# Towards Diversity in ERP Education – The Example of an ERP Curriculum

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# Towards Diversity in ERP Education – The Example of an ERP Curriculum

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**Abstract.** The need for providing ERP knowledge by teaching the concepts of ERP systems in university courses and, above all, the possibilities of using these systems themselves in courses are frequently discussed in literature. There are many ERP systems with different technologies and philosophies available on the market. Here, the universities face the challenge of choosing the "right" number of ERP systems, how to include them in the curriculum and to what extent / how deep each of the systems should be taught. Within this paper, as a curriculum example, we will describe the ERP curriculum at the / Dresden University of Technology / Technische Universität Dresden, its different ERP courses, and how the ERP systems are provided and taught.

**Keywords:** ERP systems, curriculum, course descriptions, teaching, diversity, problem-oriented learning, education

## 1 Introduction

Today, standardized enterprise resource planning (ERP) systems are being used in a majority of enterprises. For example, more than 92 percent of all German industrial enterprises use ERP systems [1]. Due to this strong demand, there are many ERP systems with different technologies and philosophies available on the market [2]. Therefore, the ERP market is strongly fragmented, especially when focusing on systems targeting small and medium-sized enterprises (SMEs) [3]. The growing multitude of software manufacturers and systems is making it more and more difficult for enterprises that use or want to use ERP systems to find the "right" software and then to hire the appropriate specialists for the selected system. Also, for future investment decisions concerning the adoption, upgrade, or alteration of ERP systems, it is important to possess the appropriate specialized knowledge and skills in the enterprise [2], [4]. This is essential since errors during the selection, implementation,

or maintenance of ERP systems can cause financial disadvantages or disasters, leading to insolvencies of the affected enterprises (e.g., [5], [6]). In order to prevent this from happening, it is necessary to strive for a sound education on ERP systems. This places the responsibility of transferring the specialized knowledge to their students and graduates on universities, in particular on university courses in the field of information systems [7].

Because of the increasing importance of ERP systems and their educational value, many universities use or want to apply ERP systems in university courses [8] to teach and demonstrate different concepts and processes [9]. To support these courses, some ERP manufacturers co-operate closely with universities and offer their systems and resources for academic teaching [10]. One of the goals of using ERP systems in courses is to prepare students for their career by giving them at least an introduction to ERP systems. A further goal, promoted by ERP manufacturers themselves (especially by making their systems available for university courses), is for students to learn about the products as early as possible since they, later as graduates, will work with these systems or will hold enterprise positions that influence ERP investment decisions. Therefore, it is necessary for universities to offer the appropriate systems, processes, and suitable courses for their students [11], [12], [13].

The need for providing this knowledge through university courses and, above all, the possibilities of using these actual systems in courses are frequently discussed in literature (e.g., [12], [14], [15], [16], [17], [18]). These discussions clearly point out that ERP systems are or should be an important component of university curricula in information system-related subjects and courses. However, this is not a trivial task, as Noguera and Watson [19] discuss. Because there is no standardized approach, the choice of systems and their number, as well as the structure and number of ERP courses, differ from university to university [8]. For example, for teaching the respective systems, the lecturer has to be familiar with the system's concepts and its practical usage. Thus, the choice of one or more ERP system for a course strongly depends on the knowledge and experience of the lecturers. Additionally, the variety of ERP systems used in courses is limited by the manufacturers' willingness to provide their systems. This results in a situation in which only a small variety of systems and software manufacturers are represented at universities in spite of the heterogeneous ERP market.

In particular, the software manufacturer SAP is represented in numerous universities through its University Alliance program. With more than 400 partner universities participating in this program, SAP is probably the most widely used system in study courses worldwide [16], [20]. Smaller systems are rarely used in teaching; yet, a more diversified integration of ERP systems into education is advisable, especially from the viewpoint of SMEs [13], [21]. In addition, by including more than one ERP system in the curriculum, the students gain a broader overview of different ERP systems, the ERP market itself, and different ERP concepts and architectures. Furthermore, by teaching a diverse set of ERP systems, the students' awareness of functional approaches, process support, and interface ergonomics will increase. Additionally, by including ERP systems for smaller companies, the differences between SMEs and large-scale companies [22] will be illustrated to students because they are reflected in the appropriate design of the respective systems [3]. All these are reasons to strive for more diversity in ERP education.

However, at this point it is difficult to decide how many systems should be part of the curriculum and to what extent they should be taught. Of course, ERP systems and their concepts can also be described theoretically without direct system access. However, the learning experience and understanding are much better promoted through the use of real systems [23]. Yet, choosing the "right" number of ERP systems is difficult since too many systems can lead to student confusion or misunderstandings. Also, in-depth insights in selected systems are mandatory to ensure a deeper understanding of the concepts and constructs. Hence, it is not advisable to provide deep insights into too many ERP systems. Again, this would lead to student confusion or misunderstandings. Here, the universities face the challenge of how to include a couple of ERP systems in the curriculum and to what extent / how deep each of the systems should be taught.

