

MSc Research Skills

Lecture: Thesis quality

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UT/ITC Enschede

Aspects of Quality

Quality is defined as “**meeting defined standards**”.

Quality may be divided into **four aspects**, in increasing levels of abstraction:

1. Conformance to **obligations**;
2. Conformance to **specifications**;
3. Conformance to **requirements**;
4. Meeting or exceeding **expectations**.

Thesis quality

1. Conformance to obligations

- The thesis complies with defined standards of **ethical behaviour**, e.g. without fraud;

2. Conformance to specifications

- The thesis fulfills **defined standards**, e.g. of format and bibliography;

3. Conformance to requirements

- The document meets the requirements of **scientific reporting**, e.g. structure, logic, language, proper scientific method;

4. Relation to expectations

- The thesis reports research of sufficient **innovation, depth, and independence** to qualify as MSc-level work.

Some examples of thesis quality

1. **Violates ethical rules and obligations**

- The work can not be published, so can't be evaluated.

2. **Does not meet specifications**

- Not a properly-prepared document. Do not read.

3. **Meets specifications** but **does not meet requirements**

- Properly-prepared but not logical, not expressed in correct language, or poorly-structured. Not possible to judge scientific quality.

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4. **Meets specifications and requirements, does not meet expectations**

- Work is properly presented but not significant, it does not reach the level of an MSc thesis.

5. **Meets specifications, requirements, and expectations**

- Work is a proper MSc thesis and is accepted as partial fulfilment of the requirements for an ITC degree.

6. **Meets specifications and requirements, exceeds expectations**

- Work is an outstanding MSc thesis and is so recognized by its mark.

We now discuss each of these in detail.

Topic: Conformance to obligations

1. Conformance to **obligations**
2. Conformance to **specifications**
3. Conformance to **requirements**
4. Meeting or exceeding **expectations**

An MSc thesis must be prepared according to accepted standards of **scientific ethics** and **applicable laws**.

Work that does not meet these obligations can not be published.

Ethical standards: authorship

The work must be the **creative effort of the named author(s)**. Unless **explicitly stated or clear from the context**, the reader expects that:

- all **writing** is the author's;
- all **work** (field, lab.) was done by the author;
- all **ideas** are the author's.

How to acknowledge help

- **Material assistance** must be **acknowledged**, e.g. if some of the data were collected by others;
- **Editing** by supervisors or colleagues must have been **reviewed and accepted** by the author;
- **Ideas or concepts** not from the author must be acknowledged by **citations**.

Ethical standards: fraud

The work must be free from **fraud**, defined as any action which wilfully mis-represents the truth, including:

- **Fabrication**: making up data, lying about procedures;
- **Falsification**: manipulating data to obtain a desired outcome;
- **Plagiarism**: taking credit for someone else's work.

Legal obligations

1. Absence of **defamatory statements**;
2. **Conformance** with applicable **laws**;
3. **Conformance** to a **code of conduct** to which the institution (ITC) has subscribed
 - e.g. Netherlands Code of Conduct for Scientific Practice
(<http://www.vsnu.nl/>)

Absence of defamatory statements

- Absence of **libel**: a false published statement damaging to someone's reputation
- Can not question the **motives or ethics** of another worker.
- Normal **scientific disagreement** (e.g. your conclusions contradict the opinion of previous work) is OK.

Conformance with applicable laws

Examples:

- Netherlands has a strict **privacy law**: personal information can not be published without permission of the subject;
- Photographs taken **illegally** (e.g. of military installations) can not be reproduced;
- Commercial information protected by **non-disclosure agreements** can not be published;
- Results obtained with **illegal copies of computer programs** can not be presented.

Conformance to a code of conduct

ITC is part of the Dutch university system, so research conducted at ITC must conform to the “Netherlands Code of Conduct for Scientific Practice”. Translated to plain English:

1. **Scrupulousness**: Don't take short-cuts, do the research properly or not at all.
2. **Reliability**: Follow best practices in doing research and. publicizing it.
3. **Verifiability**: Research must be reproducible.
4. **Impartiality**: Don't let political or social pressures influence the results of your research.
5. **Independence**: If you were not allowed to investigate freely, explain how and why.

Topic: Conformance to specifications

1. Conformance to obligations
2. Conformance to specifications
3. Conformance to requirements
4. Meeting or exceeding expectations

A properly-presented research work must conform to certain standards, without (yet) any regard to the scientific merit of the work. This requires no special scientific insight, only careful and consistent work.

The ITC specifications for a thesis are similar to specifications for a scientific journal, all of which have “Instructions to Authors”.

