

# Introduction

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So good morning and welcome. My name is Gerald Maguire. I'm the professor here at KTH for computer communication, and it is my pleasure to welcome you to this presentation. For the Course II2202: Research Methodology and Scientific Writing.

For those of you who want to find out more information about me, the things that I'm doing, etc. If you look at the URL: <https://people.kth.se/~maguire/>

## Slide 2: Welcome to the course!

As I said, Welcome to the course. And the course should be fun. And I think it is very, very important that you actually find part of it (the course) that you're really interested in and that you find the research problem that you're really interested in.

Now, some of you may be wondering just how much work is this course going to be? Well, it's a seven and a half credit course that corresponds to four weeks or roughly 160 hours, and of that, you'll spend about 50 to 100 hours working on your project, depending upon what background you have. It can be near the lower end of fifty or the upper end.

## Slide 3: Canvas at KTH

Now we're using Canvas here at KTH -- as a learning management system. And you can find the information for this course at the course room <https://canvas.kth.se/courses/28715> And for the students who are in the P1P2 course, at the other URL noted on the slide (<https://canvas.kth.se/courses/28850> ).

Canvas is an open-source system. So if any of you say: Why does it behave the way that it does? You can look in GitHub at <https://github.com/instructure/canvas-lms>, And it is a very interesting system.

## Slide 4: Canvas user interface

Now a few words about the user interface. And one problem is that the normal default setting for KTH's Canvas uses Swedish as the user interface. Fortunately, you can change that. If you go click on "Konto", which means account in English, then "Inställningar", i.e., Settings then "Redigera inställningar", to edit your settings. Then "Språk", which means language, and choose the language you want, and there are loads of different languages. The translations sometimes are a bit questionable, but they're there. And then finally "Uppdatera inställningar", which means update your settings. And there are Canvas guides available in lots of different languages.

## Slide 5: Language of the course

Well, the language used in this course is going to be English. Most of the courses have videos, and the captions are available in English. And there's also a transcript of nearly all the lecture material available in English. Some of the material is also available in Swedish. Specifically, there is a dual English & Swedish set of videos regarding sustainability.

## Slide 6: Context of the course

Now, the context of the course is most of you are doing your Master's studies. And during this, of course, you're going to take a number of courses. Some of those courses are going to require that you carry out projects, and then you're going to need to complete a degree project with a thesis in order to graduate. And of course, following your graduation, you are going to be professionals; hence you need to develop the skills and understandings necessary for your profession. And some of these required skills and understanding are described in the Higher Education Act, Högskolelagen. This is something that if you're coming from outside of Sweden is perhaps somewhat hard to understand, but KTH is both a university and a government agency; hence our operations are governed under laws passed by parliament. And one of these is this Higher Education Act. And they're very explicit about their expectations of the things that students need to demonstrate to get a particular degree. Now, my hope is and part of the reason for my doing this course for now more than a decade is self-defense. And why do I say that? Well, because I've been the examiner for now nearly 600 theses. And if I can help you improve your ability to carry out a research project and generate a report, you will hopefully do a much better job on your thesis. And I would much sooner read a 10-page report and give you lots of feedback. Then read a hundred-page thesis that is not well-written. Well, the language used in this course is going to be English. Most of the courses have videos, and the captions are available in English. And there's also a transcript of nearly all the lecture material available in English. Some of the material is also available in Swedish. Specifically, there is a dual English & Swedish set of videos regarding sustainability.

## Slide 7: Teachers associated with the course

So there are a number of teachers associated with the course. Anders Västberg is the course responsible person. So if there's something that I do that you're unhappy with, you can let him know. I'm the examiner for the course. That means that I will actually set the grades. There are different teachers assigned to each section of the course, and you can find their names in the canvas course pages for the course. And I've tried to assign everyone in the sections based upon your area of interest, so if you're an embedded system student, you'll be in one group. If you're a student in distributed systems, you'll be in another group, etc. There are a variety of guest lectures by videos professor Carl-Mikael Zetterling, also known as Bellmon, Professor Magnus Bowman. Associate Professor Markus Hidell, Professor Mark Smith. Dr. Jon-Erik Dahlin. Retired Professor Ellen McGee (an ethicist), and professor emeritus Marilyn E. Noz from New York University. And Niklas Olsson from the I.T. group at KTH.

