ABSTRACT
This paper reports on a project aimed at using simulation for improving the quality of teaching and learning in the field of Information Systems. More specifically, the project goal was facilitating the students to acquire skills of building models of organizational structure and behavior through analysis of internal and external documents, and interviewing employees and management. The solution tested in the project was a computerized environment utilizing multi-media to simulate a business case. The paper gives an overview of the problem that the solution addresses, presents the solution, and reports on a trial completed in a first year undergraduate course at Stockholm University. The results of the trial indicate that using rich multi-media along with a case based learning approach did improve the overall performance of the students. It was also shown that both students’ and the teachers’ attitude toward the solution was positive.

KEYWORDS
Case based learning, modeling skills, information systems, IS, simulation, education, multi-media

1. Introduction
One of the important skills that practitioners in the information systems field need to possess is the skill of modeling information systems or their parts. The importance of modeling skills for IS professionals is well understood, and many courses in IS devote all, or part of their time to teaching and learning modeling skills. This is true for IS education in general, and for the department of Computer and System Sciences (DSV) at Stockholm University in particular. The main problem in teaching and learning modeling in a university environment of today is that it mainly focuses on acquiring a formal part of modeling skills. The students learn the syntax and, partly, semantics of the formal languages used for modeling, as well as some techniques of translating a model from one modeling language into another. When graduating, most of the students lack the most important part of the modeling skills – how to capture the reality to build a model, through making field observations, interviewing people, and analyzing diverse documents.

The lack of skills of the graduates described above comes as no surprise, as these skills belong to the area of tacit knowledge (Polanyi, 1969), or Ways of Thinking and Practicing (McCune & Hounsell, 2005). This kind of knowledge is considered as belonging to the area of difficult knowledge (Perkins, 2007); this knowledge can be acquired not by learning theories and methods, but via socialization (Nonaka, 1994) when students do something practical together with experts in modeling. However, it is practically impossible to arrange real modeling projects that include students. Another factor that increases the level of difficulty of learning modeling skills is that many students do not have prior work experience. They do not have their own tacit knowledge about organizations that could facilitate their learning of how to model a real-life organization.

The goal of the project reported in this paper has been to propose and test a computerized environment that would give a possibility to acquire a higher level of modeling skills than it is possible to achieve in the
standard university settings. The environment simulates a situation of apprenticeship when an underling follows the master, observes what he/she is doing, and then is handed some work to do. In our case, the “master” performs interviewing, makes observations and selects diverse sources of information, and the students are creating models based on the inner structure of organization “revealed” in the interviews and other information sources. The simulation is done by utilizing multi-media presentation of a business case. The presentation consists of recorded interviews with key stakeholders, web-site of organization under investigation, its internal documents, etc. The project included a trial which consisted of building a multi-media simulator for one course, running this course, and evaluating the results.

The course chosen for the trial is an introductory course in IS for the first year students, one of the main learning activities in the course being a project assignment. The latter requires the students in groups build a number of different models of a company whose business situation is described in the textual form. During the trial, the textual description has been substituted by a multi-media simulation implemented as a project site. Initial assessment of the trial showed that the students appreciated the new way of presenting a business case, and achieved somewhat better results in the exams than during the previous years.

The rest of the paper is structured in the following manner. Section 2 gives a literary overview of the state of the art in teaching and learning modeling skills, and using multi-media for teaching and learning. Section 3 focuses on the state of affairs at DSV prior our research project. The next two sections report on the trial completed in the frame of an actual course. The trial is described in some details in Section 5, while Section 6 is devoted to presenting the evaluation of the trial. Section 7 summarizes the results achieved and draws plans for the future.

As far as the research approach is concerned, the project has been completed according to the action research guidelines. More exactly, we followed the Kolb’s experimental learning style theory (Kolb & Fry, 1975), which can be represented as repeated execution of the four stage learning cycle: Concrete experience  Reflective observation  Abstract conceptualization  Active experimentation --> Concrete experience  …. All authors are teaching modeling in IS and had experience of this activity before starting the project. Based on our observations, we found the problems in our teaching activity, and conceptualized them in the needs of introducing simulation in teaching/learning modeling skills. The idea was realized in a real course, and now we are getting experience of teaching modeling in the new environment.

