

ACTA ACADEMIAE STROMSTADIENSIS

Lars Broman



**How to Write a Master of
Science Communication
Thesis**

No. XXIV, FEBRUARIUS MMXIV

ISBN 978-91-86607-25-8

How to Write a Master of Science Communication Thesis

Abstract

The present text is a compendium aimed at use in an introductory research course for master students specifically in science communication, but maybe also useful for master students in adjoining topics within e.g. education.

Keywords

Science communication, master education, master thesis, Science center, planetarium

Foreword 2014

During the years 2003-2009, 50 students graduated from the 50-week Masters Program in Science Communication at Dalarna University – in retrospective an amazing achievement. For unclear reasons, the Vice Chancellor of the University Agneta Stark decided to shut down the program. Presently, there is still no such education at any Swedish university while similar programs are run in many universities in other European countries.

The Masters Program at Dalarna University had a specific characteristic, aiming at training students for work in science centers, planetariums, and with interactive activities at museums. Many of the graduates indeed have such jobs today (but I have to admit that I cannot give any specific figures). Some of them also continued their academic career and now have a PhD.

Out of the 50 weeks, 20 were scheduled for writing a Master Thesis, including an introductory course, doing fieldwork at a suitable institution, writing, and finally defending the thesis at a seminar.

The present compendium, which now is published for the first time, was used during the thesis introductory course. It was for the most part taught by me, but Anna Larsson, librarian at Dalarna University, taught the literature search part. The text that she wrote, subchapter 3.2, has here been replaced by a short but updated text by me.

It is hoped that the text can find its way to students in the field and, maybe, helping pave the way to a new Master Program in Science Communication somewhere in Scandinavia.

Falun, February 2014

Lars Broman
lars.broman@stromstadakademi.se

Contents

Abstract	2
Keywords	2
Foreword 2014	2
Preface	5
1. Introduction	6
1.1 An R&D study	6
1.2 Pre-requisites	6
1.3 The process	7
1.4 The required goal	7
<i>Exercise I: James Bond, James Bond (today's date)</i>	8
2. Before the research starts	9
2.1 Finding a suitable project	9
2.2 Writing a proposal	9
3. The research	11
3.1 Method	11
3.2 Literature search	12
3.2.1 Useful Scientific Data Bases	13
3.2.2 Selected Open Access Science Communication Journals	13
3.3 Required tools	14
3.4 Measurements and data treatment	14
3.4.1 Basics	14
3.4.2 Advices	15
3.4.3 Examples of possible R&D studies	15
3.5 How to terminate a project	16
3.6 Handling a failure	16
<i>Exercise II: James Bond, A science communication micro study</i>	18
<i>II.1 Step one: Field work</i>	18
<i>II.1.1 Fieldwork 2003-4</i>	18
<i>II.1.2 Fieldwork 2004-5</i>	19
<i>II.1.3 Fieldwork 2005-6</i>	20
<i>II.1.4 Fieldwork 2006</i>	20
<i>II.2 Step two: Writing a report</i>	21
4. The thesis	23
4.1 Contents	23
4.1.1 Abstract	23
4.1.2 Keywords	23
4.1.3 Introduction	23
4.1.4 Method	24

4.1.5 Experiments, observations, and measurements	25
4.1.6 Results	25
4.1.7 Discussion	26
4.1.8 References	26
4.1.9 Appendices	26
4.1.10 Ethics and photos	26
4.2 Writing and grading process	27
4.3 Form	27
<i>Exercise III:</i> James Bond, A science communication project proposal	29
Appendix 1 This is Science Communication at Dalarna University	30
A 1.1 Dalarna University - Högskolan Dalarna HDa	30
A 1.2 Science Communication at Dalarna University	31
A 1.2.1 Introduction	31
A 1.2.2 Staff 2005-6	31
A 1.2.3 International co-operation	32
Appendix 2 Questionnaire for micro study task 12-14/9 2006	34
Appendix 3 Examples of R&D Tasks	36
Appendix 4 Curriculum Science Communication Master Program	37
Appendix 5 Science Communication Theses 2004-9 at Dalarna University, Borlänge, Sweden	41

Preface

The third group of Master in Science Communication - for short, MSC - students are now in the middle of their studies. Your teachers have therefore gained some experiences from their work with two previous groups, and our aim is to keep improving.

Some parts of the program have however been tried out at beforehand. Thus, the first 7.5 credit course in Science Center Education at Dalarna University started in the fall of 1995. It was followed by yearly courses, and gradually new courses were added, so towards the end of the millennium it was possible to study 30 credits of Science Center Education. These courses were all part-time distance courses. (Credits here are the standard ECTS credits. One Swedish "academic point" equals 1.5 ECTS credit as well as one full week of study.)

The next step was to create a 30 credit A-level one-semester full-time course that was built on the previous experiences and also influenced and inspired by the Masters Program in Communicating Science at University of Glamorgan in co-operation with the Techniquest Science Center in Cardiff, Wales. This course is an optional program course for students studying to become teachers, but also open for other students. It has been given yearly since 2001. It consists of the following four 7.5 credit units:

- Communicating science, general part: Science and informal learning.
- Communicating science by means of interactive exhibition.
- Communicating science by means of experience program.
- Evaluating science communication.

The course was slightly revised for the academic year 2004-5 and re-named Science Communication A. More information on the course is found at www.ScienceCommunication.se and at the course home page (at fronter.du.se).

In late 2001, a new kind of Master exam was introduced in Sweden, called "Master with width" while the old one is a "Master with depth". This new kind of master studies should be open to students with different backgrounds, it should be multidisciplinary, and it should prepare for a profession. I immediately realized that a program leading to a Master of Science Communication (or, as it was initially called, Master of Interactive Science Communication) would be an ideal "Master with width". It is a 75 credit 50-week program with six 7.5 credit units from September through March plus a seventh 30 credit Master thesis to be accomplished during five months, April through August. One of the six first units is called Research methodology, and this compendium is one of several texts included. It took some time to make this new education become a reality, but the first group of MSC students met on 1 September 2003.

There is however one more background to this compendium: In 1999, a master level program in solar energy engineering, called European Solar Engineering School ESES, started. I soon found out that the students needed an introductory course at the beginning of their thesis work, so I wrote a compendium called "How to Write an ESES Thesis". Some experience from the use of that compendium is also background to the present one.

Finally, this has to be looked upon as a gradually improved version of a compendium. Your comments are appreciated! (4th Ed., slightly revised and expanded September 2006.)

Lars Broman, September 2006

1. Introduction

The MSC curriculum says the following about the aim of the 1 1/4-year program: The aim is to give knowledge and experiences of science communication specializing in interactive methods. Its aim is also to prepare students with undergraduate education for work with extramural learning, especially at museums, science centers, and planetariums.

In order to reach this goal, and also to fulfill the requirements of a Swedish master's degree, a major research or evaluation project leading to a master level thesis, is included in the program. According to the curriculum, the master thesis unit contains three months supervised field work at a science center, planetarium or museum with opportunities to participate also in the institution's activities. The field work is followed by writing of a thesis and a seminar week where several theses are presented and discussed.

The aim is to give familiarity with a science center, planetarium or museum, and to write and defend a 30 cr. thesis in Science Communication. It is strongly believed that working together with professionals at such an institution, to perform independent R&D (research and development) work including writing and defending a thesis provides a good background for future work in the field.

1.1 An R&D Study

The Norwegian scientist Svein Sjøberg describes scientific research as consisting of two phases: *Phase one is creative and constructive, almost artistic. Phase two is systematic, well structured and critical. Science advances in an interplay between these two parts. Even if it logically is two different phases, they will in practice often walk hand in hand, more or less simultaneously. Bold thinking and critical testing.*

This is an aim to strive for! To add some creative new knowledge instead of re-inventing what is already known, knowledge that survives criticism. While your thesis will be in the field of applied social science rather than in basic science, the aim is the same. With this in mind, the 20 weeks of internship, field work, writing and defending a thesis, is preceded by a 10-week half-time research methodology course.

1.2 Pre-requisites

You, the student, have the following personal pre-requisites (or you would not have been admitted to MSC studies in the first place): BA or BSc with major in your chosen subject. Minimum half a year of professional experience. But at the beginning of your work, you won't (necessarily) have much previous knowledge of a museum, science center or planetarium. Probably, you also have no or very little experience of doing R&D (research and development) work related to such an institution.

Therefore, it may take some time both to decide what you want to do and to have sufficient subject knowledge to be able to judge your work. This is why the interplay between you and your local supervisor will be important right from the beginning. She (or he) will be an

experienced museum, science center, or planetarium professional. You will also have a supervisor who is an experienced researcher and (typically) based at Dalarna University. The supervisors are part of the pre-requisites. Together you will have to decide your area of work.

Depending on the type of work, certain equipment will be needed. The project that you will be involved in is likely to include visitor observations of and interaction with persons visiting or in other ways associated with the place of your field work. It may include experiments, measurements and/or computer simulations, but it may be solely theoretical. In any case, you will at least need access to a computer for both literature search and writing your thesis.

1.3 The Process

In your R&D work, you will participate in most of the activities that are normally included in such work: Find a suitable project. Write a proposal. Decide which research method(s) to use. Make a literature search. Get access to necessary equipment. Acquire appropriate theoretical background knowledge. Perform the observations and other field work. Compile and interpret data. Draw conclusions and formulate the results. Write and defend a thesis.

Since you are a research student, no-one expects you to know how to do all these things beforehand. This is why you need supervisors who guide you through the R&D process. Some of you will chose to work (more or less) on your own, while others will participate in the work of a group, consisting of other students and/or museum/science center/planetarium personnel.

In the process you will have to study and learn about your subject, so by the end you have a good understanding of what you have done.

1.4 The Required Goal

You are expected to write a thesis that contains some originality, either on your own or with co-authors; in the latter case, a preface and summary explaining your role in the joint project is required. You are also expected to defend your thesis at a seminar where one of your fellow students acts as an opponent. Finally, you are expected to read a fellow student's thesis, present it at a seminar, and expose your fellow student's thesis to well-founded criticism. The grading of your thesis work will be a weighted average of how well you do all the three tasks. The defending and opposition will for students beginning a fall semester take place during the last week of next October and for those beginning a spring semester during the last week of the following March.

For students studying part-time, a later defense will be accepted, but usually it is requested that at least two students' thesis are discussed during the same days.