## Slide 8: Goals, Scope, and Method

So the goal, scope, and method of the course is: The goal is to help you be successful in your Master's courses, your thesis project, and your professional career. And the scope of the course is research methodology, a scientific assignment. And scientific writing. So we're not going to focus on writing in general; we're going to focus on scientific writing. The method we're going to use is we have a number of lectures by videos. There are quizzes with them to help give you a quick feedback. We'll have advising sessions where you can ask questions about your specific interests, problems, etc. There is a whole variety of literature: books, articles, websites, tools, et cetera. And we are going to do this by carrying out a staged project, starting from the proposal all the way to the final report and opposition. And I will hopefully teach you a process that you can repeat again and again in your other courses and in your degree project.

## Slide 9: Aims

The aims are to give you the theoretical and practical skills to be able to plan, conduct, analyze and present in both oral and written forms, a scientific assignment in the area of information, communication technology (ICT). And to develop insight and understanding of research, methodology, ethics, and sustainability. And some of you will say, why are ethics and sustainability so stressed in this course? But one is they are important to us as professionals. Another is that they're actually required in the law for you, for a Master's or civilingenjör degree. And they help guide us in choosing research problems that we want take it upon as our research topic.

## Slide 10: Learning Outcomes

Now, the important thing is. The learning outcomes. After the course, you as students, should be able to explain and apply scientific methodologies, methods and techniques for scientific writing. Choose a research methodology and prepare the writing of the scientific report. And again, that also applies later to your degree project's thesis. To actually be able to perform the evaluation and evaluate using a particular set of methods that you've chosen. And to explain and take a position on or assess the results. As well as list and summarise related work. So lots of people think: Why is related work so important? Well, if we look in science, we see that. Newton said the reason he was able to advance was because he stood on the shoulders of those who came before him. So building upon what others have done is very, very useful. If you're into software, it's often talked about as software reuse, but it's also using ideas, is expanding upon them and extending them. And often one of the things we learn from related research, is: what are the questions and what are the metrics that we should be using to assess whether we've done a good job or not? We want to be able to apply the knowledge and scientific writing and research methodology and use it whenever you're writing your scientific report and opposition report. And as I said, it's very important in this course, learning both to receive feedback from others and giving feedback to others. And the opposition, although some of you might think that's a sort of harsh sounding word, it is meant here in the nice academic sense: as a formal peer review. You should be able to identify and

describe examples of sustainability related to the ICT area, and you should be able, both orally and in writing, give examples and explain societal and ethical aspects of sustainability in the ICT area. And you should be able to perform an opposition.

### **Slide 11: Prerequisites**

. Now, the prerequisite, which hopefully everyone has, are a good knowledge of English and basic knowledge of information and communications technology - which we've been studying in your previous studies.

### **Slide 12: Contents**

. Now the course is divided into three major parts: research methodology and scientific writing and the scientific assignment itself. And they're integrated in this project. And they're examined by the project plan, the method description, the scientific report, and the opposition report. And along the way, you'll give oral presentations and peer reviews.

### **Slide 13: Lecture and on-line material**

So we have this first lecture. And in addition to it, there more than 12 hours of videos, many associated with with quizzes. I suggest you watch them as soon as you possibly can. Now, if you look at the syllabus, you'll see that there is a date and time for each of these things. The times are meant to order them. The dates are designed so that you have the material by the time you would need it, but learning it before then is perfectly fine. I also love to watch videos at one and a half times or higher speed. But it's also possible and another great feature is you can rewind it and say, I didn't understand what you said. Let me go back and hear that again - I was busy thinking of something else. And this is very, very useful. Some people have also found the transcripts useful because some people prefer to read rather than listen. Whereas for some people, it's the reverse. Their set of deliverables described in a set of templates to help you produce them. However, purposely, there is one template missing. And the idea is to help you learn that you, too, can use the idea of templates by going between the two that you're given to have the intermediate one that you need for a particular assignment.

### **Slide 14: Course schedules**

There are two different course schedules for the P1 students that is August through October. And as I say, when in doubt, look at the syllabus in the course, and of course, it's perfectly fine to work ahead.

### **Slide 15: Syllabus page (P1 and P1P2) - Course timeline**

I just talked about the timeline. It's very, very useful to think in terms of the timeline, as "I should have it completed by this time". It doesn't mean that you should wait until that time to work on it. Work in plenty of time in advance.

