Theory and Methodology of Science

Course memo for period 2, 2019-20

Master level: AK2030, AK2036, AK2050, DA2205

PhD level: FAK3012, FAK3014, FAK3024, FAK3137 (F1N5113)

1. Introduction

Welcome to Theory and Methodology of Science (TaMoS)! During your TaMoS studies, you will acquire concepts and tools for situating the methods of your discipline into the wider context of science. You will also practice using intellectual tools that enable reasoned and critical assessment of scientific results and methods from a variety of disciplines.

In this document we have collected information that you need in order to participate in the course. We strongly recommend that you read it as soon as possible to get a handle on the structure of the course – the modules it includes, which of the modules are mandatory, which can award bonus points for the exam, and so forth.

There are many versions of TaMoS for master and PhD students alike. Each version has its own course code and differs from other versions with respect to which course elements it includes. Therefore, make sure you know your course code and keep it in mind when reading this document. Not all information is relevant for students of all course codes.

The core modules of TaMoS are lectures, seminars (1,5 ECTS) and a written exam (3 ECTS). For master students, the 7,5 credits versions of the course also include a project part (3 ECTS). For PhD students, some take an essay part (3 ECTS). Note that students enrolled in 7,5 credit versions of the course are expected to work 20 hours per week. Students enrolled in 4,5 credit versions of the course, are expected to work 12 hours per week. Students enrolled in a 3 credit version of the course are expected to work 8 hours per week. *We therefore strongly encourage you to plan your studies accordingly!*

For any question regarding TaMoS, please send them to tamos.courses@abe.kth.se, which is an account that is shared by those who administrate the course.

2. Intended Learning Outcomes

The overarching aim of TaMoS is to provide students with a deeper understanding of the methodological and underlying philosophical issues that relate to scientific practices, and inspire them to reflect on such issues – especially in relation to their own areas of study. After completion of a TaMoS course, students are expected to have acquired basic knowledge of the foundational issues in the methodology and philosophy of science.

As was mentioned above, TaMoS is strictly speaking not one course, but many. There are several versions of TaMoS and the intended learning outcomes may vary somewhat between the different course codes. However, the following three learning outcomes are common to all versions.

After having completed the course, the student should, with regards to the theory and methodology of science, both orally as well as in writing, be able to:

- Identify definitions and descriptions of concepts, theories and problem areas, as well as identify the correct application of these concepts and theories.
- Account for concepts, theories and general problem areas, as well as apply concepts and theories to specific cases.
- Critically discuss the definitions and applications of concepts and theories as they applies to specific cases of scientific research.

1. Registration

3.1. Master students

You register for the course online. By making a course registration, you declare that you intend to follow the course. A course registration is necessary for it to be possible for you to follow the course and have your grade reported. It is also a requirement for you to be able to sign up for the exam. You find the web registration function via *Manage my studies* under *Services* in the personal menu at the top of the kth.se website. If you cannot find any courses to register for, it might be because you have not been admitted to the course. If so, contact your master program coordinator. The web registration is open at the beginning of the period. After that you need to contact tamos.courses@abe.kth.se – provide your name, personal number and which course you wish to register for.

3.2. PhD students

PhD students sign up for the course by having the course in their e-ISP, being admitted by a local Ladok admin at the school and then registering online. You also need to fill out a form online for billing purposes, send a request to tamos.courses@abe.kth.se where after further instructions will be provided.

4. Schedules and Information

Course administration and information are managed through the Canvas system at kth.instructure.com. To get access to the event *Theory and Methodology of Science*, you need to be admitted to the course in the central grade and course system (Ladok). Once you have access to the Canvas page, look at the *Home* section for a course overview. **All course material (readings, assignments, instructions, etc.) can be found on the course page in Canvas.** Canvas is also where you do all quizzes and submit all assignments.

The course schedule is available through TimeEdit at www.kth.se/schema, and also at the student web and on your personal pages. These schedules include lecture, seminar, and exam information. You will also be sent weekly updates about what to do in the upcoming week. However, we strongly recommend that you make your own schedule for the course elements that are included in your version of TaMoS.

The time slots for all seminar groups will appear in the schedule. However, you will only join *one* group. Note that there might be available groups to choose from that are not on display in your *personal* schedule, due to the fact that the seminar series is a mandatory part in all the different versions of TaMoS (see section 7 for more information).

NOTE: Some things are not stated in the TimeEdit schedule. Quiz deadlines are not included in these schedules. For more about deadlines see each respective assignment in Canvas. Project part deadlines (see below) are not included in these schedules. See separate pages in Canvas for schedules.

NOTE: Since you take the course with students from other versions of TaMoS, and by accepting the invitation in Canvas, you allow students from other TaMoS-courses to see your full name. If this is for any reason problematic for you, please contact the course administration.

5. Lectures

The lectures are the foundation of TaMoS. It is in the lectures that important course concepts are introduced, explained and discussed. By preparing for and attending the lectures, you are therefore also preparing for the exam. There are three different types of lectures – 4 standard campus lectures, 2 on campus flipped classroom sessions, as well as 7 pre-recorded online video lectures. Most lectures are given by Prof. Till Grüne-Yanoff.

5.1. Campus Lectures

There are four campus lectures:

- Scientific Knowledge
- Philosophy of Social Science
- Philosophy of Technology / Philosophy of Economics / Algorithmic Reasoning and its Limitations
- Science at Risk

The first lecture introduces the topic of methodology, and discusses what knowledge is and the relation between knowledge and science. In this lecture, the general structure of the course is also introduced, as well as the bonus point system (see section 6). This lecture introduces information that is crucial for master and PhD students that are going to take the project part (see section 9).

With the exception of the first lecture, you are encouraged to read the assigned readings and do the associated preparation quiz before attending. This way, we believe you will get more out of your lecture attendance. The assigned readings will provide an introduction or some particular perspective on a topic which will be further discussed during the lecture.

5.2. Video Lectures

There are seven pre-recorded video lectures:

- Scientific Inference
- Observation and Measurement
- Experiments
- Models
- Statistics and how to Interpret it
- Explanations and Causes
- Research Ethics

The video lectures are all segmented into several parts. They are available via Canvas and you can watch them at any time. To make it easier for you to plan your studies, we have indicated time slots in the schedule for when it might be suitable to watch them.

For each video lecture, there is an associated quiz, testing your understanding of the content. After watching the videos, you are also requested to submit a question in the discussion forum intended for the flipped classroom – see below!

5.3. Flipped Classrooms

There are two on campus flipped classroom sessions based on two of the video lectures. In the flipped classrooms, the lecturer will answer questions that you have submitted beforehand to the discussion board, stating things that you found to be challenging or complicated in the video lectures. On the discussion board, you can see other students' questions and vote on which of the questions you think are the most relevant and pressing.

The lecturer will choose a few questions among those in the top and answer them during the flipped classroom session.

During the second part of the flipped classroom, you will be given an exam-style question to answer by working in pairs. After working with a partner for 10-15 minutes, you submit your answer on Canvas. To be eligible for the bonus points, you must submit an answer – even if it is the same answer as the one your partner submits. The lecturer will then choose an answer at random and go through it and provide feedback, and present ways of thinking about answering the question. This exercise is about how to target a methodological problem and may be helpful to you in the project or essay part, as well as on the exam.

5.4. Lecture Exceptions

Not all lectures are taken by everyone, as can be seen in the schedule. Here is an overview.

- Students enrolled in AK2030, AK2036, AK2050, FAK3024, FAK3137 (F1N5113), and AF2023 do not take the ”Philosophy of Economics” or the ”Algorithmic Reasoning and its Limitations” lectures.
- Students enrolled in AK2032, AK2038, FAK3136 (F1N5112), and FAK3138 (F1N5114) do not take the “Philosophy of Technology” or the ”Algorithmic Reasoning and its Limitations” lectures.
- Students enrolled in AK2034, AK2040 and DA2205 do not take the “Philosophy of Economics” or the “Philosophy of Technology” lectures.
- Students enrolled in FAK3014 do not take the “Research Ethics”, “Science at Risk”, ”Philosophy of Economics” or the ”Algorithmic Reasoning and its Limitations” lectures.
- Students enrolled in FAK3012 do not attend any lectures.

6. Bonus Points

The bonus point system used in TaMoS is a way to incentivise active engagement with the course material throughout the entire course, rather than cramming information right before the exam. Completing the bonus point awarding tasks will help you keep up with the pace of the course. If you are a master student, the bonus points cannot help you pass the exam – but they can help increase an already passing grade. For PhD students, the bonus points are applicable slightly below passing score.

The maximum amount of bonus points you can get is 9,5. You get a maximum of 1,5 points for the lecture participation questions (3 x 0,5 p), 1,5 for the preparation reading questions (3 x 1,5) 3,5 for the video lectures (7 x 0,5) and 3 points for the flipped classrooms (2 x 1,5). For the PhD course FAK3014 the maximum is 8 bonus points.