The Dresden University of Technology / Technische Universität Dresden (TUD) – especially the Chair of Information Systems (IS in Manufacturing and Commerce) – has gained much experience with including a diverse set of ERP systems in its curriculum for students in Information Systems. Within this paper, we will describe the different courses and how the ERP systems are provided and taught. Therefore, the paper is structured as follows. Following this introduction, we provide the general design of the curriculum. The different IS programs are briefly described and a state of the art of teaching ERP systems at German universities is given. Afterwards, the respective ERP courses (lectures, projects, and seminars) are described in detail before an evaluation of the courses is given. Finally, we address limitations and summarize the overall curriculum design and major aspects.

## 2 Background and General Design of the Curriculum

### 2.1 Teaching ERP Systems at German Universities

For gaining an insight into the current ERP teaching at German universities, we conducted a survey among 92 university chairs [10]. Among those 92 respondents, 59 are teaching ERP topics. Our investigation resulted in a large variety of teaching methods, which are used to familiarize students with ERP knowledge and skills. The question on the employed teaching methods was mostly answered with "Lectures". Eighty-five percent of all the participants who are involved in ERP topics use ERP at least in their lectures. Practical exercises and case studies were mentioned by 36 and 29 participants (cp. Table 1). Therefore, lectures and practical exercises can be seen as the typical methods employed, whereas the other methods mentioned allow for a deeper learning experience. For example, case studies help students to not only understand enhanced ERP system functionality but also to strengthen their individual soft skills like problem-solving or teamwork. However, despite this variety of teaching methods, out of these 59 participants only 38 (64%) are using ERP systems practically (e.g., in computer lab exercises, projects, independent teaching formats, etc.). A majority of the participants who are teaching ERP systems practically are using SAP (35 out of 38; 92%) [10].

**Table 1. Teaching methods (multiple answers allowed, n=59)**

| Teaching methods | Absolute frequency | Relative frequency (n= 59) |
|---|---|---|
| Lectures | 50 | 85% |
| Practical exercises | 36 | 61% |
| Case studies | 29 | 49% |
| Projects | 23 | 39% |
| Seminars | 20 | 34% |
| Assignment paper | 14 | 24% |
| Simulation games | 4 | 7% |
| Other teaching methods | 4 | 7% |

Other ERP systems used are Microsoft Dynamics NAV and AX (39%), Semiramis (10%), and ProAlpha (10%). Mostly, more than one ERP system is used. Thus, many participants who use ERP systems in teaching employ different systems. This fact supports the demand mentioned in our introduction [10].

## 2.2 Aim of the ERP Curriculum at the Technische Universität Dresden

The role of knowledge as a strategic resource is well understood in the business world. However, the question of how to teach and to make best use of it still remains insufficiently answered [24]. For universities, there is always a small degree between academic "truth" (in terms of general, but too broad domain knowledge or theories) and practical skills (that may be outdated in a few months) [4]. Therefore, our ERP curriculum is based on the idea of providing theoretical knowledge about ERP systems and their concepts as well as practical abilities in using these systems for bachelor students and later on for master students.

In general, people pass several competence stages when they acquire knowledge. For example, in the Dreyfus model of skill acquisition, five stages of knowledge acquisition from novice to expert are distinguished [25]. Researchers agree that reflective practice is necessary in order to go through different stages of learning. It involves considering personal experiences in applying gained knowledge to practice while being coached by professional tutors [26]. According to the stages of maturity on the competence ladder [27], students have to go through different levels of competence acquisition in order to achieve sufficient knowledge and hence competency within their focused field of study. The views of North and Hornung [27] differ from learning about incoherent symbols and data without meaning to information that becomes knowledge in combination with certain experiences and in a specific context. Furthermore, the actual application of knowledge to know-how and its critical reflection, in terms of gaining competency, allows for the final goal of individually applying different methods, instruments, and experiences in a unique and hence competitive way (cp. Figure 1). This complements Kolb's experiential learning theory model that outlines four approaches towards grasping experience, namely