## Slide 16: Topics

Now the topics they were are going to talk about. We said research methodologies - we are going to focus mainly on qualitative and quantitative methods. It's important that you consider alternative methods and choose a suitable method. We're going to have this scientific assignment where you're going to propose and, of course, motivate your investigation, why should you study this? If you're going to choose, then apply your quantitative or qualitative methods as you collect and analyze your data and carry out your investigation. For the scientific writing: you need to report your results both orally and in writing. And it's also very, very important that you avoid plagiarism. Now, is this just because, oh, if I get caught, I can be disciplined? No, it's because plagiarism fundamentally violates one of the most important things in higher education, and that is whenever you are submitting material to be evaluated, if you're submitting someone else's work, then you're not getting evaluated. So it's both unfair to others but it's also unfair to yourself. As I mentioned, the opposition, it's really important to learn to give and receive feedback, and there's a very nice book by Stone and Heen, about this, and there is a copy available in the library. We'll talk about research and professional ethics. And we'll talk about sustainability. In particular, focused on sustainable development as it's defined and used here in Sweden.

## Slide 17: Project Assignments

Now the project assignments starts with this project proposal, which you develop into a research plan. That means you actually need to do a little bit of literature review to figure out, OK, what's the real problem? Is it already been solved? If there's existing work, how can I build on it? Then you need to think about a method description. And at this point, you need to think about what's the theory that I'm going to use? What method am I going to choose, and why am I going to choose that method? If I have people participating in it because, for instance, I'm evaluating the usability of something or I'm comparing one formulation with another, I might have participants trying this. I need to figure out who are they? How many do I need, etc., and I need to figure out what other sources of data there are. And that's going to end up producing a first draft of the report. And you will iterate on this. There'll be an opposition report as a written report submitted before the final seminar, and then the scientific report will be presented orally in a final seminar where there will be an oral opposition. And then after that, and getting the feedback from both the written opposition and the oral opposition, you'll submit your final written report. So the idea is really to develop it in stages. As I say, it's a process. And the projects will be done in teams of two persons. [student says: Oh!] Now, why two persons - you might say, Well, one of the reasons, as I say, is so that you have someone else that can be looking at it. And now the two of you with two sets of eyes are more likely to find problems than if you're only looking at it yourself. The other is you have to learn how to communicate and how to work with other people. And this is very, very, very important in research. Now, some people have said, oh, but I have to do the Master's thesis by myself. And yes, you have to do it by yourself, but you also have an entire semester to do it. And that's the only thing that you would be doing during that period of time. We have to somehow be able to carry out a full research project just in one period.

### Slide 18: Deliverables

So the deliverables or your project proposal, the presentation of your proposed research as a short video clip where you'll talk about the ethics and sustainable development aspects of what it is that you're proposing. So it's very important that you think about this at the beginning of your research. You'll have the first draft of your research plan, and that will be input into your final grade. There's the presentation and peer review of the draft plans, project plans. Then there will be a quantitative exercise - so that everyone gets some experience in quantitative data analysis and how to present quantitative data. There will be a qualitative exercise where everyone will get some experience in how you collect qualitative data. And one of the big surprises that occurs in this exercise is many people realize just how difficult it is to do a qualitative study. To generate good questions is a very, very difficult task, but it's a very useful skill to learn how to do. There's a first draft of your report, and it goes into the final grading. There's the presentation, peer review of the draft report, and then there's the written opposition before the seminar, the final seminar with the oral presentation and oral opposition, and the final written report. And all of those go into the final grade.

### Slide 19: Assessments

Now, why talk about these things that are in the final grade and things that are not in the final grade? And that falls under the topic of assessments. And in this course, I'm using two forms of assessment. One called, formative assessments, and the idea here is to give you feedback early. But give you a chance to make mistakes - so you get feedback, you get a chance to improve. As opposed to summative assessments, which actually determine the final letter grade. So in the formative assessments there, quizzes with the videos, there are the peer reviews, the presentations, and the exercises. Now, some of you might say, oh, but I'm not getting graded on them, it doesn't matter to my final grade, well, yes, it does, because if you don't do them: A. you're missing the information that you should have. And B. you are not meeting the learning objectives. So if you don't give your oral presentation with your ethics and sustainability of your aspects of your research, then you can't possibly meet the learning objectives. And if you don't meet all of the learning objectives, you can't pass the course.

### Slide 20: Equivalent courses

Now, some of you may say, oh, but I've already had a research methodology course before: Why do I need to take this? Well, KTH has a process for evaluating equivalent courses. One problem I've encountered, having evaluated lots of these requests, is typically the courses haven't had material on sustainability and ethics. And if that's the only thing that you're missing, there's a one and a half point course, called II2210 Ethics and Sustainable Development for Engineers, that you can take. But you can't get credit for both that course and II2202. An evaluation of the course equivalences is done by me as the examiner for the course.