All bonus point awarding tasks are optional. You do not need to complete any bonus point assignment to pass the course.

The bonus points are valid for the standard exam of the relevant period, and for the re-exam for that period. For later exams, you may re-register for the course and earn bonus points anew.

6.1. Campus Lecture Bonus Points

You can earn bonus points for the exam by completing a preparation quiz which is related to the assigned readings associated with some campus lecture. You get one attempt at the quiz, and by completing the quiz successfully, you get 0,5 bonus points.

During the campus lectures, the teacher will sometimes pause and ask a question for you to answer. By answering all questions in a lecture, you earn 0,5 bonus points for the exam. You do not have to answer correctly to get points. You answer the question by logging on to the Canvas page and completing the relevant “Lecture Quiz”. If you do not have a portable device with internet access, you can submit your answer on paper to the lecturer instead. If so, remember to state your name, personal number and lecture date and time.

NOTE: The first lecture is a try-out session, and for this lecture no bonus points are given.

6.2. Video Lecture Bonus Points

For each video lecture, there is an associated quiz available on Canvas. By answering the video lecture questions in these quizzes correctly (1 error/quiz is allowed), you can earn 0,5 bonus point per lecture. These quizzes can be taken as many times as you want before the deadline stated in Canvas.

6.3. Flipped Classroom Bonus Points

If you submit a question in the associated video quiz before the deadline, participate during the flipped classroom session by answering the lecture questions and submitting an answer to the exam-style question, you earn 1,5 bonus points.

7. Seminars (1,5 credits)

There are four seminars. Each seminar is given several times in the same week. All four seminars are mandatory for all students - except FAK3014 students who take only the first three, and FAK3012 students who only attend the essay meetings. The seminars target some of the topics introduced in the lectures. In the seminars, you will practice at engaging with these topics independently and in-depth, working in smaller groups with tasks provided by the teacher. At the end of the seminar, you and your peers will discuss your and other groups’ suggested solutions to the tasks.

To pass each seminar, you must do the following things:

- Read the assigned literature, watch the assigned videos, attend the relevant lectures, re-read the slides etc.
- Successfully complete the assigned seminar preparation quiz by getting minimum 50% of the answers correct before your seminar. If you attend the seminar without having passed the seminar quiz, you will not be marked as attending and will have to re-take the seminar.
- Be prepared for in-class discussion of questions relating the concepts to your field of study (see below).
- Be prepared to answer oral questions relating to the core concepts listed for each seminar (see below).
- Actively participate on the seminar by discussing with the teacher and your peers.
- Sign the attendance sheet.

If you fail to do any of the above tasks, you will not get registered attendance for the seminar. At the end of each course period, all four seminars are given once more. If you missed a seminar or missed a quiz deadline, you can attend the associated compensation seminar.

In preparation for the seminar, make sure you understand and can account for, exemplify and discuss the concepts below. The teacher might ask you to answer questions such as "What are some differences between stipulative and lexical definitions?", "Give an example

of an operationalization.", or "Does it matter if we use vague terms in a scientific hypothesis?"

In preparation you should also prepare answers to discussion questions relating the course concepts to your field of study. By “field of study” below we intend the area of engineering or science that you believe you will end up working with. If you are not yet sure, you can choose to answer these questions from a field of research that you find interesting.

The seminar is a learning environment, but it also examines the oral aspect of the course’ intended learning outcomes. You should be able to account for the meaning of the seminar concepts, at the start of the seminar. However, do not worry if you think something is complicated or hard to understand. We primarily expect you to show that you have studied the material and tried to get a grasp of it.

You find more information about each seminar below and in the course memo. Texts are found in the Files-section.

During the seminar series you join one seminar group. You choose your seminar group on the course page in Canvas by pressing the “People” tab in the left-hand menu. If you take a social science version of the course (AK2032, AK2038, FAK3136 (F1N5112), and FAK3138 (F1N5114)), make sure to join a social science group!

For FAK3014, the seminars are 1 credit.

7.1. Seminar Instructions

7.1.1. Seminar 1 – Definitions, Operationalizations and Hypotheses

In the 1st seminar, we will examine and discuss the interplay between definitions, operationalizations and hypotheses in science. After the seminar, you should be able to account for different types of definitions, for operationalizations, as well as for hypotheses. You should also be able to critically discuss what makes a definition, an operationalization, or a hypothesis good or bad from a methodological perspective.

Seminar taken by:

- Everyone except FAK3012

Texts:

- Art of Doing Science: sections 2.2-2.8, 3.1-3.2, 5.0-5.1, and 5.8
- Video lectures: “Scientific Inference”, "Observation and Measurement"

Prepare answers for classroom discussion of these questions:

- Give an example of a definition used in your field of study – state clearly what is the definiendum and definiens and if it is lexical or stipulative.
- Give an example of an operationalization used in your field of study – state clearly what is the feature of interest, the hypothesized causal chain and what is directly observable.
- Give an example of a hypothesis from your field of study, which satisfies the three criteria for a good hypothesis. If you cannot find a real example, try creating a hypothesis that could be tested in your field of study.

Concepts that you should be able to explain:

- Stipulative and lexical definitions
- Narrowness and broadness (as applied to definitions)
- Vagueness and ambiguity

- Hypotheses (what they are and what makes them good or bad)
- Direct, aided and indirect observation
- Operationalization
- Construct validity

Quiz: Seminar 1 - Preparation Quiz

7.1.2. Seminar 2 – Experimental Design

In the 2nd seminar, we will design hypothetical experiments and discuss what methodological considerations say about the interpretations we can make of an experiment. After attending this seminar, you should be able to use, and critically discuss the usage of the concepts discussed in the seminar. In other terms, you will be able to distinguish different control mechanisms that can be used in experiments and implement these as a means to deal with various sources of error.

Taken by:

- Everyone except FAK3012

Texts

- Art of Doing Science: sections 3.7, 4.2-4, and 5.1-3
- Video lecture: "Experiments"
- Experiments (Lecture Script)"
- Assigned material for the previous seminar

Prepare answers for classroom discussion of these questions:

- Give an example of an experiment, observational study or a model from your field of study and explain why it is this type of study rather than one of the others.
- Give an example of a measurement method in your field of study that gives high accuracy, high precision or both.
- How can control and treatment groups be implemented in a test in your field of study?

Concepts that you should be able to explain:

- Experiment, observational studies, and models
- Intervention and observation of difference (Mill's method of difference)
- Internal validity and external validity
- Experimental control
- Constancy, elimination, and effect separation
- Randomization
- Control group and treatment group
- The interpretation problem and the influence problem
- Single and double blinding
- Accuracy and precision (measurement qualities)
- Measurement error (random and systematic error)

Quiz: Seminar 2 - Preparation Quiz

7.1.3. Seminar 3

The 3rd seminar differs in content between the social science versions and the remaining versions of the course – *make sure you read the right material and join the right group!*

For **natural science, computational science and FAK3014** students, seminar 3 is centred on evaluation of scientific studies by using methodological concepts and considerations. We will discuss the problems one can face in determining what claims or results an article or study really succeeds in providing evidence for, and to what extent the results hold for a more generalized context. After the seminar you should be able to apply the seminar concepts to an example case, as well as critically discussing such cases from a methodological perspective.

Seminar taken by:

- AK2030, AK2034, AK2036, AK2040, AK2050, FAK3014, FAK3024, FAK3137, DA2205

Texts:

- Art of Doing Science : sections 1.6-7, 3.7, 3.9, 5.3-5, 5.7, 7, 8 and the box on p. 24
- Text: "Seminar 3 Cases"
- Video lectures: "Statistics", "Explanations and Causes"
- Assigned material for the previous seminars

Prepare answers for classroom discussion of these questions

- Give an example of how the hypothetico-deductive method could be applied in your field of study. Do not forget to state the relevant auxiliary hypotheses.
- Give an example of an explanation used in your field of study – make sure to state what is the explanandum and what is the explanans. Then, consider the explanatory virtues – which ones do you think it fulfils?