ITC thesis specifications

1. Language
2. Document organization
3. Format (page style, typography)
4. Abstract
5. Acknowledgements
6. Table of contents, list of figures, list of tables
7. List of abbreviations
8. Glossary
9. Equations
10. Tables
11. Figures

12. List of references

13. Terminology

Language

ITC theses must be written in **English**, with spelling and word usage according to a standard reference, e.g. Concise Oxford English Dictionary

Spelling by preference is British but other standard spelling is allowed if applied **consistently**. Spelling of references should not be changed.

non-English text may be used as supplementary information if relevant to the thesis argument, e.g. a legal document, declaration, or survey responses, where the specific wording is important.

The original must also be **translated** to English.

Document organization

The document must have the following overall structure:

1. **Cover page**: title, author's name, month and year of publication. When this is printed at ITC, it will also include the ITC logo
2. **Title page**: same information as the title page; also the composition of the thesis assessment board (names and titles), and the authoritative statement, as a set phrase:

“Thesis submitted to the Faculty of Geo-information Science and Earth Observation of the University of Twente in partial fulfilment of the requirements for the degree of Master of Science in Geo-information Science and Earth Observation. Specialisation:”, followed by the specialization name

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3. **Disclaimer page**, also a set phrase:

“This document describes work undertaken as part of a programme of study at the International Institute for Geo-information Science and Earth Observation of the University of Twente. All views and opinions expressed therein remain the sole responsibility of the author, and do not necessarily represent those of the Faculty.”

4. There is no explicit copyright © statement; the copyright is implicitly with the publisher (UT/ITC) but the author (student) retains intellectual rights. This implies that any paper which uses original data or interpretations from the thesis must include the student as a co-author.

5. Abstract page

6. Acknowledgements page

(continued ...)

7. Thesis body

8. List of references

9. Appendices (optional)

Format (page style, typography)

The document format must be **consistent** and **clear**.

- **Headings** (chapters and sections) must have a consistent style of font and numbering;
- Page **headers and footers**, including page numbers, must be consistent;
- **Running text** must be in one font and one size (the main document font);
- A consistent font variant must be used for highlighting (e.g. **bold** or *emphasis*);
- **Computer code** must be in one monospaced font, different from descriptive text. Example:

```
model.1 <- lm(log10(Cd) ~ x.coord + y.coord)
```

Mathematical notation

Thus must be in a consistent font, and clearly **distinguished from running text**, either in-line (in the text) or set apart.

Examples:

“If $W = I$, the diagonals are 1 and the off-diagonals 0, then these formulas give the same results as those for unweighted \hat{k} .”

“These are then combined to produce weighted \hat{k} , as shown in Equation 1:”

$$\hat{k}_w = \frac{\theta_{w1} - \theta_{w2}}{1 - \theta_{w2}} \quad (1)$$

Abstract

The abstract gives a brief (no more than 350 words, on a single page) description of the work.

The abstract should follow the “**paper in miniature**” style as explained in detail in another lecture.

Acknowledgements

All persons or institutions that **contributed materially** to the work must be named, along with their **specific contributions**. This is most important for data, materials, logistic support or facilities.

Example (adapted from the MSc thesis of Fekerte 2006):

“I am greatly indebted to Mr . . . , Planning Division manager of the Ethiopian Roads Authority for arranging my field work in Addis. I would also like to thank Mr . . . of . . . Construction Company, who kindly arranged for laboratory testing, and Mr . . . for performing the tests.”

Acknowledge any organization that provided **financial assistance**, e.g.:

“I would like to thank the Netherlands Fellowship Programme (NFP) and my employer, the . . . , for giving me the opportunity to study at ITC.”

Dedication

This is an **optional** single page, without title or header, naming someone to whom the work is dedicated.

This can prove embarrassing in later years (like a tattoo), so be careful.

Table of contents, list of figures, list of tables

These are ordered lists of each heading, figure and table, with page numbers. They allow the reader to quickly find a relevant section of text, illustrative figure, or table.

The **table of contents** (ToC) also shows at a glance the **overall structure** of the research. Grammatical style should be consistent within the table.

Use **short names** for all of these. Not:

Introduction to the study area: Majella National Park, Abruzzio, Italy, EU

but

Study area

or

Majella National Park

List of abbreviations

An optional list of abbreviations can make the thesis easier to read. It may be placed after the lists of figures and tables, or as an appendix. The list is alphabetical by abbreviation, and has at least the full text, and possibly a definition or reference:

Example:

ADB	Asian Development Bank
CTI	Compound Topographic Index
DEM	Digital Elevation Model

Use of abbreviations in the text

Define each abbreviation the **first time it appears in the text**, with the **abbreviation in parentheses**; subsequently the abbreviation only should be used.