Exercise I: James Bond, James Bond (today's date)

(This exercise is omitted for MSC students unless otherwise requested)

You shall write a report with less formal requirements than a research report. The report is about yourself and shall include the following chapters:

- General background
- Academic background
- Interest related to MSC
- Expectations on MSC year
- Plans for the future

The report shall be 1-3 pages long and written on PC computer in Word (.doc) format and using Times New Roman 12 pt or similar font. Its main text shall be written as running text with full sentences, paragraphs of suitable length, and in English. Use a spell-check program. Include an electronically processed photo of yourself. The report shall be submitted both on paper and as a file on diskette.

You shall also make a summary as an itemized list and minimum 18 pt text as a PowerPoint (.ppt) file; just one page. You will be requested to present your report orally and using your file at a seminar, where each student will get 5 minutes to present her/his report. The report shall be presented two weeks after receiving the assignment. Distance students will have to submit a recorded 5-minute presentation.

Towards the end of the MSC year, you will get a chance to add a chapter on how your expectations were met as well as any changes regarding your future plans.

2. Before the Research Starts

The idea behind the organization of courses is to make it possible for MSC students to be engaged in research-related activities during two semesters. The time interval between start of the second semester and beginning preparation of the R&D work should therefore not be too long. There is however a certain process involved in finding a suitable project and planning how to proceed.

2.1 Finding a Suitable Project

The theme of your project is chosen in agreement between you, your local supervisor, and your main supervisor. The initiative can both be yours or one of your supervisors'. Typically, the project is related to the institution where you do your field work.

First when a project has been decided upon, the next step can be taken, writing a proposal. Ideally, this is done during the research methodology course, i. e. before the field work starts. In some cases this is not possible, but has then to be done as early as possible during the field work. Appendix 2 will give some examples of R&D tasks.

2.2 Writing a Proposal

Once the student has chosen a R&D project, she/he has to write an R&D proposal. This is typically 3-10 pages long and contains the following information:

- i.** Your name.
- ii.** Project title, or at least a provisional title.
- iii.** Aim of the work. If it is part of a group work, both the goal of the whole project (which may be several years ahead) and what you, the student, plans to achieve should be stated. Your aim should be to create knowledge that has some aspect of newness to it. This doesn't mean that you have to invent a completely new way to do visitor studies, or write a new computer program, but for instance finding out the educational result of an existing exhibition or program in a surrounding in a place or in a way that this hasn't been done before. It can also be to compile data or knowledge in a new (and hopefully useful) way, or finding out how some exhibits can be modified or used in a previously untried way.
- iv.** Work place: the museum, science center or planetarium where you are an intern.
- v.** Supervisors. The proposal must be accepted by both the local supervisor and the main supervisor before it is presented.
- vi.** Financing. Your field work might be associated with costs. Such costs may be for equipment, construction material, technical help, or travel. It is unlikely that Dalarna University will be able to cover more than SEK 1000 for a single student.

vii. Starting point. The proposal shall include some information of the present state of knowledge regarding the project. Best is a short description including a reference to recently published report or journal article. The student may instead cite a supervisor (or some other expert). Include also some reference to a book or article where theoretical background is found. A more thorough literature study can wait until later.

viii. Rough time table. This should include approximate start and end times of the different phases of the project as outlined in Chapter 3; note that of course phases may overlap in time. Make room for a progress report at a special seminar (at Dalarna University or at the institution where the fieldwork is done) towards the end of the internship. You are advised to start writing the thesis no later than two months before it shall be defended and plan to have it printed no later than one week before the defense.

The student is advised to stay in contact with both the local and the main supervisor when making the proposal.

Writing a proposal is one of the mandatory tasks in the Research methodology unit. It will be graded as all other tasks that you do during your science communication studies.

3. The Research

A master thesis in Science Communication is either a research project, or an evaluation project, or both. While a research project aims at providing results that can be generalized, an evaluation study is chiefly of interest for the institution where the study is done. Both kinds are quite appropriate for a thesis. Since the field work is done while the student is an intern at a science center, planetarium or museum, it is really evident that the study will be an evaluation of some activity that is related to the internship place.

Once the proposal has been accepted both by the local and the main supervisor, possibly after some revision, the work should get started without delay as soon as you have become acquainted with the field work place. Even if you work more or less on your own, make sure to stay in touch with your supervisors on a regular basis - at least once every two weeks - even if there isn't much to report. Note that this is your responsibility, not the supervisor's!

3.1 Method

Your R&D work may be predominantly based on (visitor) observations, interviews or use of questionnaires. The work can be dominated by compiling research from field work already done. Your study is probably an evaluation relevant for your place of field work, but it may also be possible to draw some general conclusions. You can work alone (under guidance, of course), in pairs, or as a member of a team. Your study may be typically realistic or typically idealistic. You will, as good as possible, know at an early stage which parameters you are interested in, and conduct your study accordingly.

R&D studies related to science centers, planetariums and museums usually mean visitor studies. On the other hand, visitors constitute a disparate group, and visitors are not the only interesting persons to study. Thus, the possible categories to investigate are:

- (1) Visitors: school groups (pupils, teachers), family groups (adults, children), other groups (adult groups, teachers, scout groups, etc).
- (2) Staff: educators, exhibition constructors/designers, docents, voluntaries, directors, trustees.
- (3) Non-visitors: the interested/non-interested general public, politicians, executives at financing councils/foundations/funds, and even science communication students.

There are many phenomena that could be investigated: The institution itself. Exhibitions. Separate exhibits. Outreach programs. Participatory theater in the science center. Special campaigns. Educational supplementary material. Prepared v. non-prepared school visits. School visits as part of a series of class activities. Visitor roles in e. g. mixed adult and child groups. How visitors interact with exhibits. Comparison between exhibit(ion) intentions and outcome. Interactivity in the planetarium. And these are just examples.

There are several variables that you may want to investigate. In what ways are visitors influenced by the visit (and pre- and post-visit activities)? New knowledge, new attitude, new interest, special or side effects (like ability to cooperate, proficiency in experimenting, courage to experiment)?

Then, there are different variables that may affect the outcome of e. g. a visit to a science center: Gender, age, school grades, education, teacher's enthusiasm, previous visits, etc - the list can be made very long and the researcher's problem is to decide which such variables should be studied.

Especially when studying learning, you might couple the visitor's experience to Howard Gardner's eight intelligences (linguistic, musical, logical-mathematical, spatial, bodily-kinesthetic, interpersonal, intrapersonal, existential), or to Benjamin Blooms hierarchy of understanding (knowledge, understanding, analysis, synthesis, evaluation), or to Perry's six factors that determine museums as places of learning (curiosity, confidence, challenge, control, play, communication), or to George Hein's characterization of the constructivist museum, or Abraham Maslow's hierarchy of human needs (bodily needs, safety, solidarity and affection, appreciation, self-realization).

You are advised to procure a large (and well-bound!) **note book**, which you use as a diary during the whole research period - planning - field work - thesis writing - thesis defense. Here you write down ideas, study setups, plans, discussion notes, quotes from articles, field work data, calculations, references, contacts, ... - in short, *everything* that is related to your project, in chronological order. You will soon be amazed by how quickly you forget little details if you haven't written them down, and by how many times you realize that something that seemed less important at a time, later proves to be a quite useful piece of information.

3.2 Literature Search

This important part of the work is heavy in the beginning, but seldom completed until the very end. The reason is mainly threefold:

- To provide the theoretical background of the work.
- To give an actual list of (recently) published work related to the present with special emphasis of what has been done before - and what has *not* been done.
- To be able to include a good reference list in the thesis that gives the reader a chance to study first-hand both background theory and contemporary related publications.

Typically, the search begins at the Science Communication library and the university library, which contain still small but growing numbers of useful books, journals and articles. Probably your supervisors will give you some ideas about where to start. Articles found will contain references to previous papers that may be of interest. Authors will be found interesting and you will try to find more recent publications by them.

Next, you will use the university library's electronic facilities to search for literature related to your work. The library has access to a large number of data bases and electronically published articles, abstracts, key words, headings and authors. The number of possibilities is growing all the time.

3.2.1 Useful Scientific Data Bases

Google scholar, <http://scholar.google.se/>. Advanced search permits combining words, sentences, author, etc. This is a quite comprehensive and useful search tool

There are also two Swedish useful data bases where scientific texts are listed:

DiVA, Digitala Vetenskapliga arkivet, <http://www.diva-portal.org/>. Almost all Swedish and a few Norwegian Universities list most publications in DiVA. Here you can also find all issues in Acta Academiae Stromstadiensis – also of course available also here: <http://www.stromstadakademi.se/Skriftserier.htm>. Many titles in DiVA are available in full-text.

Libris, <http://libris.kb.se/>, is where all titles at Swedish libraries – both university and public libraries are found. Most titles are listed just as titles, but you will find the libraries that have them. Through e.g. a university library, you can make distance loans of else hard to find books.

3.2.2 Selected Open Access Science Communication Journals

Many scientific journals in the field of science communication are available open access on the web, either with article abstracts or with full text articles. Here follow some examples.

International Journal of Science Communication,
<http://www.tandfonline.com/loi/rsed20#.Usr69yyA3IU>

Journal of Research in Science Communication,
[http://onlinelibrary.wiley.com/journal/10.1002/\(ISSN\)1098-2736](http://onlinelibrary.wiley.com/journal/10.1002/(ISSN)1098-2736)

JRST - Journal of research in Science Teaching,
[http://onlinelibrary.wiley.com/journal/10.1002/\(ISSN\)1098-2736](http://onlinelibrary.wiley.com/journal/10.1002/(ISSN)1098-2736)

Journal of Science Education and Technology,
<http://www.springer.com/education+%26+language/science+education/journal/10956>

JCOM – Journal of Science Communication, <http://jcom.sissa.it/archive/12/3-4>

Public Understanding of Science, <http://pus.sagepub.com/>

Science Communication, <http://scx.sagepub.com/>

Studies in Communication Sciences, <http://www.sciencedirect.com/science/journal/14244896>

Along list of over 40 journals in science education is available at
<http://homepages.wmich.edu/~rudged/journals.html>

3.3 Required Tools

For all kinds of research, tools are required, and this applies to some degree also to social science R&D. Typical tools can be monitoring equipment (video, audio recording), computer with necessary software, means of transportation, a special exhibit that shall be tested. While the equipment you will use usually is present at the place where you do your field work, it may have to be supplemented with additional instruments or tools. There is (of course) a limited budget for purchasing additional equipment, and the University sometimes has

bureaucratic ways of handling purchases. Therefore you are advised to discuss any purchases with your supervisor(s) (unless you are prepared to buy something with your own private money).