## Slide 21: Examination requirements

. So what are the examination requirements? There is one project. moment of 7.5 credits, and it is graded on the "A to F" scale. Note that "Fx" is not a final grade. But it means that you haven't failed, you have an opportunity to bring your work up to the level, to get a passing grade, in which case you can get an "E". Note that the grades are assigned individually. So if your teammate isn't contributing equally, discuss it with them, discuss it with the teacher working with your signature, and finally discuss it with me as the examiner.

## Slide 22: Grades: A..F (ECTS grades)

some people will say, How do I get a? Well, to get an "A", your project plan, the method description, the scientific report, and the opposition report have to be excellent. So they all have to be excellent. I often say in courses when people say, What do I have to do to get an "A"? My usual answer is to say, I should go. "Wow. I wish I had done that." So this truly means excellence. [For] a "B", all of those things are very good, or at least very good. [For] a "C", they're good. [For] a "D", you met the learning objectives, but you have a weakness in one of your deliverables. And if you have some errors like incomplete references and failing to consider the relevant aspects of research methodology, ethics, and sustainability, the highest grade that you can get will be an "E".

## Slide 23: Grades (continued)

If you fail to meet the learning objectives or your project has serious errors, the grade will be an "F". But if you're close to passing, you'll have the opportunity to complete the part where you're weak, submitting a revised version of the deficient components, but the highest grade that you'll get, is that an "E". Note that once you've gotten an up a grade of "E" or higher, you have no opportunity to raise your grade. So in Swedish, there is no "plussning".

## Slide 24: Literature

So the course literature. The course website gives the list of books and a paper that you're encouraged to read. It gives lots of useful tips, tools, and other information. It points to sources of open data, etc. But the most important part of your literature will be your project-specific material. And part of that is actually learning to develop your skills in finding, evaluating, and summarizing related work. So many of the students I've had in the past are able to find things, but they're not actually able to evaluate, is this work any good? Do I trust it? Why should I trust it? And therefore, they often put in things that are very, very questionable. And that's usually a sign of immaturity in your research. In your specific material, you'll need to find the background material and the tools that you need. Both to understand and use them to carry out your project. And all too so to support your data collection, analysis, and presentation(s). You will want to use citations to support your statements. It gives support to what it is that you are trying to claim.

## **Slide 25: Observe proper academic ethics and properly cite your sources!**

. It's very important that you observe proper academic ethics. This means you need to cite your sources properly. Now, KTH has a policy of zero tolerance for cheating. So if you use someone else's words, they must be clearly indicated as being a quotation with the proper citation. And it's important to note that from the copyright law point of view, every figure, table, cetera has its own copyright. So if you're going to use someone else's figure, picture, et cetera, you need to both cite the source, and you need the copyright owner's permission to use it. If you haven't done both of those things, you can't use it. Now, you can, of course, be inspired by looking at someone else's figure and say, oh, that's a really cool idea. [Draw your own version] And now what you would put in the caption of that figure is to say, blah, blah, blah. Adapted from and now you'll cite the source that you adapted it from. And that way, another reader can come along and look at that and say, oh, yes, I can see that this is their own version [and see] where they've taken their own figure to replace this figure that someone else had.

## **Slide 26: Ethics, Rights, and Responsibilities**

Now, it's important to understand ethics, rights, and responsibilities. And as I mentioned just a moment ago, KTH has a policy of zero tolerance for cheating and plagiarism. And you can read about the relevant policies at this URL before you begin to write. I encourage you to read the document about cheating and plagiarism. And there's also a very good book by Jude Carol and Carl-Mikael Zetterling called "Guiding Students Away from Plagiarism". It's also a fun book because it's in both English and Swedish. If you turn the book upside down, read it from the other direction, and it's in the opposite language. So it's interesting [Swedish] practice. But this is extremely important. If I find or one of the other teachers finds that you're cheating or plagiarizing, we must deal with it. This is a requirement from the President of the university. We cannot ignore it. And it's one of the last things that I want to have to deal with - is reporting someone to the President for disciplinary reasons.