In preparation for the seminar, make sure you understand and can account for, exemplify and discuss the following concepts:

- Repeatability, reproducibility, and replicability
- Statistical evaluation (p-value, significance level, control group)
- Causal explanation
- Deductive-Nomological account of explanation
- Correlation and causality
- Hypothetico-Deductive method for hypothesis testing
- Duhem-Quine thesis
- Ad hoc-hypothesis
- Falsificationism (Popper)

Quiz: Seminar 3 - Preparation Quiz

For **social science** students, seminar 3 will target some topics and concepts special to the social sciences, and whether the social sciences use a different methodology than the natural sciences. After the seminar, you should be able to apply the seminar concepts to an example case, as well as critically discussing such cases from a methodological perspective. Seminar 3: Philosophy of the social sciences (Social science versions of the course)

Seminar taken by:

- AK2032, AK2038, FAK3136, FAK3138

Texts:

- Lecture script: Philosophy of the Social Sciences
- Text: Kitto, Simon C, Janice Chester, Carol Grbich. “Quality in Qualitative Research”

- Assigned material for the previous seminars

Prepare answers for classroom discussion of these questions:

- To be announced

Concepts that you should be able to explain:

- Methodological holism and methodological individualism (as applied to the social sciences)
- Naturalism and anti-naturalism
- Belief-desire explanations
- Quantitative and qualitative research
- Criteria for assessing qualitative research
- Causal explanation
- Deductive-Nomological account of explanation
- Hypothetico-Deductive method for hypothesis testing
- correlation and causality
- Duhem-Quine thesis
- Ad hoc-hypothesis
- Falsificationism (Popper)

Quiz: Seminar 3 (AK2032 & AK2038 & FAK3136 (F1N5112) & FAK3138(F1N5114)) Preparation Quiz

7.1.4. Seminar 4 – Risk and research ethics

In the 4th and final seminar, you will evaluate cases from the viewpoint of research ethical principles and normative ethical theories. After the seminar you should be able to evaluate example cases in light of those normative theories and the research ethical principles, as well as being able to critically discuss them and what their affect is on scientific and engineering practices.

Seminar taken by:

- Everyone except FAK3014 and FAK3012

Texts:

- Art of Doing Science: Section 9
- Text: “On Being a Scientist: Responsible Conduct in Research“
- Text: Ahlin, Jesper, “Ethical Thinking”
- Video lecture: Research ethics
- Slides: “Science at risk”

Prepare answers for classroom discussion of these questions:

- Give an example of when the precautionary principle might be applied in your field of study.
- Give an example when one of the quantitative notions of risk might be applied in your field of study.
- Give an example of an ethical problem related to your field of study, and try to give a consequentialist and a deontological analysis of the problem.

Concepts that you should be able to explain:

- Gift authorship and ghost authorship
- Informed consent
- Falsification, fabrication, and plagiarism
- Precautionary principle
- Qualitative risk and quantitative risk
- Descriptive/normative distinction
- Deontology, consequentialism, and virtue ethics

Quiz: Seminar 4 - Preparation Quiz

8. Exam (3 credits)

The final part of the course is a written exam. Master students sign up for the exam at kth.se, whereas PhD students sign up online, or by sending an e-mail to tamos.courses@abe.kth.se. More information is available on the course page in Canvas.

The exam consists of three parts. Each part is directed at testing at least one of the intended learning outcomes. The first part of the exam consists of a set of multiple-choice questions. This part tests your ability to identify correct definitions, descriptions or applications of course concepts. For every question, there are four answer options and for each question, at least one of these options is correct. You mark all and only the options you believe to be correct. If all the correct options, and no wrong options, are marked, one point is given. No partial points are awarded on the first part of the exam.

The second part of the exam primarily tests your ability to account for, or describe, course concepts as well as the ability to apply these concepts to example cases. Part two contains two questions of this nature and invite brief essay style answers. The third, and final part of the exam is intended at testing your ability to critically analyse and discuss course concepts and their application. You will be asked to evaluate a summary of some hypothetical scientific research. You do this by pointing out and discussing strengths and weaknesses of the presented case, and by motivating why these are strengths and weaknesses, as well as by suggesting, and provide justification for, possible improvements.

Since the different parts of the exam test different learning outcomes, the letter grade for master students is determined by the lowest score on part two or part three, in combination with your total score. For example, to receive the grade B a total score of 32/40 is required, as well as a distribution of these points so that you received at least 8/20 points on part one, 5/10 points on part two of the exam, and 5/10 points on part three of the exam. If you do not receive a minimum passing score on all of the parts of the exam, you will receive F. Bonus points are added on the condition that you have received a total score of 20 points or more (for FAK3014, 16 points) as well as received the minimum score for a passing grade on each part of the exam. The grade table and grade criteria can be found in the appendix.

Master students can receive the grade FX. Students who receive an FX will be given a home exam which they will have ten working days to complete and submit. A submitted passing FX exam will result in grade E. No submission or a failed submission will result in grade F.

A student who is unable to take the exam anytime in the foreseeable future due to special circumstances can request a home exam. Such a home exam can only result in either an E or an F. To request such an exam, send an e-mail to the examiner and explain your situation. Contact details can be found in the appendix.

If you believe that there has been an error in the correction or marking of your exam, you may request a re-evaluation of your exam. Contact the course administration to receive a form to place a request. The request will be submitted to the examiner who makes formal

decision on whether the request should be approved or not. A review may or may not result in a change in grade. See appendix for contact details. A request for review should include a proper motivation for why you believe that there has been an error in the correction. Simply stating "I think I should have more points" is not sufficient.

For FAK3014 students, the exam is 2 credits.

9. Project Part (3 credits)

9.1. Master students

9.1.1. Science Communication and Evaluation (AK2036, AK2038)

In the project part, master students enrolled in either the AK2036- or the AK2038-version of the course will practice two skills that are important for any engineer or scientist, namely: presentation and evaluation of scientific research. You will be assigned an article to work with throughout the entire project. Note that TMLEM students take a different project part. This exercise is divided into several tasks that are grouped into three different blocks. All tasks are intended at practicing either popularized presentation of scientific research or critical evaluation of methodological aspects of scientific research. **Failing any task means failing the entire project part.** If you fail the project part, you will have to do the project part anew in another period to complete the course.

Learning outcomes: after having completed this part of the course, the student should, both orally as well as in writing, be able to…

- Summarize and present research reports or scientific articles in a way that makes them accessible to a non-expert audience.
- Account for standard structural and qualitative criteria for scientific writing and apply these to research reports or scientific articles.
- Identify and critically discuss specific theoretical and methodological problems in research reports or scientific articles.

In the first week of the course, **it is highly recommended that you attend the project part information lecture**. In this lecture, Till Grüne-Yanoff will explain the general structure of this version of the project part. The lecture will also explain how scientific content can be presented to a general audience, and how a critical evaluation of methodological aspects can be performed and presented. Finally, the lecture contains information on how to provide peer feedback.

After attending the information lecture, you will read a scientific article assigned to your master program and start working on the tasks. You will be working with the article that you have been assigned throughout the entire project part. The articles are found in Canvas. If there is no article for your program, contact the course administration.

Detailed instructions for the project part are found in the appendix, as well as on the assignment pages on Canvas. Read them carefully! Below is a summary of the three blocks of the project part.

Block 1: The first block of the project part focuses on popularized presentation of scientific research. To be able to present research to a wide audience in a brief, engaging, and pedagogical manner is an important skill for a scientist or engineer. This is required in communication with the general public, or with peers from other fields who may be unfamiliar with the details of your research area. In block 1, you will therefore give a popularized presentation of one aspect to the article that you have been assigned. Thereafter, you will give peer-feedback – another important skill – on another student's submission, as well as receive feedback on your own.

Block 2: The second block is focused on critical – methodological – evaluation of scientific research. Methodology is about justification of method choice. Whereas a method can be an experiment, a longitudinal cohort study, or a computer simulation, methodology discusses the aptness of those methods given some context and purpose. In block 2, you will write a brief methodological evaluation addressing the research described in the article that you have been assigned. In your submission, you will point out and discuss one methodological strength and one methodological weakness. After submitting your critical evaluation, you will give feedback on the submissions of a small number of other students, as well as receive feedback from them.

Block 3: The third block is devoted to writing an essay which includes a popularized overview as well as a critical evaluation of a research article. In block 3, you will join a group of other students who have been assigned the same article. Together, you will work to produce an essay which includes a popularized presentation and an evaluation of the method choices made by the researchers behind the article. Your first task will be to submit a draft version of your essay. You can include content from your previous, individual, submissions in the essay. After this, you will give feedback on other group's submissions. Finally, you will work with your group to improve your essay based on the feedback you got and submit a final version which will be assessed and graded by a senior teacher. The essay will be approved or failed. If the teacher judges that a failed essay could be passed after revisions, the teacher might also ask you to revise the essay. If the revision is approved, then essay receives a pass, otherwise fail, and you will then have to complete the project part in an upcoming period.

Exception: Students without a group
Some master programs only have one or two students taking the course in a given period. If you are a student without a group, you perform the tasks in block 1 in the same way as everyone else. After block 1, you will be assigned to a group of 3-5 other students without a group. You will then do the tasks in block 2 in much the same way as everyone else, with the difference that you will review a text that is not from your field. In block 3, you write your own, individual, complete text in the same way as described for block 3 above. The individual assignment has a lower minimum requirement on word count than the group assignment. You will give peer feedback on a submission from another student without a project group.

9.1.2. Meta-mathematics (AK2040, mathematics masters in AK2036)

For master students in mathematics (TMTHM, TMAKM, TTMAM, TDTNM) the project part consists in a meta-mathematics project. This project provides a brief introduction to the field of meta-mathematics; how the notion of truth can be rigorously defined for a formal language, what a formal system of deduction is, and how Gödel's first incompleteness theorem imposes limitations on such a system.