In order to be able to use any equipment in meaningful measurements, you have to master the apparatuses. Be prepared to spend time learning how some special equipment is used. Note that safety may also be involved. A good way to learn how to use some specific equipment is to do the same measurements as someone else has done before. You will be satisfied when you are able to replicate previously known data.

Among useful tools is different computer software, both general (like Excel) and specific statistical programs. Again, you will usually have to spend several hours with a program in order to be able to use it meaningfully.

You may be able to do useful measurements without being an expert on the theories behind the phenomenon that you study, but in order to be able to interpret your data, you need to understand the science behind your study. You have learned basic knowledge on informal learning, museology, and research methodology before doing the field work of your study. Most probably, you will in addition to this need to read other texts more specifically connected with your work. A continued literature search when you work with your project is encouraged, since, as you work, you will understand more and more the theoretical background that is relevant for your thesis project.

3.4 Measurements and Data Treatment

3.4.1 Basics

Experimental research includes measurements - direct or recorded observations, interviews, enquiry forms. Your study objects are usually human persons even if the aim of your study is to evaluate an exhibition, a planetarium program, or some other product. How to do a study that is both valid - measures what you want to measure and nothing else - and reliable - gives reproducible data - is not always easy to know. While validity cannot really be measured, there are statistical tricks to control the reliability, like randomly dividing the studied population in two groups and compare the result between the groups. If triangulation - doing a study three times, with three methods, or on three separate populations - is performed, and the three studies give the same result, then it even should be possible to generalize the results.

A realistic or idealistic study? Both kinds of study have its merits. In a realistic study you try to do your observations under controlled circumstances and measure variables that can be treated with statistical methods, including being able to calculate uncertainties making it possible to prove (or "prove"?) that e. g. a certain effect has been reached. An idealistic study instead permits you to stumble upon interesting facts since you do the study more open-minded and your observations may drift away into the unpredicted.

Other variations, somehow connected with this, is whether you do structured or unstructured interviews, whether your enquiry forms have only closed answers (multiple-choice) or space for open answers (which will be more difficult to categorize for statistical analysis), and whether your visitor observations are described by ticking boxes in a table or described in words. R&D can have the form of action research, where you yourself are active in what is

studied. Even if it is generally regarded as difficult (since it is so hard to keep unwanted parameters under control) it is frequently advised to have a control group when you will study how an activity has changed the behavior of the studied group.

3.4.2 Advices

It usually requires quite a lot of experience to do good experimental measurements, but there are some general advices that will be of good help for the not-so-experienced researcher:

- Keep a diary! It is virtually impossible to write too many details. Write it chronologically. For every comment, write both date and time of entry.
- Don't just measure for many days without contemplating your results! You may be on the wrong track, or be missing some important parameter or constant. Show results frequently to colleagues and discuss with them. Use results to determine following steps.
- Don't vary more than one parameter at the time. It is hard enough to get good statistics with one variable. Since you may want at least twenty experimental values for each variable, with just five simultaneous variables you will need over three million variable combinations - more than enough for a lifetime's research!
- Do measurements several times, if possible with more than one method or using more than one study object. You will have no or very little idea of how certain your results are until you have come back to the same variable value at least three times. Then, but only then, do you have sufficient amount of data to get a good average value - with experimental errors.
- When starting a study of something unknown or using a newly invented method, it is usually a good idea to first measure something that is known. If you get the same result as the previous, then you can trust your method.
- When presenting data in a diagram, be sure you understand the difference between statistical fluctuations and real fluctuations. A single point over or above a smooth curve is never ever a real deviation from the average trend. Don't just connect experimental points.

3.4.3 Examples of Possible R&D Studies

Here are some examples of what could be studied:

- (1) Invite pupils (school classes) who investigate an interactive exhibition that you have constructed. Especially observe the exhibits' "attracting power", "holding power" and "learning power".
- (2) Ask teachers and pupils what they want a science center to provide if they were allowed to wish whatever they want.
- (3) Ask pupils and their teachers about their favorite planetarium show topics. (And make sure to interpret the answers correctly - some might suggest astrological themes rather than astronomical.)

(4) A previous study has shown that senior high school students who major in natural sciences have become more interested in this field by visiting science centers. The study also showed increased interest in astronomy as result of visiting a planetarium. This was done several years ago, so it is time to do the study once more, but this time include also other senior high school students and other activities (like excursions into nature, visiting science festivals, and popular science programs in TV).

(5) Visit a school and bring a Starlab mobile planetarium. Give several classes a lesson in the Starlab. Return a week later and find out what pupils (and teachers) thought about the experience and find out whether they learned anything.

(6) Find classes who have experienced both a mobile planetarium and a normal planetarium and ask pupils and teachers to compare the experiences.

(7) Find all science centers, planetariums and mobile planetariums in the Nordic countries, establish contacts with someone working there, and list basic facts including how and how much it is used. Then interview the staff at some of the places and ask them (e. g.) to characterize their work situation.

3.5 How to Terminate a Project

Unfortunately, a project seems never to reach its goal. It may well reach the initial goal, but during the work, new interesting problems will appear and you will want to include their solutions as well. On the other hand, solving the original problems may be much trickier than anticipated from the beginning. So when the time comes to start the final writing of the thesis, you will just have to ask yourself (and your supervisor) this question: Have I done sufficient work and reached interesting enough results anyway? If the answer is Yes, terminate. If the answer is No, you will have to accept facts and realize that you won't be able to finish in time.

3.6 Handling a Failure

First: A complete failure should not have to happen! After all, you have supervisors, and if you follow the advices in this compendium, you meet and discuss with her/him on a regular basis. If anyone of you realizes that your assigned project is heading towards a disaster, switch to another project!

Secondly: A partial failure just may happen. With this I mean that the end product, your thesis, is of a lower quality than either you or your readers are happy to accept. Again, the choice is yours: Either, add a month or two of hard and intelligent work, and you may be happy with what you have achieved. Or, you will have to accept that this time you weren't up to something better than this, and will have to live with it. Maybe science communication wasn't really your field after all?

Exercise II: James Bond, A Science Communication Micro Study

The themes of the science communication micro studies for February 2004, 2005, and 2006 are given below. You will have two weeks to complete the task. The research project itself ought to be conveniently completed in no more than one or two days, which should give you sufficient time to write a nice little report, essentially following the guidelines in Section 4.1.

Your report shall be handed in electronically as a Word file. You shall present your results during max. 10 minutes at a seminar, so you are requested to produce a PowerPoint file for this occasion as well. A distance student may instead supplement the file with a recorded oral presentation. Bring a few paper copies to the seminar on 8 February 2006 at 1630-18.

The main reason for these projects is to give MSC students some training in writing an R&D report in a similar form to that in which the final theses will be written. Since you, the student, will have no more than about 40 hours of time for the whole project, the investigation itself will have to be a very short one. It is, on the other hand, more interesting if what you do still is useful, which it will be if the combined effort of all students is useful. The micro study project for 2006 will, for every student, therefore have the title

A Summative Evaluation of X Interactive Exhibits in Y science Centers Using Visitor Studies

and give some clue to the question "Why seem some exhibits appeal to visitors more than others?"

II.1 Step one: Field Work

II.1.1 Fieldwork 2003-4

The field work is done during the study tour. You will be assigned an A-level student and two of the science centers that we visit on the tour. You and the assigned student will go together at the center, and you will have to note how long you stay at each exhibit (where you stay more than just a few seconds).

The A-level students will know beforehand that they will be studied for a training research study. You should however NOT tell her what you are studying (except that they will see that you take notes during the visits). Only some weeks after the tour, when your report is ready, will they learn the aim of your investigation.

After the visit, in the evening the same day, you will interview the student. This time, don't use a recorder, but take notes. Ask these questions:

(1a) What did you like the center that we visited together today (/in comparison with other centers that you have visited before)?

Possible answers: Not much. Average. Among the best. (Or some other answer.)

(1b) What was the chief reason for your judgment?

(2a) Name the three exhibits that you found most rewarding in order from the best to the number 3.

(2b) Why did you like these exhibits?

Possible answers: It was amusing. It was educational. I think kids like it. I haven't seen an experiment like this in a science center before. (Or some other answer.)

Note the reasons for the three exhibits separately.

(3a) Give an example of an exhibit that you didn't like.

(3b) Why didn't you like this exhibit?

NOTE: Master's students who don't participate in the study tour will have to do the same study on their own. Try to choose a visitor who has some academic background, so your results are comparable with the others' results.

II.1.2 Fieldwork 2004-5

During the study tour 31/1-4/2 2005, you shall investigate minimum five different exhibits at three different science centers during at least 15 min each. You shall determine how good is the exhibits' attraction power, their holding power, and their learning power. You shall do this by observing visitors - families or school children. The chapter "Observations" should name and shortly describe the investigated exhibits (name also the science center). Your result is a table with the five (or more) exhibits, giving a ranking No. from 1 (the best) to 5 (the last) in the three categories of power.

For determining learning power, use the Hilke (1989) categories of action-events which are considered learning-related (as cited in Hein 2001, p 112):

Learn first hand or fact-oriented	Learn second-hand or interpretive
COOPERATIVE	
Ask to verify	Ask to describe
Verify	Describe
Verify response	Describe response
Ask to deny	Read aloud
Deny	Ask what someone thinks
Deny response	Ask interpret
Ask inform	Interpret
Inform	Interpret response
Inform response	Ask explain
Ask name of	Explain
Name	Explain response
Name response	Ask for analogy
Ask to show	Make analogy
Show	Analogy response
Show response	Verbal cooperation
Ask minimum	Show how
Say minimum	
Minimum response	
Say don't know	
Repeat	
Correct	

PERSONAL	
Touch	Look graphics
Move-on-look	Listen
Gaze at	Listen intently
Look intently	
Manipulate	

You might want to add some categories since you are in a science center, not in a museum. You might want to omit some categories in order to simplify your task - especially since (most of) you don't understand what the visitors say to one another (so you have to rely on their body language - this procedure is not unheard of; even if the observer knows the language it is usually difficult to hear what the visitors say at a distance).

