

# Learning objectives for a degree of Doctor – activities and assessment

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**Abstract**—Learning objectives of the third cycle education are stated by the Higher Education Ordinance. Some of these learning objectives are not easily connected with actual assessable activities for the PhD students. In this study, we have used Trafford & Leshem’s twelve stepping-stones to achieve “doctorateness” to visualize the meaning of the different learning objectives. We have also listed examples of practical activities that can be used to fulfill the learning objectives, as well as to track the progress of the third cycle education.

**Index Terms**—Assessment, Doctoral education, Individual study plan, Learning objectives

## I. INTRODUCTION

QUALITY of the doctoral education and the excellence of recently graduated doctors can to a large extent be assured by:

- (i) Open, competitive, competence based recruitment [1].
- (ii) High-quality supervision [2].
- (iii) Continuous assessment of the learning objectives of the third-cycle (doctoral) studies.
- (iv) Half-time assessment in the form of a seminar or a licentiate dissertation.
- (v) Pre-assessment of the doctoral thesis.

The aim of this work is to focus on the third point, the continuous assessment of the learning objectives. These learning objectives are written in a rather ambiguous way, and there is a general need for a deeper understanding of what the learning objectives mean in practice – what activities could the doctoral student do to demonstrate the intake of new knowledge and skills, and how can these activities be assessed, demonstrating a progress in the student’s third cycle studies? Most importantly, why is it important for a doctoral student to learn these skills and to obtain certain new knowledge? What does it take to be an excellent researcher?

## II. DOCTORAL EDUCATION: A PROGRESS TOWARDS A HIGHER DEGREE OF “DOCTORATENESS”

According to Vernon Trafford and Shosh Leshem [3], there are 12 components that are often examined in doctoral dissertations, see Figure 1. When the doctoral student can handle all these 12 components, and there is a demonstrated synergy between them, the student shows a high degree of

doctorateness and maturity in terms of being ready for the doctoral dissertation.

Contribution to knowledge	→ Stated gap in knowledge	Explicit research questions	Conceptual framework
Conceptual conclusions	<b>DOCTORATENESS</b>		Explicit research design
Research questions answered			Appropriate methodology
Coherent argument	Engagement with theory	Clear/concise presentation	‘Correct’ data collection (e.g. lab work)

Fig. 1. Components of doctorateness [3].

Figure 1 shows the most relevant components of demonstrating doctorateness. Obviously, these are also the “stepping-stones” when conducting research, i.e. the research methodology. Full explanations and thoughts about these different “stepping stones” are given by Trafford and Leshem [3].

In our own research group, the Green Technology Group at Lund University ([www.kilu.lu.se/cas/research/green-technology-group](http://www.kilu.lu.se/cas/research/green-technology-group)), our PhD students found it mainly difficult to grasp the meaning of “conceptual framework” and “coherent argument”. To explain just those two, a conceptual framework is a map or framework of how the research will be conducted, based on existing assumptions within the field, which in turn are based on theory. The conceptual framework has several functions, e.g. to bridge theory and practice; to map the different concepts; and to give a picture of the theoretical territory.

A coherent argument is an intellectual argument involving the selection of the most relevant ideas and presenting them for a purpose. To give a coherent argument is to step back from one’s own investigation, and to look for connections, build bridges between theory and practice, and communicate one’s knowledge efficiently.

In an effort to understand the learning objectives of the third-cycle studies, and to be able to suggest different assessable activities for our doctoral students, we have employed Trafford & Leshem’s 12 components of doctorateness. Some of the learning objectives are slightly outside the Trafford & Leshem’s box of doctorateness but still included here – teaching skills; third task communication abilities and research ethics.

## III. LEARNING OBJECTIVES AND SUGGESTED ACTIVITIES

The individual study plan (ISP) is used to monitor the progress of the doctoral education, as required by the Higher

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Education Ordinance [4]; and in the ISP, activities aimed to fulfil the learning objectives should be described. There is however a risk that the assessment of progress using the ISP is summative rather than formative [5]. Below follows the learning objectives, combined with what we consider the appropriate component(s) of doctorateness along with some suggested activities for the PhD students.

