6 800 of them were willing to pass on the questionnaires to their doctoral students. The basis for the first extrapolation stage was benchmarks from the statistics on higher education personnel. Referring to 2010, those figures covered all 33 800 professors at German institutions of higher education with a right to award doctorates. From them, benchmarks for the professors were derived regarding the areas of study or subject groups, main or secondary occupation, sex, distribution by former territory of the Federal Republic as well as Former East Germany and Berlin-East, and the common distributions between areas of study and the professor's activity.

In the second stage of the survey, about 8 700 (43%) doctoral students had responded to the survey referring to 1 800 professors out of the 6 800 who were willing to pass on the questionnaires to their doctoral students. The basis for the second extrapolation stage was benchmarks of the enrolled doctoral students, taken from statistics of higher education for winter semester 2010/2011. To ensure that both extrapolations refer to the same number of doctoral students, the number of doctoral students calculated in the first stage was taken as an additional benchmark in the second extrapolation. A strong correlation was found between the number of a professor's doctoral students and the probability that at least one of them participated in the survey. During extrapolation, this correlation was taken into account by

weighting. The surveys on doctoral students in Germany thus provide results both at the level of professors and at the level of doctoral students.

4 RESULTS

The surveys on doctoral students in Germany provide comprehensive information on doctoral students in Germany in winter semester 2010/2011. They show that in winter semester 2010/2011, the approx. 33 800 professors at German institutions of higher education with the right to award doctorates supervised almost 200 400 doctoral candidates.

In all, around 2.2 million persons studied at German institutions of higher education in winter semester 2010/2011. According to the results of the official statistics of higher education, this figure included around 104 000 doctoral students enrolled at the institutions of higher education and seeking a doctorate. This means that almost the same number of persons who were not enrolled at an institution of higher education was working on a doctorate under the supervision of professors.

According to the results of the official statistics of higher education 25 600 persons successfully earned their doctorate in 2010.

4.1 Doctoral students by selected areas of study

Around 58 400 doctoral students were seeking a doctorate in the area of study Mathematics and Natural Sciences; that was 29% of all doctoral students in winter semester 2010/2011. With 44 500 doctoral students (22%), Engineering was the area of study with the second-largest proportion of all doctoral students. 38 700 doctoral students (19%) were supervised in the subject group Languages and Cultural Studies, followed by Law, Economics and Social Sciences with 35 900 doctoral students (18%). In the area of Human Medicine and Health Sciences, 8 300 persons (4%) were seeking a doctorate.

A comparison of the proportions of doctoral students by areas of study with those with a completed doctorate shows that these proportions clearly deviate. Students' tendency to pursue a doctorate varied depending on the area of study. The employment situation in higher education, the availability of research funding and doctoral scholarships, the importance of the doctorate for the desired career track and personal reasons all have an effect on the willingness of university graduates to pursue a doctorate.

Whereas students in the area of study Law, Economics and Social Sciences made up 31% of all students, the proportion of this area of study in enrolled doctoral students was 19% and all doctoral students of the surveys 18%. In turn, only 14% of awarded doctorates went to the area of study Law, Economics and Social Sciences. The situation was the reverse for the area of study Mathematics and Natural Sciences: in winter semester 2010/2011, 18% of students belonged to this area of study. The proportions of enrolled doctoral students and all doctoral students contained in the surveys were substantially higher, at 34% and 29% respectively. A doctorate appears advantageous for pursuing a career in this area. In the area of Mathematics and Natural Sciences, there are research topics for which funding is also available. With 32%, the proportion of completed doctorates in Mathematics and Natural Sciences was the highest of all areas of study (see Table 1).

The area of Medicine represents a special case. The proportion of students in the area of study Human Medicine and Health Sciences out of all students in winter semester 2010/2011 was 6%. For the enrolled doctoral students and all doctoral students of the surveys as well, only low proportions of 6% and 4%, respectively, were achieved. By contrast, 28% of all doctorates in 2010 were completed in this area. The reasons for the large differences could be that a doctorate is standard in medicine, and doctoral students in medicine pursue their doctorates concurrently with their regular studies and thus complete it in a shorter period, or while working as assistant physicians or learning a specialty.