abstract conceptualization, reflective observation, active experimentation, and concrete experience [28].
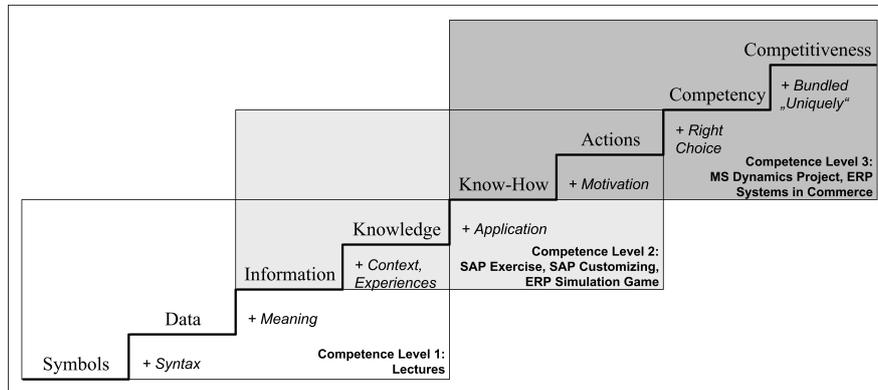


**Figure 1. Stages of maturity on the competence ladder with regard to the ERP curriculum (cp. [28], [29])**

Competence Level 1 consists of theoretical lectures on IS development and the usage of managerial IS, especially ERP systems. Aim of Competence Level 2 is the application of theoretical background based on SAP ERP 6.0 exercises, business processes, and customizing as well as on an SAP simulation game. Competence Level 3 seeks to transfer knowledge of various systems in depth (e.g., implementation of Microsoft Dynamics) and breadth (e.g., overview case studies on various medium-sized ERP systems).

Thus, in order to allow for a broad education combined with several deep insights, we decided on setting up an ERP curriculum with lectures, seminars, and projects in the Bachelor IS program and in the Master IS program at TUD.

It consists of different lectures where especially ERP topics are focused in the third and fourth semester as mandatory parts of the bachelor program. In combination with the lecture of the third semester, a mandatory hands-on exercise (SAP Exercise) is provided as well as an optional project seminar (MS Dynamics Project) in the second half of the third semester. Following the lectures of the fourth semester, in semester five another hands-on exercise is given (SAP Customizing). Within the master program two practical courses are included in the curriculum. Both courses take place in the first half of the first semester of the master program. The first course is a project seminar (ERP Systems in Commerce) that lasts the whole semester. The second course is an SAP-based simulation game (ERP Simulation Game), which takes place in the second half of the first semester.

Before the different courses and lectures are described in detail, a short overview of the mentioned bachelor and master programs is given in the following sections.

## 2.3 Bachelor IS Program at the Technische Universität Dresden

The Bachelor program in Information Systems at Dresden University of Technology / Technische Universität Dresden (TUD) is a six-semester program comprising 180 ECTS that lead to a "Bachelor of Science" degree. It is one of four bachelor programs the TUD faculty of business & economics offers. The IS program combines classes in Information Systems, Informatics, Mathematics, Business Administration, and Economics. Each area has to be attended and offers different types of classes such as lectures, exercises, seminars. In addition there is a module specifically intended to acquire soft skills during a mentoring program and two projects. In the fourth and fifth semester, students have to select two specialization modules (minor) from offerings in business and economics. However, there are electives within many of the other mandatory modules as well where students choose from a well-defined catalog of offerings. The program ends with the writing of a research-oriented bachelor thesis.

The ERP curriculum is integrated into two of the four information systems modules (IS track) that build on an introductory IS class in semester 1, which is an integral part of the four bachelor programs the faculty offers. The logic of the IS track is to reverse the order of a system lifecycle by starting with the intended outcome of information systems and then proceeding backwards step-by-step to what is required in order to achieve this outcome. Thus, there are three modules reversing the lifecycle logic that structure the IS track as follows:,

- Module 1 in semester 2: Adding value through information systems
  (6 credits, 2 lectures, 1 project)
- Module 2 in semester 3: Using information systems
  (9 credits, 1 lecture, 2 hands-on exercises, 1 project)
- Module 3 in semesters 4 & 5: Providing information systems
  (12 credits, 2 lectures, 1 hands-on exercise, 2 projects)

and one additional module with IS electives, that is

- Module 4 in semesters 5 & 6: Selected topics in information systems
  (6 credits, 2 courses from a catalog of offerings).

The ERP curriculum is mainly included in modules 2 and 3 and encompasses one of the hands-on exercises (SAP Exercise) and the project (MS Dynamics Project) in module 2 and parts of the lectures and one of the exercises (SAP Customizing) in module 3.

## 2.4 Master IS Program at the Technische Universität Dresden

The Master IS program is one of five master programs the TUD Faculty of Business & Economics offers. It provides students with the ability to identify and frame problems related to using and providing information systems and information technology in private and public companies and organizations, to analyze these problems by applying scientific methods, and to work out feasible solutions. The integration of Management and Informatics in the program allows students to identify, illustrate, and consider interdisciplinary coherences.