2. Literature overview

The importance of acquiring modeling skills is well understood in the IS and related disciplines, such as Computer Science and Software Engineering, see, for example (Bezivin et al., 2010; Engels et al., 2006; Fenstermacher, 2004). The differences between the novice modelers and real experts who tacitly know Ways of Thinking and Practicing (McCune & Hounsell, 2005) are also well understood and some methods of transferring this knowledge have been suggested and tested (Venable, 1996).

Several ways of using case based learning is applied in teaching situations as well. Teaching modeling skills in IS often uses case-based techniques where a student builds a model of a real or imaginary organization. Traditional methods of presenting this organization to the students are as follows:

- Textual description of the organization (Fenstermacher, 2004), which is often used at DSV.
- Role play when one group of the students plays roles of managers/employees of an organization, which the other group is then trying to model (Costain & McKenna, 2011). Some courses at DSV use this technique as well.
- Modeling an on-line or real business which the students can easily access, e.g. Amazon, ePayPal, etc. (Recker & Rosemann, 2009). Some courses at DSV use this technique.
- Modeling a real organization of which the student is part (e.g. as an employee). This is used in vocational programs (MA, MBA) with students having working life experience (Truex et al., 2010), but is not used at DSV.

Rich-media has also been used to teach the field of IS. The teaching profession of IS has understood the capability of rich-media provided by Internet relatively early. The first organizational simulator, HyperCase, for teaching system analysis appeared as early as 1990. According to its designers, HyperCase showed to be more appreciated by the students than the traditional methods described above (Kendall et al., 1996). Though HyperCase was introduced in 1990, it is still in use (Kendall et al., 2013) as an accompanier for an IS course.
book (Kendall & Kendall, 2013). Though the possibility of using rich media has been discussed in IS education literature (Guy et al., 2000), no other environment than HyperCase has been reported in the literature.

Medical profession uses teaching cases supported by a simulator – i.e. a virtual patient - in much greater scope than IS. There are reports of successful usage of this approach for students’ activated learning (Bergin & Fors, 2003), and for students’ collaborative learning (Bergin et al., 2003).

Based on the analysis of the literature, we can conclude that there are positive evidences of using teaching cases based on simulated/virtual objects both in IS discipline (e.g. virtual enterprise/organization) and other disciplines (e.g. virtual patient in the medical profession). Rich environments for building such cases exist. However, a systematic method for building virtual objects, organizations in our case, from the learning objectives defined for the course and/or the program, has to the authors knowledge not been attempted yet.

3. Analysis of the practice of teaching modeling skills at DSV

DSV has a tradition of using a case-based method for teaching/learning modeling skills. Cases are artificial and they are created by teachers as the needs arise. Cases are often reused in the same or different courses often with modifications. A case represents an imaginary organization, e.g. an enterprise, a hospital, etc., and it consists of two basic components: case presentation and suggested solution. Case presentation is in the form of a text that describes the behavior and structure of the imaginary organization, and can include requirements on an IT system that the organization would like to introduce, or an organizational change that it wants to carry out. Sometimes, the text is presented as a transcript of an interview with the representatives of the imaginary organization. Suggested solution is a model of the imaginary organization built from the case presentation by a teacher. The same kinds of cases are used during examinations when students are required to build a model based on a short case description.

The problem with the current practice is that it does not explicitly focus on teaching and learning of how to obtained information needed for building a model. Case presentations are created in the ad-hoc manner, and do not always represent situations that can be found in a real modeling practice.

4. Trial

This section contains the details of a proof of concept trial that has been completed in the frame of the project. The goal of the trial has been:

1. To investigate whether there are any particular problems in introducing a multi-media project presentation in a course at DSV.
2. To evaluate whether the change from the textual description to multi-media presentation affects the learning results achieved in the course.