“An important terrain parameter is the Compound Topographic Index (CTI), defined as . . . The CTI has been shown to be a good predictor of hydromorphic soils . . .”

This is required whether or not there is a list of abbreviations.

Non-English acronyms

These should be spelled out in the original language, and then translated to English (in parentheses).

Example:

DPAE Dirección de Prevención y Atención de Emergencias, Bogotá
(District Office of Emergency Prevention and Management)

In the text the English equivalent should be given at first use:

“In the capital district, the DPAE (District Office of Emergency Prevention and Management) is responsible for disaster management planning. In its coordinating role, the DPAE ...”.

Glossary

This is an optional **list of technical terms** used in the thesis along with their **definitions**. The glossary is alphabetical by term. If the definition is not by the author, it must be quoted and cited.

Example:

Land characteristic	Any measurable property of the land (atmosphere, soil, water, substratum, occupation, location) at a defined geographic location, either point or area
Land evaluation	“The process of assessment of land performance when [the land is] used for specified purposes” (FAO 1983)

Numbers

Numbers should be reported with an appropriate number of **significant digits**, justifiable by the precision of measurement and calculation by which they were obtained.

Correct: Soil depth at the 20 sites ranged from 12 to 135 cm, with a mean of 45.8.

Incorrect: Soil depth at the 20 sites ranged from 12 to 135 cm, with a mean of 45.837.

(If the original measurements were in whole cm, a mean value with more than one more significant figure is false precision.)

Powers-of-ten exponential notation should be used for any number with more than two leading or trailing zeros.

Correct: 0.023, 120.3, $1.03 \cdot 10^6$, $1.03 \cdot 10^{-6}$

Incorrect: 1030000, 0.00000103

Equations

- Equations should have a **consistent format** and symbols must be **consistent** within the document.
- All **symbols** used in equations must be **defined**, either in the explanatory text or in a glossary.
- **Standard mathematical symbols** (e.g. matrix inversion or transpose) need not be defined.
- Equations may be numbered for easy reference in the text. Otherwise they can only be discussed immediately before or after their presentation. E.g.:

‘The GLS estimate $\hat{\beta}_{glS}$ of the regression coefficients is given in Eq. 2:

$$\hat{\beta}_{glS} = (q^T \cdot C^{-1} \cdot q)^{-1} \cdot q^T C^{-1} \cdot z \quad (2)$$

where z is the data vector, q is the design matrix; and C is the covariance matrix of the residuals.’

Statistical results

Follow a consistent style for reporting the results of statistical tests or summaries.

Tables

- Every table must be **referenced in the text**.
- Table **captions** must be short but self-explanatory.
- Tables must add to understanding, i.e. the organization and formatting of the table should lead the reader to the most important information.

Figures

- Every figure must be **referenced in the text**.
- Figure **captions** must be short but self-explanatory.
- Figures must be **legible**.
- Avoid colour except when it adds understanding, i.e. it conveys extra information to the reader beyond what a grey-scale figure would.

For more details see topic “Graphic presentation” in this series of notes.

List of references

- **Every citation in the text** must be in the **list of references**.
- **Every item in the list of references** must appear in the **text**.
- A **standard citation style** must be used in the text.
- A **standard bibliographic style** must be used in the list of references.

For more details see topic “Topic: Literature review, Citations, and List of references” in this series of notes.

Appendices

An appendix to a document contains additional **relevant information** that is **too detailed** to be included in the main text.

The information may be needed to fully evaluate the work, or to reproduce it, but, if presented in the main text, would distract the reader and obscure the overall argument.

Typical examples are:

- Complete tables of stream gauge readings, daily weather data;
- Detailed laboratory results;
- Computer programs, database queries.

In a scientific paper these are typically included as “on-line supplementary information”, not published with the paper but indicated with a URL.

Terminology

Follow standards for the field, as given in a relevant **style manual**, e.g.:

- Many biologists and ecologists follow the **Council of Biology Editors (CBE) style manual**.
- The **Chicago manual of style** is a general reference for style not specific to any area, and is used as a basis by many journal styles, for example by the IEEE Computer Society.
- The American Society of Agronomy's **Publications Handbook and Style Manual** gives rules for the presentation of formulas, the use of SI units of measurement, as well as specialized terminology such as crop growth stages and soil classification.
- The **Oxford University Press style manual** covers both general and specialized usage.

Specialised terminology

Each field has its own standards for terminology. These must be followed consistently.

