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General syllabus for doctoral (third-cycle) studies in Mathematics and Science Education at Luleå University of Technology

Decided by the Chair of the Board of Faculty of Humanities and Social Sciences on 27 September 2023.

1. Subject description

English name: Mathematics and Science Education

Mathematics and Science Education is a research subject studying the teaching and learning of mathematics and science at different levels of the education system. It provides a research-based foundation to develop and strengthen teaching in these subjects. This is achieved by studying various teaching and learning processes, how subject knowledge is communicated in various contexts, and how individuals and groups construct and apply their knowledge. Research areas of special interest include learners' motivation, prerequisites, and attitudes as well as various teaching methods in modern learning environments.

2. Programme aim and intended learning outcome

The aim of the doctoral (third-cycle) studies in Mathematics and Science Education at the University is to give the doctoral student specialised knowledge in Mathematics and Science Education, in-depth knowledge of different research methods and a good understanding of the challenges related to research and its practical application. The overall objective of the programme is that the doctoral student develops into a critical and autonomous researcher in Mathematics and Science Education, able to plan and carry out research projects. The doctoral student shall fulfil all the qualitative targets specified in the Higher Education Ordinance as well as in the locally decided qualitative targets, if any (see attached Annex A).

3. Admission requirements and selection

3.1 General entry requirements

An applicant meets the general entry requirements for doctoral (third-cycle) studies if he or she has been awarded a Master's (second-cycle) qualification, has satisfied the requirements for courses comprising at least 240 credits, of which at least 60 second-cycle credits, or has acquired substantially equivalent knowledge in another way, in Sweden or elsewhere (Higher Education Ordinance (2010:1064) Chapter 7 Section 39).

3.2 Specific entry requirements

In addition to the requirement for basic qualifications, a minimum of 90 credits in mathematics, physics, chemistry, biology, or engineering is required, of which a maximum of 30 credits can consist of courses in the didactics of the subjects.

3.3 Selection

In selecting among applicants who meet the requirements, their ability to benefit from the course or the study programme shall be taken into account. However, the fact that an applicant may be

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credited for previous courses and study programmes or for professional or vocational experience may not alone give the applicant priority over other applicants (Higher Education Ordinance (2010:1064) Chapter 7 Section 41). The University's local guidelines in the Admissions procedure for doctoral (third-cycle) studies must also be applied.

The following criteria will be used in the selection of applicants for doctoral (third-cycle) studies in Mathematics and Science Education.

- Proficiency in oral and written communication in Swedish and/or English.
- Other knowledge relevant to ongoing projects.
- Personal attributes pertinent to education at the doctoral level.

4. The degree

The doctoral (third-cycle) studies lead to a Degree of Doctor. Within Mathematics and Science Education, a student admitted to doctoral studies has the right to be awarded a licentiate degree after having completed at least 120 credits of the programme leading to a Degree of Doctor.

4.1 Degree requirements

For a Degree of Doctor, the doctoral student shall

- have been awarded a pass grade for courses of at least 60 credits
- have been awarded a pass grade for a research thesis (doctoral thesis) of at least 120 credits.

The thesis and the courses shall together amount to 240 credits for a Degree of Doctor.

For a Degree of Licentiate, the doctoral student shall

- have been awarded a pass grade for courses of at least 30 credits.
- have been awarded a pass grade for a licentiate thesis of at least 60 credits.

The thesis and the courses shall together amount to 120 credits for a Degree of Licentiate.

4.2 Titles of degree

- After the completion of the Degree of Doctor in Mathematics and Science Education the doctoral student is awarded the title Doctor of Philosophy.
- After the completion of the Degree of Licentiate in Mathematics and Science Education, the doctoral student is awarded the title Licentiate of Arts.

A request of a title of degree other than the stipulated may be submitted in accordance with laid down guidelines.

5. Programme structure and implementation

5.1 Programme scope and structure

The doctoral (third-cycle) programme includes two blocs; courses and thesis work. The programme comprises four years (two years for the licentiate degree). In case the doctoral student has a doctoral studentship and carries out departmental duties to a certain extent (no more than 20% of the whole programme), a corresponding prolonged period may be approved.

5.2 Individual study plan and supervision

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An individual study plan outlining the implementation of the studies is drawn up for each doctoral student. The plan is established in consultation with the supervisor is decided by the Head of Department by delegation of the Vice-Chancellor. The plan is reviewed and revised at least once a year.

The Head of Department shall appoint at least two supervisors, one of whom is appointed principal supervisor, for each doctoral student. The person appointed principal supervisor shall have at least qualifications required for appointment as a docent and be employed by the University. A principal supervisor who no longer meets the job requirements may continue as supervisor until the doctoral student completes his or her studies, by an individual agreement with the relevant department. The doctoral student is entitled to supervision during the studies, unless the Vice-Chancellor has decided otherwise in accordance with the Higher Education Ordinance (2010:1064) Chapter 6 Section 30. A doctoral student who so requests may have another supervisor (Higher Education Ordinance (2010:1064) Chapter 6 Section 28). The request does not need a justification.

5.3 Courses

The individual study plan shall specify the courses to be included in the doctoral student's education. The goal attainment is examined according to the examination procedure specified in the course syllabus. Credits may be transferred in accordance with the local guidelines in the Admissions procedure for doctoral (third-cycle) studies.