During the studies courses in Research Methodology, Additional Qualifications, an internship and a research seminar have to be attended. Students specialize in different fields by choosing six specializations, two from the field of information systems, two from informatics and two from any specialization the school offers (including IS). Thus students can either go for a broader range of areas by choosing two IS specializations only or heavily concentrate on information systems by choosing four IS specializations. Each specialization consists of two modules with 6 and 9 credits. The IS specializations are:

- Application Systems in Business and Administration
- Business Intelligence
- Information Management
- Systems Development

The ERP curriculum is mainly included in the first specialization which is the one chosen by most of the IS students. Within this, "ERP Simulation Game" and "ERP Systems in Commerce" take place.

The study program ends with the writing of the research-oriented master thesis.

## 3 Description of the ERP Curriculum's Elements

In this section we will describe the respective ERP courses. We will focus on the practical parts of the ERP curriculum – the hands-on exercises, the project seminars, and the ERP simulation game. Additionally, we will refer each course to the competence ladder and its different competence levels (cp. Figure 1). We will not describe the lectures, since within the lectures "common" ERP topics (e.g., packaged vs. home-grown applications, ERP architecture, ERP selection and implementation, license models, etc.) are taught.

### 3.1 SAP Exercise – Competence Level 2 (Bachelor IS Program)

SAP Exercise is a hands-on exercise. It takes place within the third semester of the Bachelor IS program and is a mandatory course.

For this exercise, we chose SAP as one of the big players because our university was already a member of the SAP University Alliance Program. The access to the system (SAP ECC 6.0) was easy to establish. Also, detailed instruction materials and click-by-click process descriptions needed for the course were provided through SAP´s University Competence Centers (UCC). Furthermore, the lecturers were already familiar with this kind of course and with the corresponding system.

Since the students learned some theoretical basic knowledge about ERP systems within the lectures, the students got a first practical hands-on understanding of one ERP system while attending SAP Exercise. The scenario for SAP Exercise is part of the materials and therefore, it was predetermined because of the click-by-click instructions provided by the UCC. In order to gain access to the detailed instructions, one has to be a member of the SAP University Alliance Program. Table 2 shows a short compendium of the scenario.

The three parts (production, controlling, and retail) of this course were performed in three separate sessions, which took place in the computer lab of the university. For every session a time slot of three hours was scheduled. This was enough time to let the students perform the processes at their own pace.

**Table 2. Scenario for SAP Exercise (compendium)**

| | |
|---|---|
| **Generic production process** | Create a stock of materials<br>Create bill of materials<br>Create routings<br>Generate a production order<br>Assembly of the individual parts<br>Assembly of the whole product |
| **Controlling Case Study** | Create Cost Centers<br>Plan the Number of Employees<br>Plan Primary Cost Inputs<br>Plan Internal Activity Inputs<br>Automatic Price Calculation<br>Create Work Centre<br>Integrate Work Centre in Routing<br>Perform New Product Cost Estimate |
| **Generic retail process** | Create master data for customers and vendors<br>Enter a framework contract<br>Create Sales Order<br>Create Production Order<br>Create Purchase Order<br>Outbound Delivery with Order Reference<br>Create Transfer Order for Delivery Note |

Before the beginning of each session a lecturer gave a short overview of the process which should be performed during the session. Additionally, one or two lecturers (depending on the number of students) stayed in the lab during the whole session to provide helpful advice or solve problems if the students had done a wrong click, forgot to enter some data, etc. Furthermore, before the three sessions took place a "navigation-session" was offered to the students during which they could learn how to work with an SAP system. This was optional, but the majority of the students who did not have any experience with SAP participated. For example, students who had worked with SAP during internships did not attend this "pre-session".
A more detailed description of the course and the approach of setting up this course can be found in [21].

**3.2 MS Dynamics Project – Competence Level 3 (Bachelor IS Program)**

MS Dynamics Project is an optional project seminar in the third semester of the Bachelor IS program. Students who attended SAP Exercise can take on this project seminar to deepen their gained ERP knowledge. For this seminar, we chose Microsoft

as manufacturer of ERP systems for small and medium-sized enterprises. Even though Microsoft has a university program, too – the so-called Microsoft Business Solutions Academic Alliance (MBSAA) – detailed instruction materials are not provided. Instead, access to the ERP systems of Microsoft (Microsoft Dynamics NAV and Microsoft Dynamics AX) as well as to other Microsoft Business Solutions are provided without fees. Therefore, in this course the participating students had to evaluate the functionalities of Microsoft Dynamics NAV 5.0 (winter semester 2009 / 2010). By repeating this course in winter semester 2010 / 2011 we changed the system to Microsoft Dynamics AX 2009. There is no need for changing the system within this course from a learner perspective. However, from a lecturer's perspective this allows for gaining more experience with different systems (see for a more detailed argumentation why we chose to change the system in [21]).

