COURSE INTEGRATION: DESIGN FOR BETTER LEARNING?

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Abstract

Educating information systems (IS) developers is an important task for universities as information systems are playing an increasingly important role in organizations, municipalities and people's individual lives. Information systems development (ISD) requires an understanding of the business processes the system is to serve, the users of the system and the technological platform for the system. A learning environment for ISD therefore needs to include all these elements. This paper describes students' reflections on their learning experiences in ISD related to product, process, and meta learning from a learning environment where three systems development courses were integrated through common cross-course project activities in the same semester. Students' reflections were analyzed based on Harden's integration ladder and in terms of philosophical hermeneutics. The concepts of hermeneutics shed light on the idea of course integration as the students' understanding of a cross-course project reflected the hermeneutic learning circle involving wholes and parts. According to the students' reflections, learning took place mainly through their experiences in the different courses, expressed as mutual understanding of wholes and parts, as they interrelated in the context of the common cross-course project. According to philosophical hermeneutics, experiencing wholes and parts and the relationships between them challenges people's understanding and therefore provide learning opportunities. This paper addresses a theoretical perspective for motivating and analyzing course integration, as well as practical insights on how to design opportunities for cross-course experiences for better learning ISD.

1. INTRODUCTION

How can a learning environment in a bachelor program be designed in order to achieve a best possible learning outcome for the students learning information systems development (ISD)? An information systems developer needs to be able both to understand the users of the system to be developed and to "model the real world as future users will see it" (Mathiassen et al, 2000, p. 45) so that the end users of the information system to-be-developed effectively can solve their tasks. It may be challenging to analyze and design a new and/or improved information system. However the results of modeling activities may improve the developers' understanding of the problem domain and of the application domain for the system. Such modeling requires that systems developers are able to analyze a given situation, and to model and design a system accordingly. Students in universities often have little understanding of business processes in organizations in general. One way of giving the students learning opportunities is to design a learning environment where the students will experience the consequences of their own work and the work needed to handle the consequences through their own learning process.

Based on the authors' previous theoretical work and experience (Nordheim and Omland, 2002), we use the ideas in that paper to design an actual learning environment for Bachelor students. The students are attending three courses in their 3rd semester; a systems analysis and design course, a

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database course and a programming course. Part of the design for learning is to let the students reflect on their experiences attending the courses. In the mentioned paper (Nordheim and Omland, 2002) we used an integration ladder as a basis (Harden, 2000). Inspired by Harden's (2000) ladder for integration of courses we therefore probe the following research question:

> How can we as university lecturers design a learning environment to facilitate students learning information systems development?

We suggest that philosophical hermeneutics (Gadamer, 1989) is a good theoretical background for analyzing how learning takes place in the context mentioned. Philosophical hermeneutics focuses on the process of human understanding. We therefore apply hermeneutics to analyze how students reflect on their learning.

This paper analyzes the learning outcomes as logged in students' own reflections during the semester. In the following we present the theoretical basis for our study followed by a description of the research method used. The case is thereafter described, analyzed and the results discussed before the paper ends with a conclusion.

2. THEORETICAL PERSPECTIVES

Universities are designed for learning and for research. This paper concerns a learning environment where learning is understood as a relatively lasting change in behavior caused by acquiring new knowledge through experiences (Evenshaug and Hallen, 1975). Learning in this sense cause students to modify and/or reinforce their existing knowledge that lead to changes in students' preferences, values behaviors, and skills. This view of learning supports the objectives in the learning environment studied in this study focusing on change. Learning therefore includes more than just acquiring factual and/or procedural knowledge. The students are expected to go through a process of reflecting on their experiences that may lead to changed behavior partly through reflecting on what to change, why to change it, and what consequences possible changes may have for their future behavior in ISD.

Universities therefore have to offer a learning environment so that students may achieve this kind of learning. One way of designing learning environments is to integrate courses in the same semester to make the students experience how the courses are interrelated, how the content in the different courses relate to each other, how the courses together supply a learning environment for better learning ISD, including learning through experiencing how the results of their actions in one course influence work in other courses. Examples of such learning environments are student projects that integrate material from three courses in mechanical engineering (Yoder at al., 2003), and software engineering projects across four courses (Sindre et al., 2003).

Harden (2000) suggested integration of courses from the lecturer's perspective. We expanded Harden's perspective and suggested that we could view the integration also from the students' perspectives (Nordheim and Omland, 2002). We further suggested, theoretically, that it is possible to integrate courses on a relative low level of Harden's integration ladder from the lecturers' perspective and still let the students experience encounters that may lead to learning on a higher level of Harden's learning ladder (Nordheim and Omland, 2002). One way of such integration may be by letting the students work with a common project in the different courses.

2.1 The integration ladder

Harden (2000) suggested the integration ladder as a tool for curriculum planning and evaluation within the medical profession. The ladder addresses the need for greater integration between courses, by presenting 11 steps in the level of integration. Harden's (2000) objective was to improve education for the students within the medical profession. We argue that integration ladder can be used for curriculum planning and evaluation also within the IS field. Over the years different theories within the ISD field have been promoted for improving development of information systems. An example is social-technical development theory (O'Day et al, 1996) that suggested that a technical analysis was to

be made alongside an analysis of the social factors in the organization to use the developed IS. The technical analysis and the social analysis were then to be combined to understand what system to develop. Another theory is the PSO-view (Personnel, System, and Organization) of ISD (Andersen, 1981, p. 283). The PSO-view theory suggests that all the three areas mentioned must be developed when successfully develop an information system. These theories imply that ISD is more than the technical part and thereby that the developers need to understand and deploy a competence that is wider than just technicalities. The competence they need should therefore be supplied through their education to become more than just theoretical or procedural competence and evolve into "competence-in-action" (Omland, 2009, p. 20).