II.1.3 Fieldwork 2005-6

During the study tour 30/1-3/2 2006, you shall investigate minimum eight different exhibits at four different science centers during at least 10 min each. You shall determine how good is the exhibits' attraction power and their holding power. You shall do this by observing visitors - first semester students. The chapter "Observations" should name and shortly describe the investigated exhibits (name also the science center). Your result is a table with the eight (or more) exhibits, giving a ranking No. from 1 (the best) to 8 (the last) in the two categories of power. You should also include a personal comment for each exhibit on how well you think that the exhibit lives up to the six criteria of your choice, Paris' or Perry's (see below). Do this by giving a grade from A (best) to F (failed) for each criterion.

II.1.4 Fieldwork 2006

During the study tour 12-14 September 2006, not only second semester students (who do the micro study) but also other students (first semester students and course students) will participate. These students shall be given a questionnaire, common to all students. On Friday 8 September 1500-1700 some students met with me and finalized the questionnaire. The questionnaire is in Appendix 2, page 35f. It consists of two parts:

- (1) 5 questions related directly to the student including name, gender, previous academic background, country of origin, plan of future work or studies. Questions 2-4 will be used as variables, and each of the micro researchers will concentrate on one variable each.
- (2) (a) 2 questions labeled A and B related to the visited science centers/museums as a whole (comparing them with one another) + (b) One question on each center labeled C-F comparing 5 different exhibits on how they are liked.

After the study tour, each micro researcher should have a full set of answers (so some copying will have to be done), collect them in a table (and maybe also a diagram), find out how answers differ (or don't differ) according to the variable, and formulate a conclusion in a short Discussion chapter. **Example:** If your variable is age (under 25, over 25) compare how the group of young students and the group of older students answered questions A-F.

Don't forget that you should have a list of references! The list should as a minimum contain the compendium How to Write an MSC Thesis.

II.2 Step two: Writing a Report

The report shall look like the Master's Thesis that you will write after your big field work, but of course it will be very much shorter. Therefore, it has to include all the chapters that the Thesis will have, as outlined in Chapter 4. Use Times New Roman throughout the report.

Page 1 is the title page. Write your name with 16p bold letters high on the page. Write the title with 24p bold letters in the middle of the page. Write "Master of Science Communication Micro Study, February 2006" with 14p bold letters low on the page.

Page 2 contains the contents of the report, written somewhere in the middle of the page. It shall read as follows:

Contents (14p bold)

	page
Abstract	x
Keywords	x
1. Introduction	x
2. Methods	x
3. Observations	x
4. Results	x
5. Discussion	x
References	x
Appendix	x

On page 3, the text of the report begins. Use 12p letters throughout, except chapter headings, which are 16p bold. Use straight left hand margin, but don't justify (i. e. no straight right hand margin). Leave two empty lines above each heading and one empty line after each heading. Paragraphs start at the left hand margin (no indent) and are separated with one empty line. If you have a figure, a diagram or a table, put the caption below it and use 12p italics.

Note that you shall not start each new chapter at the top of a page (which you will do in your master's thesis); nor will you use any sub-headings (labeled 1.1, 2.3.4, or the like). The complete text will probably be between 2 and 4 pages long, so the complete report will be 4-6 pages.

Your Introduction chapter should include the theoretical background, i. e. the Paris' and Perry's criteria plus the reason why you prefer (and use) the one that you have chosen. Then in the Discussion chapter you can comment on the validity of the criteria for your study of exhibits, while they were originally meant for a whole museum visit.

This is Paris' list "the 6 Cs" (with comments after Frøyland):

- Constructing personal meaning - visitors are more motivated to learn something that seems personally relevant and useful.
- Choices - when visitors choose what to learn, they will use more energy to learn.
- Challenges - the activities should neither be too difficult nor too simple.
- Control - it has been shown that a child who governs the process of learning learns more.
- Collaboration - social relations motivates and is stimulating, and people in a group work harder.

- Consequences of learning - solving problems in collaboration with others makes visitors more focused on processes that to learn the right answers.

Perry's six factors for a successful museum experience (see comments in Hein 2001):

- Curiosity - the visitor is surprised and intrigued.
- Confidence - the visitor has a sense of competence.
- Challenge - the visitor perceives that there is something to work towards.
- Control - the visitor has a sense of self-determination and control.
- Play - the visitor experiences sensory enjoyment and playfulness.
- Communication - the visitor engages in meaningful social interaction.

References:

Paris, S. G. (1997). Situated motivation and informal learning. *Journal of Museum Education* Vol 2, No 2-3, pp 22-27. See also Frøyland, M.(2002). MEMUS, a theoretical framework for museum mediation, p 3. In Frøyland, M.(2002). *From Granite to Real Silver*, University of Oslo. Oslo: Unipub forlag (in Norwegian).

Perry, D. L. (1992). Designing exhibits that motivate. *Association of Science-Technology Centers Newsletter* Vol 20, No 1 pp 9-10 and 12. See also Hein, G. E. (2001). *Learning in the Museum*. London: Routledge, p 152.

4. The Thesis

For title page, the same design as this compendium will be used. The layout will be added afterwards, so the first page of your manuscript should have the following information, each on separate line(s): The title of the thesis. The word "Author(s)" followed by the name(s). The word "Supervisor(s)" followed by the name(s).. Leave page 2 without text. Paginate (page numbers) on the top and central - no number on page 1! - as in this compendium. Use MSWord and Times New Roman - no other fonts. Bread text in 12p.

4.1 Contents

Contents follows on page 3. Use the style used in this compendium. Heading (without number) in 14p bold.

4.1.1 Abstract

The Abstract follows on page 4. It is a summary of your report, 100-200 words long (not shorter, not longer). The abstract should be placed after 10 empty 12p lines. Heading without number in 14p bold. An empty 12p line between the heading and the text

4.1.2 Keywords

On the same page, after the Abstract, and after an empty line, follows the keywords of your thesis. Begin the text line(s) with "**Keywords:**" in 12p bold. Then, on the same line, list, with commas between the words, 5-15 keywords. Some obvious keywords are science center, science communication, visitor studies. Other keywords that you might want to use are enquiry, extramural learning, hands-on exhibits, informal learning, interactivity, interviews, museum, outreach program, planetarium, visitor observations, and several others.

4.1.3 Introduction

This is your first chapter, so its heading reads **1. Introduction**, written in 18p bold. It begins on page 5. A new chapter always starts on a fresh page, so insert "new page" before each new chapter. Add three empty 18p lines before the heading and one after.

Chapters are usually divided into sections, and sections into sub-sections. Section headings (16p bold, numbered as 1.1) and sub-section headings (14p bold, numbered as 1.1.1) get two empty lines before and one empty line after. It is not recommended, but if you want even lower grade headings (12p italic, numbered as 1.1.1.1) they have one empty line above and no empty line below.

More important, what should the Introduction chapter contain? These are the seven "must"s:

(1) Place of field work.

(2) Background: why and how was the project chosen?

(3) Aim of the project; usually also a hypothesis regarding the results. Later, in the Discussion chapter, you will compare the aim and the hypothesis with the outcome of your study. The hypothesis is rather based on previous studies or theory than on intuitive guess.

(4) Previous knowledge, previous studies. To prevent yourself from "re-inventing the wheel", you have to find out what is already done and known according to published articles and books. A good literature study before doing the field work also helps you to - as Isaac Newton is supposed to have said - stand on the shoulders of giants. A study that begins where a previous investigation has stopped has a good chance to yield a useful result. Previous studies may have used questionnaires, interview forms, classification schemes or some other tool that could be useful; it would e. g. make it possible to compare the outcome of your investigation with that of a previous one which maybe was done in a different setting, or in similar institution somewhere else. Proper references must be given to all articles and books which you pick information from (or even cite; see below).

(5) Theoretical background. Since your study will be related to communication of science, you will want to show that you are literate in theories of learning and possibly other aspects of communication between individuals. Rather than referring directly to Piaget and Vygotsky (as almost everyone does), I suggest that you refer to more modern authors that have brought the elder giants' theories a bit further. Proper references, of course!

(6) If there is more than one author of the thesis, a statement that describes in some detail each author's contribution to the study.

(7) Thanks to your hosts and supervisors and possibly others who have been helpful to you.

A note on citation: If you describe in your own words something from a paper or a book, you treat it as regular text. If you make a direct citation and pick one or several sentences from another work, you should put the text in separate paragraph(s) and give the citation an extra 1 cm margin both left and right - like I have done with this paragraph. Be stingy with direct citations!

4.1.4 Method

Chapter 2, Method, describes what the title says. Explain when, where and how the study was done. Tell what you have investigated. If you have studied people (and you probably have), describe the group(s) that you have studied - visitors (family groups, school children, teachers, etc), science center staff, politicians, people who haven't visited the place, etc.

Describe the method(s) used: visitor observation, interviews, enquiries, if you have done an action type study (where you e. g. find out how an activity that you have governed has affected your studied group), if you have investigated your studied group both before and after, if you use a control group. During interviews, did you record, videotape, or take notes?

Also describe any assisting material you used like classification sheets, exhibition maps, visitor used cameras or recorders. If you have used a combination of methods, then described how you did it (as e. g. first a questionnaire handed out to 100 pupils followed by interviewing 10 selected pupils).

Classify your study as quantitative or qualitative, realistic or idealistic. Describe the method(s) you have used when analyzing your data, if you have done a statistical or other quantitative analyzes.

4.1.5 Experiments, Observations, and Measurements

The third chapter describes the field work. If your prime data (e. g. transcribed interviews or staff diaries) fills many pages (say more than five), you are advised to put them in an appendix and here just give tables and specially interesting quotations. If your prime data fills more than (say) twenty pages, you might have to consider presenting just typical responses.

In any case, when describing your study, you must treat your studied individuals in such a way that it impossible for a reader of your report to identify them. Instead of (e. g.) labeling visiting schoolchildren "girl A", "girl B", "boy C", "boy D", etc, you make the thesis more pleasant to read if you use aliases like Andrea, Betty, Charlie, and David.

Sometimes, it might even be that your study is sensitive to the institution where you did it, especially if it is unfavorable for it. Then you should get its permission to disclose its name in the report (and hopefully get it). In any case you must write the true story and absolutely not present tampered data.

The heading of this chapter will probably differ from the suggested "Experiments ...".

