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Guidelines for top master Nanoscience students and supervisors on individually supervised course units

The Research projects

The research projects generate the experience in each of the stages of research: planning, data collection, journal keeping, analysis, writing and presentation. The emphasis of the first research project (small project) is on proper training and guidance in each of these stages – more than on obtaining truly breakthrough results. Thus, the topics chosen are usually not technically risky, so that a clear result is likely. The large research project (master project) repeats all of the stages with a great deal of independence of the student.
A research project comprises the following phases:

1. Planning and preparation of research: Students start discussing the project with their supervisor, read relevant literature, write a literature review and methodological planning of the research project.
2. Data collection and analysis: Data will be collected according to the agreed research plan. The data collection and analysis must be documented in the lab journal, which for the small research project also serves as part of the evaluation.
3. Presentation: For the small research project students are required to present the results during the Nanoscience symposium. At the end of the large research project an oral presentation is given to a scientific audience (it must be announced widely within the Zernike Institute at least one week before the event).
4. Report: The results of the large master project will be presented in a report, which includes the literature review, a material and methods section, a presentation and analysis of the data obtained, and a discussion of the results in terms of the research question addressed.

The following guidelines apply to the organization and implementation of the research projects:

- The research projects are always conducted under the supervision of one of the examiners appointed by the Board of Examiners (the supervisor).
- For the large research project the supervisor selects and makes contact with a suitable 2nd examiner (referent). A referent can be selected from the list of examiners appointed by the Board of Examiners, but the referent should be from another research unit than the supervisor, and someone who is not already closely involved in the project. For the small research project the course coordinator has the role of the referent.
- The supervisor may assign a daily supervisor from the research group to take care of supervision of daily tasks and instruction. If no daily supervisor is assigned the supervisor also perform the duties described here for the daily supervisor.
- The large project should not be a simple continuation of the small project, but the student must experience something new in terms of topic, research group, and method.
- Regular progress meetings (at least every week) with the daily supervisor will take place, in which the student will be given feedback and instructions on the day-to-day research. Progress meetings (at least every four weeks) with the supervisor should take place, in which the student will be given clear feedback on his or her progress.
- Halfway through the large master project, the supervisor and student will discuss the progress of the project. The referent may be asked to be present as well. For this purpose the *midterm assessment form* is available.

- The practical work must be completed in good time so that the oral presentation can be prepared for the date of the nanosymposium and for the large project so the report can be written within the total agreed period for the project.
- The final assessment form is used to mark the research project and is signed by the supervisor and the referent. The original assessment form needs to be handed in or mailed to the Education Support Desk by the first examiner and a pdf copy must be provided by e-mail.
- To complete the student's dossier the final report should be uploaded to the repository of the University Library.
- Part of the research projects may be performed external. However, the internal supervisor is always the first examiner. The assessment will be based on the advice of the referent as well as that of the daily supervisor about the daily performance of the student, the final report and the oral presentation is given in the group of the examiner in Groningen. In case of an external project the student must provide the internal supervisor with an update at least every four weeks (written or in the form of a skype meeting). Further details may depend from situation to situation and projects performed externally must always be discussed with the course coordinator well in advance.
- All deviations have to be approved by the Board of Examiners.

Assessment and possible remediation of the research project

The research project is assessed by the supervisor and the referent in consultation of the daily supervisor. The grade is determined on the basis of the assessment forms. The relevant assessment form is completed and discussed with the student. After signing, the assessment form also serves as evidence for passing the exam.

The emphasis in the assessment is on the scientific research skills of the student. For the large research project the supervisors assess the research carried out with emphasis on research content, research management, the quality of the written report and the oral presentation. For the small research project the supervisor assess the quality of the lab journal, the contribution to the hands-on work, and the scientific depth. The presentation skills are further assessed by the referent and staff assigned by the referent at the nanosymposium.

If the assessment cannot take place at the agreed date the student and the assessors select a new date. If the period between the new date and the original date is longer than 10% of the time of the project, an extension has to be requested from the Board of Examiners by the student with the consent of the assessors.

