Knowledge Integration in Information Systems Education Through an (Inter)active Platform of Analysis and Modelling Case Studies

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Abstract. In this paper we discuss how knowledge integration throughout system analysis, modelling and development courses can be stimulated by giving an overview of our MIRO-project at K.U.Leuven. This includes offering an online knowledge base of all-embracing case studies, structured according to the Zachman framework. Supported by collaborative groupware, students not only get the opportunity to consult and compare solutions for the case studies, but also actively discuss and contribute to alternative solutions. In this Problem Based Learning (PBL)-context, students are able to influence and understand the development of a certain process through interactive computerized animations and demos.

Keywords: Cooperative information systems, information systems education, implementing collaborative groupware, digital libraries, knowledge integration.

1 Introduction

1.1 Knowledge Fragmentation Problem

Students in business informatics are exposed to the concepts of analyzing, designing, modelling, developing, implementing, evaluating and optimizing information systems in organizations. Unfortunately, not everything can be studied within one single course, due to the scope and complexity of a complete phased system-development path.

Therefore, this material is spread out over separate individual courses. Each course deals with a certain phase of the development path and illustrates that phase with its own case studies. The dissimilarity in case studies between separate courses results in severe knowledge fragmentation. Consequently, students experience serious difficulties in acquiring insight in the overall system development path.

1.2 Unfavorable Aspects of Isolated Courses

– In most of the courses students only analyze a part or a certain phase of the whole development path in depth.

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- The different courses illustrate the phases by means of different case studies; sometimes even with seemingly contradictory solutions.
- The comparison of alternative approaches is limited because the different courses are not well adjusted to each other. Due to the use of different cases, the comparison of solutions becomes difficult.
- Both students and teachers are putting two times as much effort in the completion of their tasks. Students have to study several cases and teachers have to write several cases, whereas focusing on global cases which are part of several courses would be more effective and efficient.

The figure below presents a summary of the knowledge fragmentation problem described above. A single arrow points at a consequence while a double arrow indicates a contrast:

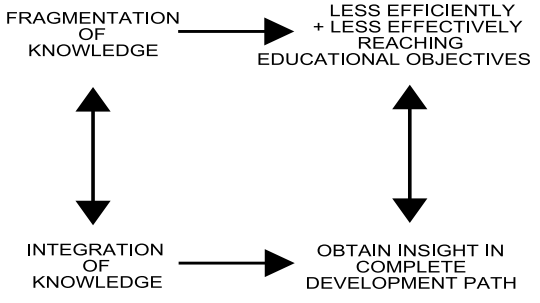

Fig. 1. Knowledge fragmentation problem

1.3 Ways to Stimulate Knowledge Integration

How can this problem of knowledge fragmentation be solved? The solution we had in mind was to make cases covering and integrating the study material of several courses, accessible to students. Those cases can be presented during the contact moments of these courses. Thereby, the offering of cases is possible either with or without support of information and communication technology.

This is where the fundamental nature of the MIRO-project jumps in: giving students the opportunity to quickly compare alternative solutions to certain case-related problems and influence and understand the development of a certain process through interactive computerized animations and demos. Thanks to the computer support that will be organized during the project, students and teachers are offered the possibility to reach their educational objectives more effectively and efficiently.

2 MIRO Solutions and Expected Results

2.1 Main Objective

The major goal of the project is to stimulate the integration of knowledge by offering an interactive online platform with case studies that exceed the fragmental image of the individual courses. This project runs between 2005 and 2007.

2.2 Subgoals in Order to Realize This Main Objective

- Structure the study material in a clearly defined and understandable way.
- Present a navigational framework that gives the opportunity to obtain more and more detailed information as students navigate deeper and deeper into the global picture.
- Stimulate and involve students actively in their process of knowledge integration by offering interactive animations and demos.

2.3 Expected Results

While positioning the project against the core educational purposes of an institution like a university, it shows an added value towards teachers, students and the institution itself.

From the teachers' point of view the project joins the competence and specialization of the separate individual teachers thanks to the exchange of knowledge. Large economies of scale are present because of two reasons. First there is the need for computer aides, demonstrations, simulations and packages according to which computer support offers a clear added value with regard to the knowledge-exchange in a paper version. Second, building such tools and examples is very labor intensive, but by offering them on a common platform, the whole institutional community can take advantage of it.

The project does not offer advantages only for the experienced teachers, but also for new teachers since the adjustment to other related courses is strongly promoted by an educational site.