The courses component of the degree shall encompass general and thesis-specific courses, contingent upon the prerequisites of the doctoral candidate. The selection of courses is determined through consultation between the student and his/her supervisor, and is formalized within an individual study plan. In some cases, courses can be pursued at other institutions or academic establishments.

The following courses are to be included in both the licentiate and doctoral degrees in Mathematics and Science Education, unless equivalent knowledge is already possessed:

- Courses addressing pivotal concepts and trends within didactic research in the context of mathematical or science-oriented subjects.
- At least one course in research methodology within educational sciences.
- In-depth courses aligned with the research area.

Furthermore, it is mandatory for the doctoral student to acquire knowledge about gender equality.

5.4 Thesis

The thesis may take the form of either a single coherent work (a monographic thesis) or a compilation comprising a number of scientific articles interrelated by an introductory summary chapter (a compilation thesis). Quality and scope requirements for the research activities do not differ between the two alternatives. The scientific articles or, as appropriate, the monograph must be of such quality that they meet reasonable requirements for publication in a peer-reviewed scientific forum.

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A monograph is written individually and typically spans 130–150 pages. A compilation thesis comprises several scientific articles along with a thorough summary. The number of articles can vary based on the doctoral student's contribution to each work and the extent and the scientific quality of the articles. A typical compilation thesis consists of 3–5 articles, of which a minimum of three have been accepted for publication in international peer-reviewed scientific journals and/or books. All articles must meet the standards for an international scholarly publication. The doctoral student should be the responsible first author of at least one journal article and the sole author of at least one article. The licentiate thesis must always take the form of a monograph.

The introductory summary chapter shall include a separate section describing the doctoral student's contribution to the articles.

The doctoral thesis shall be defended at a public defence seminar. The grades for the thesis are either 'pass' or 'failed'. When grading the thesis, the content and the defence of thesis shall be taken into account. The grade of a doctoral thesis is decided by an examining committee, appointed anew for each thesis.

A doctoral student wanting to be awarded a Degree of Licentiate shall, after consultation with his or her supervisor, request approval from the responsible Head of Department. The doctoral student defends his or her licentiate thesis at a licentiate seminar after which the thesis is graded 'pass' or 'failed'. When grading the thesis, the content and the defence of the thesis is taken into account. An examiner, appointed by the Head of Department, grades the licentiate thesis.

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ANNEX: QUALITATIVE TARGETS

Qualitative target in accordance with the Higher Education Ordinance (HF)

Degree of Doctor

Knowledge and understanding

For the Degree of Doctor, the doctoral student shall

- demonstrate broad knowledge and systematic understanding of the research domain as well as advanced and up-to-date specialised knowledge in a limited area of the research domain, and

- demonstrate familiarity with research methodology in general and the methods of the specific research domain in particular.

Competence and skills

For the Degree of Doctor, the doctoral student shall

- demonstrate the capacity for scholarly analysis and synthesis as well as to review and assess new and complex phenomena, issues and situations autonomously and critically

- demonstrate the ability to identify and formulate issues with scholarly precision critically, autonomously and creatively, and to plan and use appropriate methods to undertake research and other qualified tasks within predetermined time frames and to review and evaluate such work

- demonstrate through a dissertation the ability to make a significant contribution to the formation of knowledge through his or her own research

- demonstrate the ability in both national and international contexts to present and discuss research and research findings authoritatively in speech and writing and in dialogue with the academic community and society in general

- demonstrate the ability to identify the need for further knowledge, and
- demonstrate the capacity to contribute to social development and support the learning of others both through research and education and in some other qualified professional capacity.

Judgement and approach

For the Degree of Doctor, the doctoral student shall

- demonstrate intellectual autonomy and disciplinary rectitude as well as the ability to make

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assessments of research ethics, and

- demonstrate specialised insight into the possibilities and limitations of research, its role in society and the responsibility of the individual for how it is used.

Research thesis (doctoral thesis)

For the Degree of Doctor, the doctoral student shall have been awarded a pass grade for a research thesis (doctoral thesis) of at least 120 credits.

Degree of Licentiate

Knowledge and understanding

For a Degree of Licentiate, the doctoral student shall

- demonstrate knowledge and understanding in the research domain including current specialist knowledge in a limited area of this field as well as specialised knowledge of research methodology in general and the methods of the specific field of research in particular.

Competence and skills

For a Degree of Licentiate, the doctoral student shall

- demonstrate the ability to identify and formulate issues with scholarly precision critically, autonomously and creatively, and to plan and use appropriate methods to undertake a limited piece of research and other qualified tasks within predetermined time frames in order to contribute to the formation of knowledge as well as to evaluate this work,

- demonstrate the ability in both national and international contexts to present and discuss research and research findings in speech and writing and in dialogue with the academic community and society in general, and

- demonstrate the skills required to participate autonomously in research and development work and to work autonomously in another qualified capacity.

Judgement and approach

For a Degree of Licentiate, the doctoral student shall

- demonstrate the ability to make assessments of ethical aspects of his or her own research,
- demonstrate specialised insight into the possibilities and limitations of research, its role in society and the responsibility of the individual for how it is used, and

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– demonstrate the ability to identify the need for further knowledge, and take responsibility for his or her ongoing learning.

Thesis

For a Degree of Licentiate, the doctoral student shall have been awarded a pass grade for a research thesis of at least 60 credits.