#### A. Knowledge and understanding

1. Demonstrate broad knowledge in and a systematic understanding of the field of research, together with deep and up-to-date specialist knowledge in a defined part of the field of research.

**Doctorateness:** Engagement with theory; Conceptual framework.

**Activities:** Take courses within subject; Take broader courses; Teaching; Read and present a scientific article for the group; Read literature in own subject; Collaborate with scientists in a different field.

2. Demonstrate familiarity with scholarly methods in general and with methods in the specific field of research in particular.

**Doctorateness:** Appropriate methodology

**Activities:** Take course in research methodology; Read literature in own subject; Plan and perform experimental work; Oral presentation of own research; Teaching in the lab – coupling theory to practice; Teach how an instrument is working including both theory and operation.

#### B. Skills and abilities

3. Demonstrate an ability to engage in scholarly analysis and synthesis and in independent, critical examination and assessment of new and complex phenomena, issues and situations.

**Doctorateness:** Engagement with theory; Coherent argument; Conceptual conclusions.

**Activities:** Review a scientific article (first together with the supervisor); Read and present a scientific article for the group; Interpret and discuss own results and from these draw reasonable conclusions as well as identify new knowledge gaps and research questions.

4. Demonstrate an ability to identify and formulate issues, critically, independently and creatively, and proceeding with scientific precision, and to plan and, using appropriate methods, conduct research and other advanced tasks within specified time limits, and to scrutinise and evaluate such work.

**Doctorateness:** Explicit research question; Explicit research design; Appropriate methodology; Correct lab work.

**Activities:** Take a course in research methodology; Draft a plan of research project including research question(s) and methods, and discuss this with supervisor; Write a research proposal; Review others' research proposals; Plan (knowledge gap, research question, methods, theory) and perform an experiment; Write a halftime report; Prepare and present a research project either as a poster or oral presentation; Write introduction and materials/methods of a scientific article.

5. Demonstrate, in a dissertation, their ability to make a substantial contribution to the development of knowledge by their own research.

**Doctorateness:** Demonstrate a synergy between the 12 different components of doctorateness.

**Activities:** Write articles to be included in doctoral thesis; Write and discuss own doctoral thesis; Prepare the oral presentation for the doctoral dissertation.

6. Demonstrate an ability to present and discuss research and research results with authority, in dialogue with the scholarly community and society in general, orally and in writing, in both national and international contexts.

**Doctorateness:** Clear and concise presentation.

**Activities:** Poster presentation at a conference; Oral presentation in own research group; Oral presentation in collaboration project; Oral presentation at a conference; Oral presentation in front of school children; Write a scientific article; Write a scientific review article; Write a thesis; Write a popular science text.

7. Demonstrate an ability to identify their need of further knowledge.

**Doctorateness:** State a gap in knowledge.

**Activities:** Read literature in own subject and based on this phrase a research question; Write conclusions and future research as part of a scientific article; Read literature and write a review article based on this; Participate in an international conference and thereafter present to own research group a selection of interesting research; Write a research proposal.

8. Demonstrate a potential to contribute to the development of society and support other people's learning, both in the field of research and education and in other advanced professional contexts.

**Doctorateness:** Teaching skills; Third task communication abilities.

**Activities:** Teach in the course lab; Teach student groups in exercises; Orally present own research in a cross-disciplinary collaborative project (popular science presentation); Support high school students in their project work; Give a popular science lecture.

#### C. Judgement and approach

9. Demonstrate intellectual independence and scholarly integrity and an ability to make ethical assessments relating to research.

**Doctorateness:** Coherent argument; Research ethics.

**Activities:** Take a course in research ethics; Describe ethical aspects in a scientific article; Write and defend a half-time report; Write and defend a doctoral thesis.

10. Demonstrate deeper insight into the potential and limitations of scholarship, its role in society and people's responsibility for how it is used.