From the students' point of view it is valuable to consult several examples of packages or solutions to one and the same problem. The opportunity to analyze the same problem from different angles (e.g. the data model in the database course, the object model in the analysis course or programme examples in the software development course) but covered in the same case study stimulates the integration of knowledge originating from related courses. A click-into-detail possibility on the framework's visual representation is also an important stimulator of knowledge integration.

Moreover, it is not only about consulting in a passive way: also interactive animations of several algorithms will be recorded so that students are able to influence and understand the development of a certain process.

On top of that, students are not restricted to consulting alternative solutions. Also the comparison of solutions and the integration of these comparisons during course discussions contribute to an actual educational improvement. Besides, students actively contribute to the project by elaborating solutions themselves in a PBL-context during seminars and course projects and adding them to collaborative software. Their dynamic learning process can be stimulated by giving them opportunities to participate in online-community discussions and actively further build and complete the content by elaborating solutions with the support of collaborative software.

By giving an overview of the students' contributions, the collaborative software can offer students a possibility to self-reflexion on their learning activities. Thereby students can get a clear sight on the level of understanding they have achieved during and after the learning process. Additionally, practical experience suggests that people learn in a more motivated way when they not only learn for themselves but are also able to share the yield of their learning process with others on collaborative groupware [1]. These results can in turn be used as subject matter for other students in the group based learning environment.

From the institutional point of view, the project fits perfectly into the educational concept of "guided self-study" in which guidance by teachers and more active contributions of students is expected, which will be both driven by the project. A learning management system (LMS) is already available but does not cross the boundaries of single courses. Moreover extra attention will be given to specific themes like the development of course-exceeding capabilities like handling a lot of information, reporting results, communication and presentation skills, participating in a virtual community and the completion of study material by students.

3 Identification of the Target Group

Courses are often part of different educational programs with different educational objectives which can be viewed on three levels (Fig. 2):

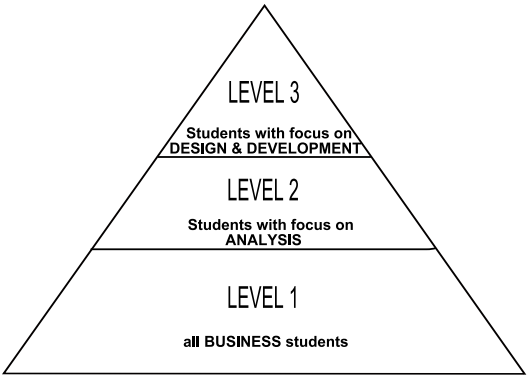

Fig. 2. Levels of educational programs in business informatics

- Level 1: all business students
  - Objective: obtain insight in an organization and its underlying processes by recognizing the role and evaluating the impact of information systems.
- Level 2: students with a focus on analysis of information systems
  - Objective: previous objective + analyze and optimize those organizational processes.

- Level 3: students with a focus on design and development of information systems
  - Objective: previous objectives + design and develop the organizational systems technically.

The information systems that are subject of discussion are the same, but the angle from which they are studied varies from recognizing, evaluating and analyzing to designing and developing the system. As a consequence, the role and contribution of students is different for each target group.

4 Actual Realization of the Integration Project

4.1 Create Structure with the Zachman Framework

The framework that will support students in structuring their acquired knowledge is the Zachman framework for Information Systems Architecture which has been further developed in cooperation with J. Sowa. [2], [3]. This Zachman framework offers the opportunity to structure system architectures on the basis of 6 questions (What?, How?, Where?, Who?, When?, Why?) and 6 interest groups (the planner, the owner, the designer, the builder, the programmer and the end user). That reasoning scheme has specially been designed to aide getting an overview of complex subjects like an enterprise. In addition, students can focus on one subcomponent at a time without losing sight on the system's global context.

4.2 Cover the Different Courses with Extensive Case Studies

A number of problem descriptions will be offered in the form of real life case studies. Thereby students can brainstorm about what actions they would take under realistic conditions to solve the problems described in the case. As a consequence, students do not remain passive observers, but are forced and trained in a learning-by-doing context to take concrete decisions and actions in order to obtain a reasonable outcome to the problem and analyze their results [4].

These case studies include problem descriptions of a complete development path of an organizational system and vary from the organization of a classical order entry system or library-system to a more complex insurance process [5], [6]. Dependent of the technique, language or method used, several solutions will be obtainable for the different phases of one and the same case-study. The solutions will be structured into the earlier-mentioned framework.