For MS Dynamics Project, the chosen scenario contains a generic retail process that has to be examined by the students. Additionally, a generic production process that contains the assembly of a product consisting of individual parts was added to the scenario. Table 3 gives an overview of the scenario. The complete scenario for MS Dynamics Project in English and German can be requested from the first author.

**Table 3. Scenario for MS Dynamics Project (compendium)**

| Generic production process | Create a stock of materials<br>Create bill of materials<br>Generate a production order<br>Assembly of the individual parts<br>Assembly of the whole product |
| --- | --- |
| Generic retail process | Create master data for customers and vendors<br>Enter a framework contract (1,000 motorcycle helmets for 299 Euro each)<br>Normal purchase price 349 Euro each<br>Order 150 motorcycle helmets for next month for 299 Euro each<br>Supplier sends a delivery notification<br>Supplier delivers 150 motorcycle helmets that have to be checked and stored<br>A customer asks for an offer for 10 motorcycle helmets<br>The customer orders 8 motorcycle helmets relating to the initial offer<br>Take order amount from the warehouse and ship to the customer |

By providing the scenario, the students should be able to identify the processes that have to be performed within the ERP system and therefore to define the necessary work packages. This enables them to organize their teams for themselves. Furthermore, additional literature is helpful to compensate possible gaps in the students' knowledge (e.g., for retail literature, [30], [31], [32]). During a kick-off

meeting we described the organizational basics and general conditions of the course as well as the idea of the scenario and the tasks that had to be fulfilled.

During the course, participants worked independently in small groups on the given processes with their ERP system. The students were given two months (until the beginning of the fourth semester) to evaluate the ERP system and to write the required documentations. There was no training for the students by the ERP manufacturers. Once they had access to the system, the students independently performed the initial skill adaptation training. The mentoring of the lecturers was only required for individual group meetings, during which the teams could ask questions concerning technical aspects or problems with regard to the content of the scenario. Students had to evaluate the ERP systems based on the requirements of the scenario. They had to enter all necessary data in order to properly document the functionality later and had to reproduce the processes based on the functionalities of their ERP systems. If some aspects of the scenario were not supported by the system because of missing functions, students mentioned this in their written documentation. Access to the systems was granted during the kick-off meeting. There, the students had to install the system on their own laptops (Microsoft Dynamics NAV 5.0). For Microsoft Dynamics AX 2009, we provided access to the system through the computer labs with an installation on faculty servers. Afterwards, the students had to organize themselves to fulfill the tasks.
A more detailed description of the course and the approach of setting up this course can be found in [21].


### 3.3 SAP Customizing – Competence Level 2 (Bachelor IS Program)

SAP Customizing is a hands-on exercise, too. It takes place during the second half of the fifth semester of the Bachelor IS program and is a mandatory course.

For this exercise, we chose SAP, too, since all of the students in this semester as well as the lecturers were familiar with this system.

Since the students learned some theoretical basic knowledge about tailoring ERP systems within the lectures of the fourth semester, this course gives a hands-on understanding of how to configure / customize a specific ERP system. The scenario for SAP Customizing, again, is part of the materials provided from the UCC and therefore, it was predetermined because we referred mainly to the provided click-by-click instructions.

Contrary to SAP Exercise, this course also consists of some theoretical parts. In general, three different components are part of this course. The scenario deals with a smaller company that is inherited from a large multi-national enterprise. Therefore, the first part of the course is to understand the different organizational structures of the two companies. Additionally, the students have to identify the different organizational units of the SAP system that refer to the companies' structures. Afterwards, the students have to perform the configuration of the companies within the SAP system practically by using a click-by-click instruction. The third part of this course sums up both previous parts. Here, the students get another (shorter) scenario similar to the previous scenario. Again, they have to identify the necessary organizational units and perform the configuration within the SAP system. However,

for this part, we do not provide any detailed instruction materials. The students have to "use" the knowledge learned during the other parts and have to work on their own. The parts of this course were performed in three separate sessions (3 hours each), which took place in the computer lab of the university. Within the first session a strong interaction between the students and the lecturers is necessary, to ensure that the students understand the scenario correctly and that they identify the "right" organizational units. Students complete parts two and three at their own pace. Additionally, one or two lecturers (depending on the number of students) stayed in the lab during the whole session to provide helpful advice or solve problems if the students had done a wrong click, forgot to enter some data, etc.

**3.4 ERP Simulation Game – Competence Level 2 (Master IS Program)**

This course takes place in the first semester of the master program. As the course title indicates, this course is based on a simulation game, originally designed by academics of the HEC Montreal. Contrary to other simulation games, this game includes SAP as ERP system to handle the business activities and processes [33], [34].