**Doctorateness:** Third task communication abilities; Research ethics.

**Activities:** Take a course in research ethics; Take a course in research methodology; Take a course in science communication; Take a course in risk uncertainty and decision-making; Take a course in sustainable development; Take a course in popularizing science; Write a popular science text about societal aspects of own research to be included in doctoral thesis.

## IV. ASSESSMENT AND PROGRESS

We propose that individual doctoral student portfolios

should be used, which include self-reflection reports for formative assessment on how the 12 components of doctorateness are addressed in a variety of research activities. To ensure progression, the size and complexity of the self-reflection reports, as well as the student's responsibility, is increased in a long-term perspective. Supervisor(s) will give feedback on these reports.

In a first year activity the student could for instance be responsible for a minor part of a collaborative study, such as planning and conducting some experiments as well as writing a part of the paper (from conceptual framework to clear/concise presentation, Fig. 1). In a last year activity the student will be expected to take full responsibility of a whole study including identifying a knowledge gap to conceptual conclusions and contributing to knowledge (entire cycle in Fig. 1).

Examples of questions for self-reflections are; *Conceptual framework* – How did the bridging theory and practice help you to design your research?; *Explicit research design* – What practical/methodological considerations influenced/restricted your choice of variables?; *Coherent argument* – “Please tell us how your theoretical perspectives helped you to frame the research issues, develop conceptual frameworks and design you research” [3]. Feedback given by the supervisor(s) on complex tasks exemplified above, i.e. the overall coherence and focus of the work, rather than structure, grammar and spelling, is in line with the recommended sequence of feedback [5].

The progression of doctoral education is illustrated in form of a stairway in Figure 2. In terms of revising the ISP, the progress in “doctorateness” should be transformed into the learning objectives. The aim is to enable a formative assessment with respect to the progress in the PhD education towards the dissertation of an independent researcher.

Another recommended checkpoint is the half-time review. An external reviewer (appointed by the department) reviews a half-time report, that includes an overview of relevant literature in the field as well as all manuscripts irrespective of their status (published, accepted or incomplete), and prepares thoroughly for the seminar in order to scrutinise the report, manuscripts and the current updated individual study plan [6]. The seminar given by the doctoral student will be followed by a closed meeting where the doctoral student, supervisor, external reviewer and subject representative (or equivalent) will discuss the continued research study towards the public defence, and possibly make changes to the ISP.

Moreover, in order to ensure as good quality of the doctoral thesis as possible, three months before dissertation, the thesis should be pre-assessed by the subject responsible (or equivalent).

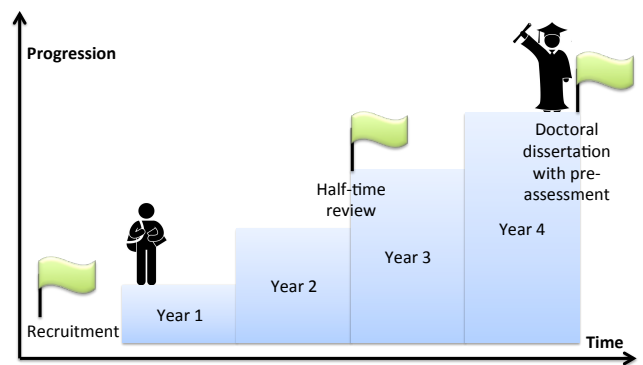


Fig. 2. Stairway of doctoral education including quality checkpoints.

## V. CONCLUSION

The 12 stepping-stones to achieving your doctorate by Trafford and Leshem [3] is a useful guidance to put the learning objectives into practice, which in turn will make the learning objectives easier assessable. This is because the learning objectives are difficult to grasp, while the 12 components of doctorateness are more straightforward and in line with how research is conducted.

Further, process oriented supervision aims through active engagement of the supervisor(s) over time to guide the doctoral student towards excellence in doctorateness.

Further work will explore how different supervising styles in combination with different doctoral students' “styles” will function together towards the aim of fulfilling the learning objectives. Is there any right or wrong in how supervision is done? Should certain supervisors recruit doctoral students of a certain style, or preferences in how to be supervised? Is it possible to consider aspects of supervising styles in the recruitment process?

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