Table 1 Proportion of doctoral students, enrolled doctoral students, the Doctor's degree examinations and students in the official statistics of higher education by areas of study in winter semester 2010/2011* (in%)

Areas of study	Survey on doctoral students	Official statistics of higher education		
	Doctoral students	Enrolled doctoral students	Doctor's degree examination	Students
Languages and Cultural Studies	19	23	11	19
Law, Economics and Social Sciences	18	19	14	31
Mathematics/Natural Sciences	29	34	32	18
Human Medicine	4	6	28	6
Other subjects	29	17	15	27
Total	100	100	100	100

* Variations of 100% conditioned by roundings.

Source: Federal Statistical Office of Germany, Promovierende in Deutschland 2010; Fachserie 11, Reihe 4.1, Wintersemester 2010/2011; Fachserie 11, Reihe 4.2, PJ 2010

When comparing the various statistics, it must additionally be considered that no information is available on withdrawals and length of doctoral studies in the respective areas of study. A large proportion of the doctoral students and a low proportion of completed doctorates could indicate a long doctoral duration or a high withdrawal ratio.

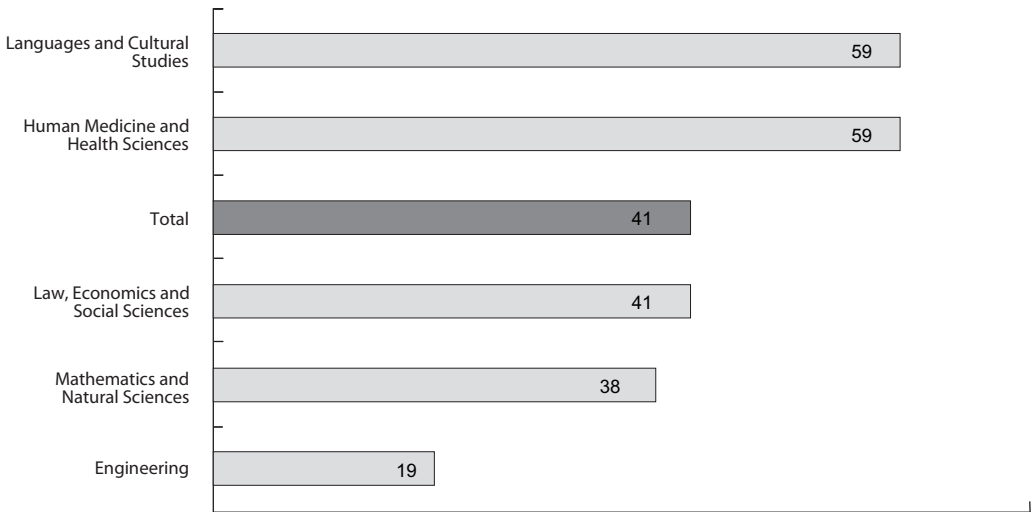
4.2 Doctoral students by gender

41% of all doctoral students in Germany were women in winter semester 2010/2011. Compared to all students (proportion of women: 48%) and enrolled doctoral students contained in the official statistics of higher education (proportion of women: 45%), the proportion of women among all doctoral students was thus somewhat lower. The proportion of women among completed doctorates was 44% in 2010. The gender distribution of all doctoral students by areas of study varied markedly. As for students overall and enrolled doctoral students contained in the official statistics of higher education, and for all doctoral students there were areas of study in which men were overrepresented, and those preferred by women. In the areas of study Languages and Cultural Studies and Human Medicine and Health Sciences, women doctoral students were overrepresented, with 59% in each group. In the area of study Law, Economics and Social Sciences, the proportion of women, at 41%, corresponded exactly to the average of all areas of study. In the areas of study Mathematics and Natural Sciences (proportion of women: 38%) and Engineering (proportion of women: 19%), by contrast, women doctoral students were significantly underrepresented (see Figure 1).