A curriculum for educating information systems developers will necessarily include many different subjects. The subjects in the curriculum may relate to each other in many different. To get a better understanding of the integration ladder we describe the 11 steps in the ladder (Harden, 2000) and how the subjects/courses given in a curriculum may relate to each other. The 1st step in the ladder, Isolation, indicates that each course in the curriculum is taught independently not considering other courses. In step 2, Awareness, the lecturers are aware of the other courses and their contents and may therefore seek to avoid overlap between the courses. The 3rd step, Harmonization, implies some communication and consultation between the courses in the curriculum for adapting to each other's curricula. In Nesting, step 4, the lecturers of the courses may target skills related to other courses so that teaching/learning in the related courses may lead to a broader curriculum outcome than the sum of the related courses. In step 5, Temporal co-ordination, each lecturer in the courses is responsible for his/her own teaching. A temporal co-ordination of courses would include coordination of the dates in the different courses as for when topics are taught and for scheduling possible compulsory hand-ins. The students are expected to find and understand the relationships between the courses that are temporal coordinated by the lecturers. The so-called 'integrated teaching programs' are, often for all practical purposes, temporally coordinated programs or curriculums (Harden, 2000).

Sharing, step 6, implies joint teaching in the courses focusing on shared concepts, skills and attitudes. Typically this step is a situation where two departments share parts of a common course, and the course is considered an end in itself. The next step, step 7 Correlation the emphasis is still be on the different courses with a discipline-based focus most of the time. But integrated teaching sessions will take place bringing areas and themes of common interest into the courses (Harden, 2000).

Moving on to step 8, Complementary, a complementary program will contain some subject-based teaching, but common or integrated sessions will constitute the relationships between the courses. Continuing to the higher integration steps, step 9 is Multi-disciplinary meaning that a number of subject areas are brought together in a single course while step 10, Interdisciplinary, focuses even more on the themes for learning and communalities across the disciplines themselves. Step 11, Trans-disciplinary, leaves the disciplines and focuses the fields of knowledge as found in the real world (Harden, 2000).

Harden (2000) aims at integration for planning and evaluation at the curriculum-level. In our opinion this perspective is in many ways teacher/lecturer-oriented. We will therefore in this study focus both on the lecturers' side and the students' side of the integration and the consequences of integration ladder from both perspectives inspired by Nordheim and Omland (2002).

2.2. Hermeneutics

The focal point of hermeneutics is how understanding occurs. We base our hermeneutic perspective mainly on Gadamer's (1989) philosophical hermeneutics. Originally developed to understand text, hermeneutics is now a recognized and accepted approach to achieve and explain understanding in general (Ricoeur, 1981). Our hermeneutic perspective is in line with previous interpretive research in IS based on hermeneutics, which has been premised primarily on Gadamer (e.g., Boland, 1989; Boland et al., 2010; Cole and Avison, 2007; Francis, 1994).

According to philosophical hermeneutics, the constitutive element of all understanding is the hermeneutic circle. This circle is the structure of interpretation and applies to the full range of

situations, actions, or texts we encounter in our everyday lives (Gadamer, 1989). It is a circular relationship. The anticipation of meaning in which the whole is envisaged becomes actual understanding when the parts that are determined by the whole themselves, also determine this whole. Thus the harmony of all the details with the whole is the criterion of correct understanding (Gadamer, 1989). We study how this perspective is driving the students in their reflections on their learning.

While Gadamer (1989) is careful not to refer to the hermeneutic circle as a formal methodology, the circle is a means to clarify the conditions under which understanding can occur. There are three such conditions: pre-understanding, prejudice, and horizons of understanding.

Pre-understanding is the general and provisional understanding one has of a phenomenon before studying the phenomenon. "Interpretation begins with fore-conceptions that are replaced by more suitable ones." (Gadamer, 1989, p 267). Hence, one always has a pre-understanding that is a necessary part of the evolving understanding.

Pre-understanding is in turn based on prejudices. They determine how one at first sight understands a phenomenon. While continually attempting tentative understandings, one immediately assumes something, due to the prejudices. A prejudice is not negative; it is simply a precondition for understanding per se (Gadamer, 2001).

The complete set of a person's prejudices is called the horizon of understanding. The horizon of understanding is the range of vision that includes everything that can be seen from a particular vantage point. This is related to what is called a hermeneutical situation, which means to be inside a situation. Project work in groups is therefore a hermeneutic situation. A situation represents a standpoint that limits the possibility of vision. (Gadamer, 1989).

Table 1 is a brief summary of key hermeneutic concepts, illustrated from data in this case study.