Learning outcomes: After having completed this part of the course, the student should, both orally as well as in writing, be able to:

- Translate sentences of ordinary mathematical English into a formal language.
- Engage in rigorous reasoning about the capabilities of a formal system of deduction
- Systematically apply a precise truth definition to a given sentence in a formal language.
- Demonstrate an understanding of the technical content of Gödel's first incompleteness theorem, as well as of its philosophical import.

The meta-mathematics project consists of seven non-mandatory lectures, non-mandatory home exercises and a mandatory home assignment. In our experience, many students have a hard time managing without the lectures. Therefore, lecture attendance is highly recommended, even if it is not mandatory. Lecturer is Prof. Tor Sandqvist. The literature can found on the special Canvas page to which all AK2040 students are added. Credits are awarded for satisfactory completion of a home assignment, which will be uploaded to the meta-mathematics Canvas page around the time of the last lecture. Possible grades are Pass, Revision required, and Fail.

9.1.3. Ethics of Medical Technology (TMLEM-students from AK2036 and AK2050)

For master students from the medical engineering program (TMLEM), the project part focuses on ethical issues with medical technology. This project part is given in period 2. Students of period 1 will be added to the page, students in other periods should contact the course administration after reading this memo. After completing the module students should be familiar with the most common theories and methods of applied ethics and their relevance for medical technology. They should be able to conduct independent moral reflections on practical problems in the ethics of medical technology, both verbally and in writing. Lecturer is Dr. Jesper Ahlin Marceta.

Learning outcomes: After having completed this part of the course, the student should, both orally as well as in writing, be able to:

- Account for and apply the most common theories and methods of applied ethics and account for their relevance for medical technology.
- Carry out independent moral reflections concerning practical problems in the ethics of medical technology.

This project consists of three mandatory lectures and two mandatory seminars. Students are expected to read the course material continually during the course and prepare for the lectures and seminars. To pass, students must have participated in all the lectures and seminars. Before all sessions, except the first lecture, students are required to complete a written assignment. Should anyone be unable to attend one or more lectures/seminars, fail to submit their home assignments on time, or submit incomplete or unsatisfactory home assignments, they will have to complete a compensation assignment. Students must also complete a home assignment on how to write a philosophy essay. Finally, students must write an essay on a topic of their own choice from the ethics of medical technology. Students from AK2036 take this as a 3 credits part and thus write a longer essay, while AK2050 students, who take this as a 1,5 credit part, write a shorter essay.

9.2. PhD Students (FAK3012, FAK3137, FAK3138)

For PhD students, the project part is a chance to focus on the methodological aspects of their own research. This is a 3 credit part and consists of three mandatory meetings and three text submissions that eventually add up to an essay in which you describe, discuss and attempt to solve a methodological issue relating to your research project. All meetings must be attended in person during the same period.

It is recommended that PhD students that intend to take the project part of the course have completed at least a year of research.

Learning outcomes: After having completed this part of the course, the student should, both orally as well as in writing, be able to:

- identify and critically discuss fundamental theoretical and methodological problems within the their own area of research.

- identify and critically discuss specific theoretical and methodological problems within their own research projects.
- identify and critically discuss specific theoretical and methodological problems relating to others' research projects.

Are you not sure you know what a methodological problem is? Make sure you attend the TaMoS Project Part Lecture to get a handle of this concept! Prepare for the project meetings by carefully studying the TaMoS course material. Most meetings take place in Aristoteles seminar room at the division, see appendix.

Structure:

Meeting 1: Before meeting one, you will submit a short essay proposal which will be discussed on the first meeting.

Meeting 2: Before meeting two, you will submit a draft version of your entire essay. Before and at the meeting, you will also provide feedback on other students' submissions, as well as receive feedback on your own.

Meeting 3: Before meeting three, you will submit a final version of your essay. You will receive feedback from your fellow students and a senior teacher at the third and final meeting. The senior teacher will also grade your final submission: pass or fail. Finally, you will work to improve your essay based on the feedback you got and submit a final version which will be assessed and graded by a senior teacher. The essay will be approved or failed. If the teacher judges that a failed essay could be passed after revisions, the teacher might also ask you to revise the essay. A revision results in a pass or fail.

Detailed instructions for the PhD-version of the project part are found in the appendix. Read them carefully!

10. Disability: Support via Funka

If you have a disability, you may receive support from Funka. More information at: https://www.kth.se/en/student/studentliv/funktionsnedsattning. We recommend you inform the teacher or the course administration regarding any need you may have since Funka does not automatically inform the teacher.

11. Appendix

11.1. Contact information

- Course administration e-mail: tamos.courses@abe.kth.se
- Examiner: Till Grüne-Yanoff (gryne@kth.se)
- Course responsible: Johan Berg (johan.berg@abe.kth.se)
- Lecturers:
  - Tor Sandqvist (tor.sandqvist@abe.kth.se)
  - Jesper Ahlin-Marceta (jesper.ahlin@abe.kth.se)
- Senior teacher:
  - John Cantwell (john.cantwell@abe.kth.se)
- Seminar teachers:
  - Edvin Åström (edvin.astrom@abe.kth.se)
  - Martin Rissler (martin.rissler@abe.kth.se)
  - Henrik Lundvall (henrik12@kth.se)

    - Adam Lundström Ramírez (adamlr@kth.se)
    - Henok Girma Abebe (hgirma@kth.se)
- Exam coordinator, Ladok administrator:
    - Fatemeh Tayebi (fatemeh.tayebi@kth.se)
- Visiting address: Teknikringen 76, 3rd floor/bottom floor (the V-building).
    - Seminar room Aristotle - 3rd floor/bottom floor
    - Seminar room Hypatia – 5th floor

11.2. Literature list

- Introductions and Scientific Knowledge
    - Sven Ove Hansson - The Art of Doing Science, Chapters 1, 2 and 9
    - Lecture slides
- Scientific Inference (video)
    - Sven Ove Hansson - The Art of Doing Science, Chapter 5
- Observation and Measurement (Video)
    - Sven Ove Hansson - The Art of Doing Science, Chapter 3
- Experiments (Video)
    - Sven Ove Hansson - The Art of Doing Science, Chapter 4
    - Till Grüne-Yanoff, Experiments (lecture script)
    - Lecture slides
- Models (Video)
    - Till Grüne-Yanoff, Models (lecture script)
- Statistics and How to Interpret It (Video)
- Philosophy of Social Science
    - Till Grüne-Yanoff - Philosophy of the Social Sciences (lecture script)
    - Verification Strategies for Establishing Reliability and Validity in Qualitative Research
    - Lecture slides
- Explanations and Causes (Video)
    - Sven Ove Hansson - The Art of Doing Science, Chapter 7 & 8;
- Philosophy of Technology [Courses: AK2030, AK2036, AK2050, AF2023, DA2205, FAK3014, FAK3024, FAK3137]
    - Galle, P., & Kroes, P. (2013) Science and design: Identical twins?
    - Sven Ove Hansson - Some Issues in the Philosophy of Technology
    - Lecture slides
- Risk and Risk Assessment
    - Sven Ove Hansson - "Risk" in The Stanford Encyclopedia of Philosophy (Spring 2014 Edition), Edward N. Zalta (ed.).
    - Lecture slides
- Research Ethics (Video)
    - Excerpt from National Academy of Sciences et al., On Being a Scientist: Responsible Conduct in Research
    - Jesper Ahlin, Ethical Thinking
- Philosophy of Economics [Courses: AK2032, AK2038, FAK3136, and FAK3138]
    - Till Grüne-Yanoff - Philosophy of Economics (lecture script)
    - Satz, D., & Ferejohn, J. (1994), Rational Choice and Social Theory
    - Lecture slides
- Algorithmic reasoning and is limitations [Courses: AK2034, AK2040, DA2205]
    - To be announced

11.3. Grading criteria

Below are the grading criteria for masters students, in Swedish, with English translation. For PhD students, the grading criteria are the same as fulfillment of the the intended learning outcomes. The letter grade is determined by the fulfillment of all required criteria for each grade, as well as the criteria for the seminars and project part if applicable. In practice, the letter grade is determined by a lowest score on each part on the exam, as well as a total score. See the grading table.