## **Slide 27: Some of the ways to fail the course**

Now, some of the ways to fail the course. And perhaps for some of you, this is the first time you've ever had a course where the teacher described, here's how you can fail the course. But it's important to highlight some of these. And the first way to fail the course is choose an inappropriate topic. Typically, one you can't carry out in the time available or you don't collect enough data to reach your desired confidence level. So I'm not forcing you to say, oh, you have to have a 95% confidence level. No, it's perfectly OK to have an 85% confidence level or a 60% level. You have to define what your confidence level is that you're aiming for. But then you have to actually achieve it. Another way to fail the course is misconduct, including plagiarism. Another method is failing to present appropriate arguments in your report or not discussing related work or improper/incorrect analysis of your data or not considering the social, ethical, and sustainability aspects of your topic or failing to consider if your results are valid or not, i.e., this isn't a document that can be supported by the arguments



that you've given. If so, too bad it fails. Failing to submit the matter on time. The course takes place during one period or in the case of the P1-P2 students in the course of the semester, but that is the period of time that you need to submit the material. And everything is organized along in the syllabus to give you time to submit material and also to give your opponents and peer reviewers time to give you feedback. And it's important to give that feedback in a timely manner so that people can proceed on to the next stage, as I said, of this process of going from idea to final report. And another way to fail is failing to give feedback to others or failing to utilize the feedback that you get. So if you've got feedback saying, no, this isn't a correct way to use citation or this isn't a complete reference, and then if I see that again. You didn't use the feedback that I gave you, so why am I wasting my time again on it? That is not the way to take and use the feedback that you get. View the other people's time, as valuable as you hopefully value your own time as valuable. And, of course, there are other ways to fail. But these are the key ones. In my experience as an examiner for Master's thesis and Bachelor's thesis, the number one reason that students fail to complete their thesis in a project in a timely fashion is they don't start from day one and write every day. And during the thesis process, I generally suggest to students they want to aim for one draft age per day. Now you don't have to write a document that long (for this course), but it's important that you take this idea of you need to be writing every day. If you think of a question, write it down. When you think of the answer, you can write it down. Sometimes one of the most important things that you can have in a thesis is the things that you tried that failed. To clearly document why didn't this idea work out the way I thought it could, so that the next person who comes along and is trying to do research in this area, does it make the same failure.

### **Slide 28: Research Methodology**

So what is research methodology? Well, it concerns the questions of what is research? Why do we do research? How do we do it? What shall we research? How can we be sure of what we know? And where did we gain our knowledge? And can we believe our knowledge? Can we believe these sources?

### **Slide 29: What/Why/How of research?**

So let's start with the What? Why? and How of research? So what research? It's the gathering of data, information, and facts for the advancement of knowledge. So we want to advance knowledge. So it should be something new. It should be original. Why do we do research? We do it to solve problems. Prove new ideas, develop new theories, and to achieve and attain knowledge, to establish new facts, establish truth, refute falsehood, or driven by curiosity. And curiosity-driven research is a small part of research, but an organization like Vetenskapsrådet (VR) in Sweden funds curiosity-driven research. How do we do research? Well, typically involves systematically collecting and analyzing data to increase our understanding of the phenomena we're studying. And we need to conduct that research in an ethical manner.

### Slide 30: What shall we research?

So this question: What shall we research? Well, sometimes it's an assignment either for a course or your thesis, or it's part of your job, but it's essential that the research should have a worthwhile purpose. Hence, it should benefit someone, society, the research subjects, and or gain useful knowledge. Otherwise, basically, it's just intellectual masturbation. So you need to make sure that there's a reason, and you have to ask yourself who benefits from the result of this? It doesn't mean that everything results in an economic gain or that it is a societal advantage. It could be just new understanding. Oh, I actually can figure out how to cover this ground in less than four colors. Hey. Suddenly, that enables all kinds of new insight. And if you think, oh, they're topics that are very well researched, and people know tremendous amounts about them, I would point out that just the simple problem of finding a minimum in a multidimensional set, there had been no theoretic analysis until just recently to show exactly how hard from a computation of complexity [point of view] that problem actually is. There are lots of ethical issues about what research you do and what research you don't do. And some of this may be set in a particular society or set by your own ethical considerations. But it's very important that you actually think about them.