Table 1. A summary of key hermeneutic concepts

Concept	**Description**	**Illustrative example**
Pre-understanding	A provisional understanding of a phenomenon before studying it. A necessary precondition for understanding.	"a focus on IS 200 is most important"
Prejudice	Our pre-understanding is based on our prejudices.	"the acceptance criteria for IS 202 are fairly low"
Horizon of understanding	The complete set of a person's prejudices, here related to a phenomenon under study.	Getting an overview of the student project
Encounter	A situation where one meets a phenomenon that resists one's prejudices	Project group meeting where discussions take place
Whole	A phenomenon that is being reflected on	A sprint or a mandatory assignment
Part	Details about the phenomenon reflected on.	A user story or a software package
Hermeneutic circle	The iteration between the whole and the parts. We understand the whole in terms of the parts, and the parts in terms of the whole. The harmony of all the details with the whole is the criterion of correct understanding.	"after two sprints we realized that we should have appointed a scrum master"

2.3 Connecting wholes and parts in integration

The reason we use hermeneutics to analyze the students reflections is to find out if the wholes they reflect on includes more than one of the three courses. For further understanding the results of the students' reflections we suggest, in this study, to couple the hermeneutic principle of wholes and parts for understanding with the ladder of integration in that three courses, given in the same semester, relate to each other through the common project. In this study wholes and parts may be viewed from many different perspectives i.e.: the project as a whole, the different activities in the project work as parts, learning as a whole, the different courses as parts, a course a whole, the different elements in the course as parts.

2.4 Relationship between learning and hermeneutics

We are concluding the theoretical discussion with a reflection on how we understand the relationships between learning and hermeneutics in this research. Hermeneutics supposes that a student has a pre-understanding of a phenomenon. Through a meeting either with a text or a situation that challenges the pre-understanding, a new understanding may be reached by the student. The changed understanding is not in itself learning, but an important prerequisite for the learning process that may lead to learning as relative lasting changes in behavior.

3. RESEARCH METHOD

An exploratory research method is suitable for studying learning when students experience this integrated environment for learning ISD. A case study approach (Yin, 2014) was chosen where data was gathered through the reflection reports that the students wrote during the semester. As interpretive research (Walsham, 2006), Klein and Myers' (1999) principles for interpretive research have been followed, in particular principles No. 1, 2, 3, 4 and 6.

The data was analyzed using philosophical hermeneutics (Gadamer, 1989), including the concepts in Table 1. We used hermeneutics both as a tool for data analysis, and as a process for organizing the data analysis. Our pre-understanding is summed up in the case description in the introductory part of Chapter 4 and in section 4.1, Lecturers' perspectives in the case. Figure 1 illustrates our pre-understanding of the case before starting the data analysis.

The two authors were involved as lecturers in two of the three courses involved in the project. Thus the authors were involved in designing the project and supervising work related to their courses. As lecturers following the students through the semester studied we observed changes. Obviously, the students learnt something. On the contrary we hesitate to bring our observations into measuring the learning that took place.

In this study we are measuring learning based on the students self-reporting where they state that they learned something in one sprint in their Scrum process and that they therefore did something different in the following sprint. We further understand that using the students self-reporting on learning may be questioned.

A formal evaluation of learning in the cross-course project would have strengthened this study.

The data analysis was interpretive, and was performed on 38 students' diaries, a total of 160 pages. The students did not get any hermeneutic thinking as input when writing the diaries. One of the authors initially analyzed the data, and the findings were discussed. The analysis started out by identifying important aspects of learning, as viewed by the students themselves. Then the students' reflections were analyzed in terms of the hermeneutic concepts as presented in Table 1. In a first iteration of data analysis we coded the data according to hermeneutic concepts, mainly focusing on parts of the text. One result of this analysis is the examples of hermeneutic concepts found in the data (illustrative examples in Table 1). In a second iteration of data analysis we focused on the wholes which the students reflected on, before a third iteration focused on the parts of the text in the students' diaries again. The following section presents results mainly from the second and third iteration of data analysis.

4. CASE DESCRIPTIN AND CASE ANALYSIS

In the following we give an overview of the Bachelor program at the time of the data collection (cf. Table 2).

Table 2. IT and Information Systems Bachelor Program 2012 – 15				
Semester 1st	IS-100: Introduction to IS	IS-104: User interfaces development	IS-107: Creative problem solving	
2nd	IS-102: Object-oriented programming	IS-105: Data communications and operating systems	ORG-110 Organizational theory for IT students	BE-107 Business administration
3rd	IS-200 System analysis and design	IS-201: Data modeling and database systems	IS-202: Programming project	
4th	Minor subject 1: Electives: IS courses or other courses			
5th	Minor subject 2: Electives: IS courses or other courses			
6th	IS-304: Bachelor thesis in information systems		IS-305: Information resources management	

The first semester consists of three 10 ECTS courses: Introduction to information systems (IS), Interface design and development, and Creative problem solving. The emphasis on information system development is continued in the second semester, including two 10 ECTS courses: Object-oriented programming, and Data communication and operating systems, and two 5 ECTS supplementary courses: Organizational theory for IT-students, and Business administration for IT-students.

The direct focus on ISD temporarily culminates in the third semester with three 10 ECTS courses: System analysis and design, Data modeling and database systems, and Object oriented programming. In the fourth and the fifth semester the students have to choose between electives. The system development focus returns in the final semester, when the students develop a Bachelor thesis (20 ECTS), based on a project they have carried out for an external client and attend a 10 ECTS course in Information recourses management.

Compared to another study of a cross-course software engineering project (Sindre et al., 2003), this project (i) followed an iterative development using Scrum, (ii) they were given the same assignment, but (iii) requirements had to be elicited as part of the IS-200 course, (iv) they developed a client-server system with a relational database, and (v) used some pre-developed code.

In the following we first present the lecturers' perspective for designing the learning environment for the semester followed by case description and analysis of the case based on data from the students' reflection logs.