Using a continuous-time simulation, students have to run their business with a real-life ERP (SAP ECC 6.0) system. The students are divided in teams of 3 to 4 members. They have to operate a firm in a make-to-stock manufacturing supply chain (manufacturing game) and must interact with suppliers and customers by sending and receiving orders, delivering their products, and completing the whole cash-to-cash cycle. [35]. Additionally, for German universities, a "distribution game" was developed that incorporates reduced functionality of the make-to-stock manufacturing game. We use this "light" version of the game for introductory purposes. The students have to play this game before playing the extended version.

A simulation program was developed to automate some of the processes to reduce the game's complexity and the effort required of the students. For example, the sales process, parts of the production process, and parts of the procurement process are automated. Automation is especially applied to steps where no business decisions are involved. Using standard and customized reports in SAP, students must analyze their transactional data to make business decisions and ensure the profitability of their operations [34], [35].

To get access to the game, the university has to be a member of the UCC program of SAP. Then again, detailed instruction materials as well as training for the lecturers are provided.

In winter semester 2010 / 2011 we included this game in the curriculum for the first time. The students had to play the game three times. For every session a time slot of three hours was scheduled. Within the first session, the distribution game was played to allow the students to "get in touch" with the game. Afterwards, the students continued to play the manufacturing game with reduced complexity and functionality within the second session, before playing the manufacturing game with full functionality in the third session. Before the games started, a lecture was given as introduction to the respective game and to its processes in order to ensure an overview for the students. After the introduction one or two lecturers (depending on the number

of students) stayed in the lab during the whole session to provide helpful advice or solve problems.

A more detailed description of the course and the approach of setting up this course can be found in [33], [34], [35].


### 3.5 ERP Systems in Commerce – Competence Level 3 (Master IS Program)

This course is based on a project seminar described by Winkelmann and Matzner [4] and its enhancement in Winkelmann and Leyh [13]. It takes place in the first semester of the master program. Similar to MS Dynamics Project, a problem-oriented, learner-centered approach [18], [36] is used. With case studies, the students train themselves independently in small groups to use different ERP systems and present their findings and experiences through live demos of the respective system, for example. The seminar participants can increase their knowledge through investigating different ERP systems. We have enhanced the original concept [4] and simultaneously applied their model to three different universities [13].

We chose a scenario of existing processes from enterprises that served as a starting point for the students' evaluation. At the end of the semester, after the analysis of the respective systems, students had to present their results. We divided the students into groups of 2-6 each. Every group had to fully explore one ERP system and take a look at the other systems in order to derive questions for the final presentations. Each team had to present its ERP system in a similar, structured way, but the detailed focus and design of the presentation was incumbent upon each team.

This project has been part of the curriculum for three years. It is taking place each winter semester at the universities of Dresden, Koblenz-Landau, and Muenster. During a kick-off meeting, at the beginning of the seminar, we described the organizational basics and general conditions of the seminar as well as the idea of the scenario and the tasks that had to be fulfilled. In analogy to MS Dynamics Project, during the seminar, participants worked independently in small groups on the given processes with their respective ERP system. At the end of the semester, they provided a written evaluation of "their" ERP system. Additionally, a presentation of the systems had to be done. Presentations in a two-day block meeting were considered practical, since the ERP systems and their functionality were presented in a condensed way during a short period of time and allowed immediate comparison of the different systems. Therefore, each team had 60 minutes for the presentation and an additional 30 minutes for a discussion and questions. For the presentations, the participation of all students was mandatory. This guaranteed that learning outcomes did not remain limited to one system but were extended to the other ERP systems.

Again, there was no training for the students by the ERP manufacturers. The students independently performed initial skill adaptation training after they got access to the systems. Contact with the manufacturers was only necessary if a technical problem evolved and prevented further processing of the scenario (e.g., missing access rights, running out of the license). The mentoring of the lecturers was only required for individual group meetings. Since we offered the e-mail addresses of the teams from the other universities to each ERP team, they were able to solve most technical and economic questions among themselves. However, we also had to send

questions to the ERP vendors. During the different semesters, we changed the set of ERP systems used. Therefore, Figure 2 shows the different systems per winter semester (WS) with the access possibilities.

