INTEGRATING PORTAL BASED SUPPORT TOOLS TO FOSTER LEARNING COMMUNITIES IN UNIVERSITY COURSES

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ABSTRACT
This paper identifies four criteria for systems that aim at supporting learning communities in university courses, and describes the web-based environment iPAL (internet Portal to Augment Learning) that addresses these criteria in an integrated manner. The iPAL environment extends a freely available content management system through some self-developed components. Practical experiences with the system are outlined, and a first evaluation is given.

KEY WORDS
Educational portals, blended education, distance support for presence lectures

1. Introduction

University lectures that surpass a certain number of attendants are usually accompanied by a loss of personal contact between students and university staff. This means that the individual support for learners is diminished and especially younger students in their first years of studies may feel discouraged.

The growing availability of networking facilities, both at home and especially also with campus-wide wireless local area networks which have been established by several universities[1], enables an enhanced kind of course support that might make up for the disadvantages caused by growing course sizes. The "blended learning" scenarios that arise from these situations are indeed promising as they allow for combining advantages of traditional teaching methods with those that new technologies offer [1]. A basic media-based support of the learning process provided by web-based portal technologies can, e.g., enable the students to find all kind of information related to a course (like lecture notes, exercises, feedback to submissions). Further chances to augment learning scenarios by means of content management systems are discussed in [2].

Additionally, web portals have a great potential for community support [3] and can e.g. offer virtual meeting places for students and staff with asynchronous or synchronous communication functionality. The content of a portal, including the history of recent discussions, can also be seen as an artifact or "community memory" and may thus become a learning resource itself, e.g. for following courses or even for the current course [5].

1.1 Criteria for Learning Support Systems

These *learning process* and *community* supporting features are not the only type of support portals can provide in educational contexts. For the staff of the course it is often time-consuming to publish all the learning material on time, keep everything continually updated and permanently track deadlines, e.g. for submitting exercises. A portal system can automate some of these tasks and thus relieve staff from organizational effort and unnecessary overhead tasks. Through an integration of exercise publishing, electronic submissions, distribution of tasks to the tutors and feedback to the submissions, *organizational* support for the staff and *task support* for the students can go hand in hand.

So far only few systems offer a complete integration of all these features for courses. An integrated platform, however, increases interoperability between the tools it contains, and, in addition, provides a good means for the evaluation of resource usage and community interactions. Within the following sections, we describe our approach for implementing such an integrated platform, and present some experiences we gained with the system.

2. CMS Technology as System Foundation

Generally, choosing a system architecture (both in terms of general design and in terms of concretely used technologies) is an essential decision as it determines considerable parts of the properties and characteristics of the platform. Given the particular aims as outlined in the introduction, the main requirement in our case is the construction of a learning support environment that meets the different needs of both learners and teachers in a heterogeneous setting, consisting of presence and distance

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[1] An example from Germany is the „notebook university" programme funded by the ministry of education and research, at our university implemented in the eCampus project [4]

learning elements. The environment has to meet the different criteria mentioned: organizational, community, learning and task support. Aiming at "real-world" applications of the system, usability issues and additional requirements like security and portability of the environment also play an important role. Further reasonable demands requirements lie in the areas of deployment, platform-independency, and standardization. For the latter reasons, a web-based architecture seems appropriate for the intended learning community support system. As it is unrealistic to develop a functionally very ambitious and highly usable web application from scratch (especially with limited resources in terms of funding and time), and established technology in this field already exists, a search for a standardized web platform which meets most of the basic needs and supports the specific necessary developments was motivated. Our choice for this system base was to go for a content management system (CMS). In contrast to most of the generic web application platforms, a CMS already provides some basic and widely tested functionality that is useful for our purposes like

- a good and (usually) secure user management,
- embedded communication support facilities that are useful for community building [3],
- a high degree of acceptance, due to the increasing number of web pages are deployed with a CMS, and
- tested and expressive programming interfaces that allow the development of custom-made modules and their integration into the environment.

3. Implementation of Support Criteria

This section describes our implementations of the different support types that we motivated within the introduction. As outlined in the previous section, we decided not to "start from scratch" but build upon an existing CMS.