4.1.6 Results

Here you present and summarize the results of your study, in tables, diagrams, and/or by categorizing the studied visitors (or other individuals, exhibits, labels, or whatever you have studied). Here you might categorize visitors according to gender, age, education, whether part of a group, time spent in an exhibition, or other categories that could be interesting.

It is fairly important to make the description of the results readable and understandable - and of course in a way that makes the results of your study seem interesting. If there are no gender differences, for example, that seems to be of minor interest - but, if another similar investigation showed definite such differences, then this result is important.

4.1.7 Discussion

In this chapter, results compared with your hypothesis, with previous results and with theory. You should point out what in your results are new, and comment upon the usefulness for your host institution and (possibly!) for other similar institutions. A sub-chapter that describes the validity and the reliability of your work is mandatory.

4.1.8 References

Whenever you get information from another source, you must refer to it. The reference list must contain all articles, papers and web sites that you refer to in the text. You may not include anything in the reference list that you haven't referred to in the text.

You should use the so called Harvard system for references. That means that in the text, you make a reference in one of two ways. Examples:

"As Eva Lund (1998) has stated, ..." "In another study (Lind and Ek 2003b), it was shown ..."

Then in the reference list, start each reference at the left margin and have an empty line between the references. References are given in alphabetical order after the first author's name. If there is more than one reference to an author, they are listed in order of publication year. If the same author has more than one publication in the list that is published the same year, the references are labeled (2003a), (2003b), etc. The title of the book or the journal is written in italic. Examples:

Lind, Anna and Ek, Olof (2003b). How to increase the holding power of interactive exhibits. *Journal of Informal Learning* Vol. 6, pp 132-142.

Lund, Eva (1998). *Science Communication Research in the Nordic Countries*. New York: Bantam Books.

How many references? Well it would be strange if a master thesis wouldn't need at least ten references. On the other hand, a hundred references is definitely too many.

4.1.9 Appendices

Here, you will put the different tools in form of questionnaires, enquiry forms, etc. Examples of answers if they are interesting (like children's drawings if you have asked a group of pre-school kids to respond to you in this way). Raw material like transcripts of recorded interviews. Personally, I like as much as possible of such material to be included, but then the problem is that the Appendix section of your thesis may become too large. In order to keep the number of pages down, you are here allowed to save space by using as little as 10p in transcripts. Still, the upper limit is about 20 pages or 1/3 of the complete thesis, whichever is lowest.

4.1.10 Ethics and Photos

You do your field work in an institution that has accepted you as a field worker and accepted that your thesis is about the institution. Therefore, you can write where the field work was done, and you can also have photos from the place. Research ethics however require that persons that you interview or who answer your questionnaires are anonymous in your thesis.

There is also a problem if you have photos of people in your thesis. If people are recognizable, you need their permission to publish the photo. This is especially important if you have children in the photos - then you need the custodian's permission. A way to come around the problem is to take photos where the people in them are seen only from behind. This is OK to publish and good research ethics.

4.2 Writing and Grading Process

The writing is either your own work, or it is done together with your co-worker(s). In the latter case, a summary of the work, written by you, that includes an account of your part of the work and the achievements must be included in the Introduction chapter. Your co-author is probably a fellow student, but sometimes your work results not only in your thesis but also in a journal paper, co-authored with your supervisor(s). Make sure to start writing long before the spring semester has come to an end! And make sure that your supervisor follows and comments on your writing while chapter after chapter reaches a preliminary form. Always use a spell-check program before letting anyone else read what you have written.

The thesis must be ready and printed ten days before the day of the seminar when you will defend your thesis. Defense week is the last week of October for students who begun the previous fall and last week of March for students who begun the previous spring. At this occasion, when many students, the main supervisor (and maybe some local supervisors) and some examiners are present, one of your fellow students will have read your thesis. She/he will give a short account of its contents and then you will have a chance to comment or add something. Then, your fellow student will ask questions and criticize your thesis, and you will defend what you have written. Finally, the others present will be able to ask questions, comment, and criticize your work, and your defense continues. The whole process should take no more than one hour.

During the rest of the week, the other students' theses will be described, criticized and defended in the same way. You are supposed to be the presenter and main critic of one fellow student's thesis (and you will have one week to prepare this).

After seminar week, you will get the chance to improve your thesis, making use of comments and advices given at your defense. While there is no specific time limit before handing in your final version, but you are recommended to do so within 2 weeks. The grading will be set primarily from the quality of your thesis, secondly from the quality of your defense, and thirdly from the quality of your description and critic of your fellow student's thesis.

4.3 Form

A MSC thesis presents the results of the equivalence of 20 weeks full time study. It has the form of a report, size A4, text and figures on one side of the pages. The report is typically 40-80 pages long and it contains normally the chapters outlined in Section 4.1.

There are two basic forms of a MSC thesis: Either it is a monograph, authored by the student, or it consists of one or more articles, which are authored by the student, by the student and a fellow student and/or her supervisor. In the latter case, the thesis must include an introduction that presents the highlights of the paper(s) and specifies the student's contribution to the reported project. Both forms are equally acceptable.

Especially in the second case, with the supervisor as co-author, the paper(s) are probably also published in some other way - in a conference proceeding or in a scientific journal.

The MSC thesis will be published in two ways: in paper form and electronically in .pdf (Acrobat) format. The paper copy will be of the type "print on demand" and very few copies

will be made (initially). Interested readers will be encouraged to retrieve the thesis from the home page on www.ScienceCommunication.se, where it will be available free of charge. Because of this, the thesis has to be submitted complete as one file, with graphics and all, in .doc (MS-Word) format. The file can be on diskette or CD-ROM, or as an e-mail attachment. Dalarna University will then add a standard front page, print a few copies, and - after the thesis has been accepted - put it as a .pdf file on the home page.

It is suggested that the student uses the font Times New Roman (or its equivalent) throughout, with the bulk text in 12 pt. single spaced. Separate paragraphs with an empty line and don't use indentation. The first page carries the student's name in 16 pt. and the title in 24 pt. Chapters begin on a new page and are numbered 1, 2, etc. Chapter headings are 18 pt. bold. Sections begin after double space, are numbered 1.1, 1.2, etc. and use 16 pt. bold as heading font. Sub-sections begin after double space, are numbered 1.1.1, 1.1.2, etc. and use 14 pt. bold as heading font. The thesis has page numbers starting with "1" centered on top. See for instance this manual as an example both of what is mentioned here and of other format specifications (like margins).

***Exercise III:
James Bond, A science communication research project
proposal***

Write a Proposal following the outline in Section 2.2. One week after given the task, you will be expected to present it at a seminar (using one or more transparencies) during maximum 10 minutes. The discussion following your presentation may suggest some changes or additions before your proposal is finally accepted. Distance students will have to provide a recording of the oral presentation.

The Proposal shall be written as running text with full sentences, paragraphs of suitable length, and in English. Use a spell-check program. Included illustrations (diagrams, etc.) shall be incorporated electronically in the same file as the text, since the report shall be submitted both on paper and as a file on diskette.

Appendix 1

This is Science Communication at Dalarna University

A 1.1 Dalarna University - Högskolan Dalarna HDa

Högskolan Dalarna is one of Sweden's newer universities situated in Dalarna, one of Sweden's most picturesque provinces, north-west of Stockholm. The University currently has about 7000 students coming from all parts of the country. Approximately half of them study in Falun, the administrative capital of the province, while the rest study in the neighboring town of Borlänge; this is where science communication is studied.

We offer a choice of over 50 complete programs of study and over 200 one-semester courses. Högskolan Dalarna has made great progress in developing a new approach to research and post-graduate programs. We offer a cross-disciplinary environment for post-graduate study in which students have close contacts with senior research staff and other post-graduate students at the same time as they read courses and receive additional supervision at a traditional university or institute of technology.

The University has chosen to sharpen its focus in certain specialty areas. Applied research and development work, including technology transfer, are activities of growing importance. These are undertaken in close cooperation with other universities, other partners in the public sector and a wide range of partners in private enterprise. An ambitious reorganization program has resulted in the new profiled groupings and has committed the University to increased support of research and advanced course work as well as strengthening the range of courses offered at undergraduate level in these groupings.

The University is also organized in five institutions, each of which is divided into subjects. Science Communication is a subject that belongs to the Institution of mathematics, science and technology.

At Dalarna University, students can study on first degree programs and for Master's degree in a variety of subjects ranging from the humanities and social sciences to natural sciences and engineering. Options include reading a set program of study or combining subjects to create an individual degree program. Freedom of choice and flexibility characterize our programs of study making changes of direction or moves to other universities entirely possible. We also have a considerable number of international student exchanges and research contacts with a number of universities in several countries.

For more information see www.du.se.

A 1.2 Science Communication at Dalarna University

A 1.2.1 Introduction

The subject Science Communication carries out education and research specializing in how science communication is done in science centers, in planetariums, and with interactive methods in museums. Courses are given at undergraduate and master level. See also our home page www.ScienceCommunication.se.

A 1.2.2 Staff 2005-6

Five DU staff members teach most of the lectures, seminars, and laboratory exercises:

Lars Broman, professor and subject leader, lbr@du.se

Hannu Salmi, adjunct professor, hsl@du.se, hannu.salmi@heureka.fi

Ernst van Groningen, associate professor and program leader, evg@du.se

Maria Björkroth, assistant professor, mbj@du.se

Per Broman, BSc, pbn@du.se

Some other DU staff members teach in the courses as well:

Jan-Erik Berg, assistant professor, biology education, jeb@du.se

Dick Nilsson, lecturer, literature science, dni@du.se

Svante Nordlander, licenciate of technology, solar energy engineering, snr@du.se

Also external experts lecture, including:

Örjan Hamrin, lecturer, Dalarnas Museum, orjan.hamrin@dalarnasmuseum.se

Daniels Sven Olsson, director, Falun Copper Mine Museum,

daniels.sven.olsson@kopparberget.com

Claus Michelsen, visiting professor, claus.michelsen@dig.sdu.dk

Advisory Council:

Elisabet Eronn, director, Futures' Museum, elisabet@framtidsmuseet.se

Jan Raihle, director, Dalarnas Museum, jan.raihle@dalarnasmuseum.se

Daniels Sven Olsson, director, Falun Copper Mine Museum,

daniels.sven.olsson@kopparberget.com

(Note: Almost all emailaddresses are now (January 2014 obsolete)

A 1.2.3 International Co-operation

(Note: The following was in effect in 2006)

We participate in the network **NNORSC**, Nordic Network of Researchers in Science Communication. For information about the network, see www.ScienceCommunication.se/nnorsc.htm.