When a student's performance in an individually supervised course unit is assessed on the basis of different categories, the student passes only if each of the categories is assessed with a mark of 5.5 or higher. This includes the requirement of meeting deadlines. If the student fails the assessment, the mark will be registered at the ESC, and the student will be offered a remediation trajectory. A remediation plan will be agreed upon and a new assessment date will be established. For the small research project this will involve an oral presentation given at another time than the nanosymposium. The remediation trajectory may be no more than 30% of the total time of the original project. If after the remediation trajectory the student fails the assessment again this will be registered at the ESC. The student will not be offered another remediation trajectory.

Duties and expectations to supervisors and student

Duties of the supervisor

The responsible supervisor will keep track of how the work progresses. He or she will keep track of attitude, motivation and quality of the work during the research phase, judge the quality of the report and the oral presentation and give a motivated proposition for the grading. The supervisor is expected to give feedback on the research progress at least once every four weeks and more frequently if required. For the large master project the supervisor must read and give feedback on the outline and at least one draft version of the report, before the final version is handed in and graded. The supervisor will report issues that may delay the project beyond the planned time to the course and programme coordinators. The supervisor must check for plagiarism using the programs made available by the university. If there is the slightest doubt about the originality of (parts of) the written report this must be reported to the course coordinator. For the large research project the supervisor is further responsible for the selection of the referent.

Duties of the referent (second examiner)

The referent must be present during the oral presentation of the students and must examine the lab journal for the small research project or the report for the large research project. Preferably the referent is also present at the large project midterm evaluation.

Duties of the daily supervisor

The daily supervisor should be available to help and address questions of the student on a regular (essentially daily and at least weekly) basis. The daily supervisor will report on attitude, motivation and quality of the work, as well as problems, including failure to follow rules in the research group, and extensive absence to the supervisor. The daily supervisor will make efforts to include the student in group-activities.

Duties and expectations to the student

The research projects are performed in research groups of the Zernike Institute for Advanced Materials, the Stratingh Institute, or the Groningen Biomolecular Sciences and Biotechnology Institute. The main focus is to learn to conduct research, however, it is also an opportunity for the students to extend their professional network. Therefore, it is expected that the students participate in group-activities of the host group during their project period. This for example includes regular group meetings, and group outings. The students are further expected to attend the Zernike Colloquia as well as seminars and meetings relevant to the research group that they are a part of. The student must meet deadlines and thereby provide sufficient time for the supervisor and second examiner to perform their tasks.

Appendix

The appendix contains a general guideline for writing the research report, for the oral exam, and issues of plagiarism. These topics are covered in detail in the kick-off meetings and academic skill workshops, which are obligatory to attend.

The research report

Structure

The report should contain:

- Title
- Abstract
- Table of contents
- Introduction to the research question
- Materials and methods
- Results
- Discussion and conclusions
- Contribution section

The order and exact wording of these sections may vary between groups. The extend of the thesis should be in the range of 40-60 pages excluding appendices.

The literature cited should appear in a bibliography. A preface/afterword and/or appendices are optional. Before you start with the full report, make an outline and discuss it in detail with your supervisor! Hopefully, this will save you the disappointment of having to radically restructure. Note that the description here is a guide rather than a manual. Deviating from this description may be justified, but should be discussed with the supervisor.

The thesis is not a journal paper, it is your description of your project. Use "I" whenever you describe things that you did yourself and when describing your own interpretation of the results. Only use "we" (which is often used in papers sometimes even by single authors) when you describe things that were really done by you as part of a team.

Title: The title should informative and to the point; avoid unnecessary frills ('Some contributions to the knowledge of....' etc.). If necessary, use a subtitle. The title should appear on the title page together with the author, student number, date, research group and supervisor(s). The sources for any figures on the title page should be reported on the inside page.
Abstract: This is a very brief summary of the essence of the report (no more than half an A4 page). Stick to the main points and avoid too much detail.
Table of contents: Make sure that the page numbers in the text are correctly listed in the table of contents (All text editing programs have an automated function. It is worth checking them out!). If necessary, you can subdivide chapters into sections and subsections, but avoid a three or four-step subdivision.
Introduction: Here you should work from the literature towards the research question, using all the information that is relevant to your argument. A good way to structure your introduction is to focus gradually on your particular research topic against a background of the broader research area. The research question will then follow logically from the introduction. Formulating a good research question is not easy. This should occur naturally to the reader as a result of your presentation of the known facts. The research question can be of a purely exploratory nature, or the arranging of known facts can produce a hypothesis to