11.3.1 Exam

	Lärandemål 1 : Identifiera definitioner och beskrivningar av begrepp, teorier och problemområden, samt identifiera den korrekta applikationen av dessa begrepp och teorier. ***Learning outcome 1:*** *Identify definitions and descriptions of concepts, theories and problem areas, as well as identify the correct application of these concepts and theories.*	**Lärandemål 2:** Redogöra för begrepp, teorier och generella problemområden, samt tillämpa begrepp och teorier på specifika fall. ***Learning outcome 2:*** *Account for concepts, theories and general problem areas, as well as apply concepts and theories to specific cases*	**Lärandemål 3:** Kritiskt diskutera definitionerna och tillämpningarna av begrepp och teorier med avseende på specifika fall av vetenskaplig forskning. ***Learning outcome 3:*** *Critically discuss the definitions and applications of concepts and theories as they apply to specific cases of scientific research.*
A	Studenten identifierar **ett flertal** av definitioner och beskrivningar av begrepp, teorier och problemområden korrekt samt identifierar den korrekta tillämpningen av dessa begrepp och teorier. *The student identifies* ***multiple*** *definitions and descriptions of concepts, theories and problem areas, and identifies the correct application of these concepts and theories.*	Studenten redogör korrekt, samt med **stor utförlighet** och precision för kursbegrepp, teorier och problemområden samt gör rimliga tillämpningar av dessa begrepp och teorier på ett **mycket övertygande sätt**. *The student provides correct,* ***extensive*** *and precise accounts for concepts, theories and general problem areas, and provides* ***very convincing*** *applications of those concepts and theories to specific cases.*	Studenten framställer en **välargumenterad** diskussion av definitionerna och tillämpningarna av begrepp och teorier med avseende på vetenskaplig forskning på ett utförligt, **självständigt** och **mycket precist** sätt. *The student presents a* ***well-argued, independent,*** *extensive and* ***very precise*** *discussion of the definitions and applications of concepts and theories as they apply to specific cases of scientific research.*
B		Studenten redogör korrekt och med **precision** för kursbegrepp, teorier och problemområden samt gör rimliga tillämpningar av dessa begrepp och teorier på ett **övertygande sätt**. *The student provides correct and* ***precise*** *accounts for concepts, theories and general problem areas, and provides* ***convincing*** *applications of those concepts and theories to specific cases.*	Studenten framställer en **huvudsakligen välargumenterad** diskussion av definitionerna och tillämpningarna av begrepp och teorier med avseende på vetenskaplig forskning på ett **utförligt** och precist sätt samt med **viss självständighet** i framställningen. *The student presents an* ***extensive,*** *precise****, mostly well-argued****, and* ***somewhat independent*** *discussion of the definitions and applications of concepts and theories as they apply to specific cases of scientific research.*
C		Studenten redogör **korrekt och tydligt** för kursbegrepp, teorier och problemområden samt gör **rimliga tillämpningar** av dessa begrepp och teorier på specifika fall. *The student accounts,* ***correctly and clearly*** *for concepts, theories and general problem areas, and provides*	Studenten framställer en diskussion av definitionerna och tillämpningar av begrepp och teorier med avseende på vetenskaplig forskning på ett **precist** sätt med **ansats till argumentation och självständighet**. *The student presents a discussion of the definitions and applications of concepts and theories as they apply to*

		reasonable applications *of these concepts and theories to specific cases***.**	*specific cases of scientific research in a* ***precise way*** *with an* ***attempt at independent and argumentative*** *reasoning*.
D		Studenten redogör **i huvudsak korrekt** och med **tillräckliga beskrivningar** av kursbegrepp, teorier och problemområden och gör acceptabla tillämpningar av dessa begrepp och teorier på specifika fall. *The student provides mostly correct and* ***sufficiently satisfactory*** *accounts of concepts, theories and general problem areas, and provides acceptable applications of these concepts and theories to specific cases***.**	Studenten framställer en diskussion av definitionerna och tillämpningarna av begrepp och teorier med avseende på vetenskaplig forskning **utan större felaktigheter eller motsägelser**. *The student presents a discussion of the definitions and applications of concepts and theories as they apply to specific cases of scientific research* ***without substantial errors or contradictions***.
E		Studenten redogör **med knapphändiga beskrivningar i huvudsak korrekt** för kursbegrepp, teorier och problemområden och gör **acceptabla tillämpningar** av begrepp och teorier på specifika fall. *The student provides* ***sparse, but mostly correct*** *accounts of concepts, theories and general problem areas and provides* ***acceptable*** *applications of those concepts and theories to specific cases***.**	Studenten framställer en diskussion av definitionerna och tillämpningarna av begrepp och teorier med avseende på vetenskaplig forskning **som knapphändig, eller i enstaka fall felaktig eller motsägelsefull.** *The student presents a* ***sparse*** *discussion of the definitions and applications of concepts and theories, as they apply to specific cases of scientific research, with* ***some notable errors or contradictions***.
FX		Studentens redogörelser av kursbegrepp, teorier och problemområden **är markant inkorrekta eller mycket knapphändiga**. Studentens tillämpningar av begrepp och teorier på specifika fall är **delvis inkorrekta.** *The student's accounts of concepts, theories and general problem areas are* ***very sparse or contains substantial errors***. *The student's applications of those concepts and theories are* ***partially incorrect***.	Studenten gör en **ansats** till att diskutera definitionerna och tillämpningarna av begrepp och teorier med avseende på vetenskaplig forskning, men framställningen är **markant otydlig, felaktig eller motsägelsefull**. *The student presents an* ***attempt*** *at a discussion of the definitions and applications of concepts and theories as they apply to specific cases of scientific research, but the discussion is* ***substantially unclear, wrong or contradictory***.
F	Studenten identifierar som mest **enstaka** definitioner och beskrivningar av begrepp, teorier och problemområden korrekt eller identifierar inte den korrekta tillämpningen av dessa begrepp och teorier. *The student identifies at most a few definitions and descriptions of concepts, theories and problem areas, or does not identify the correct application of these concepts and theories.*	Studentens redogörelser av kursbegrepp, teorier och problemområden **saknas eller är** (mestadels eller helt) **inkorrekta** och tillämpningarna av begrepp och teorier på specifika fall **saknas eller är i stor utsträckning felaktiga**. *The student's accounts of concepts, theories and general problem areas are (substantially or completely)* ***incorrect or missing***. *The student's applications of those concepts and theories are* ***largely incorrect or missing***.	Studenten **genomför inte** en diskussion av definitionerna eller inte av tillämpningen av kursbegreppen, eller så är dennes diskussion **otydlig, felaktig eller motsägelsefull**. *The student* ***does not present*** *a discussion of the definitions and applications of concepts and theories as they apply to specific cases of scientific research, or their discussion is* ***unclear, wrong or contradictory***.

11.3.2 Seminars

För godkänt ska studenten…

- Muntligen identifiera definitioner och beskrivningar av begrepp, teorier och problemområden, samt identifiera den korrekta applikationen av dessa begrepp och teorier.
- Muntligen redogöra för begrepp, teorier och generella problemområden, samt tillämpa begrepp och teorier på specifika fall.
- Muntligen kritiskt diskutera definitionerna och tillämpningarna av begrepp och teorier med avseende på specifika fall av vetenskaplig forskning.

For a passing grade, the student should orally provide…

- *identifications of definitions and descriptions of concepts, theories and problem areas, as well as identify the correct application of these concepts and theories.*
- *accounts for concepts, theories and general problem areas, as well as apply concepts and theories to specific cases.*
- *critical discussions of the definitions and applications of concepts and theories as they apply to specific cases of scientific research.*

11.3.3 Project part

För godkänt ska studenten…

- Skriftligen sammanfatta och presentera forskningsrapporter eller vetenskapliga artiklar på ett sätt som gör dem tillgängliga för en mottagare som saknar expertkunskaper.
- Skriftligen redogöra för standardmässiga strukturella och kvalitativa kriterier för vetenskapligt skrivande och tillämpa dessa på forskningsrapporter eller vetenskapliga artiklar.
- Skriftligen identifiera och kritiskt diskutera specifika teoretiska och metodologiska problem i forskningsrapporter eller vetenskapliga artiklar.

For a passing grade the student should, in writing…

- *summarize and present research reports or scientific articles in a way that makes them accessible to a non-expert audience.*
- *account for standard structural and qualitative criteria for scientific writing and apply these to research reports or scientific articles.*
- *identify and critically discuss specific theoretical and methodological problems in research reports or scientific articles.*

För studenter från mastersprogrammet medicinsk teknik (TMLEM) AK2036/AK2050. För godkänt ska studenten muntligt så väl som skriftligen…

- Redogöra för och tillämpa de vanligaste teorierna och metoderna inom tillämpad etik samt redogöra för deras relevans för medicinsk teknologi.
- Genomföra självständiga moraliska reflektioner med avseende på praktiska problem inom den medicinska teknologins etik.

For students from the master's programme medical engineering (TMLEM) AK2036/AK2050. For a passing grade, the student should, orally as well as in writing…

- *account for and apply the most common theories and methods of applied ethics and account for their relevance for medical technology.*
- *carry out independent moral reflections concerning practical problems in the ethics of medical technology.*

För studenter från mastersprogram i matematik (TMTHM, TMAKM, TTMAM, TDTNM) AK2036/AK2040. För godkänt ska studenten skriftligen…

- Översätta satser från vanlig matematisk engelska till ett formellt språk
- Resonera på ett följdriktigt sätt om vad som går att göra i ett formellt deduktivt system
- Systematiskt tillämpa en exakt definition av sanning på en given sats i ett formellt språk
- Demonstrera en förståelse av den tekniska innebörden av Gödels första ofullständighetsteorem, såväl som dess filosofiska betydelse.