We are members of **ESConet**, European Science Communication Network, www.esconet.org.uk.

We are members of **ECSITE**, the European Collaboration for Science, Industry and Technology Exhibitions, www.ecsite.net.

We are members of **NPA**, the Nordic Planetarium Association, www.planetarium.se/npa. Lars Broman is president and Per Broman secretary/treasurer of NPA.

We are members of **IPS**, the International Planetarium Society, www.ips-planetarium.org. Lars Broman is member of the IPS Council as representative for the Nordic and Baltic countries, and he is co-editor of Planetarian, the journal of IPS. IPS gives yearly a 500 US\$ grant to two science communication students, who do internship/fieldwork at a planetarium.

We participate in the EU projects **ESCW** and **Hands-on - Brains-on** on science communication studies, financed by the EU Commission ucapt0s@ucl.ac.uk.

We co-operate with a large number of science centers, museums and planetariums, on field work and internship for master students:

CANADA

H.R. Macmillan Space Centre, Vancouver, BC, www.hrmacmillanspacecentre.com

Science North, Sudbury, Ontario, www.sciencenorth.ca>

Science World British Columbia, Vancouver, BC, www.scienceworld.ca

DENMARK

Elmuseet, Bjerringbro, www.elmus.dk

Experimentarium, Copenhagen, www.experimentarium.dk

Orion Planetarium, Jels, www.orionplanetarium.dk

ESTONIA

AHHAA, Tartu, www.ahhaa.ee

FINLAND

Arctic Centre, Rovaniemi, www.arcticcentre.org

Heureka, Vantaa, www.heureka.fi

FRANCE

Explor@dome, Paris, www.exploradome.com

GERMANY

Museum am Schölerberg, Natur und Umwelt, Planetarium, Osnabrück, www.museum-am-schoelerberg.de

ITALY

Fondazione IDIS - Città della Scienza, Naples, www.cittadellascienza.it

Volcan-Explor-Action, Palermo, Italy www.volcana.org

SWEDEN

Dalarna University's 101 Experiments and Stella Nova Planetarium, Borlänge
www.sciencecommunication.se

Falun Copper Mine World Heritage, Falun, www.kopparberget.com

Innovatum, Trollhättan, www.innovatum.se

Navet, Borås, www.navet.com

Technichus, Härnösand, www.technichus.se

Tekniska museet, Stockholm, www.tekniskamuseet.se

Tom Tits Experiment, Södertälje, www.tomtit.se

TRINIDAD AND TOBAGO

NIHERST/NGC National Science Centre, www.niherst.gov.tt/scipop/nsc/index.htm

UK

at-Bristol, Bristol, www.at-bristol.org.uk

Planetarium, South Tyneside College, South Shields, www.stc.ac.uk

VANUATU

Vanuatu Cultural Centre, www.vanuatuculture.org

Appendix 2: Questionnaire for micro study task 12-14 September 2006

1. **Name:** _____

2. **Gender:** Male Female

3. **In which continent were you born:** _____

4. **BSc/BA major subject:** _____

5. **What are your plans after studying Science Communication?**

Work in a Science Center

Continue to PhD studies

Work as a teacher

Others: _____

A) You have visited four institutions (Tom Tits Experiment, National Museum of Natural History, National Museum of Science & Technology, Heureka) list them in order of how much you liked them starting with the best

- 1) _____
- 2) _____
- 3) _____
- 4) _____

Why did you like your number 1 as the best?

B) List these four institutions according to the level of interactivity.

- 1) _____
- 2) _____
- 3) _____
- 4) _____

C) List from number 1 to number 5 the following exhibits at Tom Tits Experiment in order of how much you liked them: The Diver. The Penrose Pattern. The Chaotic Disc. Magnetic Art. Total Morphing.

- 1) _____
- 2) _____
- 3) _____
- 4) _____
- 5) _____

D) List from number 1 to number 5 the following exhibitions at Nat. Museum of Natural History (same order).

4½ billion years – The history of Life on Earth
 Life in Water – Water, light and nutrients
 Swedish Nature
 Discover the extraordinary world of the Polar Regions
 Treasures from the earth's interior

- 1) _____
- 2) _____
- 3) _____
- 4) _____
- 5) _____

E) List from number 1 to number 5 the following exhibits at Nat. Mus. of Science and Technology (same order).

The Model Railway
 Amateur Radio Station
 The Mechanical Alphabet
 Metals
 The First Furnaces

- 1) _____
- 2) _____
- 3) _____
- 4) _____
- 5) _____

F) List from number 1 to number 5 the following exhibits and/or exhibitions at Heureka (same order).

Find your way through the maze
 Cube to infinity
 It's about time
 The universe and the laws of nature
 The changing environment

- 1) _____
- 2) _____
- 3) _____
- 4) _____
- 5) _____

Appendix 3

Examples of R&D Tasks

Evaluation of an exhibition

Front-end evaluation: Participating in the planning process of an exhibition

Formative evaluation: Studying an exhibition while it is produced, set up and inaugurated

Summative evaluation: Studying an exhibition while it is in use

Evaluation of an institution

Front-end, formative or summative evaluation of a science centre, planetarium, or museum

Evaluation of an activity

Co-operation between a science centre and schools, researchers, industry, or associations

Co-operation between science centres

Use of computers or IT in a science centre

Use of labels, both from institution and visitor point of view

Use of drama in a science centre

Study comprehensive actions

Study public (national or regional) and private financial and other support of science centres

Compare how different support situations affects science centre activities - industry views?

To what degree and in what way are guides/explainers used in different science centres

Study comprehensive ideas

Investigate reasons for running science centres regarding target groups

What topics are cherished by science centres? 19th century physic or . . . ?

Making kids interested in science, or working for PUS - public understanding of science?

What education and background do science centres/planetariums want when hiring new staff?

Connection between science centres and science, pseudo-science, democracy, religion, freedom of speech, cultural environment, media, special interest groups, environmental issues

Basic methods

Visitor studies - visitor observations, questionnaires, interviews, focus groups

Staff studies

Studying other groups - policy and decision makers, politicians, informal leaders

Literature studies - theoretical background, other research, previous evaluations, media using books, journals, proceedings, reports, theses, internet

Research or evaluation?

Research is connected to current research in the field and results can be generalized

Evaluation is predominantly of (great!) value for the studied institution

Appendix 4

CURRICULUM

Science Communication

Vetenskapskommunikation
75 ECTS Credits

fall03-

Master education

Course leader/Examiner: Lars Broman

The course is given at Campus Lugnet.

AIM

The aim of the course is to give knowledge and experiences of science communication specializing in interactive methods. Its aim is also to prepare students with undergraduate education for work with extramural learning, especially at museums, science centers, and planetariums.

CONTENTS

Science Communication consists of seven parts; six 7.5 credit parts and a 30 credit master thesis:

- (1) Popular science.
- (2) Informal learning.
- (3) Introductory museology.
- (4) Popular science writing.
- (5) Applied museology.
- (6) Research methodology.
- (7) Master thesis.

Part 1: Popular science 7.5 cr.

The part consists of popular science deepening by means of lectures by, among others, invited researchers, and by reading of actual popular science literature and "research close" journals, which are discussed during seminars. The aim is to give acquaintance with the research frontier within current sciences and the habit to follow the development within different sciences, especially the own science.

Part 2: Informal learning 7.5 cr.

The part consists of studies in science education with special emphasis on informal learning such as it is used in science centers, planetariums, and museums. Field trip with visits on museums, science centers and planetariums. The aim is applicable knowledge about learning, especially informal learning with emphasis on the own subject.

Part 3: Introductory museology 7.5 cr.

The part contains basic museology with special concentration on interactive exhibitions, science centers and planetariums. Laboratory work aiming at giving some insight in how to construct interactive exhibits and audiovisual slide shows, as well as how to handle a mobile planetarium.

Part 4: Popular science writing 7.5 cr.

The part gives an introduction to popular science writing, partly for different media (newspaper articles incl. presentations and evaluations, manuscripts for radio and TV, planetarium programs and other audiovisual programs), partly for interactive exhibitions (exhibit labels, exhibition brochures). The aim is familiarity with different aspects on popular science writing.

Part 5: Applied museology 7.5 cr.

The part emanates from a theoretical deepening within a specific science area. In relation to this build a hands-on exhibition is built and an audiovisual slide show for computer projection is produced, taking target group, scientific contents, educational aspects, design, labels, security, technical aspects, pictures, narration, background music, audio sound and visual effects, and costs. The aim is knowledge and practical experience regarding how to create interactive exhibitions and planetarium programs.

Part 6: Research methodology 7.5 cr.

The part consists of basic social science research methodology with special emphasis on education research in museum, science center and planetarium environments, including library knowledge and information search. The aim is to prepare the students theoretically for writing a 30 cr. thesis in science communication.

Part 7: Master thesis 30 cr.

The part contains three months supervised field work at a science center, planetarium or museum with opportunities to participate also in the institution's activities. The field work is followed by writing of a thesis and a seminar week where several theses are presented and discussed. The aim is to give familiarity with a science center, planetarium or museum, and to write and defend a 30 cr. thesis in Science Communication.

MODES OF STUDY

The course is primarily for full time studies, but it can also be studied part time (1/4 or 1/2 time studies) or as distance studies. Partially problem oriented mode of work. Lectures by specialists (also as tele conference and in connection with study visits) and seminars. Contacts lecturers/students between lectures by means of Internet. One week field trip. Individual subject deepening (chosen in agreement with the examiner). Creative work within the chosen science area. Individual educational master thesis. Course languages Swedish and English.

EXAMINATION

Students who have a Swedish university exam with a minimum of 120 Swedish points (180 ECTS cr.) or a comparable foreign exam, and who have studied the course and passed all the exams will achieve a Degree of Master of Science Communication, Magisterexamen i vetenskapskommunikation. Examinations consist of: Written exams. Written/oral reports of theoretical and practical home work, of subject deepening, and of the individual thesis. Presentation and documentation of exhibition and audiovisual program. Mandatory participation in field trip and seminars, and of opposition to another student's master thesis.