Figure 1. The iPAL modules
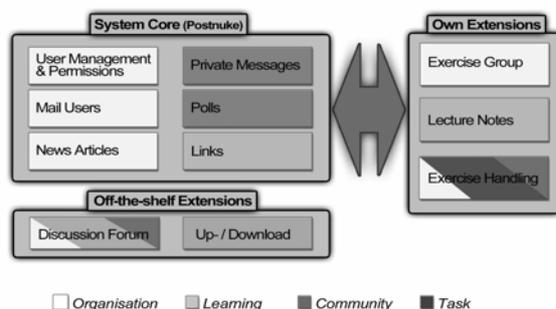
From the variety of available CMS, we chose Postnuke [6] as the base for our iPAL (internet Portal to Augment Learning) developments. Reasons for the choice of Postnuke included previously made positive experiences with this modular PHP based CMS in research projects

like SEED [7], and its release under the GNU Public License, which allows a legal and free use of the software, including distribution and modification. In particular, the last point was highly important for us as we planned to change parts of the core system.

Figure 1 shows the modules of our iPAL system, consisting of the Postnuke core system, some off-the-shelf extensions, and several self-developed modules. All components are classified according to their contribution areas (learning, task, community or organization), some components obviously belonging to multiple areas. In the following of this section, we go into detail about the contributions to the different fields.

3.1 Community Support

As noted in the introduction, there are quite a number of general-purpose communication modules for Postnuke (like for most CMS) that can serve well the purpose of *community* support, provided they are used in the right context. Examples include Wikis[2] or chat components. Here, we only outline the standard or publicly available extension components that we make use of. The main communication feature within iPAL is a discussion forum. We use PNphpBB [8], a special version of the phpBB bulletin board, one of the most popular and sophisticated forums on the internet, that can be smoothly integrated into Postnuke. Together with the option of sending private messages between users, this tool seems to contribute a lot to collaborative learning processes (cf. section 4).

Another generic Postnuke functionality we employ is the poll module. In our application of the system (cf. 4.), the learners had the option to answer to questions (one per week) related to the lecture, the exercises, or the portal itself. We received continuous and valuable feedback and were thus able to improve both the system and the course organization. As these polls were completely anonymous, the students had a place to "safely complain" about everything related to the course, knowing that their lecturers would notice it. From our point of view, this is also an important function within a learning community which consists of people with different roles (each of these associated with certain rights and duties), and can intensify the community.

These examples show that existing content management systems already provide quite a lot of useful features to support learning communities. However, in order to augment this towards a really useful and innovative support system for learning communities, especially when combined with presence lectures and exercise groups in blended scenarios, the CMS needs to be extended with custom modules. In terms of our support categories, these custom extension modules will mostly have to aim at *organization*, *task* and *learning* support: the *community* level is already well supported by the basic portal.

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[2] www.wiki.org

3.2 Organizational Support

While most CMS are clearly not especially designed for learning support, some "standard" modules are well suitable for our purposes. In particular, the aspects of group organization and the basic support for community building are well covered. The existing options to publish news articles on the index page and to send e-mails to all registered users are valuable for the *organization*, e.g. when new assessment results are available.

In a number of university courses, one course format that can benefit from *organizational* support is the exercise groups. The management and maintenance of these groups can be problematic, especially with larger student numbers. The iPAL system supports the teacher in this task: the teacher just has to provide the dates and the maximum number of participants for each group before the courses start. If there are still places left, a registered participant can then sign up for a group – the users are permanently aware of the state of all groups. If a chosen date does not fit any longer, it is always possible for a

3.3 Learning Process Support

During traditional lectures in higher level education, the teacher usually writes his notes on a chalkboard. In our case, we have replaced the board with an electronic whiteboard and the chalk with the handwriting software NoteIt! [9]. This combines the advantages of traditional handwriting with the possibility to prepare parts of the notes, store results for re-use and publishing and therefore helps in creating lecture notes on the fly automatically. Uploading the original notes in digital format as *learning* resources to the web application enables a tight integration of the real lecture with the supporting web portal – the notes of the lecture are accessible for the students from anywhere at anytime, so they do not have to take their own notes in the lecture (unless they want to) and can even comment on them in order to initiate discussions on topics of the course. In addition, this kind of reuse avoids media breaks and ensures authentic learning materials in the sense that the online available resources really have their origin in the lecture. The right