For students from the master's programme in mathematics (TMTHM, TMAKM, TTMAM, TDTNM). For a passing grade the student should, in writing...

- *translate sentences of ordinary mathematical English into a formal language.*
- *engage in rigorous reasoning about the capabilities of a formal system of deduction*
- *systematically apply a precise truth definition to a given sentence in a formal language.*
- *demonstrate an understanding of the technical content of Gödel's first incompleteness theorem, as well as of its philosophical import.*

11.3.4 Grading tables

PhD students

Minimum requirements	Total score	Grade
PI: 8 PII: 3 PIII: 3	≥28 <28	P F
Otherwise...		F

FAK3014

Minimum requirements	Total points	Grade
PI: 5 PII: 3 PIII: 3	≥22 <22	P F
Otherwise...		F

Master students

Minimum requirements	Total score	Grade
PI: 8 PII: 6 PIII: 6	≥36.0 32–35.5 28–31.5 24–27.5 20–23.5 16–19.5 <16	A B C D E FX F
PI: 8 PII: 5 PIII: 5	≥32 28–31.5 24–27.5 20–23.5 16–19.5 <16	B C D E FX F
PI: 8 PII: 4 PIII: 4	≥28 24–27.5 20–23.5 16–19.5 <16	C D E FX F
PI: 8 PII: 3 PIII: 3	≥24 20–23.5 16–19.5 <16	D E FX F
PI: 8 PII: 2 PIII: 2	≥20 16–19.5 <16	E FX F
PI: 8 PII: 1 PIII: 1	≥16 <16	FX F
Otherwise...		F

11.5. Study techniques and the ILOs

The intended learning outcomes (below) are a great help in understanding what is required of you in your studies, so it might be a good idea to take some time to consider what they mean, and how to best fulfil them.

1. *Identify definitions and descriptions of concepts, theories and problem areas, as well as identify the correct application of these concepts and theories.*

One learning outcome is to be able to *identify* terms and concepts related to the course. A main course component is the terminology used – and there are a lot of words to learn. We think the best way is to create your own word list, starting from lecture one or the first course text and then continue to write down every concept that is important in the course. Write down the meaning and the definition of the term and how it is used in the context. If you know all the course terms and what they mean, you have come a long way in learning what you are to know after finishing the course.

2. *Account for concepts, theories and general problem areas, as well as apply concepts and theories to specific cases.*

However, just saying the right words doesn't get you all the way. You also need to be able to explain what they mean and how to use them. You can start with the word list you made before, and add after the formal definition an account of what it means. We think a good way is to give a pedagogical explanation: if you can explain something to someone else, you probably have good knowledge of what it means. The words are supposed be used in practice to communicate with others, so the final part of this learning outcome is being able to apply the concepts to a practical situation you have not seen before. Work with a friend, and come up with a situation you think a certain concept can be applied. You can take inspiration by analysing research in your own field. Show it to your friend and see if you friends agrees and applies it in the same way. If you disagree – discuss! You are always welcome to contact any of the teachers to explain it further.

3. *Critically discuss the definitions and applications of concepts and theories as they applies to specific cases of scientific research.*

The final part of the three intended learning outcomes that are common to all course codes, is being able to critically discuss the definitions and applications. An important part of the course – and philosophy in general – is to be able to take a step back and reflect on the words and concepts, and discussing exactly what they mean and how they should be applied. Philosophy is, at least to some degree, an activity, something that you do, and in this case you are to show that you are capable of performing a discussion of these concepts. A discussion features presenting arguments for or against one position and attempting to evaluate the strength of this argument, by comparing it with other arguments. This is something you will practice in the seminars, but one way to practice for yourself is to take one of the concepts and the definition and try to find one case where the definition does not hold. Another way is, of course, to discuss with others.

11.6. Project part instructions

11.6.1. Science communication and evaluation (AK2036, AK2038)

Below you find detailed instructions for all of the tasks constituting the science-communication-and-evaluation-version of project part. *Failing any of the tasks means failing the entire project part.* If you fail the project part, you need to do it anew in another period to complete the module. The project part tasks are grouped into three blocks.

BLOCK 1
Block 1 is constituted by two tasks, both of which target popularized presentation of science or engineering.

Task 1 (a) – Popular presentation of a scientific item

In task 1 (a), you will be working individually. After having carefully studied the scientific article that you have been assigned, you choose **one** item - either a method or a concept - that is used and plays a significant role in the article. It is important that you limit your submission to one item – no more. Choose an item

that you think a general audience of non-scientists or non-engineers would find difficult to understand.

Your task is now to write a description of the item you have chosen. Your submission should be **400-700 words** and provide an overview of this item. Imagine writing a description to a layperson: for instance a first year KTH-student, a journalist or a teacher. None of these people are familiar with the exact thing you are writing about, so you need to write your presentation in such a way that they will all be able to understand it, but they have a lot of background knowledge. Think of magazines or websites, podcasts or conference talks that you may have encountered where science or engineering was presented to a non-expert audience.

In general, writing a popularized presentation means that you do not go into detail. Focus instead on the most important aspects that you believe your audience should understand. Illustrate your descriptions with the help of intuitive examples, analogies, metaphors and/or pictures. Avoid including specialized technical terms and complicated graphs, statistics, equations and the like. Remember who your target audience is and think about what they may or may not know beforehand!

NOTE: If you submit a file, it is up to you to remove any information that gives away your identity. In MS Word you can use the feature "Inspect document" under File. Pdf-files must NOT be copy protected/editing restricted.

Task 1 (b) – Peer-feedback

In task 1 (b), you automatically will be randomly assigned another student's submission of task 1 (a) after the deadline. This submission might be about something previously unknown to you. That might even be an advantage for you as a peer-reviewer, since task 1 (a) is about presenting a scientific item to a non-expert. You will read the submitted text and provide feedback to the student who submitted it. You post your feedback in the comment box on the submission page. Your feedback should be based on the headings 1-3 below. **You are expected to write at least 50 words per heading**. The questions below each heading are guiding suggestions on what you can include in your feedback.

When providing feedback we want to provide constructive criticism. You should point out where there is room for improvement whilst maintaining a positive tone. Point out if there were things you didn't understand; because the description was too complicated or otherwise difficult to follow. The peer review is anonymous unless you write your own name.

Your feedback should be based on these headings and for each heading, your answer should include at least 50 words:

1. **General impression, context and content (min. 50 words).**
    a. Are technical terms explained and made understandable? Which could have been explained better?
    b. Do you think that the target audience could understand the text? What could be a problem in understanding?
    c. Comment on parts you think are well explained, and point out what could be made clearer.
2. **Structure and outline (min. 50 words)**
    a. Is there a clear introduction that makes you want to read it? How could it have been improved?
    b. Is there a logical sequence, a "red thread", in the text? How could the structure have been made clearer?

c. Is the end of the text (the conclusion) clear, or does it just stop? What would be a good conclusion?

•

3. **Language and formatting (min. 50 words)**
    a. Is the language in the text dry and complicated, or is it lively and pedagogical? Suggest an improvement.
    b. Are there any spelling or grammatical errors that make it hard to understand the text? What in particular?

If you are unsure of what a how to write peer-feedback you can review the lecture material from the TaMoS Project Part Introduction lecture. Everyone who submits task 1 (a) and task 1 (b) will be assigned to a group.

BLOCK 2

Block 2 is constituted by two tasks, both of which focus on the methodological evaluation of research.

Task 2 (a) – Methodological evaluation

In task 2 (a) you will be working individually. After having carefully studied the scientific article that you have been assigned, you will assess and analyse the article from a methodological standpoint and write a presentation of your critical evaluation. The article that you have been assigned describes methods, strategies or means for exploring something. A method could be an experiment, a longitudinal cohort study, or a computer simulation, for example. In task 2 (b), it is your job to evaluate the methods and the associated results as described in the article. **Your submission should be 700-1000 words** and it should bring out at least one methodological strength of the article and one methodological weakness. Make sure you do not only state what you think is good and bad, but also discuss *why* it is good or bad. If several methods are described in the article, do not try to cover all of them. Prioritize writing a thorough discussion of fewer methods, rather than a briefer discussion over several methods. This will also be to your benefit in Block 3.

Begin your submission by briefly explaining the methods that you are about to discuss and the role of that/those method/s in the greater context of the article. Task 2 (a) can be more technical than task 1 (a) but should ideally also be understandable to a wide audience.

The TaMoS courses are designed to provide analytical tools fit precisely for methodological evaluation of scientific research. We therefore encourage and expect you to use TaMoS concepts (e.g. “internal validity”, “construct validity”, “random error”, “operationalization”, “explanatory virtues”, etc.) as analytical tools in your evaluation. You might be asked to revise if you have not used the TaMoS concepts when they would have applied.