GRADES

Grades are given as Passed with distinction (ECTS: A, B, or C); Passed (ECTS: D or E); or Not passed (ECTS: F). The grade Passed with distinction on the whole course requires Passed with distinction on 37.5 credits of courses and Passed on the other courses.

PREREQUISITES

A Bachelor of Arts or Science Degree (corresponding to 180 undergraduate Swedish credits) or equivalent. Minimum of 1/2 year professional work, preferably within the area of the degree, also preferably at a science center, planetarium, or museum.

Subject: Additional.

Host subject: Science communication.

Area of study: Natural sciences 70 % Education 30 %.

Literature

Master Course in Interactive Science Communication 75 ECTS credits

(The part to which the titles belong are given with a figure in bold.)

Bell, J. 1999. Doing Your Research Project: A Guide for First-time Researchers in Education and Social Science. Open University Press. 248 pp. ISBN 0335203884. or Bell, J. 1995.

Introduktion till forskningsmetodik. 3e uppl. Studentlitteratur. 174 pp. ISBN 9144013957. **6**

Broman, L. 1999. Naturvetenskap på museum, 2a uppl. Högskolan Dalarna. 160 pp. **2, 3, 5**

Broman, L. 2003. Monertexter/Exhibit Labels. HDa. Ca 50 pp. **4**

Broman, L. and Ott, A. 1997. Naturvetenskapens världsbild, 2nd ed. Liber. 128 pp. ISBN 9163414201. **1**

Broman, P. 2001. Om konsten att skapa bildspel på dator/How to create audiovisual shows on computer. Broman Planetarium. 51 pp. **5**

Broman, P. 2002. Aktiviteter i astronomi. Broman Planetarium. 32 pp. **3**

Broman, P. 2002. Starlab planetarium - en handledning/Starlab Planetarium - an Introduction. Broman Planetarium. 21 pp. **3**

Broman, P. 2003. Compendium on Excel in Social Research. Högskolan Dalarna. Ca 10 pp. **6**

Burcaw, G. E. 1997. Introduction to museum work, 3e uppl. Alta Mira Press. 237 pp. ISBN 0761989269. **3**

Delsemme, A. (2001). Our Cosmic Origins. Cambridge Univ Press. 322 pp. ISBN 0521794803. **1**

Hein. G. E. 1998. Learning in the museum. Routledge. 216 pp. ISBN 0415097762. **2**

King, S. 2001. On Writing. Nel. 367 pp. ISBN 034076998X or King, S. 2001. Att skriva: En hantverkarens memoarer. Bra Böcker. 246 pp. ISBN 9171337792. **4**

Levin, J. and Fox, J. A. 2003. Elementary Statistics in Social Research, 9th ed. Allyn and Bacon. Excerpt 200 pp. ISBN 0205362702. or Edling, C. och Hedström P. 2003. Kvantitativa metoder. Studentlitteratur. 205 pp. ISBN 9144041578. **6**

Lovelock, J. (2000). Gaia: A New Look at Life on Earth. Oxford Univ Press. 176 pp. ISBN 0192862189. **1**

Ott, A. 2000. Science Center - Forum för lärande. Göteborgs universitet. 80 pp. **2**

Scanlon, E., Whitelegg, E., and Yates, S., red. 1999. Communicating Science: Contexts and Channels. Routledge. 286 pp. ISBN 0415197538. (Part I: What the public needs to know and why. 36 pp. **3** Part II: Alternative contexts for communicating science. 138 pp. **6** Part III: Science and the media. 112 pp. **4**

Serrell, B. 1996. Exhibit Labels. AltaMira Press. 256 pp. ISBN 0761991069. **4** or Ekarv, M., Olofsson, E., and Ed, B. 1991. Smaka på orden. Carlsson. 270 pp. ISBN 9177983920. **4**

Sjøberg, S. 2000. Naturvetenskap som allmänbildning. Studentlitteratur. 430 pp. ISBN 9144009992. **2**

Sundstedt, K. 2001. Att skriva för film. Ordfront. 270 pp. ISBN 9173246115. **4**

Thurén, T. 2000. Populärvetenskapens retorik. Liber. 156 pp. ISBN 9147049952. **4**

Wilson, K. 1994. So you want to build a planetarium. Int. Planetarium Society. 31 pp. **3**

Zinsser, W. 2001. On Writing Well. 8th ed. Quill. 308 pp. ISBN 0060006641. **4**

One semester of subscription to two popular science journals such as Forskning och Framsteg and Sky and Telescope, and following popular science reporting in radio and TV. **1**

Further popular science literature within the student's area of interest, chosen in agreement with the examiner. **1**

Articles chosen from the international journal Planetarian. Ca 100 pp. **5**

Texts for deepening within a scientific area, chosen in agreement with the examiner. 300-500 pp. **5**

Text related to the thesis, chosen in agreement with the examiner. Ca 500 pp. **7**

Referenslitteratur (studerar extensivt):

The Exploratorium Science Snackbook. 1991. Exploratorium Teacher Institute. 290 pp. ISBN 0943451256. **5**

Journal articles incl. articles in scientific journals, compendiums, museum and exhibition brochures, etc.

Separate titles can be exchanged to equivalent literature in agreement with the examiner.

(Ca 2000 pp)

Note: After agreement with the examiner, certain titles can be exchanged with comparable literature.

Appendix 5

Science Communication Theses 2004-9 at Dalarna University, Borlänge, Sweden

HDa-SC-01

Kristel Mõistus, Estonia (2004)

Supervisor Lars Broman

Local supervisor Chantal Barriault, Science North, Sudbury, Ontario, Canada

Visitors' Interaction with the Exhibits According to the Learning Behaviour

115 pp

HDa-SC-02

Thomas Keilman, Norway (2004)

Supervisor Lars Broman

Local supervisor Delphine Dalencon, MicroCosm, CERN, Geneva, Switzerland

Experiencing Science in Action: The Use of Exhibition Techniques in Guided Tours to a Scientific Laboratory

90 pp

HDa-Sc-03

Celeste Chariandy, Trinidad and Tobago (2004)

Supervisor Lars Broman

Local supervisor Maureen Manchouk, NIHERST/NGC National Science Centre, Trinidad and Tobago.

The Impact of the NIHERST/NGC National Science Centre, Trinidad and Tobago, on Visiting Student Groups

61 pp

HDa-SC-04

Claudette Martin, Canada (2004)

Supervisor Lars Broman

Local supervisor Donna Livingstone, H R MacMillan Space Centre, Vancouver, Canada.

Examining Visitor Attitudes and Motivations at a Space Science Centre

48 pp

HDa-SC-05

Hamid Asgari and Kayvan Seyed Nejadin, Iran (2004)

Supervisor Lars Broman

Local supervisor Per Broman, Högskolan Dalarnas temporära Science Center, Falun, Sweden

Important Parameters in Designing and Presenting Exhibits and Planetarium Programs in Science Centers. A Visitor-Based Framework

160 pp

HDa-SC-06

Petter Börjesson, Sweden (2004)

Supervisor Lars Broman

Local supervisor Elisabet Eronn, Framtidsmuseet, Borlänge, Sweden

Public Authorities' Use of Exhibition

72 pp

HDa-SC-07

Gloria Tiny Seitei, Botswana (2004)

Supervisor Lars Broman

Local supervisors Valerie Collins and Catherine Aldridge, @Bristol, Bristol, UK

A Front End Evaluation of 'Tester' Exhibition to be Developed into a Traveling Interactive Sports Exhibition

84 pp

HDa-SC-08

Renée Göthberg, Sweden (2005)

Supervisor Lars Broman

Local supervisor Sara Bagge, NAVET, Borås, Sweden

NAVET's Boxes – an Evaluation of the Post-Visit Loan Service at a Science Centre in Borås

61 pp

HDa-SC-09

Karin Lundberg, Sweden (2005)

Supervisor Lars Broman

Local supervisor Catherine Aldridge, @Bristol, Bristol, UK

Citizens and Contemporary Science. Ways to Dialogue in Science Centre Contexts

97 pp

HDa-SC-10

Lottie Engdahl, Sweden (2005)

Supervisor Lars Broman

Local supervisor Karl-Olof Cederberg, Historiska museet, Stockholm, Sweden

Middle Ages Dead or Alive. An Evaluation of the First Interactive Exhibition at the National Museum of History

79 pp

HDa-SC-11

Md. Khademul Islam, COUNTRY (2005)

Supervisor Lars Broman

Local supervisor, Ernst van Groningen, Högskolan Dalarnas tillfälliga Science Center, Borlänge, Sweden

Pupils' Interaction with a Science Center: Communication Perspective Analysis

94 pp

HDa-SC-12

Ning Zhang, China (2005)

Supervisor Hannu Salmi

Local supervisor Kati Tyystjärvi, Heureka, Vantaa, Finland

Science is primary. Children Thinking and Learning in the Chemistry Laboratory

78 pp

HDa-SC-13

Joseph Merlin Bayeck, Cameroon (2005)

Supervisor Hannu Salmi

Local supervisor Per Broman, Dalarna University; field work done at Falun Copper Mine, Falun, Sweden

Evaluation of the "Mechanical Alphabet" of Christopher Polhem: Comparative Study of Two Models at the Falun Copper Mine

87 pp

HDa-SC-14

Gemuh Nicol Nsobam, Cameroon (2006)

Supervisor Ernst van Groningen

Local supervisor, Helen Penny, @Bristol, Bristol, UK

How well has the Live Science Zone(LSZ) of Explore, @-Bristol met its objectives?