be tested in your research. It is then important to predict as accurately as possible the outcome of the research on the basis of this hypothesis.
Materials and methods: Here you explain how the experiments or theoretical approach were designed, what the experimental set-up or the theoretical framework was and how the research was carried out. Use figures to supplement, shorten or clarify the text. Demonstrate clearly (perhaps with an example) how and in what form you collected and processed your data. Describe the statistical approach you used. Be meticulous about your statistical approach. Report the number of measurements, the margins of error and whether certain trends or differences are significant. If your research set-up and methodology differed from the literature, you must describe them in detail. If you used established methods, a brief description, with a reference to the literature, will suffice.
Results: Present the findings in brief using figures and tables. Emphasize the points that relate to the research question, first the main points and then any interesting details. Figures and tables form the basis of this part of the report. Present the results point by point and in a logical sequence. Avoid giving the same information twice in a different form. Generally speaking, tables should be used to make numerical comparisons and graphs to show or compare trends. Be aware that an interpretation is already inherent in the way in which you present and summarize the findings. This is where your conclusion begins to take shape.
Conclusions and discussion: First of all, take a positive global look at the results, and only then go into detail. State explicitly the conclusions arising from the results and discuss or substantiate them from the literature. Distinguish between direct conclusions and further interpretations. You may also point out positive or negative aspects of the method used, and explore the question as to why you arrived at these particular findings and whether they match your expectations. Finally, you may make recommendations for further research. You can draw conclusions from the results, stating your arguments for doing so. Where possible, test the conclusions against your own expectations or the literature, being as specific as possible. Argued speculations may be included, but avoid risky suggestions or vague assumptions.
If the results do not confirm your hypothesis, don't immediately assume all manner of vague 'errors of measurement' or 'inaccuracies' (nor should you do so if the findings *do* match your expectations). If there is a specific reason for this, try to assess the effects of a particular error or anomaly on your results. Do not immediately start to qualify the results in favour of the hypothesis. If you have measured properly, accurately and reliably, your results are facts; the hypothesis was only an intellectual construct.
Bibliography: This should contain all the cited literature. Bibliography programs such as Endnote or Reference Manager do make your life easier. Follow the conventions used in recent editions of reputable journals. Make sure to use a consistent style, which include all necessary information to find the cited literature.
Appendices: It may be useful to include the raw data as appendices to the report. This allows the reader to check your results or to process them in some other way. Present the raw data in the form of graphs and tables that are referred to in the report. Each appendix should have an identifying number or letter and a heading.
Preface/Afterword/Acknowledgements: (optionally) This is where you state the reasons for or objectives of the research which are not part of the academic objective; words of thanks, etc.
Contribution Section: **(compulsory)** The thesis must contain a contribution section. A contribution section tells who did which part of the presented research and is different from an acknowledgment section. A standard comparable to that of the Nature journals is advisable. It should be defined: Who designed the research. Who did each (set of) measurement. Who did which (set of) calculations. Who prepared or provided the sample. Who synthesized the chemicals (or where were they bought). Who constructed the setup. Who wrote the computer code (or was it commercially available). Who analyzed the data.

Who made the conclusions. The contributor may be a person, a research group, or a company. If the supervisor does not agree on the content of the contribution section of the final thesis it must be updated before upload to the repository and an agreed upon contribution section must be written on the grading form.
Examples of a contribution section:

> **Contributions**
> The author proposed the research question and designed the research together with A. Engel. All chemicals were acquired from Sigma-Aldrich. The author prepared all samples and performed all spectroscopic measurements under the supervision of W. Pauli. W. Bragg performed all x-ray diffraction experiments on the samples and analyzed the x-ray data. The existing spectroscopic setups of the C. Raman group were used for all spectroscopic measurements. All spectroscopic data were analyzed by the author. The conclusions presented in the conclusion section were all drawn by the author.

> **Contributions**
> R. Verlet proposed the research question and the initial research approach. The author proposed the improved simulation scheme described in Section 2. The molecular dynamics simulations were performed with the existing GROMACS code. The molecular dynamics trajectories were analyzed with the analyze_my_data.c code written by the author. All experimental data were provided by the M. Orrit group. The ab initio calculations were performed by F. Hund from the F. Hamilton group. The conclusions in the conclusion section were drawn by the author and R. Verlet.

