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Completing a PhD thesis: reflections and suggestions

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Purpose of this document

What makes a PhD thesis complete and ready to be defended? General rules for the PhD thesis are outlined in the Vrije Universiteit Amsterdam (VU) Doctoral Regulations. In this document we provide more details for PhD theses of the Faculty of Science.

In the Faculty of Science there is typically a minimum number of scientific publications required. In most disciplines this ranges between 3-5 publications.

In view of the fact that

1. a significant fraction of PhD trajectories lasts well beyond the four years, and
2. there is a national ([Recognition & Rewards](#) initiative) and international ([DORA](#)) movement towards designing new criteria to evaluate scientists, based more on quality - and in a broader sense - than on quantity (*i.e.* number of publications),

it is questionable whether the requirement of minimally 3-5 publications is still sensible.

The fundamental requirement for a PhD trajectory, including writing a thesis, is a qualitative one, namely that it “must demonstrate that the PhD candidate is capable of independently carrying out academic research” (Article 16.1 of the VU Doctoral Regulations). Our current practices with respect to the number of publications in a thesis are a means to this end, not a goal in itself.

The final assessment of the quality of the thesis prior submission is done by the promotion team, the team of (co)promotors that supervise the PhD candidate during the promotion trajectory, consisting of a minimum of 2 supervisor(s)/promotor(s) and optional co-supervisor(s)/co-promotor(s). All members of the promotion team have to agree on this. The head of the department can be asked for advice if there is a difference of opinion within the promotion team.

Premise: 'one size fits all' will not work

The Faculty of Science hosts a variety of different disciplines, which have different scholarly quality criteria and very different timescales for publication. Also the composition of the thesis varies between disciplines/departments. A rigid prescription valid for the whole faculty is therefore not realistic. The purpose of this document is rather to start a reflection on the subject, and provide suggestions for valid alternatives that should always be checked for high scientific quality standards in the relevant discipline(s).

Part of a PhD thesis is demonstrating an active grasp of what it means to conduct research along the lines of adequate scientific methodology. Methodologies will differ across research subjects and scientific disciplines. The PhD thesis requirement of careful consideration and justification of research methodology, as well as result interpretation is general across the sciences (Article 21 of the VU Doctoral Regulations). Discussing and understanding methodological pitfalls, as well as creating inventive solutions, make up an important part of the PhD candidate's learning process in all scientific disciplines.

Comparison with other PhD thesis standards

There is a general feeling that we (Vrije Universiteit Amsterdam, VU) are more demanding, at least in some scientific disciplines, than in other countries or even in other NL universities.

An analysis of VSNU from 2018 showed that the duration of the PhD trajectories at the Dutch universities was the highest at the VU (5.6 years, compared to the Dutch average of 5,1 years). An analysis of the Hora Finita registration of the promotion trajectories completed in 2022 showed a spread of the duration of promotion trajectories within the Faculty of Science of 4,6-7,3 years with an average of 5,8 years.

Thesis composition guidelines

Number and contents of thesis chapters

It is useful for PhD candidates to have guidelines about the composition of the thesis and the number of chapters. In the VU doctorate regulations (article 16) general guidelines are given on this topic. The Faculty of Science suggests that most theses will have an introductory chapter¹, 3 main chapters, and a discussion/conclusions/future perspective chapter, reflecting the personal vision, ideas and outlook of the PhD candidate. However, in some departments one main chapter may be sufficient, provided that the promotion team agrees. All main chapters in a thesis should each represent original research work. At least one main chapter should be based on published work (or accepted for publication), peer reviewed according to the scholarly standards of the field. One other main chapter should be publishable. The third chapter can be

¹ Some PhD candidates publish (an early version of) the introduction, for example as a peer-reviewed contribution to a doctoral consortium of a conference. Such publications are part of the mix, but typically do not have the same weight as a regular chapter.

an alternative chapter, see below. Once more, we stress that these are possible indications, they need to be adapted to each discipline.

The inclusion of at least one peer-reviewed (or accepted for) publication provides evidence that researchers outside the circle of the candidate and the supervisors believe that research work of the candidate has academic merit and meets methodological and other standards of the discipline. In addition, the PhD candidate has experienced the peer-reviewing process at least once. The publication(s) should be in fora (journals, conferences, books) of an appropriate quality for the discipline.

The publishable character of other, not yet published, main chapters is assessed by the doctorate committee.

