

Attributes of biomedical theses – a quantitative comparison of theses published in Sweden and the Netherlands

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Background and aim

In the early 1990s, Swedish and Dutch doctoral theses were based on average on 5 published or in-press peer-reviewed papers. Using the Science Citation Index to rank the journals of publication and scoring the position of authors and number of authors per paper, revealed that the quality of work was comparable between Sweden, the Netherlands and the UK. It was concluded that publications-based theses could be a model for Europe with a proposal of 4 papers for the PhD to be completed in 4 years and 3 papers if in 3 years.

Our current work investigates various traits of PhDs in biomedical sciences, including: number of theses per country, number of papers per thesis, gender patterns, internationalisation, and the career development of PhDs. Theses quality is an obvious quality assessment tool for higher education institutions but information about future careers and publishing activity are also valuable if they can define patterns that predict future excellence.

Methods

This work is based on a combination of surveys. Briefly, 538 Swedish biomedical thesis (ca 70% of the year output); a longitudinal survey of Swedish biomedical thesis presented in the first quarter of 1991, 2000, 2003, 2006, 2009; the pattern of publishing in English during the past 3 years of Swedish MD-PhDs of 1991 and 2000; publishing activity at Leiden University Medical Center; publishing by Dutch medical students during their studies; and a review of 141 Dutch MD-PhD thesis for 2008 from 6 universities; and data in the public domain (eg NSF of USA). Data are being collected to complement these surveys. We found that data collection and comparison between countries is complicated by differences in the presentation of educational statistics.

Number and quality of biomedical theses

The total number of biomedical theses is still increasing in Sweden and the Netherlands though may be approaching a plateau. For Sweden doctorates awarded in health and biomedical sciences in the first quarter of 1991, 2000, 2003, 2006 and 2009 were 73, 107, 150, 189 and 195 (NB – likely an underestimates because it uses the first quarter of the year and most PhDs are done in the 2nd and 4th quarter). Preliminary recent results for Holland show a slight increase (based on the whole year): 938 in 2006, 962 in 2007 and 977 in 2008. The Swedish biomedical theses of 2008 were found to have on average 4 works (either 3 publications and one manuscript or 2 of each), a reduction of 2 to 3 published works per thesis from 15 years ago, while the Dutch theses of 2008 were not less than 15 years ago.

From public statistics the proportion of doctorates in USA (the pre-eminent research nation and the country of origin of most of the foreign examiners – see below), Sweden and the Netherlands can be compared based on population and gross domestic product (GDP).

For USA, the biomedical PhDs in 1991, 2000, 2003 and 2006 (the last year with comparable data) when adjusted for population become 28, 31, 30 and 33 PhDs per million and when related to GDP the figures are 0.93, 0.91, 0.83 and 0.79, respectively. For Sweden, the corresponding figures are 34, 48, 67 and 83 PhDs per million population, and when related to GDP 1.54, 1.78, 2.40 and 2.74. In comparison, estimated Dutch figures for 1991, 2000 and 2003 were 32, 50 and 54 per million, and 1.68, 1.97 and 2.34 by GDP. For 2006–2008 they are 57, 58 and 59, and 2.37, 2.38 and 2.37. Thus, while the proportion of PhDs by population in 1991 was about the same, in USA the rate remained constant while it more than doubled in Sweden from 1991 to 2006. The estimated Dutch increase was less and seems to have stabilized. When rates were compared on the basis of GDP, the increase for Sweden was biggest while for USA there was a steady 15% fall over the period. Explanations for these findings are being investigated, including possible impact of changes in regulations and level of funding, and whether comparison with the USA because of its size and structure of research funding can be meaningful.

Age distribution and MD-PhDs

The age distribution of MD-PhD candidates was found to differ between Sweden and the Netherlands. In Sweden, the age pattern was biphasic with 20% doing their PhD aged about 30 years, and 80% around age 40. Also between 1991 and 2000 there was an increase in the median age from 39 to 43 years with a substantial high age tail. In contrast, in our preliminary survey of the Netherlands the MD-PhDs were aged about 30 years with <10% much older. We are collecting data on the age distribution of both non-MD and MD doctorates. The Swedish survey found that the actual number of MDs who completed a doctorate remained fairly constant (47, 48, 47, 61 and 54 for the first quarter of 1991, 2000, 2003, 2006 & 2009) representing 20-25% of doctors who qualified in Sweden over the past 20 years. In USA between 2004-2007 12.1% of medically or dentally qualified (statistics do not separate the degrees) go on to a PhD.

Gender and Socio-economic outcomes

The longitudinal study of Swedish biomedical PhDs from 1991 to 2009 shows a number of other patterns. During this period there was a 2.5-fold increase in biomedical PhD graduates, especially women, and mainly non-medically qualified. In Sweden women were 56%, 59% and 62% of biomedical PhDs in 2003, 2006 and 2009, respectively, while in the 2008 survey based on Dutch biomedical theses, the male to female ratio is 50%. The results will be discussed in relation to policy and management of scientific research systems and national economic capacity. We found that in Sweden that when female candidates were more likely than men to be examined by female examiners, it was because of expertise relevant to the thesis topic. Analogous data are being collected in the Netherlands.

Internationalisation

In the 2008 survey of Swedish biomedical theses, 50% of the external examiners came from abroad. A subsequent longitudinal study of Swedish biomedical PhDs from 1991 to 2009 found that Swedish biomedical research was already well internationalised in 1991, when 38% of the external examiners came from abroad, though this may have reached its peak with 53% around 2003 because in 2009 the figure had returned to 42%. The USA and UK were the most common countries but 2% even were Australian. Unfortunately, the Netherlands cannot be assessed by foreign external examiners because of different examination rules. We found only 2 of 6 Dutch universities that used examiners from abroad (USA and UK most commonly). We are collaborating on other methods of assessing

internationalisation. Options include the number of co-authors from abroad or the number of foreign institutions per paper.

Career development

We are developing tools to assess their career development in an objective manner as opposed to subjective answers to questionnaires, initially concentrating on MD PhDs as an example of a professional branch of biology that has a clear career pathway with good employment. We are bringing into line separate studies using slightly different methodology. A survey based on theses of two cohorts MD-PhDs (1990-1992 and 2000-2002) at Leiden University Medical Centre shows big differences in publishing activity, with a positive correlation between high publishing activity and working in a university medical centre or teaching hospital. The publication patterns of Swedish MD-PhDs of 1991 and 2000 were assessed using the number of papers in the English language in PubMed during the past 3 years. About 70 % of Swedish MDs who passed their PhD in 1991 and 2000 published papers in English during the last 3 years. The proportions with 3 or more and with 10 or more publications were significantly less in the 2000 than in the 1991 cohort. A smaller proportion of those of 2000 than of 1991 had moved to universities other than where they did their PhD. We are also comparing the publication pattern of medical students prior to qualification.

A quality assessment tool

The purpose of our work, in which we combine a variety of heterogeneous source material, includes improvement and development of new methods for assessing the quality and success of higher education including individual outcomes. One aim is to find criteria that predict future excellence from graduate and undergraduate work. Such indicators are needed for the management of higher educational systems and institutions, and for governments and umbrella organisations such as the EU. The similarities and differences between the Swedish and Dutch systems make them excellent laboratories for testing ideas about assessing educational outcomes and collaboration between Academia and the Private and Public Sectors. This may result in viable alternatives for the EU instead of simply copying the USA.

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