When writing your methodological discussion, consider questions such as: Should the researchers have considered using a different method than the one that they used, and if so, why? Were there any problems with the implementation of the method used? Should the researchers have improved their observations or carried them out differently? Is the suggested explanation of observation x plausible? Are there available alternative explanations for observation x? Are there possible sources of error which were not dealt with by the researchers? Was the data collected, interpreted and evaluated in a correct and transparent manner? Is the overall reasoning in the article coherent? Are the conclusions justified? Are the

claims made by the researchers proportional to the amount and type of justification provided in the article?

In a methodological discussion, justification is imperative. Merely stating that you think a model study was bad is not sufficient. What aspects of it do you think were bad, and why? What qualities did it compromise? What were the (possible) consequences of the errors being made? Where there any available alternatives? Discuss!

Still unsure of what methodology is about? Then review the lecture material from lecture 1.

Task 2 (b) – Peer-feedback

By now you have been assigned a group with other people from your master program. In block 3, you will be working as a group. In task 2 (b), you start the group work by providing feedback on the task 2 (a) submissions of your group members. You read the submissions of your group members, and for at least two of them, you post feedback in the comment box on the submission page. Peer reviews are found on the main page, under "coming up" and in the course activity stream.

Your feedback should be based on the headings 1-3 below. **You are expected to write at least 50 words per heading**. The questions below each heading are guiding suggestions on what you can include in your feedback.

When providing feedback we want to provide constructive criticism. You should point out where there is room for improvement whilst maintaining a positive tone. Point out if there were things you didn't understand; because the description was too complicated or otherwise difficult to follow. Also, were TaMoS concepts included? If so, were they correctly presented and applied? Could more, or other, TaMoS concepts have been included? This peer review is not anonymous!

You will give feedback on **at least two submissions**. Your feedback should be based on these headings and for each heading, your answer should include at least 50 words:

1. **General impression, context and content (min. 50 words)**
    a. Are methodological terms used and utilized correctly? Are there any missing which you would expect?
    b. Does the text explain why the strength is a strength and the weakness is a weakness? If yes, show how it is done, and if no show what is missing.
    c. Comment on parts you think are well explained, and point out what could be made clearer, to help the student improve the text.
    d. Do you agree with the arguments made in the text (that is: do you agree that the weakness is a weakness and that the strength is a strength)?
2. **Structure and outline (min. 50 words)**
    a. Is there a clear introduction that makes you want to read it? How could it be improved?
    b. Is there a logical sequence, a "red thread", in the text? What different structure could you imagine?
    c. Is the end of the text (the conclusion) clear, or does it just stop? What would be a good conclusion?
3. **Language and formatting (min. 50 words)**
    a. Is the language in the text dry and complicated, or is it lively and pedagogical? What would have helped with the readability?
    b. Are there any spelling or grammatical errors that make it hard to understand the text?

BLOCK 3

Block 3 is comprised of three overall tasks. You will be working in groups to produce an essay which provides a popularized presentation as well as a methodological discussion of the research presented in the article that you and your group members have been assigned. Your group has a group home page, which you can find in Canvas under "People" and "Groups". The group page includes a discussion forum and a files section where you can upload and share files. If any group member does not participate, contact the course administration.

In task 3, it is allowed to re-use material that you have already submitted in task 1 or task 2, but since this will be automatically flagged as plagiarism please note what material is being re-used in your text, to make the manual plagiarism check easier.

Task 3 (a) – Group work: Draft essay

In task 3 (a), you will work with the other members of your group. We therefore recommend that you book a room to work on the task. Together you will produce an essay presenting the article that you have all been assigned. The essay will synthesize a popular presentation and a critical, methodological evaluation of the article. **The essay should be minimally 4000 words (2000 words for individual assignments).**

Your essay should include the following two headings: "Popularized presentation", and "Critical evaluation". The paragraphs following these headings should be of roughly equal length. The critical evaluation could also be somewhat longer than the popularized presentation, but not the other way around.

When writing the popularized presentation, imagine writing for a target audience consisting of prospecting- and first year KTH students. When writing the critical evaluation, imagine writing for an audience consisting of people from a similar master program but who are not familiar with the particular research that you are presenting. This audience can understand a somewhat more technical presentation, but not too technical. They expect you to be pedagogical.

Structure your essay properly. Begin with an introduction: What is the article about? What is the main aim of the researchers? Also relate the article to the research field in general: Are the researchers trying to target any particular research gap? What is the current status of research in that area? We don't expect you to write an exhaustive background, but include some background that enables the reader to contextualize the research you are writing about. Then move on to give a popularized overview, or summary, of the research described in the article. You don't need to include every element of the article. On the contrary, part of the task is to identify and focus on what you as a group believe are the most important or otherwise interesting elements of the article. Next, you move on to the methodological discussion – pointing out weaknesses and strengths. This part should be the bulk of your essay. Again, focus on a few aspects that you as a group find to be most pressing, and in most need of discussion. Finally, include a conclusion. Here we encourage you to relate the conclusions from your critical analysis to the aims or claims of the researchers that you described in your essay introduction. You can use your previous submissions when writing the essay, but these then need to be re-worked to fit into the overall essay. You want to be writing a coherent essay with a red thread running through it and keeping the pieces together!

The TaMoS courses are designed to provide analytical tools fit precisely for methodological evaluation of scientific research. We therefore expect you to use

TaMoS concepts (e.g. “internal validity”, “construct validity”, “random error”, “operationalization”, “explanatory virtues”, etc.) as analytical tools in your evaluation.

Task 3 (b) – Peer-feedback

In task 3 (b) you will again be working individually. You will be automatically assigned another group's submission or another individual’s submission to provide feedback on. You carefully read the text and post your feedback in the comment box on the submission page.

Your feedback is to be based on the headings “Popularized part of the essay” 1 – 3, and on “Critical evaluation part of the essay” 1 – 3. **You are expected to write at least 50 words per heading**. The questions below each heading are guiding suggestions on what you can include in your feedback.

When providing feedback we want to provide constructive criticism. We can point out where we think there is room for improvement whilst maintaining a positive tone. Point out if there were things you didn’t understand; because the description was too complicated or otherwise difficult to follow. This peer review is anonymous unless you write your own name!

Popularized part of the essay

1. **General impression, context and content (at least 50 words).**
    a) Are technical terms explained and made understandable? Which could have been explained better?
    b) Do you think that the target audience could understand the text? What could be a problem in understanding?
    c) Comment on parts you think are well explained, and point out what could be made clearer.
    •
2. **Structure and outline (at least 50 words)**
    a) Is there a clear introduction that makes you want to read it? How could it have been improved?
    b) Is there a logical sequence, a “red thread”, in the text? How could the structure have been made clearer?
    c) Is the end of the text (the conclusion) clear, or does it just stop? What would be a good conclusion?
    •
3. **Language and formatting (minimum 50 words)**
    a) Is the language in the text dry and complicated, or is it lively and pedagogical? Suggest an improvement.
    b) Are there any spelling or grammatical errors that make it hard to understand the text? What in particular?

Critical evaluation part of the essay

1. **General impression, context and content (at least 50 words).**

    a) Are technical – scientific, engineering, or methodological – terms explained and made understandable? Could any of them have been explained better?
    b) Do you think that the target audience could understand the text? Why/Why not?
    c) Comment on parts you think are well explained; in what sense are they explained well? Also point out descriptions that could be made clearer. What is it you find difficult to understand about the descriptions?

2. **Structure and outline (at least 50 words)**
    a) Is there a clear introduction that sparks interest and presents an overview of what the essay will be about? How could the introduction have been improved?
    b) Is there a logical sequence – a "red thread" – in the text? How could the structure have been made clearer?
    c) Is the end of the text (the conclusion) clear, or does it just stop? What would be a good conclusion?

3. **Language and formatting (minimum 50 words)**
    a) Is the language in the text dry and complicated, or is it lively and pedagogical? Suggest an improvement that would improve the readability of the text.
    b) Are there any spelling or grammatical errors that make it hard to understand the text? What in particular?

Task 3 (c) – Group work: Final essay

In task 3 (c) you will be working together with your group members again to produce a final version of your essay. Based on the feedback your group submission received from its peer reviewers, you will consider making changes to the essay; correcting errors, re-working paragraphs, including TaMoS concepts, or other changes that might be relevant for your group.

The finalized submitted essay will be assessed and graded by a senior teacher. The essay may receive a passing grade, or it may receive a failing grade. The group may also be asked to revise the essay. If so, more instructions will be provided to the group members. A revision will result in a pass or a fail.

The teachers' verdict holds for all group members (in case of individual assignment, just you), unless there are reasons not to pass a particular group member. These reasons include that a particular student has not submitted a text, a peer review or self-evaluation, or have submitted a clearly insufficient text, peer review or self-evaluation, or that this student has not taken part in the group work creating the final text.