4.1 Lecturers' perspectives on the case

We describe the case from the lecturers' perspectives as lecturers in IS-200 and IS-201 (Cf. Table 2) clarifying what we did, together with the lecturer in IS-202. When designing the relationships between the courses in the third semester (cf. Table 2) we aimed to provide the students with learning opportunities through experiencing wholes and parts when they developed their deliverables in the three courses.

The third semester was originally designed to give the students a broad view of ISD, of the competence in various disciplines that was required to successfully complete an ISD project, and provide an experience of using the results of their own work across courses. The students, however, generally focused separately on the deliverables and other products that they were required to hand in in each course. It seemed that they did not see, or at least did not reflect on the relationship between the courses and the importance of extending what they learned in one course to the other two courses, thereby not reaching the overall learning objectives for the semester. While the learning objectives for each course are made very clear to the students, the overall learning objectives for the whole semester were not clearly formulated by the lecturers. These findings led the lecturers to decide on the following measures redesigning the learning environment in order to rectify the unwanted situation:

1. We decided to let the students work on a common project that the content of each of the three courses should contribute to solve

2. The semester was to start with a common introductory lecture where the semester's learning objectives for all the courses were explained to the students. We would give a short briefing on the ISD process, and the lecturers responsible for each course would explain what their course was about, and how it contributed to the project.
3. In each course we would emphasize that the learning from and products made in the other courses were important input, particularly in the programming course (IS-202) that focused entirely on the students as programmers working in project groups to implement the user stories developed in the systems analysis and design course (IS-200).
4. The project was run by using Scrum with one pre-sprint (lasting 2 weeks) and three formal sprints (3 weeks each). The aim of the pre-sprint was to get started, to produce user stories and to suggest acceptance criteria for the user stories to be implemented. After the third sprint the students could use two weeks to do the final adjustments to the IS and the project report.

In this paper we analyze the students' reflections meeting the learning environment designed through the measures (1-4) as the students describe in their reflection logs.

The lecturer gave the following information about the reflection logs in general terms: write about what you have learnt and about that is positive and what is negative with the common cross-courses project. Some more detailed instructions were:

1. 1. Write about your concrete experiences – what happened? What did I do, see, hear or feel
2. Analyze, reflect - Why did it happen? How can I understand what happened? How did I experience the situation? How did others experience the situation?
3. Learning and abstraction – What did I learn from my experiences and my analysis and the reflections on it? What theoretical and practical knowledge did I employ?
4. Planning and new action – How may the new knowledge be used in new situation that might resemble the "old" ones?

Figure 1 is a simplified illustration of the lecturers' perspective on the relationships between the 3 courses and their activities, expressed in hermeneutic terms illustrating the ISD project (on top) as the larger whole, with the project work within the three courses (below) as its parts. Each of the 3 courses (IS-200, IS-201 and IS-202) may be viewed as smaller wholes consisting of parts, such as: A = analysis, D = design, C = construction, T = testing. The courses then become the wholes with the different activities as parts. In a learning process there are iterations between the whole and its parts, at different levels. In addition there are iterations between each larger part (course) and the whole ISD project. The common cross-courses project is illustrated by the dotted rectangle.

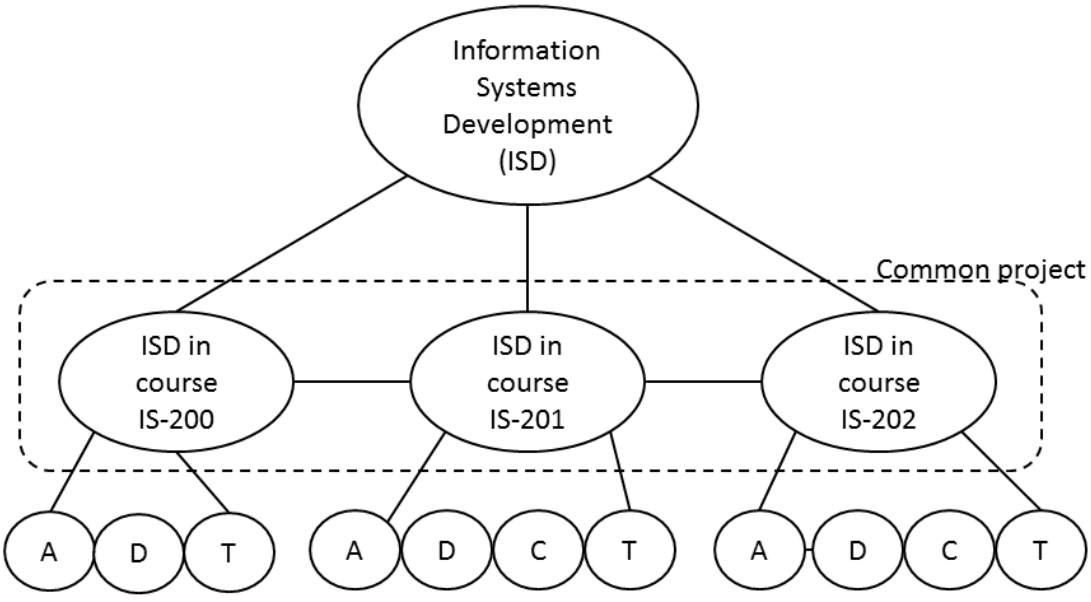

Figure 1. Course integration as wholes and parts in a hermeneutic reflection

We also found that the lecturers' perspective as illustrated in Figure 1 was shared by the students. One student expresses this course integration as follows: in "This reflection log ……. I have chosen to describe in general the three courses as they run in parallel through the semester and a common project is going to be the central core between each of the courses". Another student remarked that "These courses and the lecturers in the courses cooperate well, and the courses "interconnect", which I think is very fascinating and good".