Figure 2. Transition of lecture notes from lecture hall to portal
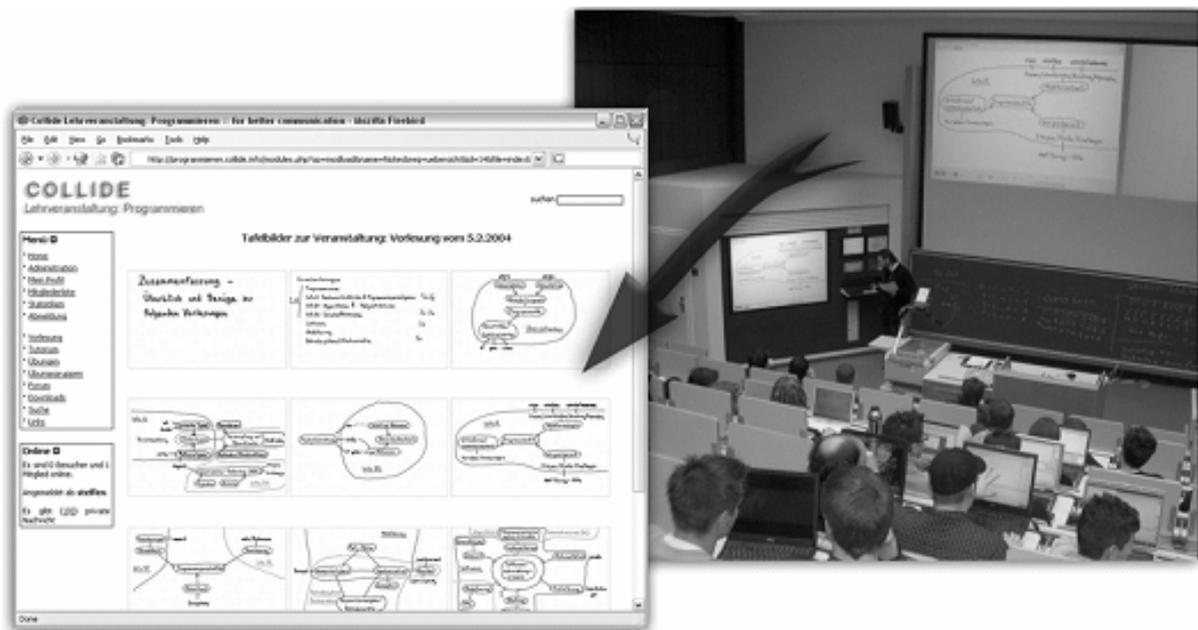
user to change to any other non-occupied group. Tracking the current state of the groups, the teacher can think of offering additional groups when really needed, or merging groups and thus better use the expensive human resources. Other areas of organizational support, in particular the exercise handling and assessment, are described in section 3.4.

part of figure 2 shows a typical lecture scene with the electronic whiteboard.

In order to make use of these functions in a convenient way, iPAL contains a module that enables an automatic upload of all the notes of a lecture directly from the lecture hall. The notes are grouped by lecture date and shown in an overview window, with the possibility to enlarge and comment on each one. In addition, also a PDF version is auto-generated upon upload to conveniently allow for printouts. The left part of figure 2 illustrates the appearance of the lecture notes in the portal.

3.4 Task Support

Task support in interactive learning environments, especially in blended learning scenarios, can take various forms, from explicit workflow mechanisms to "softer" techniques, e.g. through the provision of guiding material. The iPAL system includes two different types of task support components. First, we use the generic Postnuke modules for downloads and links. In a learning scenario, these are (due to their numerous extra-functions like rating of the quality of resources, hit counts or comments) well suited to provide material for specific *tasks*, e.g. course-related exercises, or to offer general *learning* resources. With an extension, which is also released under GNU Public License, the download module can be extended with upload functionality. The iPAL portal uses this extension and thus allows the participants of the course to submit their own contributions to the learning resources pool.

