PROGRESS REPORT. APE TRACK A

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Context

1a. Experiment and track name

Experiment 2 - Content archives, student portfolios & 3D environments (APE).

Track A:Content and Context of Mathematics in Engineering Education

The track comprises two studies:
Study 1: Modelling of conceptual development in mathematics on the Information Technology Program at KTH.
Study 2: Portfolio based reflection on the curriculum of the Media Technology Program at KTH with focus on mathematics.
A common comparative study links these two studies.

1b. Principal Investigators:

Ambjörn Naeve, KTH (CID) (Study 1 and 2).

Carl Gustaf Jansson, KTH (DSV) (Study 1).

Leif Handberg, KTH (MED) (Study 2).

1c. SweLL organization:

Coordinator: Donald Broady, Director Uppsala Learning Lab

Evaluation and documentation adviser: Monica Langerth, Uppsala Learning Lab

1d. Staff/faculty involved

Nils Enlund, KTH (MED)	Klas Karlgren, KTH (DSV)
Robert Ramberg, KTH (DSV)	Gunnar Jonsson, KTH (MAT)
Matthias Palmér, KTH,MSc student.	Mikael Nilsson, KTH, MSc student
Daniel Pettersson, KTH, MSc student	Johan Olsson, KTH, MSc student
Sofia Olsson, KTH (KTH Online)	Kristina Edström, KTH (KTH Online)

1e. Collaborative partners

Helen Chen, Stanford Learning Lab, the research thrust on Personal Learning in a Social Knowledge Network , track "Capturing learning experiences, Stanford.

Brad Osgood, Mathematics and Stanford Learning Lab, Stanford.

David Hestenes, Physics, Arizona State University.

Activities and progress (overview)

This section gives an overview of the main activities, outcomes and timing during the first six months. For further details, see section 4. At this stage of the project, activities are running according to work schedule.

Table 1: Activities overview in Study 1, Information Technology Program at KTH

Activity	Outcome/Results	Realized/Timing
Integration of the project activities within the framework of the IT program, year 1.	A positive and stable context for carrying out the study.	Spring
Seminars and conceptual modeling exercises for faculty involved in IT-program	Making the involved teachers more familiar with conceptual modelling	Spring
	Widening the range of the conceptual modeling exercises to include other subjects than mathematics on the IT-program. in a longer perspective.	
Design of study-material for IT students	A paper on conceptual modelling of mathematical knowledge	Summer
Preparation of tasks	Short papers specifying the students tasks	Summer
Development of a lecture series	A specification to be integrated with the descriptions of the IT program curriculum	Summer
Design of evaluations for the study	Scheme of evaluations	Summer
Software development	Usability tests by the end of the summer	Summer
	Start of two masters theses	Spring
Design of interactive web-support	Conceptual modeling activities and links to suitable interactive exercises (e.g. UML Tutorial).	Summer
Dissemination and outgoing activities such as: meetings, workshops, conferences, talks, presentations etc. (see section 6 for further details)	Contacts and future collaboration opportunities	January-June

Table 2: Activities overview in Study 2, Media Technology Program at KTH

Activity	Outcome/Results	Realized/Timing
Program Summary Course	First seminar with focus on tools and methods for digital portfolios.	May and coming seminars on a regularly basis
Individual interviews with students attending the Media Technology Program.	In depth knowledge of e.g. students' progress and development of personal digital portfolios and their conceptions of learning environment. Qualitative data (collection) for evaluation and course-development	Spring
Lecture on history of ideas and concept formation in mathematics	Introduction to concept modeling in mathematics.	Spring

Initial activity for the shared comparative study

A comparative study have planned for the Media Technology, Information Technology and Electrical engineering programs. This study will be based on a course in wave physics, where students on the three programs study nearly the same course. A test will be carried out after each version of this course. The task will be to select concepts from a mathematics concept map and judge the use in a wave physics context. The three groups of students will have different experience in reflection regarding the use of mathematics:

3 Time frame and current state compared to project and activity plan

The project proceeds according to the proposed schedule.

Content and current state compared to project plan

1f. Comments on activities in Study 1

Integration of project activities within the framework of the IT program, year 1. Carl Gustaf Jansson has in dialog with the involved faculty and Ambjörn Naeve planned the study within the context of the IT program. The students will get a task split up into two parts (solutions to be submitted at the end of each term), a series of lectures integrated with the regular courses, studymaterial on modelling in general and modelling of mathematical concepts, intercative studymaterial and computerbased tools for modelling. Formally the students will get 1 credit for this course out of the 5 credits for the course Introduction to IT.

Seminars and conceptual modeling exercises for faculty involved in IT-program. Ambjörn Naeve has on several occasions, illustrated the basic techniques of conceptual modeling in UML for the teachers involved in the IT-program at Kista, and shown examples of how this technique will be used in the mathematics courses. This has formed a good base for the current studies and created interest in widening the range of the conceptual modeling exercises to include all the different subjects on the IT-program.

Design of study-material. Ambjörn Naeve has written a study-material that presents conceptual modeling at a suitable level for this experiment. No material meeting the pedagogical requirements did exist. Apart from being a basis for this study, the produced material will have a much wider applicability.

Preparation of tasks. Carl Gustaf Jansson, Klas Karlgren and Ambjörn Naeve have designed and compiled a conceptual modelling task to be presented to IT students in the autumn and which will be the basis for their work within this study during 2000, 2001. The task should be solved in two steps (term 1 and term 2) The tasks are of three kinds, producing maps of high level conceptual maps, detailed maps on particular concepts and maps on the structure of proofs. The conceptual maps are assumed to be annotated in such a way that the students selfreflection concerning understanding, perceived difficulty and applicability is reflected. A preparatory exercise has also been produced, with the aim of training the students on modeling of the high school mathematics that is part of the curriculum during the introductory weeks.