4.2 Case description and analysis

The case description and analysis is based on the data reported in the students' reflection logs and is ordered and analyzed showing three different wholes focused in the students' reflections on learning: (i) most students, 36 of 38, had a product perspective (i.e. on the system); (ii) some students, 31 of 38, also had a process perspective (i.e. on the project); (iii) a few students, 23 of 38, reflected on meta learning during the process as well. The three perspectives are presented in the following.

4.2.1. Self-reflection on learning: the product perspective

The students had to produce two different products in the semester, the information system (IS) itself and the project report. The groups implemented a varying number of user stories in the IS, some groups just a few, some groups implemented many user stories. Every group had to produce a project report describing the group's work in analyzing, designing, constructing, and testing the IS together with their reflections on the work they did and the resulting IS.

Reporting on the product one student reported that "Already on Monday we had a draft on mandatory deliverable 1" (in IS-200). Another student reported and reflected on how the group had learnt to improve the report and wrote "more important, what words and notions/concepts we ought to avoid using as they give unclear meaning or are unfit".

Reflections on the IS were on wholes and parts. One student reports about coding in Java EE and that the database was implemented on xeround.com. This comment relates to ISD Point C (constructing) activity (cf. Figure 1) in both IS-201 and in ISD IS-202 showing that the student understands the connections between the two courses and the information system to be produced.

Other students reflected on the relationships between the whole and the parts in the same course, i.e. IS-202. "Today I have struggled to find out how I make a function so that the users can create a module. There have been some challenges with NetBeans and error messages making the progress very slow".

Another student reports that the group ran into problems in IS-202 getting the GlassFish server to work. "We had to reinstall NetBeans which took time, so in the meantime we finished the report for Mandatory delivery 2 that is to be handed in on Friday."

In the product perspective (cf. Figure 2) students' reflection focused on the IS they developed. The wholes reflected on were the mandatories that were delivered while the parts reflected on were each course's hand-in that in the end constituted the mandatories. Thus the product perspective accounts for most of the learning found in the logs (95 % of the students) and most of the encounters which were reported to generate learning were found in the product perspective. Figure 2 presents the two levels of wholes, the product perspective consisting of three parts, the three mandatories that again constitute of the different products that originated in each of the courses.

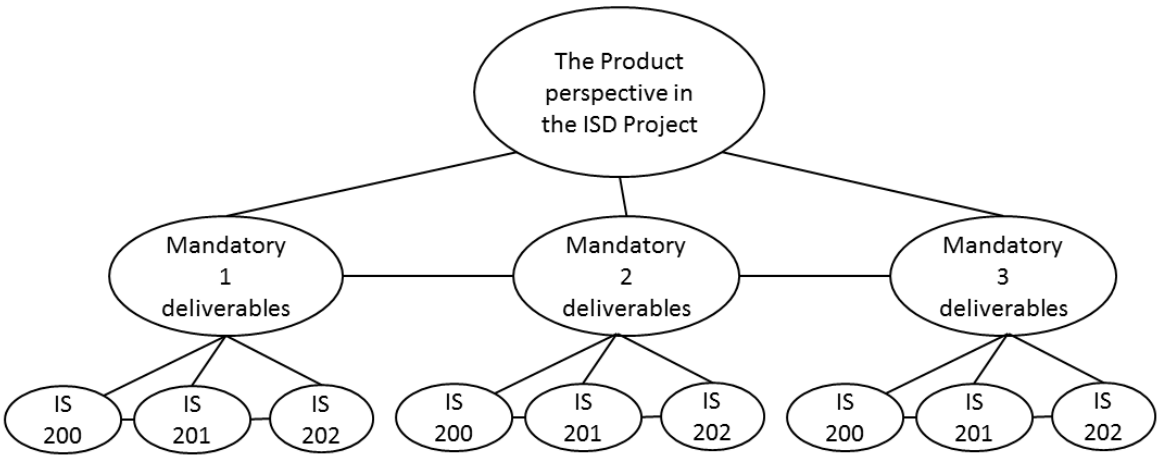

Figure 2. The students' product perspective in their reflection

4.2.2 Self-reflection on learning: the process perspective

Most of the students described and reflected on the two processes that were designed in the semester, the scrum process and the group process.

One student gives a rather contradictory account of the first sprint: "Sprint 1 went well. Unclear/difficult to grasp and we barely made it, but I knew that this group is/consists of slow starters". From the account it seems that the student evaluated the sprint from the knowledge of the group, not from a scrum process perspective.

Some describe the process from the focus that the group had on the different courses in one of the sprints, "… I (and the group) focused on IS-202 and IS201" while others mention the groups "we had group meetings 2 to 3 times a week and I find that that is a good way to work". Others reflect on including all the group members in the sprint planning and "... group members state their priorities and we distribute the tasks accordingly". The same student writes that "… a new twist in this sprint is that we swap tasks and get together two and two. I am very satisfied with that approach."