Several questions related to the lifecycle of case studies emerge, for example: how long will it take to produce a complete case study, what is the optimal number of authors to contribute to the case study, how many students will use the case study and what about the evolution of case studies? Out of the average number of students participating in the courses involved, we know that the total number of students that can use the case studies for reaching their educational objectives, will be in the order of 600-700 students. This average total number

of students is spread over the different business informatics courses: on average, there are 500 business students, roughly 150 analysis students and about 30 students with a focus on design and development. As illustrated in Fig. 2, the more upwards the pyramid, the narrower the group.

For the moment we cannot give an exact answer to the other questions however, since the project is still in an experimental phase and will be implemented next academic year (starting October 2006).

4.3 Different Roles for Different Groups

As mentioned above, the role and contribution of students is different for each target group and depends on the profiling of the educational program and the specific goals of the courses involved:

Business Students approach the organizational systems from the point of view of the upper rows in the Zachman framework (solid circles in Fig.3). They take a look at the contextual scope of the information system and the conceptual model of the enterprise in order to get insight in the organization and its underlying processes.

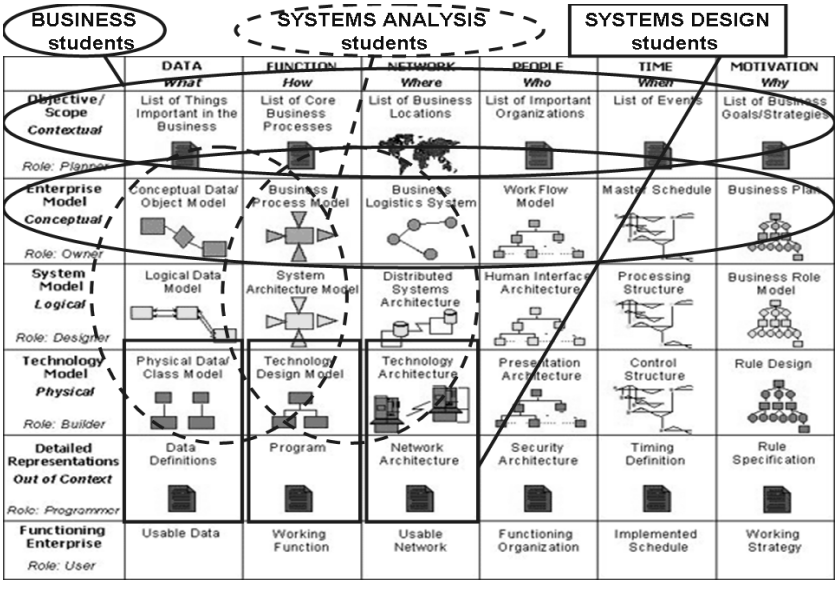

Fig. 3. Zachman framework - Points of view

Besides, these students are also able to obtain additional information about for example more technical cells in the framework that are not part of the top layers, by clicking on that cell (Fig.4). In that way, students can focus on certain

parts of the case study and have a look at demos and implementations, without loosing sight on the position of that part in the overall picture.

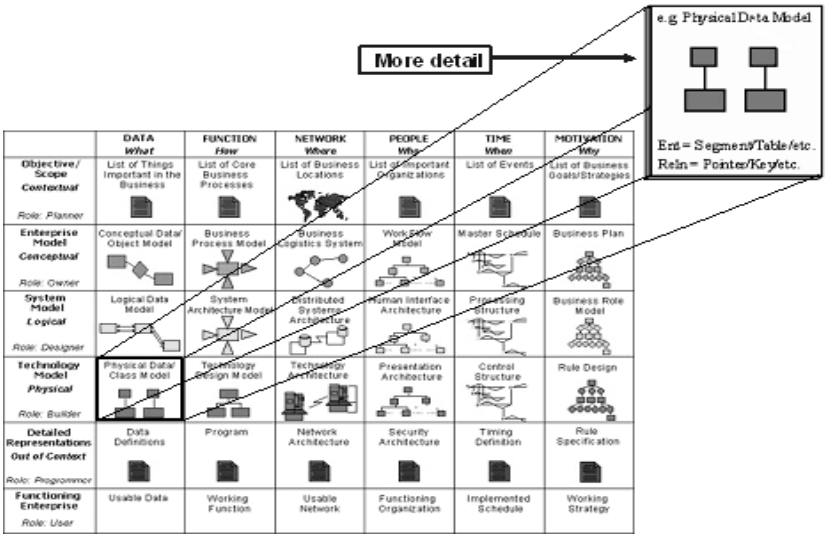

Fig. 4. Zachman framework - Detailed view

Systems Analysis Students following a program focused on analysis, have another approach towards the framework: they analyse the business models, data and processes (e.g. MDA, UML) and try to find and describe a more optimal model of the information system (dotted circles in Fig.3). Thereby, they integrate the data view with the process view, which are often taught in separate courses.