4.3 Doctoral students by age

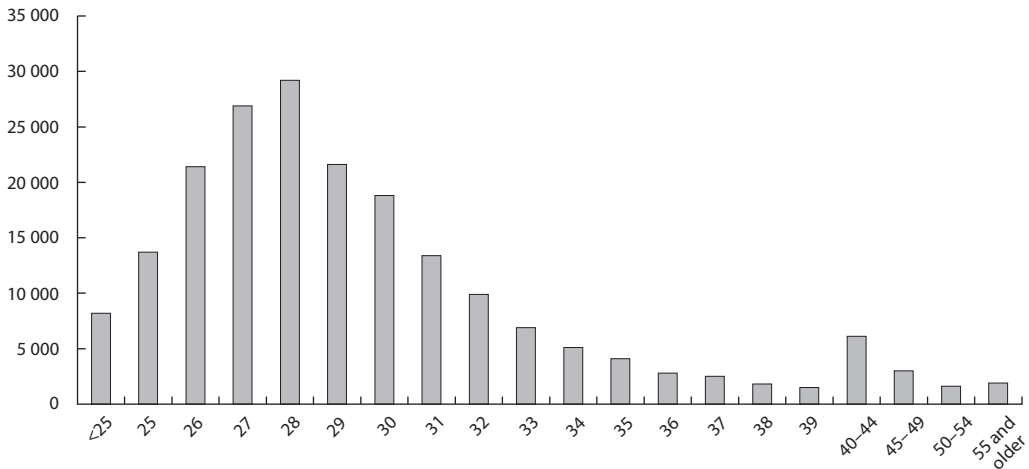
Of the doctoral students supervised at German institutions of higher education in winter semester 2010/2011, the biggest group was 28 years old (29 200 doctoral students or 15%). 27-year-olds made up the second-largest group with 26 900 doctoral students (13%). This was followed by the age groups of 29-year-olds with 21 600 doctoral students and 26-year-olds with 21 400 doctoral students, or 11% each. 18 800 (9%) doctoral students were 30 years old. Thus, in winter semester 2010/2011 around 59% of doctoral students were aged 26 to 30. 11% of doctoral students were 25 and younger. 60 600 doctoral students (30%) were 31 and older. The number of doctoral students declines rapidly with increasing age (see Figure 2).

Figure 1 Proportion of women by selected areas of study in winter semester 2010/2011



Source: Federal Statistical Office of Germany, Promovierende in Deutschland 2010

Figure 2 : Doctoral students by age in winter semester 2010/2011



Source: Federal Statistical Office of Germany, Promovierende in Deutschland 2010

A comparison of the age distribution of women and men seeking doctorates reveals that the proportion of doctoral students 25 and younger was slightly higher among women at 14%, as compared to men with 9%. On the other hand, the proportion of women in the age groups 31 and older was lower than for men. Of female doctoral students, 28% were 31 or older, as compared to 32% for male graduate students.