In reviewing the final submission, the senior teacher considers the following aspects:

1. *Is the popularised presentation understandable for a person outside of the field of research and who has not read the article?*
    a) Yes, the entire popularised text is understandable: all or almost all concepts, methods and results are explained.
    b) The popularised text is to a large extent understandable, but some concepts, methods and results are not sufficiently explained.
    c) The popularised text is not to a large extent understandable: several concepts, methods and results are not sufficiently explained.

2. *Is the critical evaluation an independent and thorough account of the methodological strengths and weaknesses of the article?*
    a) Yes, the critical evaluation utilises relevant course concepts in a correct and competent way to point out strengths and weaknesses of the article in an independent way.
    b) The critical evaluation to a large extent utilises relevant course concepts in a correct and competent way to point out strengths and weaknesses of the

article in an independent way, but some concepts were not applied or incorrectly applied, or the evaluation was not independently written.

c) The critical evaluation does not to a large extent utilise relevant course concepts in a correct and competent way to point out strengths and weaknesses of the article in an independent way, several of the concepts were not applied or incorrectly applied, or the evaluation was not independently written.

To pass the assignment the submission needs to fulfil at least (of the criteria above): 1a and 2a, or 1a and 2b, or 1b and 2a. If the submission fulfils only 1b and 2b, 1a and 2c or 1c and 2a, 1b and 2c or 1c and 2b you will be asked to revise. In any other case your submission will receive a failing grade.

11.6.2. PhD essay project (FAK3012, FAK3137, FAK3138)

The PhD project consists of **three mandatory texts submissions and three mandatory meetings**. All submissions must be submitted before their respective deadlines, and all meetings must be attended in person during the same course period. When signing up for the PhD project part, please be prepared to complete a draft version of your entire essay as soon as possible.

All text submissions must present **one** methodological aspect, or issue, relating to your own research project. Methodology concerns the justification of method choices, and "methodological problem" refers to the issue of choosing between different research methods, given that the research is going to be being conducted for a particular (scientific) purpose. A discussion of such a problem requires identifying and describing the strengths as well as the possible drawbacks of a particular method choice - especially in relation to alternative method choices. The reasons presented in a methodological discussion should be epistemological or otherwise scientific. In some cases, it may also be admissible to focus on ethical concerns, or on considerations of risk. More pragmatic concerns relating to things such as costs, your own abilities, your supervisor's preferences, what the laboratory you are working in can offer, etc., are generally *not* considered adequate. Leave such pragmatic concern out of your submissions.

Note that TaMoS is designed to provide analytical tools that you can use precisely for the purpose methodological evaluation of scientific research. We therefore encourage you to make use of TaMoS concepts (e.g. *internal validity*, *construct validity*, *random error*, *operationalization*, *explanatory virtues* etc.) in your evaluation. Also make sure you read the course literature (lecture scripts, lecture slides, course texts) when writing your essay.

The PhD project part consists of three meetings. Before each meeting, you will submit a text. Before the last two meetings, you will also provide peer-feedback on the submissions of the other meeting attendants. **All tasks are mandatory**. No compensation assignment for lack of submissions or seminar attendance is offered. You therefore have to complete all the steps presented below during one and the same course period in order to complete the PhD project.

Meeting 1 – Essay proposal meeting

Before meeting 1, you will submit a short essay proposal comprised of **at least 100 words**, and **at most 300 words**. Make sure you submit this proposal on the associated assignment page in Canvas.

In the essay proposal, you present a methodological problem, relating to your research project, that you intend to describe, discuss and solve in your essay. Make

sure to choose **one** problem - not many! Describing this problem requires describing the purpose of the method being discussed (i.e. what you want to achieve by using this method), and the alternative methods that you could have chosen instead. What justifies choosing this method over the alternatives? Does your choice result in any compromises (that alternative methods might have avoided)? Outline the reasons for or against your method choice. One of the most common mistakes is to write about your own research only, instead of framing your research in a wider methodological perspective. Avoid this mistake by making sure that you understand what is expected of you.

Meeting 2 – Essay draft and peer-feedback

Before meeting 2, you will submit a first draft version of the essay. The draft version should contain **at least 3000 words**. Note that your draft version should already resemble a final version; the overall structure of the essay should already be in place. Upload your draft on the associated assignment page in Canvas. Before the meeting, **you must also provide written peer-feedback on the submissions of the other PhD students in your group**, pointing out strengths drawbacks. Feedback is posted in the comment box on the submission page in Canvas. At the meeting, the submissions will be further discussed, and you are expected to have carefully read the submissions of all the other attendants.

In the draft version of your essay, you will develop a discussion based on the outline you submitted before the first meeting. You continue to discuss one, and only one, methodological concern. In the beginning of the text you should clearly state what methodological problem(s) you will address, and outline the structure of your text. Then you move on to presenting reasons that justify your method choice over the alternatives. Does your choice result in any compromises (that alternative methods may not have resulted in)? Why is your choice of method nevertheless better than the relevant alternatives? Discuss! Your conclusion will most likely be that careful methodological reasoning favours your method choice over the relevant alternatives. If, however, you come to the conclusion that an alternative method would have been better, make sure you present the reasons for why you think so.

Note that the purpose of this meeting is *not* to get an authoritative quality verdict. The seminar leader serves only as a facilitator. They will not subject your submission to the kind of careful scrutiny that your final version will get from an examining teacher after the third meeting. Rather, the main purpose of this draft meeting is student peer review. It is therefore **important that you read and provide feedback on all essay draft submissions carefully!** Print your comments and bring to the meeting. Whatever comments your submission received before and at the second meeting, take these into consideration when working on improvements for your final version.

Questions that you should address when commenting on others' essays:

1. Is the method described in a concise and understandable way? Give suggestions on improvements!
2. Is the methodological problem discussed in the paper well-described and clearly demarcated from other problems? Can you suggest an improved formulation of the problem?
3. Are the relevant concepts from TaMoS applied?
4. Are the concepts correctly used? Explain where you think the author has made an error!

5. Is there anything left out of the discussion that you think should have been included?
6. Can structure, choice of words or grammar be improved?

Meeting 3 – Final essay presentation

Before meeting 3, you will submit a final version of your essay. The final version should contain **at least 3000 words**, and **at most 3500 words**. The final version of your essay should be a revision of your essay draft. When reworking your essay, take the comments that you have received from your peers into consideration. Upload your essay on the associated assignment page in Canvas. Prepare to give a brief presentation (a few minutes) of your essay on the third meeting, where you will receive feedback from the other attendants as well as from a senior teacher. Read also the submissions of the other attendants before the meeting. The senior teacher will then assess and grade your essay. The essay may receive a passing grade, or it may receive a failing grade. You may also be asked to revise the essay. A revision will result in a pass or fail.

11.7. List of all course codes and their differences

- AK2030: 4,5 credits. Takes “philosophy of technology” lecture, the natural science version of seminar 3. Natural science version of the course.
- AK2032: 4,5 credits. Takes “philosophy of economics” lecture, the social science version of seminar 3. Social science version of the course.
- AK2034: 4,5 credits. Takes “Algorithmic reasoning and its limitations” lecture, the natural science version of seminar 3. Computational science version of the course.
- AK2036: 7,5 credits. Takes “philosophy of technology” lecture, the natural science version of seminar 3, the project part. Natural science version of the course.
- AK2038: 7,5 credits. Takes “philosophy of economics” lecture, the social science version of seminar 3, the project part. Social science version of the course.
- AK2040: 7,5 credits. Takes “Algorithmic reasoning and its limitations” lecture, the natural science version of seminar. Computational science version of the course.
- AK2050: 6 credits. Takes “philosophy of technology” lecture, the natural science version of seminar 3, the ethics of medical technology part. Natural science version of the course.
- FAK3012: 3 credits. Only takes essay part. Everything else is optional. PhD Course.
- FAK3014: 3 credits. Takes “philosophy of technology” lecture, the natural science version of seminar 3 and a shorter exam. Does not take “Risk and Risk assessment” or “Research ethics lecture”. Does not take seminar 4. PhD course. Natural science version of the course.
- FAK3024: 4,5 credits. Takes “philosophy of technology” lecture, the natural science version of seminar 3. PhD course. Natural science version of the course.
- FAK3136: 4,5 credits. Takes “philosophy of economics” lecture, the social science version of seminar 3. PhD course. Social science version of the course.

- FAK3137: 7,5 credits. Takes “philosophy of technology” lecture, the natural science version of seminar 3, the essay part. PhD Course. Natural science version of the course.

- FAK3138: 7,5 credits. Takes “philosophy of economics” lecture, the social science version of seminar 3, the essay part. PhD Course. Social science version of the course.

- DA2205: 7,5 credits, TaMoS part 4,5 credits. Takes “Algorithmic reasoning and its limitations” lecture, the natural science version of seminar 3. Computational science version of the course.

- AF2023: 7,5 credits, TaMoS part 4,5 credits. Takes “philosophy of technology” lecture, the natural science version of seminar 3, writes a special essay and a shorter exam. Does not take seminar 4. Natural science version of the course.