Content
You must pay attention to language use, ease of reading (not too many repetitions, clear and unambiguous sentences, etc.) and consistent subject-verb agreement. You should also consider the academic content of the Introduction, Materials and Methods, Results and Discussion:

- Have you included everything required to answer the research question?
- Have you made any claims that are not related to the research question, or that cannot be supported by demonstrable findings?
- Is all information needed to reproduce the research provided?
- Are the text/figures/tables clear and unambiguous?
- Are your arguments organized in a manner that is academically convincing?

Layout and appearance
A research report should be well presented so that it is inviting for the reader to read. The separate chapters, sections and other parts should be clearly reflected in the titles and headings. Pay attention to the layout of figures and tables (e.g. the space around them, captions, the space they take up in relation to their significance, etc.).
General layout: Label all graphs, drawings, diagrams, figures etc. as 'figures' and number them consecutively. Usually tables are labelled above, while figures are labelled below. In the text, refer to tables and figures by their number. The function of tables is the succinct presentation of processed and organized data as pure findings, while graphs should give a

quick overview of the nature of the relationships investigated. Because an interpretation is often implicit in the manner of presentation, you need to constantly ask yourself which of the two types is most appropriate for particular findings. Often, graphs are the preferred form. If you opt for tables, make sure that they are small, legible and clear. (Large quantities of data can be included in tables in an appendix.) The caption (located above a table and below a graph) should explain what the table or graph represents, usually without reference to the text. Above the columns of a table and along the axes of a graph, state which variable is plotted and the units in which that variable is expressed. The independent variable is set out along the horizontal axis of a graph and the dependent one along the vertical axis. The scale division along the axes always starts at zero, unless there are important reasons for doing otherwise (logarithmic scale, temperature). The scale division should not be too crude, nor too fine, and should present only round values. If the points on a graph suggest a clear relationship, you can attempt to draw a smooth curve along the dots. Otherwise, straight lines connecting the dots must suffice. Under no circumstances may a curve suggest a greater degree of relationship than the measuring points warrant. Do not mention numbers in the text that are listed in tables, unless for a specific reason. Round numbers in tables and text correctly.

Oral presentation

The final oral presentation is an essential component of a research project, and thus counts toward the final assessment. Through the presentation you learn to present your work orally and to discuss it. It allows you to show the kind of work you have done, the origin of the research question, your findings and what you have done with them. It also gives other members of the research group and the Zernike Institute an opportunity to give their input into your research and the processing of your findings. The students must attend the workshops for practising oral presentation skills during period of the small research project.

Plagiarism

Plagiarism is not accepted at the UoG nor elsewhere in the scientific community. In all cases in which plagiarism is found or suspected, the supervisor will inform the Board of Examiners. When the Board decides that plagiarism has occurred they will sanction in accordance with the Teaching and Examination Regulations of the FSE. In general, this will mean that a student is excluded from participation in examinations or other forms of testing of the concerning module for the current academic year.
Plagiarism means using ideas and formulations conceived by others without stating the source. Examples of plagiarism include copying an assignment from a fellow student or senior student, cutting and pasting text from the internet without stating the source of the text, submitting the same assignment more than once, copying an essay from a student at another university or copying part of a book or article. Of course, using source material is allowed, as long as the source is stated in the acknowledgement of sources

Please find below a checklist for avoiding plagiarism (from: H.R. Fowler and J. E. Aaron (2004). Avoiding plagiarism and documenting sources. The Little, Brown Handbook. 9th ed. New York: Pearson Longman):

Type of source
Are you using:
- your own independent material,
- common knowledge, or
- someone else's independent material?

You must acknowledge someone else's material.

Quotations
- Do all quotations exactly match their sources? Check them.
- Have you inserted quotation marks around quotations that are stated in your text?
- Have you shown omissions with ellipsis marks and additions with brackets?
- Does every quotation have a source citation?

Paraphrases and summaries
- Have you used your own words and sentence structures for every paraphrase and summary? If not, use quotation marks around the original author's words.
- Does every paraphrase and summary have a source citation?

The Web
- Have you obtained any necessary permission to use someone else's material on the Web?

Source citations
- Have you acknowledged every use of someone else's material in the place where you use it?
- Does your list of works cited include all the sources you have used?