Design of a lecture series. Ambjörn Naeve, Carl Gustaf Jansson and Klas Karlgren has planned a lecture series to be integrated in the different coursese of the IT program. The lectures will mostly be given by Ambjörn Naeve, but in some cases by the regular teachers.

Design of an evaluation scheme for the study. Klas Karlgren has in discussion with Carl Gustaf Jansson, Ambjörn Naeve and the SWELL assessment team developed an evaluation scheme including content and correlation analysis based on results from student task, observations and input from questionnaires.

Design of Interactive web-support. Ambjörn Naeve has together with Sofia Olsson and Kristina Edström at KTH Online developed a web-support for the conceptual modeling

activities. This web support includes a UML tutorial (Interactive UML) produced by the Open Training company, some web-based animations produced within the Conzilla tool and some additional interactive exercises.

Software development involves improvements and extensions of the Conzilla tool. This work has proceeded according to plan. Mikael Nilsson has documented the code structure. Matthias Palmer has worked on aspect filtering. Richard Wessblad from DataDoktorn has worked with the the help-service system. Ambjörn Naeve have started up two master thesis projects for two KTH-students, Daniel Pettersson and Johan Olsson. These projects both represent extensions of Conzilla that will make the program more useful as an overall tool for knowledge management.

3b. Comments on activities in Study 2.

A Program Summary course in the form of a seminar series has been started The seminars will be open for students, teachers and members of the Swe-LL and other LL teams. The following matters are discussed:
* Tools and methods for e-folio work.
* Course content for ongoing courses and how it can be described.
* Reflection over the learning situation, including the learning environment. how well does different courses fit together.

A lecture on the history of ideas and concept formation in mathematics has been given by Ambjörn Naeve. The purpose was to stimulate the students reflection on their own learning and the importance of mathematics for other courses.

Evaluation of individual e folios. At the end of the spring term the media students individual e folios. were presented and discussed with program responsibles, and experts from the dept. of Didactics. The purpose was to acquire in depth knowledge of the students' progress and development of personal digital portfolios and their conceptions of learning the environment.

4. Evaluation

4a. Evaluation plan overview

Table 3: Evaluation focus and activity plan

Focus and general objectives	Activity	Supportive technology	Data collection	Data analysis/method	Timing
STUDY 1 Promote metacognition in mathematics, including own understanding, difficulty and applicability. Promote transfer.	Concept modeling exercises and knowledge management	Conzilla UML Web-support (study material and interactive exercises)	2 * 150 concept maps Observations (field notes, participant observation) Questionnaires	Content analysis Correlation analysis on individual concept submaps, students and alternative observations	Fall 2000 - Spring 2001
Promote self reflection of learning process and course content (The Program Perspective)	Students use of digital portfolios Seminar series	HTML pages Portfolio tools and methods	Longitudinal study using documents (i.e. content created in portfolios)	Content analysis- progressive focusing using selected variables to create a domain analysis	Fall 2000 - Fall 2001
			Interviews	Qualitative data analysis (e.g. coding, interpretation, find variation and cohort in material)	
			Observations (field notes)	e.g. Correlation analysis	
Comparative study	Concept modelling task	UML	Min 3 times 20 conceptual maps	Content analysis Correlation analysis	Fall 2001

1g. Current state compared to project plan

Evaluation is scheduled to start in the second half of 2000. The planning and iterative revision of the evaluation scheme has been carried out as scheduled during the first half of 2000.

Results

1h. Deliverables

Study 1

1. A schema for integration of study activities in IT program curriculum
2. A study material on conceptual modeling for mathematics (appendix 2)
3. Instructions to students including description of project, preparatory exercises and task descriptions
4. An evaluation schema for the study
5. An interactive web support for modelling in UML
6. An improved knowledge management tool (Conzilla).

Study 2

1.A course description for the Program Summary Course.
2. Summary of evaluations of e folios for media technology students.

1i. Dissemination

1. Visit to Stanford and Arizona State University
   (March 9.29, Ambjörn Naeve)
2. Upcoming participation in SIGGRAPH 2000
   (July 2000, Ambjörn Naeve)
3. Presentation for the KK-foundation and the Swedish School Board (Skolverket) at Levintelligence (Feb 14, Ambjörn Naeve).
4. Presentation for Teachers at KTH at Dept of Didactics at KTH
   (April 4, Ambjörn Naeve).
5. Presentation for Mathematics teachers from Kista (secondary school level) at CID (April 12, Ambjörn Naeve).
6. Presentation at the inauguration of Uppsala Learning lab
   (May 25, Ambjörn Naeve).
7. Presentation for 150 science and technology teachers at KTH
   (May, Carl Gustaf Jansson)•.
8. Presentation for Human Machine Interaction graduate students at KTH
   (May 26, Ambjörn Naeve).
9. Presentations at two planning workshops for the IT program
   (Kämpasten March 7 and 8 and Hässelby May 9 and 10)
   (Ambjörn Naeve, Leif Handberg, Carl-Gustav Jansson, Klas Karlgren).
10. Presentation at the SweLL Evaluation meeting
    (May 9 and 10, Leif Handberg, Klas Karlgren)

Appendix

Appendix 1: Activity Plans for Experiment 2, APE (Track A-C). January 31, 2000.

Appendix 2: Conceptual Modeling and Mathematics, study material for the IT program, written by Ambjörn Naeve.

Appendix 3 Instructions to students in study 1.

Appendix 4 A course description for the Media Technology Program Summary Course