### Slide 31: Högskolelagen (1992:1434) Higher Education Act [Högskolelag]

. Now, I mentioned earlier this Higher Education Act, Högskolelagen, and one of the interesting features in it, and I emphasize these words in the quotation. "Is the Swedish government has furthermore added an important goal for higher education and research that may influence the choice of scientific perspectives and problems", i.e. it's telling you you need to think about this when you choose both your perspective and the problems that you work on. And that is, "It shall support a sustainable development that creates a good, healthy environment for this and future generations, economic and social, welfare and justice." So this is a legal requirement. Now, some of you might say, well, who really cares about this? Well, actually, as a government agency and a university, we expect you to care about it. So it's important. If you want to read more about this. You can go to <http://www.codex.vr.se>, and you can read about the rules and guidelines for research. This happens to come from the one on the humanities and social science, but it applies equally in engineering and natural science.

### Slide 32: Researcher's responsibilities

So what are the researcher's responsibilities? Well, of course, since you're supposed to be advancing knowledge, you need to contribute to the advancement of that knowledge and you need to communicate your new knowledge and your understanding to others. And that's in addition to your responsibilities with regard to economic, social, and ethical responsibilities. So it's really important that you don't just do it, but you have an obligation to report it and explain it to others - so they can know about it and so they can use it

### Slide 33: Research Methods and Methodologies

So what about research methods and methodologies? Well, it's really important that you want to select the most suitable method and methodologies that's going to suit your particular problem well. And then you want to correctly apply them. So you want to avoid picking methods and methodologies that don't match and don't complement each other..

### Slide 34: Combining multiple methods

Now, can you use multiple methodologies, of course you can. This is an example from a thesis by a student in 2015, Sällberg, and he used both quantitative and qualitative approaches - where he started initially by having a rather qualitative evaluation of the time to install a particular software package. He was looking at network management. But evaluating it from a very qualitative point of view in interviews with the people who did this. And this was followed then by a very quantitative study. Now the time to install a second package where he actually measured how long did it really take the person to install this particular package. And then he did a very quantitative study of the time to actually provision VMs, so virtual machines, to realize operationally this particular package. And then he did a qualitative study of the people who did that - to interview them- of how well they thought this tool actually supported them. And then finally, he did an assessment in a mixed quantitative and qualitative fashion to look at were these models that he was proposing that people use to solve these network problems, useful or not? So you can combine them.

### Slide 35: Methodology

So what's a methodology? Well, Merriam Webster's Dictionary says methodology is "a body of methods, 00:38:19,139 --> 00:38:22,260 rules and postulates employed by a discipline; a particular procedure or set of procedures." The second definition is "the analysis of the principles or procedures of inquiry in a particular field." And it's important to note here. In both cases, it's talking about employed by discipline or in a particular field. So different areas of research have different traditions about how they do research. And if you look at different research groups like Professor Jens Zander's group in radio communications, you'll see that much of the research has a similar pattern because it follows a similar methodology, because that is what is well-established in this particular field. So your choice of methodology will be often very influenced by which particular discipline or field you're working in.

### Slide 36: Research Methodologies

Now the methodologies give you the overarching theoretical and philosophical framework to guide your research. So they basically give you a theoretical perspective and principles to work from. And they guide you in solving the research problem. It guides you in helping you choose what's the right procedure to find the solutions. And the choice of methodologies governs how we use logic, how we establish what is reality, how we assign value, and what we actually consider knowledge to be. And it's really important at the start of your research

that you think about what research methodology or methodologies you want to use. So choosing the methodology is important at the start of the research.

### **Slide 37: Research Methods**

But then comes the research methods, because these are the tools, techniques, and processes that you actually use to collect your data, to conduct your research, to find your solution, support your producing high quality, valid and trustworthy research. And it's the methods that get us to the endpoint of our research. So our methodologies are important at the start. The guidance and then we apply research methods to get us to the conclusion of our research.

### **Slide 38: Quantitative and Qualitative research methods**

I mentioned quantitative and qualitative research methods. These apply at different levels. And if you take a look at the conference paper by Anne Håkansson, that's cited here from 2013. It gives you a nice diagram that shows you at all these different levels, how the research methods, be they experimental, conceptual, descriptive, empirical, etc. or the research approach Are you doing deductive or abducted or inductive research? What's your strategy? Are using experiments or doing case studies or you're doing surveys or you're doing exploratory research, or are you doing ex post facto research? Are you doing action research, grounded theory, et cetera? And I'll point out here, a very powerful strategy is ex post facto research. That means someone else has already gathered the data. But you're going to take it and use it to analyze it in a new way to get new knowledge from it. But that will reduce the amount of time it takes you to actually collect your data. And then, there are various data collection methods, experiments, questionnaires, observation interviews, language and text analysis, etc. And then, there are different methods to analyze your data. It could be statistical methods, it could be computation, it could be coding of the information you're extracting from interviews or language or text analysis. And then you have a very important set of issues about quality assurance. Is it replicable? Can someone else do this and get the same results that I did? Is it valid? And is that reliable? And, of course, you also have the issue about presentations, not only oral and written presentations but videos, posters, etc. So a whole variety of methods. And as I say, at different levels.