Other students report learning from one sprint to the next. "Sprint 2. This was the best sprint so far. As a task I had to develop a new structure for our report, develop the general software quality criteria, write explanations for state charts and sequence diagrams as well starting to write the evaluation about scrum. The goal of this sprint was for me of course to have the parts ready before the deadline." Another student reports that "…. after two sprints we maybe see that this 'team scrum' method without a boss and that all take responsibility is maybe not optimal and that maybe 'scrum master' had been more ideal for our group, but this is something we and I learn from. So, next time I will rather vote for having a 'scrum master'". The scrum meetings were commented and a student expressed as positive that the meetings "were an improvement from last sprint".

We found that many students (82%) reflected on ISD learning in a process perspective, focusing on how the project was completed. Figure 3 is a summary of the students' reflections on a process perspective. The ISD project is representing the whole in hermeneutic terms with the sprints as parts. Each sprint is constituted of parts that are work in the different courses. In this understanding of whole and parts the different courses contribute to the learning through the learning environment designed so that the students need to use what they learnt in each course to be able to develop the whole, an information system through the ISD project. Each sprint constituted both parts of this project, and sprints were wholes they reflected on. The smaller parts (cf. Figure 3) were the activities in each course as parts of the sprints.

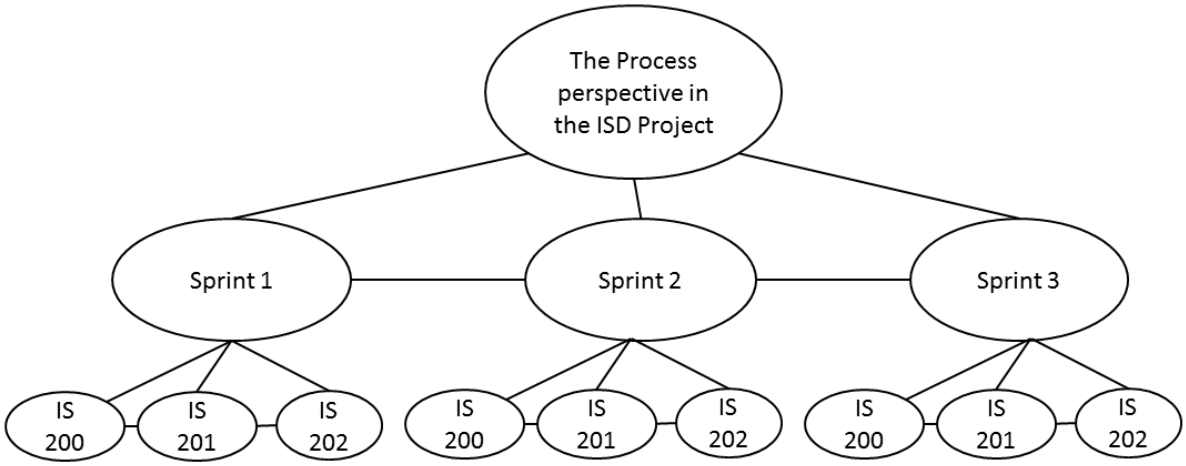

Figure 3. The students' process perspective in their reflections

4.2.3. Self-reflection on learning: the meta perspective

Quite a few students (60%) reported reflections leading to meta learning. When analyzing the students' diaries we found that some had reflected in a general meta perspective both in the relationship between whole and parts like "missing a more straightforward and holistic picture of how we are to deploy the fragments we have been introduced to until now" while others reflect more directly on a part. Others reflect more on the parts "it turns out that understanding the function list is more challenging than we expected".

We further found that the students reflected within the following categories: Communication, Meetings, Planning (including prioritization), Group work, and Self-discipline. An overview of the categories/parts of reflections in a meta perspective related to the whole is presented in Figure 4. Examples of students' reflections on each of these themes are presented in the following. The parts (the five categories) constituting meta-learning typically led to reflection on meta learning (Figure 4).

However, analyzing Figure 4 we see that amongst the five parts making up the whole (The ISD project) the parts Communication and Self-Discipline may be considered as a different type of parts than Meetings, Planning and Group work. The latter three are all activities that the students participate in while communication and self-discipline are influencing and motivating the quality of the activities carried out. However, the students report that meta learning taking place in all the five parts.

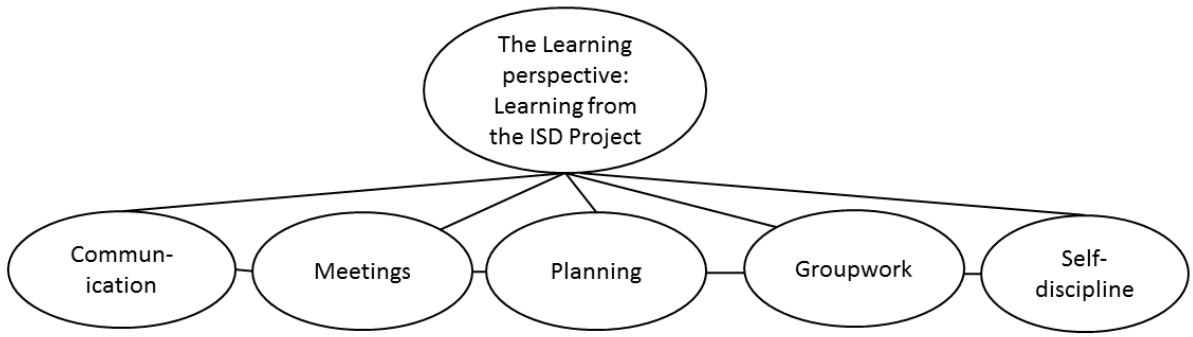

Figure 4. Meta learning in the students' reflections

Meta learning: Communication

Quite a few students reflected on their communication within the group. “So the lesson learned here is that communication within the group is very important so that other members understand why to do something in the way you are doing it and why you think that it is important. This might lead then in a higher participation and not just to a lack of understanding.”