Systems Design Students whose educational program is focused on design and development have a more chronological progress approach towards the framework. They take a look at the total evolution of an information system starting from the model, going through model transformation and ending with the implementation, with a clear focus on technical aspects (solid rectangles in Fig.3).

These students are able to view and compare additional implications involved when adjusting the technical implementation to the business model specifications. They can thereby develop different technical solutions to the same (business) problem.

4.4 Stimulate the Active Learning Process with wiki-Technology

Last but not least, the case studies will be collected and offered on a wiki. The database behind the wiki is not just a collection of material however, but an

integrated crosspoint bank of (alternative) solutions to well chosen case studies. During the courses involved in the project, the common cases will be used to facilitate students studying the same problem via different approaches; for example the data model in the database course, the object model in the analysis course or the programming examples in the software development course.

Teachers will be able to refer to the case studies on the wiki where students can use the wiki in different stages (Table 1).

Table 1. Different stages in the use of the wiki

Passive	Interactive	Active
Analyze problems in case studies	Execute simulations to understand the practical working of solutions	Elaborate (alternative) solutions themselves
Consult solutions to problems and compare alternative solutions	Experiment with interactive demos (e.g.SQL-query processor)	Add solutions to the wiki in the context of class projects
Combine and integrate knowledge from different courses	Discuss solutions and the way of reasoning with colleagues	Add comment to solutions of colleagues

Because of active online participation, the contact time during lessons can be experienced as more productive. The advantage of working with collaborative groupware like a wiki is that it encourages active participation of its users (students and teachers) [7]. For that reason, the maintainability of the wiki will be guaranteed in the long term. Thanks to the online-discussions and the results that follow, students of following years do also profit in this group based learning-process. Up-to-date research topics can be easily added and discussed on the wiki in order to close the teacher-research gap [8].

The Learning Management System that is used today [9], offers merely a limited possibility for cooperation and input of students only by discussion groups-functionality [10]. In contrast, a wiki invites every user to take the opportunity in contributing to the content itself. The combination of the present Learning Management System with an open, collaborative platform can be an interesting path of growth in the context of group based learning.

4.5 Criteria for Evaluating the Project

The evaluation criteria that can be used in order to measure the level of success of the project are divided into quantitative and qualitative criteria:

- **Quantitative criteria:**
  - Content:
    - The number of case studies available on the wiki.
    - The completeness of the case studies in terms of the number of cells elaborated in the Zachman framework.

    - The average number of alternative solutions for each cell in the Zachman framework per case study.
  - Effective use of the wiki:
    - The number of persons visiting the site (measured through the wiki-software).
    - The number and extent of contributions by teachers and students (measured through webstatistics e.g. IBM history flow software [11]).
- **Qualitative criteria:**
  - Evaluation by students:
    - Online survey investigating the level of student satisfaction in using the wiki.
  - Evaluation by teachers:
    - Examining the level of integration of the wiki-project into the involved courses.

5 Conclusion

When different phases of an information system's complex development path are taught in separate courses, a problem of knowledge fragmentation often occurs. This paper gave an outline of the MIRO-project at K.U.Leuven which proposes a knowledge integration solution.

The integration of knowledge is achieved by first putting forward the Zachman framework as a reasoning scheme in which students can position the knowledge they acquired in one course relatively to the knowledge acquired in other courses. Second, real life case studies are at hand that cover the whole system development path and integrate the knowledge of the different courses in order to prevent students from losing the thread. Last but not least, the cases and the supporting framework are presented on a wiki. In this way, students are encouraged to actively analyze, compare, discuss with their colleagues, experiment with interactive demos and add alternative solutions to the wiki.

Thanks to the active stimulation by computer support, business students, systems analysis students, system design students and teachers are offered the possibility to reach their educational objectives more effectively and efficiently.

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