### **Slide 39: Bound choice of research methods (for this course)**

Now about bounding your choice. For this particular course, you're not allowed to do a literature review as your research method. And the reason is I found that students really don't understand what a so-called comprehensive literature review is, and they think it's simply a literature study and it's not. Literature reviews are extremely difficult to do and require a lot of experience in the area. So I mentioned, ex post facto research is really useful, but make sure you have enough data and that you're going to examine it in a new way. Now, research projects that are going to do surveys I generally discourage. And the reason is that having taught this course many, many times, I've only had one student group who actually managed to get enough survey results that they could actually make a statement and have some reasonable level of confidence in their results. It's very, very, very difficult to do surveys,

and it takes much longer than you think. But if you decide that a survey is the proper thing to do as part of your research, discuss it with the teacher per your particular section of the course.

### **Slide 40: Trust but Verify!**

Now it's important to trust but verify. How can we be sure of what we know? Part of that is understanding where we got the knowledge from, which is why we want to document it carefully and cite it properly. And the other problem is, can we believe our knowledge? Do we really believe these sources? And to do that, we have to learn to read critically. What does that mean? It means when I read the paper, I'm asking myself, do I really believe this? Why do I believe it? Is this right? Is this assumption that they've made correct? And it is also important that you read widely because if you read widely, you're more likely to understand and have a feel for is this research likely to be correct? You need to examine the reliability and validity. The integrity, the authenticity, the credibility, and the criticality of the results presented. So there's a researcher at a US university, xxxx University, who's written a lot about fraud in research. And it's just recently come to light that, in fact, the very first paper that the researcher was involved in, with a group of other people, that it appears that the data was manipulated fraudulently and therefore that the conclusions from the research are not, in fact, what the conclusions of the unmanipulated data would have led to. And this is, of course, extremely bad. If you're a researcher, it means that people now will question all the other work that you've done. So it's important in everything that you do to make sure that you have been absolutely careful in correctly collecting the data and analyzing it. This also means that you don't reject data because it doesn't fit the model or what you think is going on. So a number of years ago, one of the doctoral students here at KTH showed me a plot. And there were these outliers. And he said, well, I can just get rid of those, and I said, no, no, no, you don't want to get rid of those who to understand why they occur. And in fact, his dissertation was about how to bring all the other points he was getting in his measurements to get the same high-speed performance as these outliers that somehow managed to have all the same operations that be required in processing this data - occurred in a much smaller period of time than what his other data [experienced]. So don't throw out the outliers, understand them. Actively, question your results. And that includes repeating experiments. So there are a number of universities, Stanford University, for instance, has a networking course where the focus of the course is repeating previous well-known experiments. There's enormous amount you can learn from that. Examine activity, the ethics of what you and others do, and be self-critical. So you don't mislead yourself or others. And as I often say. If you can't be self-critical and you can't have friends who criticize you, you can count on the fact that your enemies will. So be self-critical. Get your peer reviews, improve it so that there isn't something that others are going to criticize unfairly.

### **Slide 41: Why learn different research methods?**

So why learn different research methods? Well, one of the main reasons is so that you can make the appropriate choice for your particular problem. And over the course of your

professional life, you'll encounter lots of different problems. And in many cases, you choose lots of different methods for solving. So be conscious in how you make that choice. We're going to focus on two major classes of methods, quantitative and qualitative methods.

### **Slide 42: Quantitative and Qualitative research methods (in ICT)**

And quantitative methods are about measurements, numbers, data, statistics, and they lead to models, theories, verification or refutation of hypotheses, et cetera. And they typically involve logical, objective, and quantifiable procedures. Now, qualitative methods, in contrast, are based on observations, interviews, et cetera. And from that, we want to extract how does a user feel or what choices will they make or how do they explain their actions? And it involves subjective, interpretive, and seeking meaning. But, of course, also do triangulation where we combine those two different methods. [So, if you mute your microphone there, others will not hear your chair squeaking.] OK.