Some examples are now given.

Specialised terminology: Organisms

Organisms must be named by the **scientific (Latin) name** in the **italic font variant** of the main font, with the genus name capitalized but the species (and subspecies) not, and the authority, in normal font, given according to **standard botanical or zoological references**.

If you plan to use a common name, identify all organisms with both names the first time they are mentioned in the text, for example:

‘Sorghum [*Sorghum bicolor* (L.) Moench] is the most common grain crop in this semi-arid region. Sorghum is generally sown after the first rains ...’

‘Millets [*Panicum* and *Pennisetum* spp.] are used as emergency crops in very dry years.’

Specialised terminology: Soils

Soils must be named according to either of two **international systems**:

- The **World Reference Base** (or its predecessor FAO legends); or
- **USDA Soil Taxonomy**; specify the version of either.

This is the only way a study can be compared to those in other areas.

Local names (e.g. soil series) may also be used, once they are correlated to one of the international systems. Follow the formatting rules of these systems. Example:

‘The 1:250 000 scale maps contained a few small areas of Berkshire soils (well drained, coarse-loamy, isotic, frigid Typic Haplorthods formed in dense till).’

Hints for the use of Microsoft Word

If you must use Microsoft Word, ensure that you:

- Use **paragraph styles** rather than formatting blocks of text directly;
- Use **outline-numbered heading styles** for the document structure and table of contents;
- Use **cross-references** for figures and tables, and lists of these.

Topic: Conformance to requirements

1. Conformance to **obligations**
2. Conformance to **specifications**
3. Conformance to **requirements**
4. Meeting or exceeding **expectations**

These deal with the **internal quality** of the thesis: does it **properly present the scientific work undertaken?**

This does not consider the **significance** of the work, only that it is **correctly performed and reported**.

Requirements for a well-argued thesis

- **Structure:** The thesis must follow a clear structure; links between sections must be clear; each section must contain (only) relevant material;

This is explained in detail in Topic “Purpose, structure and logic of research” of this lecture series.

- **Logic:** Argumentation must be logical;

This is explained in detail in Topic “Argumentation and Technical Writing” of this lecture series, in the section on “Flawed argument”.

- **Language:** Writing must be correct English, using proper vocabulary (the right word in the right place) and grammar;

This is explained in detail in Topic “Argumentation and Technical Writing” of this lecture series, in the section on “Technical English”.

(continued . . .)

- **Scientific methods** (field, laboratory, modelling, statistical) must be appropriately-selected and correctly-applied;
- Methods must be sufficiently described for someone else to reproduce the work; this ensures **replicability**;
- **Equations** must be correct and complete (either in the thesis or in a cited source);

If these requirements are met, the thesis is a proper scientific document, and may be evaluated for its **significance** to the scientific enterprise (next section).

Topic: Meeting or exceeding expectations

1. Conformance to **obligations**
2. Conformance to **specifications**
3. Conformance to **requirements**
4. Meeting or exceeding **expectations**

Once a thesis conforms to specifications and requirements, the question arises as to whether the **science** it presents is **sufficient for an MSc project**.

This is the **external quality** of the thesis: how much does it **contribute to science**?

Note that the expectations for a **research thesis** are quite different than for other documents, e.g. for a **technical report**.

Elements of expectations

1. Scientific scope and depth
2. Critical approach
3. Innovation
4. Scientific context
5. Language

These are now discussed one by one.

Scientific scope and depth

- Is the problem **significant**
- Is the problem **novel**?
- Has it been treated **thoroughly**?

Critical approach

- Are the **assumptions** and **limitations** of the research clearly and correctly stated?
- Is the **argumentation** sufficient?

Innovation

- To what degree is the work **original**?
- Is it just repeating previous work with some small modifications, or has something **really new** been developed?

Scientific context

- Has the work been **linked** to previous work, both in problem formulation and conclusions?
- Is it clear to the reader where this work **fits into the wider context**?

Language

Use of language beyond the minimum requirement (previous quality element) enhances the value of the thesis.

- Writing should be **idiomatic**;
- Writing should be **concise**, **clear** and perhaps even **elegant**;
- Words must be used **precisely**.

Conclusion

Recall: quality may be divided into **four aspects**, in increasing levels of **abstraction**:

1. Conformance to **obligations**;
2. Conformance to **specifications**;
3. Conformance to **requirements**;
4. Meeting or exceeding **expectations**.

(1) should be easy; (2) has lots of details but these can just be followed; (3) becomes difficult (proper structure and argumentation), and (4) is where the thesis makes a contribution to science.