To achieve a sophisticated learning *task support* on the one hand and fine-grain control and course overview functions on the other hand, the built-in Postnuke functions are insufficient. A custom iPAL module manages the whole exercise system. Similar to the lecture notes, the teacher can publish the time-controlled exercise materials directly on the web page. Also example solutions, can be put in here together with a publication date that will make the solutions available automatically. If an assessment of the participants is desired, this can also be configured. In this case, the students have the possibility to upload their work via an electronic form (which facilitates paperless exercise handling, if this is desired). This option can also be constrained with a deadline after which no uploads are accepted any longer. The uploaded solutions can then be assigned to tutors. Here, the lecturer can choose between two assignment methods: Either the tutors receive preferably the submissions of the students of their "real-world" exercise group, or the submissions are distributed in a fair manner (each tutor gets the same amount of work). Of course the teacher can modify these assignments also manually.

The tutors are automatically notified when there is work assigned to them. After reviewing the student's solutions (due to the open character of the exercises in our scenario, it is on purpose that this correction task is not automatic – though this could be embedded in the portal as well), the tutor can label his corrections with different color codes (red, yellow, green) that reflect his progress of correction.

Figure 3. The exercise review module

These status labels as well as the assessments themselves can be managed in a comfortable way via a special interface (see figure 3). If the exercise of the student has to be assessed with an explicit mark, the tutors can additionally enter the achieved score in the form.

The teacher can access an overview of all submissions and their respective correction progress. When all the tutors have done their work, he can make the reviews visible to the students. These then receive a hint at a prominent position in the portal and can directly view their assessment. The score history of all users can be exported in CSV format at the end of the course for use in external spread sheet applications, which furthermore facilitates the work for the teacher who may need these tables as a source for further calculations of final marks.

4. Usage Context

The portal system as described in the previous section was used in winter term 2003/04 for the course "Programming" at the University of Duisburg-Essen in Germany. Most of the participants were studying "Applied Computer Science", smaller groups were from different other studies related to computer science. The following two subsections describe qualitative observations and empirical results about the system use within this context.

4.1 Descriptive Perspective

In the first lecture, a brief introduction to the core functions and the purpose of the portal was given, together with a policy what we would do with the collected personal data (like matriculation number or mail addresses). Due to the "Notebook University" initiative which is a part of the "eCampus" project at our university [3], an above-average number of participants owns a notebook and is able to access the university network and the internet over wireless LAN directly from the auditorium (see figure 2). Consequently, we could already observe first registrations during the introduction lecture.

After the end of that lecture (so, after 90 minutes), over 30 participants had already registered themselves.

The students accepted the web support for the course immediately. The feedback we got in both personal discussions and anonymous web polls was very positive. The question "Is this portal helpful for the programming exercises?" was answered as follows:

- 50% "Yes, in particular the forum and message system"
- 36% "Yes, in particular the online materials"
- 14% "No"

Another question asked the students about their use of the digital lecture notes. Here, we received the result that 96% of the students used these resources in varying ways: online use, printing, offline use. The usage statistics of the portal support this impression (cf. section 4.2). In particular, the students intensively used the lecture notes, the discussion forum, the links and downloads sections, and the exercise module. The integration of the lecture notes into the portal directly after the lecture was very well received. We initially hoped that the function for annotating lecture notes within the portal would lead to discussions about the lecture contents, especially about difficult aspects. But this function was not used frequently enough to get a discussion culture started in that place. Yet, the generic discussion forum module was very lively: we could observe that the students took the role of peer helpers quite frequently, although dedicated tutors (that could be recognized through a special avatar) were also active in the forum. The quality of the peer helper's suggestions was so good that frequently, the "official" tutors did not even have to answer. Compared to previous years we had the phenomenon that the established forum of the students' organization, which is usually used a lot for discussion, was almost completely replaced by the internal forum of the lecture (below 100 postings related to the course in the established forum). This clearly shows that the internal forum integrated within iPAL was well accepted. We observed open discussions, including critique despite the fact that the course staff was also participating in the forum.

Also some other features of iPAL turned out to be helpful tools for the teachers and tutors of the course: the portal greatly reduced the amount of administrative work with exercise group management and exercise distribution, correction, and assessment. The continuous feedback about the state of the exercise group occupancy was very convenient for the lecturer and allowed for a tailored solution. In the concrete case, this meant the creation of one additional group – it was possible to do this with virtually no delay, which would not have been possible in "traditional" settings.