| | | | | | |
|---|---|---|---|---|---|
| **WS 08/09** System | Microsoft Dynamics NAV 5.0 | proAlpha | SAGE Classic Line + SAGE Office Line | GodeSys SO: Business Software | Semiramis 4.4 |
| Access | Local installations on students' laptops | Remote-connection via the computer labs | Local installations on students' laptops | Remote-connection via the computer labs | Connection via web-browser |
| **WS 09/10** System | Microsoft Dynamics NAV 2009 | proAlpha | SAGE Classic Line + SAGE Office Line | GodeSys SO: Business Software | Aldata G.O.L.D |
| Access | Local installations on students' laptops | Remote-connection via limited IP-domains | Local installations on students' laptops | Remote-connection via limited IP-domains | Connection via web-browser |
| **WS 10/11** System | Ecoro (vendor: SHD Datentechnik) | proAlpha | SAGE Classic Line + SAGE Office Line | GodeSys SO: Business Software | UniTrade (vendor: Padersoft) |
| Access | Remote-connection via limited IP-domains | Remote-connection via limited IP-domains | Local installations on students' laptops | Remote-connection via limited IP-domains | Remote-connection via limited IP-domains |

**Figure 2. Overview of the ERP systems per semester**

The ERP manufacturers were asked for remote access to their system and most of the manufacturers provided this access. The Microsoft Dynamics and SAGE systems were made available locally on computers at the universities or were installed on the students' notebooks. The appropriate licenses and full versions of the ERP systems were released free of charge for the period of the seminar.

The scenario chosen contained generic and specific retail processes that were examined by the students. Additionally, a generic production process that contained the assembly of a product consisting of individual parts was added to the scenario. Table 4 gives a general overview of the processes and tasks that make up the scenario.

**Table 4. Scenario for ERP Systems in Commerce (compendium)**

| | |
|---|---|
| Generic retail process | Enter a framework contract (1,000 PCs / 299 Euro each) Normal purchase price 349 Euro each Order 150 PCs for next month for 299 Euro each Supplier sends a delivery notification Supplier delivers 150 PCs that must be checked / stored A customer asks for an offer for 10 PCs The customer orders 8 PCs relating to the initial offer Take order amount from the warehouse and ship to the customer |

| | |
|---|---|
| Specific retail process | Check for basic price conditions, transaction-based conditions, and subsequent price conditions for purchase and sales (conditions such as basic bonuses, market share increase bonuses, listing bonuses, allowance adjustment bonuses, etc., are given in the scenario) Check if the system is capable of conditions depending on specifics such as regions, customer loyalty, etc. Check for calculation possibilities in purchase (different gross and net costs, etc.) Evaluate warehouse structures in terms of organization, areas, and attributes such as restrictions in weight or article characters (explosives, chemicals, etc.) Check whether it is possible to split sales offers into orders Check whether it is possible to deliver to different stores with different prices but send all bills once a month |
| Generic production process | Create a stock of materials Create bill of materials Generate a production order Assembly of the individual parts Assembly of the whole product |

A more detailed description of the course and the approach of setting up this course can be found in [13].

## 4 Course Evaluation

### 4.1 Students' perspective

Since an evaluation of seminars and/or courses in general is of high importance for the improvement of teaching concepts [8], the same questionnaires were handed out to the students at all practical courses. Within the lectures we did an evaluation, too. But these evaluation results will not be part of this chapter. We will focus on the evaluation of the practical ERP courses and the competence levels 2 and 3 only.

The questionnaires were filled out anonymously. This questionnaire served to identify possible weaknesses and opportunities for improvements with respect to the courses' realizations, the scenarios, and the support from the lecturers as well as the adequateness of the respective ERP systems. Also, the positive aspects that should be repeated in the next cycles could be emphasized. The questionnaire consisted of 21 questions based on scale evaluations (grades 1-5), yes/no, and free text answers. Some selected evaluation results are shown in Table 5. The presented results are from the evaluation of the course in winter semester 2010 / 2011. Additionally, feedback discussions were conducted with some of the teams separately to gather further suggestions from the students. This was especially done at the end of MS Dynamics Project and ERP Systems in Commerce.

**Table 5. Results of the course evaluations of winter semester 2010 / 2011**

| | Average grade per course (1=very high, 5=very low) | | | | |
|---|---|---|---|---|---|
| | **SAP Exercise Level 2 (n=30)** | **MS Dy-namics Project Level 3 (n=12)** | **SAP Custo-mizing Level 2 (n=26)** | **ERP Simula-tion Game Level 2 (n=10)** | **ERP Systems in Com-merce Level 3 (n=12)** |
| Knowledge **before** course | 3.90 | 3.5 | 2.65 | 2.70 | 2.67 |
| Interest in ERP issues **before** course | 2.47 | 2.17 | 2.46 | 2.50 | 2.50 |
| Interest in ERP issues **after** course | 2.47 | 1.83 | 2.62 | 2.40 | 2.17 |
| Motivation for thoughts and opinion building | 3.37 | 2.17 | 3.24 | 2.10 | 2.58 |
| Increase of ERP knowledge in general | 2.43 | 3.17 | 2.35 | 2.20 | 1.92 |
| Increase of knowledge regarding the respective ERP system | 2.63 | 2.33 | 2.35 | 2.20 | 2.08 |
| Increase of knowledge in comparison to other seminars | 2.92 | 2.67 | 2.72 | 1.90 | 2.45 |
| Usefulness of the scenario | 2.50 | 2.00 | 2.24 | 2.10 | 2.18 |
| Adequateness of the respective ERP system | 2.27 | 1.83 | 2.09 | 1.78 | 2.00 |
| Level of difficulty (**2=much too high, 0=reasonable, -2=much too low**) | -0.37 | 0.17 | -0,08 | -0.10 | 0.42 |
| Effort needed (**2=much too high, 0=reasonable, -2=much too low**) | 0.13 | 0.00 | 0.00 | 0.00 | 0.58 |
| Effort needed in comparison to other courses (**2=much too high, 0=reasonable, -2=much too low**) | -0.50 | -0.50 | -0.08 | -0.40 | 0.67 |