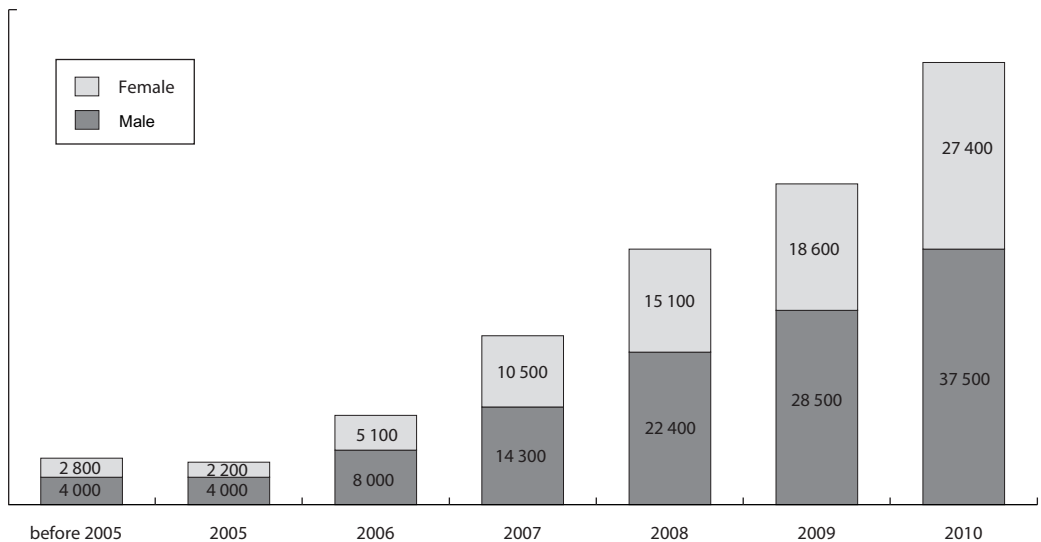
The gender distribution in the individual age groups largely approaches the gender distribution for all doctoral students. The proportion of women was greatest in the age group 25 and younger, in which women made up 51% forming a slight majority. One likely reason for this is that men usually attain their first degree later than women, e.g. on account of military or civilian service which was compulsory for

men in Germany until June 2011. In the examination year 2010, 55% of women who successfully attained their first degree were 25 years of age or younger, as compared to 41% of men. In the age groups of 29-, 30- and 34-year-old doctoral students, women were underrepresented, at 36% each. At 35%, the proportion of women was lowest among 31-year-olds.

4.4 Doctoral students by commencement of doctoral studies

One third of the 200 400 doctoral students commenced their doctoral studies over the course of 2010. 47 100 doctoral students, or 24%, began their doctorates in 2009, and a further 37 500 persons (19%) began in 2008. 24 800 doctoral students had been working on their doctorate since 2007; that is equivalent to 12% of all doctoral students in winter semester 2010/2011. Around 13 100 persons (7%) had been pursuing their doctorates since 2006, and a further almost 6 200 persons (3%) since 2005. 6 800 doctoral students (3%) had their doctorates before 2005 (see Figure 3).

Figure 3 Doctoral students by commencement of doctoral studies in winter semester 2010/2011



Source: Federal Statistical Office of Germany, Promovierende in Deutschland 2010

4.5 Doctoral students by employment situation

In winter semester 2010/2011, 165 600 of the 200 400 doctoral students were employed (83% of all doctoral students). Of those doctoral students employed, 126 000 or 76% were employed at an institution of higher education. 12 400 doctoral students (8%) were employed at a non-university research institute. Slightly less than 16% of doctoral students found employment in private enterprise or with other employers.

4.6 Doctoral students by financial aid programmes

In all, around 52 300 doctoral students received public financial aid in winter semester 2010/2011; that was 26% of all doctoral students. 57% of persons receiving financial aid were men while 43% were women. The largest group of doctoral students receiving financial aid (around 20 500 persons or 39% of all those receiving financial aid) was supported by the German Research Foundation DFG. 7 500 doctoral students (14%) received aid from a Ministry of Economics of a federal state and 4 800 (9%) from an or-

ganisation supporting intellectual excellence (Begabtenförderwerk). This category comprises a variety of foundations. The German Academic Exchange Service DAAD assisted around 2 700 doctoral students (5%; see Table 2).

Table 2 Doctoral students by financial aid programmes in winter semester 2010/2011

Financial aid programmes	Doctoral students		
	Total	Male	Female
Total	52 300	29 700	22 600
of which:			
German Research Foundation (DFG)	20 500	12 600	7 900
Ministry of Economics of a Federal State	7 500	4 200	3 300
Begabtenförderwerk	4 800	2 400	2 400
German Academic Exchange Service (DAAD)	2 700	1 700	1 000

Source: Federal Statistical Office of Germany, Promovierende in Deutschland 2010

The doctoral students supported by a financial aid programme were distributed differently over the areas of study. With 20 800 persons or 40%, the largest group of doctoral students receiving financial aid belonged to the area of study Mathematics and Natural Sciences. 20% of doctoral students in the area of study Languages and Cultural Studies (10 500 recipients) and Engineering (10 200 recipients) benefited from financial aid programmes. Furthermore, 11% (6 000 persons) of supported doctoral students belonged to the area of study Law, Economics and Social Studies.