4.2 Evaluation

At the end of the semester, the total number of registered users increased to over 340, who produced more than 470000 page views. Totally 178 students continued the course till the final examination. Thus we could observe that also people registered who were not participants of the course. With this policy of open registration also for external users we had not made any negative experiences so far: there has not been any abusive form of uploads or forum contributions.

The forum was used extensively by the students, especially when the deadline for the final programming exercise approached. All in all more than 1500 articles have been written in about 250 threads. The majority of postings (approx. 75%) were content-related, i.e. with respect to the topics of the lecture and the exercises. The upload functionality was used mainly by the staff, only to a small part by the students (out of 56 uploads, only 9 have been from students and 18 from student tutors). The download functionality was used a lot, starting with a peak of more than 320 downloads for the first lecture notes and averaging between 150 and 250 downloads per resource for the whole term. One download of an additional tutorial session that is organized by the students' organization even had more that 1000 downloads. Unfortunately, the facility of rating the quality of contributions was not used at all, so uploaders had no acknowledgement, which may be a reason for the students' little participation in that area.

As shown, the iPAL system was quite successful both in terms of usage statistics, and also considering teacher and student feedback as received from a realistic scenario. Trying to give a consolidated answer to the question if the system really helped the students in their learning activities is tough. Traditional empirical studies would have to compare "students using iPAL" with a control group and investigate whether there is a difference in learning outcome. However, these kinds of controlled laboratory studies were impossible in the real scenario.

Despite this, we decided to analyze the usage data of iPAL empirically and indeed were able to find a statistically relevant ($p<0.01$) relation between the active portal iPAL usage (unfortunately, we were not able to completely track passive usage, i.e. page views without giving contributions) and the student's scores, both in a written test and in a programming exercise. Figure 4 illustrates the correlation between the number of postings in the forum and the final score in the exam. The Spearman rank correlation coefficient in this case is $\rho=0.485$, which indicates moderate positive correlation. An interesting detail observation is that there is just one participant with a high (>30) number of postings that has a low (<40) score in the exam. The other direction (low number of postings but high score in exam) appears more frequently.

For a realistic scenario including a possibly very large number of interfering uncontrolled variables (like use of literature, external communication or lecture attendance), we consider this to be a fairly good and encouraging result that motivates further in-depth investigations.

Figure 4. Relation between postings and score
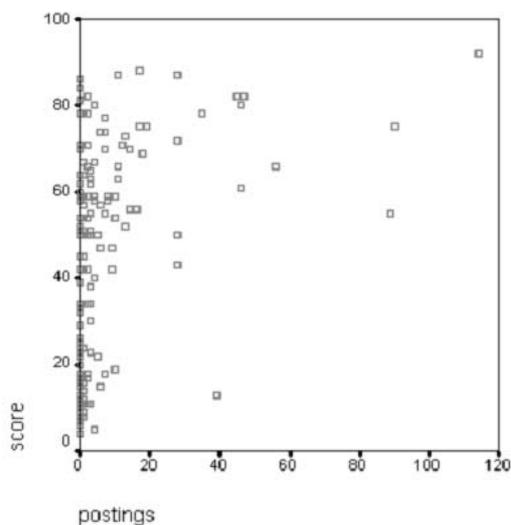
5. Outlook

Since the information within the portal is a rich repository for a detailed analysis of communication structures and their changes over time, we plan to conduct an in-depth evaluation using Social Network Analysis (SNA) [10] techniques to correlate interaction data with success in the course.

We have tested new versions of the iPAL system which are able to track also passive usage data (i.e. specific page views) in other courses. The analysis of this additional data with respect to patterns of usage, like in [11], is also on our research agenda.

6. Conclusions

In this paper, we presented four criteria for web based learning support systems:
- learning process support,
- community support,
- task support, and
- organizational support

We have presented an implementation of these four criteria that builds on the established technology of content management systems and re-uses reasonable parts of these systems, augmented by self-made components for specific functionalities.

This iPAL system has been used in several University courses, with positive and promising evaluation results both on qualitative and quantitative scales. This paper has reported on some of these evaluation results.

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