Instead of a detailed empirical evaluation that would not be statistically relevant because of the small seminar sizes, our goal is to report on students' and lecturers' experiences in order to make this knowledge available for other universities. As seen

in Table 5, the students emphasize an increase in interest in ERP issues. Only, the hands-on exercises do not lead to such an increase. The level of difficulty is seen as quite reasonable for all courses within Competence Level 2 (cp. Figure 2). For the two courses of Competence Level 3, the students feel the level of difficulty a little bit too high. Contrary to that fact, the effort for these courses in comparison to other courses is seen as quite reasonable. Only the effort for ERP Systems in Commerce is seen as too high.

Especially MS Dynamics Project and ERP Systems in Commerce turned out to be very popular among students. However for ERP Systems in Commerce (since this was not mandatory), we always feared attracting too few students, which would imply skipping some of the systems. This would have meant disappointing some of the ERP manufacturers who had invested time in advance to our seminar

## 4.2 Lecturer's perspective

The inclusion of the different lectures and hands-on exercises with the addition of "self-learning" ERP courses (MS Dynamics Project and ERP Systems in Commerce) was a good opportunity to enhance the information systems curriculum at the TUD. For the students, this not only enabled a deeper insight in specific ERP systems for large-scaled enterprises but for small and medium-sized enterprises as well.

A further benefit of MS Dynamics Project lies in the documentation of the respective ERP system produced by the students. Thereby, the lecturers obtained click-by-click instructions that can be used for further course enhancements or additional hands-on exercises. If the teams perform well in MS Dynamics Project, these documentations can be used without considerable effort for adjustment of the materials.

For ERP Systems in Commerce, the expansion of the seminar to three universities was a good opportunity for the lecturers to foster the exchange with colleagues in the same research area. They could explore and discuss in which ways the students of the other universities were educated in the field of information systems. Additionally, this expansion also created a competitive pressure among the lecturers because every lecturer wanted his or her teams to perform very well. This increased the motivation for a good and high-quality mentoring of the teams at every university. Therefore, the expansion of the seminar to more than one university was regarded as a good idea among the professors and lecturers of the respective universities.

Also during the different courses, the lecturers (professors and assistants) gained a valuable insight into ERP systems (some of them previously not known). Therefore, the courses also offer a chance to increase the individual ERP horizon.

## 5  Conclusion and Limitations

The idea of the integration of different ERP lectures and courses in the IS curriculum at TUD was to enable an insight into different ERP concepts and systems for the students. With this, a broad overview of ERP topics, functionalities, and architectural approaches is given as well as a deep practical insight into selected ERP

systems. Therefore, students become familiar with using systems. Although we regard this type of course combination aiming at more diversity in ERP education as very successful, there are some limitations too. First, we are only able to handle some ERP systems and are not able to fully cover the market. However, we do not consider this a severe disadvantage. Furthermore, not all ERP systems on the market are suitable for such an ERP course. For example, older systems are often very complicated in their installation procedure. Also, ERP systems for large companies may not be very suitable for MS Dynamics Project and for the ERP Systems in Commerce as they may be too complex for unsupervised student exercises. We tried to keep the workload at the same level for all IS students especially for the groups in the "self-learning" courses. However, some groups may have to invest less work due to better ERP documentation, better usability, or more help from Internet forums.

In conclusion, for both students and lecturers/tutors, the integration of different ERP systems in the curriculum offers a good opportunity to gain a deeper insight into ERP systems and extend their knowledge about a variety of ERP systems, sharpening awareness of system differences.

Future steps are repeating the different courses in the respective semesters and varying the ERP system used in ERP Systems in Commerce in each cycle. Additionally, we are going to include the distribution game of ERP Simulation Game in the curriculum of IS students in the Bachelor Program as well as in the business studies curriculum.

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