Out of the total of 200 400 doctoral students, 83% were employed; of the 148 100 doctoral students not receiving financial aid, this proportion was somewhat higher, at 89%. Almost two-thirds of the 52 300 doctoral students receiving public financial assistance were working in winter semester 2010/2011: eight out of ten doctoral students supported by the German Research Foundation were employed. This proportion was close to seven out of ten for those doctoral students receiving financial aid from a Ministry of Economics of a federal state. Of those doctoral students receiving scholarships from an organisation supporting intellectual excellence, only four out of ten were employed. However, it has to be kept in mind that scholarships are often only granted when the recipient doctoral students do not have any financial resources above a certain amount. Potential income is offset against the scholarship.

Further detailed results are described in the report „Promovierende in Deutschland 2010“ (publication in German language) which can be found on the website of the German Statistical Office (www.destatis.de) under “Publikationen > Thematische Veröffentlichungen > Bildung, Forschung, Kultur > Hochschulen”.

CONCLUSION AND OUTLOOK

Our analysis show comprehensive results on doctoral students in Germany in winter semester 2010/2011. It shows that in winter semester 2010/2011, professors at German institutions of higher education supervised 200 400 doctoral candidates. Almost as many persons as the 104 000 doctoral students enrolled at institutions of higher education in Germany, were pursuing their doctorates without being enrolled at an institution of higher education. Most doctoral students were seeking a doctorate in the areas of Mathematics and Natural Sciences (approx. 58 400 doctoral students or 29% of all doctoral students), followed by Engineering with 44 500 doctoral students (22%).

41% of all doctoral students in Germany were women in winter semester 2010/2011. The largest age-group of doctoral students was 28 years in winter semester 2010/2011.

About 64 900 doctoral students (32%) started their doctoral studies in 2010. About 47 100 doctoral students (24%) started in 2009 and 37 500 (19%) in 2008. In the years from 2005 to 2007, the number of

doctoral students taking up their doctoral studies was 44 100 (22%), while 6 800 doctoral students (3%) had started before 2005.

The need for data on doctoral students remains, both nationally and internationally. The results relating to doctoral students in Germany obtained through the Sec. 7 surveys provide up-to-date information on this group of persons. In the coming months, a method is to be developed for updating the results obtained on doctoral students. In order to verify the updated results and improve the calculation of updating a basis for comparison is required. For this reason, a repetition of the article 7 surveys is considered appropriate. In its position paper “Anforderungen an die Qualitätssicherung der Promotion (Requirements for quality assurance in the doctoral sector)”,⁶ the German Council of Science and Humanities (Wissenschaftsrat) recommended that the institution of higher education reports the number of doctoral students in Germany according to a uniform principle. The aim is to obtain reliable data on the doctoral students and thus also enable the observation of the doctoral process. The Council of Science and Humanities recommends granting each doctoral student “a uniform doctoral status independent of the nature of financing”,⁷ which the doctoral students receive in the form of an official acceptance at the institution of higher education. If this proposal were broadly implemented, and if all institutions of higher education counted their doctoral students completely at one central location, in future the possibility would exist of reporting information on the doctoral students in official statistics. The information about doctoral students could be integrated in the ongoing delivery plan of the institutions of higher education and thus permanently obtain reliable information about the doctoral students. However, this would require an amendment of the law of official statistics of higher education.

Having reliable numbers of doctoral students in Germany reported on a regular basis is desirable. Additionally it would improve comparisons between European countries.

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⁶ German Council of Science and Humanities (Wissenschaftsrat): “Anforderungen an die Qualitätssicherung der Promotion – Positionspapier des Wissenschaftsrates”, Halle 2011, page 37.

⁷ Footnote 6, here: page 17.