We suggest that a thesis should not contain more than 5 main (original research) chapters. In case of deviation from this norm, approval is required from the head of the department. Criteria are: the justification of the deviation, no extension of contract duration, and all those involved agree to the deviation.

Thesis Chapters

We suggest a more flexible definition for what constitutes a main chapter than the traditional “peer-reviewed publication = chapter” rule. Other chapters may also be possible. In this section we list some possible alternatives.

The thesis reviewers (doctorate committee) should be asked to put particular attention to alternative chapters, in order to guarantee their quality.

Review

A literature review can serve as a solid base for the introduction chapter. In some disciplines a systematic literature review (also called ‘state of knowledge paper’²) can be a prestigious and significant publication in its own right. In these cases, it might well be a main chapter by itself.

Negative results

Not all ideas (even very good ones) lead to positive results, which can make it more difficult to get it accepted for publication. If the original idea was scientifically valid and well-designed, and if the work has been carried out following the scientific standards of the field/discipline, the negative result constitutes a valid main chapter. Moreover, this is very useful for other researchers in the field, who will avoid repeating attempts that do not work. This is most effective when the data are published.

² A systematic review is a [scholarly synthesis](https://libguides.vu.nl/SystematicReviews) of the evidence on a clearly presented topic using critical methods to identify, define and assess research on the topic (<https://libguides.vu.nl/SystematicReviews>)

There has been a request for journals to also accept negative results³, and some actually do this. However, it is far from standard practice. It is also recommendable to submit negative results chapters to preprint platforms, e.g. preprint servers like arXiv, BioRxiv or ChemRxiv⁴.

Data chapter

The work done on producing, processing, organizing, publishing and/or sharing research data may warrant a separate chapter in the thesis. Increasingly, data are published and/or shared with colleagues, and the work involved in this is often considerable and knowledge-intensive. For example, organizing data, publishing data in some standard format, and/or adding standardized metadata are valid research activities. Such data work is also important in the efforts towards Open Science.

For some PhD candidates it might be possible to publish the work on data, as some journals now have special data sections. In any case, significant work in this area is worthy of inclusion as a chapter in a thesis.

Tool chapter

PhD candidates often develop (new or significantly adapted) tools, such as software, methods or instruments. If the work on such a tool is knowledge-intensive (as it often is), and is essential to the research, a chapter on the creation of such a tool should be considered to be included in the thesis.

Sometimes, papers on tools can be published, but this is not always possible, and should not necessarily be a requirement for inclusion in a thesis.

Replication/Validation chapter

Replication of studies is unfortunately not encouraged in the present academic setting. Yet, cross-validation is a crucial aspect of scientific practice. If a lengthy study is repeated, it is in many cases publishable only if the outcome is different with respect to the previously published results. When the outcome is a confirmation, it is usually more difficult to publish, but it can still be a valid chapter.

Valorization chapter

Knowledge transfer is becoming a well-accepted and encouraged part of the work of a researcher. PhD candidates may thus include in their thesis a chapter to describe a process that can bring or has brought their academic results to society. The chapter should meet academic standards, both for the depth of the arguments used and the quality of the written text. Examples include: the development of a business plan for the incorporation of a startup that can bring a new product to the market, an outreach program to make the research results accessible to a non-academic target audience, an analysis of the intellectual property rights

³ It is beyond the scope of this note to discuss the merits of publishing negative results. The interested reader is referred to articles such as this one: <https://www.nature.com/articles/d41586-019-02960-3>.

⁴ <https://arxiv.org>, <https://www.biorxiv.org>, <https://chemrxiv.org/engage/chemrxiv/public-dashboard>

associated to the research results, or the design of a pathway for further co-developments with a group of stakeholders. The authors should avoid considerable overlap with other chapters.

Overview of contributions of authors

If the dissertation consists of a collection of articles by multiple authors, the PhD candidate must demonstrate that, for each article, their own contribution is essential. This is done by adding a page to the dissertation containing a list of references with, for each article, an overview of the authors and an explanation on the contribution by the co-authors (Article 16.5 of the VU Doctoral Regulations). If a shared article is included in two or more dissertations, the statement on the contributions of the authors of this article should be identical in these dissertations. Whenever possible, the contribution of authors should follow the CRediT author statement (<https://www.elsevier.com/authors/policies-and-guidelines/credit-author-statement>) or any other recognized, field specific, contributor role taxonomy.