86 pp

HDa-SC-15

Elvis Ngwa Forbeteh, Cameroon (2006)

Supervisor Ernst van Groningen

Local supervisor Emma Cook, @Bristol, Bristol, UK

Developing Labels to Increase Audience Understanding and Engagement with Exhibits

73 pp

HDa-SC-16

Miao Xu, China (2006)

Supervisor Lars Broman

Local supervisor, Lars Petersen, Orion Planetarium, Danmark

A Study of Visiting Students Groups to Planetarium Shows

46 pp

HDa-SC-17

Shibly Ahmed, COUNTRY (2006)

Supervisor Ernst van Groningen

Local supervisor, Eva M. Hans, South Tyneside College, UK

The history of planetaria in UK

102 pp

HDa-SC-18

Katja Salewski, Germany (2006)

Supervisor Maria Björkroth

Local supervisor Mariana Back at Tekniska museet, Stockholm, Sweden

Museum Personalized. The Impact of Floor Staff on an Exhibition – A Holistic Approach

57 pp

HDa-SC-19

Bettina Bretschneider, Germany (2006)

Supervisor Ernst van Groningen

Local supervisor Petra Mohr at ExploHeidelberg, Heidelberg, Germany

Children Learning About Primary Science In Informal Settings

70 pp

HDa-SC-20

Yang Yu, China (2007)

Supervisor Hannu Salmi

Local Supervisors Eduard Thomas & Jürgen Rienow at Mediendom, Kiel, Germany

Exploring the Upgrade Space of Planetariums

63 pp

HDa-SC-21

Anny Markussen, Denmark (2007)

Supervisor Lars Broman

Local supervisor Julie Kjær-Madsen, Danfoss Universe, Danmark

Maximizing the Outcome for Teenagers Visiting a Science Center - with an Application to Digital Technology

42 pp

HDa-SC-22

Ziyu Jiang, China (2007)

Supervisor Maria Björkroth

Local Supervisor Georg Stenstrop at Elmuseet, Bjerringbro, Danmark

From School to Science Museum: An Evaluation of the Guided Tour Program at an Electricity Museum in Denmark Based on School Groups Grade 5-7

42 pp

HDa-SC-23

Warittha Kwamsuk, Thailand (2007)

Supervisor Lars Broman

Local supervisor Mariana Back at Tekniska Museet, Stockholm, Sweden

Enhancing the Experiences for People with Special Needs in the 4D Theatre

79 pp

HDa-SC-24

Markus Huemer, Germany (2007)

Supervisor Lars Broman

Local supervisor Emma Sanders, MicroCosm, CERN, Switzerland.

Proactive Evaluation in the Development of Design Recommendations for Interactive Exhibits

113 pp

HDa-SC-25

Yong Chin Tatt, China (2007)

Supervisor Maria Björkroth

Local supervisor Nicolas Gunslay, Arctic Centre, Rovaniemi, Finland

Front-end Evaluation for New Permanent Arctic Exhibition: Visitor and Non-Visitor Perspectives

40 pp

HDa-SC-26

Reza Saheban, COUNTRY (2007)

Supervisor Hannu Salmi

Local supervisor Nicolas Gunsley at Arctic Centre, Rovaniemi, Finland

Advertising for Science Communication: How to Apply Advertising Strategies to a Science Center

90 pp

HDa-SC-27

Luoluo Wang, China (2007)

Supervisor Lars Broman

Local supervisor Claire le Moine at Exploradome, Paris, France

Learning Experience at Two Interactive Exhibits in a Science Centre; a Visitor-based Study

49 pp

HDa-SC-28

Bilal Anwar, COUNTRYa (2007)

Supervisor Lars Broman

Local supervisor Elisabet Eronn, Framtidsmuseet, Borlänge, Sweden

Touch-Screen Visitor's Survey Programme

86 pp

HDa-SC-29

Azmat Shahzad Gondal and Zaheer Rehman Tanoli, COUNTRYe (2007)

Supervisor Ernst van Groningen

Local supervisor Hanne Ödén, Lummelundagrottan, Gotland, Sweden.

People's interaction with Lummelundagrottan According to Learning Behavior

72 pp

HDa-SC-30

Inga Gryl, Germany (2007)

Supervisor Lars Broman

Local supervisor: Olaf Kretzer, K.E. Ziolkowski Planetarium, Suhl, Germany

The Influence of Astronomy Education in Schools and Planetariums on Astrological Beliefs

146 pp

HDa-SC-31

Lu Sun and Xingxing Kang, China (2007)

Supervisor Ernst van Groningen

Local supervisor Anne Kahr-Højland, Experimentarium, Copenhagen, Denmark

The Use of Mobile Phone Technology and Narration in Guided Tours to a Science Center –Evaluation of the EGO-TRAP Project at Experimentarium

67 pp

HDaSC-32

Mahtab Davari, COUNTRY (2007)

Supervisor Ernst van Groningen

Local supervisor: Julian Kingston, Royal Ontario Museum, Toronto, Canada

Contrast of learning between Digital gallery and Hands-on laboratory

56 pp

HDa-SC-33

Olawunmi Ogunmakin, COUNTRY (2007R)

Supervisor Lars Broman

Local supervisor Esme McQuillan, the Magna Science Adventure Centre, Sheffield, UK

Visitor Reaction to Exhibits in a Science Centre Using Magna as a Case Study

73 pp

HDa-SC-34

Nina Hult, Sweden (2008)

Supervisor Lars Broman

Local supervisor, Local supervisors Elisabeth Johnson, Lundavision AB and Monica

Almqvist, Experimentörerna, Lunds tekniska högskola, Lund, Sweden

Explorateket - a Vision of a Science Center in Lund

61 pp

HDa-SC-35

Jeniffer Stonehouse, Canada (2008)

Supervisor Hannu Salmi

Local supervisors Eriko Arai and Pauline Finn, the Vancouver Aquarium, Vancouver, Canada

An Investigation of Teachers' Perceptions Regarding Teaching Science and Participation in Professional Development at an Informal Setting

92 pp

HDa-SC-36

Annika Hultgren, Sweden (2008)

Supervisor Ernst van Groningen

Local supervisor Johan Nyman, Tom Tits Experiment, Södertälje, Sweden

Science Centre Websites as a Pedagogical Resource. An analysis of 15 Swedish Science Centre Websites

65 pp

HDa-SC-37

Kati Tyystjärvi, Finland (2008)

Supervisor Ernst van Groningen

Local supervisor Lea Tuuli, Heureka, Vantaa, Finland

The Use of Internet as a Science Communication Tool of Science Centres and Museums in EU Countries

49 pp

HDa-SC-38

Salem Harahsheh, Sverige (2008)

Supervisor Lars Broman

Local supervisor Elisabet Eronn, Framtidsmuseet, Borlänge, Sweden

The Influence of Energy-Hunting Project on the Future Education and Career of 8th Grade Pupils in the fields of Natural Science and Technology in Compulsory Schools of Borlänge, Sweden

68 pp

HDa-SC-39

Bree Riddell, Canada (2008)

Supervisor Ernst van Groningen

Local supervisor: Eric Solomon, The Vancouver Aquarium, Vancouver, Canada

Aquarium Visitors' Knowledge and Attitudes about Beluga Whales and Marine Conservation

46 pp

HDa-SC-40

Darcie Hook, Canada (2008)

Supervisor Hannu Salmi

Local supervisor Sandra Scott, The Vancouver Aquarium, Vancouver, Canada

Determining Naïve Notions Around Marine Animals at the Vancouver Aquarium

100 pp

HDa-SC-41

Melanie Roberts, Australia (2008)

Supervisor Maria Björkroth

Local supervisor Ralph Regenvanu, Vanuatu National Museum, Vanuatu

The Establishment of a Knowledge Management System at the Vanuatu National Museum

87 pp

HDa-SC-42

Tobias Wiethoff, Germany (2008)

Supervisor Lars Broman

Local supervisor Hans Meinl, Zeiss-Jena Planetarium, Jena, Germany

After the digital revolution: Impact of Fulldome Technology in a Planetarium

53 pp

HDa-SC-43

Muhammad Mairaj Siddiqui and Rashid Ahmed Ayubi, COUNTRY (2008)

Supervisor Hannu Salmi

Local supervisor Per Broman, Bakgård Kosmos, Våmhus, Sweden

Pre-Visitor Study for Bakgård Kosmos Science Centre at Mora Library

52 pp

HDa-SC-44

Asfandyar and Laxman Devulapalli, COUNTRY (2008)

Supervisor Hannu Salmi

Local supervisor Per Broman, Bakgård Kosmos, Våmhus, Sweden

People's Interaction with Bakgård Kosmos According to Learning

33 pp

HDa-SC-45

Qamar Farooq and Nejob Ur Rehman, COUNTRY (2008)

Supervisor Hannu Salmi

Local Supervisor Lars Paulsson, Tekniska museet, Stockholm, Sweden

Visitor's Study According to the Learning Behaviour and Evaluation of Exhibits at Tekniska museet

50 pp

HDa-SC-46

Nataliya Kovalenko, Ukraine (2008)

Supervisor Lars Broman

Local supervisor Klim Churymov, Kyiv Planetarium

New Ways to Teach Astronomy at Kyiv Planetarium

72pp

HDa-SC-47

Josee Lebel, Canada (2008)

Supervisor Lars Broman

Local supervisor Pauline Finn, Science World, Vancouver BC, Canada

Tapping into Floor Staff: Using the Knowledge of Floor Staff to Conduct Formative Evaluations of Exhibits in a Canadian Science Centre

87 pp

HDa-SC-48

Shofiqul Islam, COUNTRY (2009)

Supervisor Lars Broman

Local supervisor Elisabet Eronn, Framtidsmuseet, Borlänge, Sweden

On Visitors' Attitudes and Learning in a Science Centre

55 pp

HDa-SC-49

David Marsh, Canada (2009)

Supervisor Lars Broman

Local supervisor Kathy Gibbler, The Dr. Sun Yat-Sen Classical Chinese Garden, Vancouver BC, Canada

Science Playgrounds, Gardens and Parks: A Study of Outdoor Learning Spaces at Science Centres and Museums

69 pp

HDa-SC-50

Jon Back, Sweden (2009)

Supervisor Lars Broman

No local supervisor; field work done at the Science Festival in Göteborg 2008

Reality as Game Board - How to Play as Method to Create Active Participation in the Real World

78 pp

HDa-SC-51

Mariana Back, Sweden (2009)

Supervisor Lars Broman

Local supervisor Björn Thuresson, field work done at Tekniska museet, Stockholm, Sweden

4U and 4D and for Everyone. On Choosing and Combining Content and Special Effects in a Multi Sensory Show

104 pp

HDa-SC-52

Samir Abusaleem and Joseph Prasanth, COUNTRY (2009)

Supervisor Lars Broman

Local supervisor Mariana Back, Tekniska museet, Stockholm, Sweden

Interactivity in 4D-Theatres. An Evaluation and Technical Study of Cino4

41 pp

HDa-SC-53

Adriana Nave and Rosella Nave, Italy (2009)

Supervisor Hannu Salmi

Local supervisors Anthony Finizola, VEA and José Antonio Chavez, Museo Santuarios Andinos, Arequipa, Peru

Renewal of The Centre of Sensitization to Volcanic Risk in Arequipa, Peru

53 pp