Several students emphasized the importance of communication like “good communication in a project is alpha and omega” and “it is important to share information with each other (group members)”. Students emphasize that everyone in the group seek help as soon as possible “either in the group or getting help from the lecturer”. In connection with sharing information a student reports that he has learnt that it is important to be active in the planning processes and “how to work in a steady pace”.

Meta learning: Meetings

An important part of the design of the learning environment was meetings. Thus meetings were designed to provide planned encounters for the students. Some students reflected on their group meetings. One student reflected on meetings as means to complete assignments, but only when the students had prepared well in advance. “Preparation for meetings is key. I experienced that the assignments could be completed very efficiently if everyone is well prepared for meetings.” In such situations meetings seem to carry significance in securing the quality of the accomplished assignments and exchange of work and information and seem to function as an arena for decisions to be made.

In other situations meetings seemed to provide a common arena for solving problems. An important prerequisite seemed to be a blackboard available for making the meeting an arena for communication. “As an easy solution to the problem we used the blackboard much more than before so that everyone could easily contribute.”

Meetings further provided a frame for holding weekly scrum. It provided regularity and opened for a deeper understanding of the task at hand “Reporting to each other. Give feedback and points of view”.

The students thus reflected on meetings as important arenas for different purposes.

Meta learning: Planning

Planning was a part of the project in that the students were requested to conduct sprint planning meetings for planning each of the sprints. Through the planning process the students had to prioritize the tasks to be completed in the sprint.

Quite a few students reflected on their group’s planning effort and some reflected on their own personal planning process as well. The reflections were found to be both on meta level and a more detailed practical level. The meta level is described like “the division of labor was not well considered in the first plan” or “today we distributed the tasks to each member of the group that we were to finished tomorrow”. Some students reflect on a meta level and a detailed level in the same sentence: “So for sprint 2 it is without any doubt necessary to be more careful and precise in the planning especially because the work itself performed by all group members was very good.“

Other students reflect on their own individual situation with basis in their personality: “as for me that like to plan full days two to three days ahead, it is preferable that I have a plan to stick to, that I know precisely which days I shall have my tasks completed”.

Meta learning: Group work

All students belonged to a group (generally consisting of 4 - 6 students, one group consisting of 7 students). Quite a few students reflected on their group work experiences. The reflections had very different foci. Some reflected on the size of the groups but for very different reasons. With up to 7 students in a group it may be difficult to get to know all of them and “… to feel that one is extra and

bothering the others" in the group. Others reflected that they needed more planning and organizing being many members in the team and that "... it is easier for persons to scrimshank (sluntre unna)" while others were reflecting on steps to organize the group work to get a better result and therefore suggested that it was important that the group had to make a decision "… what tasks that should be completed, prioritized and eventually how they should be dealt with".

Others were occupied with the differences in both learning style and learning speed for the group members where the fast learners had to help the slow learners in the group. The solution was to be an including group so that the speed of the group did not exceed the speed of the slowest. One student reflected: "This is a process I feel the group has managed in a good way, and we see steady progress". Others reflect on the initiative that the group has to take in case of problems suggesting that "... all in the group seek help if something is difficult, as soon as the problem occurs, either in the group or from the lecturers".

Meta learning: Self-discipline

One student reflected on self-discipline within the group. The reflection follows a whole-to-parts-to-whole circle including a reflection on some students taking more initiative than others and the possible results of such action. The student stated that it was important and at the same time difficult for the group as a fellowship to create self-discipline. The student reflected that self-discipline relates to the individual person and it may be differences between people where some may naturally have self-discipline while others do not have self-discipline.

Self-discipline may be motivated or demotivated by very active group members' initiatives depending on the group members reactions to the initiatives. "The more that takes initiatives and show work interest, the more we will accomplish, leading to work that are simpler and more fun." It was therefore important for the group to focus on and discuss how the group could work better together.

4.3. Combining the three perspectives of the reflection

We have described the students' self-reflections within three different perspectives: pure product perspective (Figure 2), process perspective (Figure 3) and meta perspective (Figure 4). However, we found in our data that quite a few reflections combined two or three of the perspectives: product, process and meta. In these combined reflections, wholes and parts came from any of the three perspectives.

The following student's reflections illustrate how the students combined the three perspectives in their reflection. One student wrote that the group worked in sprint 1: "We are to finish sprint 1, and most work is in this part. We are to finish the shells and produce as many functions as possible. It will be very challenging, but also a lot of work that may be challenging". In this reflection the student reflected on the whole as process (sprint 1) and the product parts (shell, functions) to be produced in the process. Another student described how the group had worked with the tasks related to IS-201 and IS-202 to get the functionality of the web site in place. At the same time they had produced the mandatory deliverable in IS-201 and handled the feed-back they got on there IS-200 report. The description shows that the group managed many different and partly related tasks in a rather short time span.

Some reflected on their worry for the group as slow starters, the group's possible will or capability to engage in the different tasks all by themselves and the possible influence on their learning process. Others had a more proactive attitude to the work. They checked all the deadlines for the closest mandatory assignments so that all the group members got an overview of what was important; "Afterwards we distributed the tasks so that everybody had some homework the same day. It was necessary to do some work at home to finish within the deadline." In that way the students combined an understanding of the whole and the parts both related to planning of the process and the product to be accomplished.