5.1 Trial settings

The trial has been completed in the frame of the first year course called “IT in Organizations” (ITO). Below, we also will refer to this course as the “trial course”. ITO is a first year course that is mandatory for approximately half of the students who enroll to bachelor programs at DSV. The number of enrolled students is approximately 250. The course is given each fall term, and it is the second course for the students. Before this course they have only completed one other course, “IT for personal use”, which presents basic theories and concepts in IT and computer science. The trial course ITO can be classified as an introduction to IS. The overall goal of the course is to give the students basic knowledge and skills on the analysis, design and development of information systems, including theories, methods and techniques for this. Additionally, the course should create an understanding of how organizations - their goals, products and services, business processes and information - can be changed by using different forms of IS. The length of the course corresponds to five weeks of full-time work for the students. Its ECTS credits are 7.5. Being an introductory course, the course has a wide scope. It includes an overview of a number of modeling techniques, such as
functional modeling (with the help of Icam DEFinition for Function Modeling 0, abbreviated IDEF0), process modeling (with Business Process Model and Notation, abbreviated BPMN, see Fig. 1), goal modeling (with Business Motivation Model, abbreviated BMM), and a number of others. The teaching and learning activities in the course include lectures, workshops, tutorials, labs and a project assignment. The project assignment is completed in groups of 4-5 students, and it is built around a fictitious company called “AFFE”. The company is said to be engaged in development and sales of a business game.

5.2 The textual way of presenting project assignment

In earlier year’s occasions of the ITO course, the AFFE’s business was presented to the students in the textual form. For example, a textual description of how the company handles invoices was available. Based on the textual description, the students complete a number of tasks. For example, one task is to “Build BPMN diagrams of business processes currently used in AFFE’s practice”. Based on the textual description, the students were supposed to produce a process diagram of the kind presented in Fig. 1.

![BPMN Diagram](image)

**Figure 1. A BPMN diagram that corresponds to the fragment of a textual description**

5.3 The multi-media way of presenting assignment

In the trial completed in the fall term of 2013, the textual assignments have been totally substituted by a project site that utilized multi-media (Bider et al., 2013). The site included the following presentation fragments:

- **Web-site of the company AFFE** that presents the company, its products, customers and organizational structure
- **Recorded interviews** with AFFE’s management (three interviews) who describe business processes currently in use (i.e. a sales process and game development process) and problems faced by the company
- **Results of twitter search on the company name** that presents the opinions of AFFE’s existing and potential customers about their product
- **Financial information** obtained via 1 (the business finder)
- **List of internal information systems** in use by AFFE. The list included references to the web sites of IT system vendors, and Excel spread sheet templates used in the sales process
- **Protocol of the management meeting** where a list of organizational changes where discussed and decided upon

These fragments and the assignments were integrated in a project web site. The site lists all sources of information having links to the fragments listed above, and it lists all assignments, and to each assignment it gives recommendations on what sources to use when completing the assignments. Fig. 2 shows an assignment with the title: “Describe graphically in BPMN the as-is business processes of the company”. The assignment page also provides links to sources needed to carry out the assignment. Fig. 3 shows such a
source, an interview with the manager of the game development department in which the manager is describing the game development processes. The project site was the only source of information that students received, no text description of the company AFFE, where handed out to them.

5. Evaluation of the trial

The trial was completed in a real course environment where we had no possibility to divide the students into two groups: first would use the project site using multi-media, and second would use the textual description. Instead, the evaluation of the trial was done indirectly in form of four sub-evaluations, listed below:

1. A project site evaluation by the students
2. An evaluation by the students based on comparison with another course
3. A project site evaluation by the teachers
4. A comparative analysis of examination results
All evaluations pointed towards some improvement in learning environment and results. Due to the limited space, below we only present the results of the evaluations number 2 and 4 from the list above, as we consider them to be the most significant ones.

In the evaluation by the students based on comparison with another course, the students’ opinions about the use of the project site with simulation were obtained contrasting it to a traditional presentation of project assignments, the one that uses textual descriptions. This was done by surveying the students that had experiences of both types of presentations of project assignments. For the majority of the students, the next course after ITO in the curriculum was the course on Object Oriented Analysis and Design (OOS). The ITO course used multi-media to describe the project assignment, while the OOS course used a traditional textual description to describe the project assignment. Therefore, the students who participated in both courses could compare two different presentations of project assignments. The method used for the comparison was a survey using a questionnaire that included two types of questions. The first type of questions was statements to which the students gave their opinion using a value between 1 (completely disagree) and 5 (completely agree). The second type of questions was the possibility for the students to post a general comment at the end of the questionnaire.