### **Slide 43: Canvas Learning Management System (LMS)**

So if we go to the home page for the chorus, we can see that it basically looks like this. You can go to a module where there's lots of different course material, you can look at the syllabus that gives you a timeline of what's going on. You can see the other people in the chorus, what sections they're in. You can see how you're progressing by looking at grade book. You can see the assignments, etc. And there's a description about all of this.

### **Slide 44: Using Canvas at KTH: Modules**

So what are these module things? Well, modules are basically. Sort of the equivalent to folders in that you can put pages, assignments and other things into a module. So here's a module and there are multiple modules of the course.

### **Slide 45: Example page: Contents**

Those pages are essentially wiki pages. And here's an example of one of them. And you have a previous and next button - so you can go through them in the order that they are in the module if you wish.

### **Slide 46: Keyboard shortcuts when watching videos**

A very useful thing when you're watching the videos is a bunch of keyboard shortcuts, and here's a quick summary of them and a little warning at the bottom about the fact that it's actually using the key codes, not the letters. So if you happen to be using a Swedish keyboard, the plus sign is actually a minus. And the key to its right mark, typically backslash is actually the plus. So as you are trying to use the Keyboard to speed up or slow down - map your fingers appropriately. But a really useful thing is the spacebar, because it can toggle between play and pause. So you can listen along at the spacebar and stop. You can also use the left and right arrows to jump forward and backwards. And with the control key, it's



multiples of 10 seconds instead of five seconds. And of course, you can hit the home key and go to the beginning or go to the end. Very useful.

### **Slide 47: FAQs and Common feedback (module)**

Now, one of the important things in the course is I spent a lot of time building, of course, content, and one of them is a frequently asked questions page for the course and another submodule with some information on common feedback, where I summarize the common feedback on project plans, research plans, and the slide presentation for common mistakes and guidance about writing, or common comments on draft reports and presentations, or things to think about before submitting your paper rather than after you've submitted your paper. It's a little too late. And there are some hints that you'll find useful for future assignments.

### **Slide 48: Good examples (module)**

There's also a module about good examples. An example of a good opposition report. A nice example of decimal aligned tables when you have tables, with numbers with decimal points in them, you want them all to align because it makes it easier to compare the results. Or pairing figures and tables. And there are a whole variety of these.

### **Slide 49: Avoiding looking stupid (module)**

But there's also another module. Which for want of a better name, I called "Avoiding looking stupid". And basically these are mistakes which if you do them, you basically look stupid. Now. Some students, and I won't pick on any particular group of students, don't pay attention to the content of the various modules and don't pay attention to the content of web pages, and so they do things like use the KTH logo in their report. But in fact, you're not permitted to do that. The only time that a non-employee can use the logo is it will appear on the outside cover of your thesis, but otherwise you're not allowed to use it. Having irrelevant references. One of my favorites is people citing Wikipedia. Wikipedia is not a primary source, so you shouldn't be citing it in your report. And a lovely set of examples where it's clear that no one had ever tried to actually find these references in the reference list because they couldn't find the.

### **Slide 50: Summary of the videos (in a module)**

It's also a summary of the videos. With the name of the video, who is responsible for it, a transcript as a DOCX file, and the caption as an SRT file. So if you're interested in textual processing, you might find this as an interesting source of data and perhaps useful for your studies.

## **Slide 51: Canvas Student App**

There's also a Canvas student application that you can run either on Android or Apple smartphones. You may find that useful.

## **Slide 52: Mobile app examples**

Some people like to, as they're going along, pull out their mobile phone, and you'll see this very commonly in Sweden. Here's what the course might look like if you looked at it with the mobile app.

## **Slide 53: Modules**

You can see the modules. You can open them up.

## **Slide 54: Syllabus**

You can see the syllabus. So you can see the dates and times of when things are due.

## **Slide 55: Quiz with video**

And you can even do the quizzes and watch the videos on your mobile device. And depending on your particular hardware, if you rotate the phone, you can get it in the landscape or portrait mode. And as I mentioned, the videos have captions you can turn them on or off.

## **Slide 56: References**

Here are some of the references for this first lecture. And there's also a Zotero group, and you'll learn more about the tool Zotero, as a means for being able to organize references that you're using and collecting.

## **Slide 57: ¿Questions?**

And now we'll take questions, and I should note, if you have questions for Professor Smith, he welcomes you to send them to him by email: [msmith@kth.se](mailto:msmith@kth.se). And you'll see later that he has a lecture about quantitative data. So at this point, I will stop [screen] sharing.