5. DISCUSSION

In this section we will discuss our findings and show how the findings expand the understanding of the relationships between learning and integration of courses, i.e. the learning environment designed.

Finding 1: We designed the third semester in a Bachelor program focusing on learning, i.e. the focus is on the student, not on the lecturers. This is comparable to another study (Sindre et al., 2003). Even though Harden's (2000) main interest is teaching planning and evaluation, he focuses on relationships between the courses given in a study program. Our student focus therefore expands Harden's (2000) way of designing a study program to include the students' learning perspective.

Finding 2: Based on the data in the study we found that students integrate their learning through the learning environment provided by the project. The project is a central part of the learning environment designed by the lecturers. The focus on the students reported in Finding 1 is strengthened by this finding. However our expanding Harden's (2000) focus from integration of courses to the designed learning environment focusing more on students learning, reveals that not all students are able to enjoy and benefit from the learning environment. We found that the students that also were able to reflect on a meta level were the ones reporting a better learning outcome, compared to those that only reflected on a product or a process level. We also found that students that were able to reflect on several of the above mentioned categories reported that they learnt more. An area of further research may therefore be to seek answers to why some students find the learning environment helpful for learning while others do not seem to benefit that much from this kind of designed learning environment, as the main idea from the lecturers' side was that the students had to shoulder responsibilities for their own learning.

Finding 3: We found that from the lecturers' perspective a low level of course integration on Harden's (2000) ladder was sufficient to create the learning environment we designed. The integration made by the lecturers was mainly focused on the common cross-course project. The focus of the semester was the common project where each course contributes individually to the students' learning of ISD. Each course contributed to the project through a common timeline with deliverables from the students through compulsory assignments.

From analyzing the data in the study we further found that through our design of the learning environment and the project the students had a learning experience at a higher level of Harden's (2000) ladder than the integration level that the lecturers designed between the courses. This finding is important for several reasons. Even a low level of integration from the lecturers' side makes it possible to integrate students learning at a higher level. One consequence of such design of a learning environment is better learning. Another consequence is that the cost of making such learning environment where the individual lecturer may supply her/his lecturing relatively independent of the other courses is lower than an integration of courses at a higher level of Harden's (2000) ladder. The lecturers have of course to shoulder a certain cost designing the project, but this cost is still small compared to a more detailed integration of the three courses. An important activity for the students in the learning environment is the meta reflection that is possible through the learning environment. The abilities the students have for reflection in several of the categories found; product, process and meta reflections, was found to be important for the students' learning processes and their reported learning.

Finding 4: The overarching explanation of the above findings is that the hermeneutic circle proved important in understanding the learning process. We found four major hermeneutic circles in the reported data: i) Courses were integrated for learning Information Systems Development as the whole with the courses as parts (cf. Figure 1). However we also found another level of a hermeneutic circle showing that different activities within the different courses formed another level of reflections on parts (cf. Figure 1) in the ISD focus. ii) The product perspective showed the relationships between the system and the mandatories as whole and parts (cf. Figure 2), and in turn the courses, as parts, that contributes to each of the mandatories as wholes (cf. Figure 2) of the product. iii) The relationships between the project as process where the project is the whole and the sprints as parts (cf. Figure 3) and another level where the courses as parts contributed to the sprints as wholes (cf. Figure 3) in the process focus. iv) The meta learning perspective where the different categories of reflections on a general level relate as parts to the ISD project as a whole (cf. Figure 4).

We found that the totality of these four perspectives constituted a learning environment that made it possible for the students to understand the systems development process, the product they produced, and what they learned though the activities and reflections they had to perform in ISD. The understanding of the interrelationships of wholes and parts on different levels of the learning environment is vital. Hermeneutics therefore adds an important perspective to Harden's (2000) model.

A practical contribution from this research is that lecturers that want to design a learning environment will benefit from explicitly considering the hermeneutic circle. The project was here reflected on as a larger whole than each course, Students reflected on how parts of each course related to the whole project. Lecturers may well encourage project reflections on product, process and meta learning as important elements in the learning processes.

6. CONCLUSION

Returning to our research question: "How can we as university lecturers design a learning environment to facilitate students learning information systems development?" our findings expand Harden's (2000) suggestions of integrating courses for better learning for students.

Our main findings are that designing and using an integrated learning environment is cost effective for the lecturers and useful for the students. Students are able to understand and utilize the learning environment centering on students learning by using a common project as the center of integration of courses. The project helped the students reflect on connections between the courses and the project, here viewed as hermeneutic circles leading to increased understanding, an important prerequisite for learning.

The lecturers may integrate on one level in Harden's integration ladder while the students in practice integrate their learning on a higher level. In a hermeneutic learning process there are several perspectives of wholes and parts at different levels. The learning environment opens for reflecting on one or more of the categories ISD development, the project, the process and the meta learning perspective. A result of this design of a learning environment is that it is cost effective from the lecturers' perspective since the integration is on a relative low level of Harden's (2000) integration ladder but on a higher level for the students learning environment.

A question for further research relates to why some students profited more from this learning environment than others. Parts of a possible answer may relate to how the students managed to work in groups. Another perspective of the answer may be if this kind of learning environment fits all kinds of students? Maybe the learning environment is more fitting for students that are able to reflect on what they do, how they do it and what possible improvements may be within the different categories designed in the learning environment.

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