The questionnaire was available to all students that have been registered on both the ITO and OOS courses. Totally, 46 students of around 150 have filled in the questionnaire. In total, 210 students were active in both the ITO and the OOS course but around 50 of these students were carrying out another type of assignment in the OOS course that was not comparable with the project assignment in the ITO course.

Below, we summarize the results of the three questions that were part of the first type of questions in the questionnaire. For each question, we have given an English translation. However, in reality the questions were formulated in Swedish.

- **Statement 1:** A project site (similar to the one used for ITO course) would facilitate the completion of the OOS project because it would provide a more comprehensive picture of the business. 46 students answered with the average of 4.2 (Figure 4).

![Figure 4](image)

- **Statement 2:** A project site (similar to the one used for ITO course) gave us better understanding of how a professional consultant worked than just having a textual description of the business. 46 students answered with the average of 4.2 (Figure 5).

![Figure 5](image)

- **Statement 3:** A project site (similar to the one used for ITO course) is to be preferred for all courses that include business/enterprise modeling. 46 students answered with the average of 4.2 (Figure 6).

![Figure 6](image)
The answers of the first type of questions in the questionnaire shows that the students’ opinions, on average, were that the multi-media presentation of project assignment similar to the one used in the ITO course was to be preferred in all courses that include enterprise modeling.

The second type of questions in the questionnaire was a general comment that students could post at the end of the questionnaire. This resulted in several comments from the students. Below, we present some of them:

- “The work using a project assignment site like the one in the ITO course is more challenging for the students. For example, the students need to transcribe and interpret the video recorded interviews, which takes time” (5 students with similar comments)
- “The project assignment site like the one in the ITO course gave a more realistic view of an organization, and is therefore to be preferred” (2 students with similar comments)
- “The project assignment site like the one in the ITO course made the work with the assignment more interesting and fun” (2 students with similar comments)
- “Information should be given both as a web site and in text form. To use just videos may lead to misunderstanding and to use just text may not give enough information to carry out the tasks” (1 student)

In the comparative analysis of examination results, we compared the exam results achieved by ITO students in the year 2012, when the textual version of the project assignments was used, with the exam results of the year 2013, when the multi-media version of the project assignments was used. We used the results of the written exams for making the comparison, as the exams had a detailed scale of grading, while the project was assessed on the pass/fail scale. The scale for the exams included: A (highest) – E (lowest) as passed, and Fx (failed on some components) – F (total failure) as not passed. The comparative results of students from years 2012 and 2013 are presented in Fig 7. As can be seen from this figure, the main difference starts at grade C 31% for 2013 vs. 23% for 2012, and shows that the “tail” of the distribution of lower grades looks better for the year 2013 than for the year 2012. We can, cautiously interpret this change as less strong students achieving better results in the year 2013 than the students in the year 2012.

To exclude the possibility of the year 2013 enrollment having “brighter” students than the year 2012, we checked whether the results of the written examination in the next course, for the same students, differed between the years 2012 and 2013. According to the course supervisor in that course there was no substantial difference between the students results in that course between the years 2012 and 2013.
6. Concluding remarks

Main achievements of the project described in this paper consist in the following:

- Explicitly formulating the problem of teaching/learning modeling skills in the University setting in general, and in DSV at Stockholm University in particular.
- Considering a solution, not widely used in the field of Information System, that showed good results in other fields, medical profession in particular.
- Conducting a trial that have shown that the solution suggested can be introduced in the IS courses at DSV, and, according to evaluation, affects positively the students learning environment.

The project site created for the ITO course, as-is or in an improved version according to the students suggestions, can be reused in the next years’ occasions of the ITO course. We will continue the work reported in this paper, and see if is possible to reuse the simulator built during the trial in other courses where IS modeling skills are taught.

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References


