

# PROJECT-BASED TRAINING PBT, AN ADDITION TO CBT AND WBT

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## Abstract

Computers and the World Wide Web have influenced many aspects of every-day-life. Especially in the field of doing business new ways of communication have emerged. Distance learning, eLearning, computer-based training, and web-based training are terms for new forms of learning based on modern technologies.

In this paper we will introduce facets of electronic learning and present our approach of project-based training. This approach is based on a web-based project management platform that we had used earlier for projects with a digital photography agency and a middle-class marketing agency. We have extended this platform to a learning environment and are now able to comfortably administer lectures and lecture projects.

## Key Words

eLearning, distance learning, computer-based training, web-based training, project-based training

## 1. Introduction

The Internet allows new ways of communication and collaboration, e.g., b2b market places, virtual companies, virtual universities. Over the last ten years, the number of virtual universities has risen enormously, offering a more advanced learning environment than ever [16]. We had earlier developed a web-based platform for communication and project management[2]. This platform had been successfully used in various projects. We have extended this platform to a web-based training tool, where students are not guided through an instructional program, but rather an instructor helps a group of students to achieve a common goal. We provide the technical foundation for communication, collaboration, and information tracking. The platform was tested in projects, where students worked together in a group and in the interaction with the lecturer to create software, case studies and papers.

In Section 2 we describe eLearning and introduce computer-based training (CBT), web-based training (WBT),

and what we call project-based training (PBT). Afterwards we give an overview of our platform for web-based communication and project management. Then we describe how to use this platform as a learning environment. Experiences are depicted in Section 5. Future work is outlined in Section 6, and conclusions are drawn in Section 7.

## 2. eLearning

New forms of education have extended learning beyond traditional classrooms. Distance learning indicates obtaining education and training from a remote teaching site, without being bound to specific media e.g., a computer, but a radio or television set could also be used [5]. eLearning means the provision of courseware over the Internet, over private networks or inhouse via an intranet. With eLearning technologies, learning can take place at individual time frames and at an individual pace. eLearning has migrated from computer-based training to web-based training, providing services anytime and anywhere. We will briefly describe the approaches of computer-based training and web-based training subsequently. Then, we will give an overview of our approach, which is web-based as well as project-based, and what we call project-based training.

### Computer-based Training CBT

Computer-based training (CBT) is provided through the use of a computer and software, which guides a student through an instructional program. CBT utilizes the computer for training and instruction. It provides interactive training sessions for arbitrary disciplines. CBT programs are sometimes called courseware. CBT was introduced on LaserDiscs, later on CD-ROMs and online. CBT courseware is typically developed with specific languages for the creation of interactive question/answer sessions [6].

### Web-based Training WBT

Web-based training (WBT) is an approach to distance learning in which CBT is transformed by the technologies

and methodologies of the World Wide Web, the Internet and intranets. WBT is media-rich training fully capable of evaluation, adaptation, and remediation, all independent of a specific computer platform. Web-based training is an ideal vehicle for delivering training to individuals anywhere in the world at any time. Advances in computer network technology and improvements in bandwidth will usher in capabilities for unlimited multimedia access. The current focus of WBT development is on learning how to use the available tools and organize content into well-crafted teaching systems. Training designers are still struggling with issues of user interface design and programming for high levels of interaction [13]. Unfortunately, there are few examples of good WBT design visible on the public Internet. As instructional designers and training analysts learn how to write and produce WBT, and as training vendors come to realize the overwhelming advantages of this delivery method, a strong increase in training offerings available over the public Internet and private intranets can be expected [12, 14].

### Project-based Training PBT

The term project-based training (PBT) is sometimes used to denote training that is customized to suit specific needs of customers. Project-based learning is “a teaching and learning model that focuses on the central concepts and principles of a discipline, involves students in problem-solving and other meaningful tasks, allows students to work autonomously to construct their own learning, and culminates in realistic, student-generated products” [4]. In the context of this paper, we use the term project-based training to characterize a form of training and learning, where the learning target is achieved by means of doing project work. With CBT and WBT, the learning content is provided by some instructional team. Another form of learning is learning by achieving a common goal in a group, e.g., programming projects. In this scenario, learning is not done by studying some predefined contents, but additionally it is the objective to fulfill the task together in a team. This kind of training is quite usual in university settings, e.g., when working on seminar papers or doing a programming project or working on diploma theses in cooperation with external companies. In order to have the team work independent of time and geographic boundaries, web-based approaches are adequate to provide a platform for this kind of learning.

PBT usually requires asynchronous communication, i.e., documents and messages have to be shared. Synchronous communication can be used when needed, e.g., chat rooms for the discussion of specific topics. We see two areas of using PBT, i.e., projects and lectures.

*Projects.* Companies increasingly use web-based project and collaboration tools like *eRoom* [7] or *OnProject* [9]. It is quite common for students, that they carry out projects, e.g., a programming project, possibly with an external company. Such projects are typically organized and managed like classic projects. At our university, students still

work mostly on their projects on campus. Participating in a team is much easier, when all information is held within an online communication and collaboration tool. With such a system, the instructor and company representatives can follow the progress of such projects without having to attend all meetings.

*Lectures.* Lectures are not like regular projects, but there are similar communication and collaboration activities:

- The lecturer hands out documents, assignments and slides, like project resources.
- Students ask questions to the lecturer and exchange information and/or documents with the lecturer and with each other.

We believe that students should be able to communicate and collaborate both with and without the supervision of the lecturer. In some settings, this will help the lecturer to prevent her students from going in wrong directions. In other cases, students will want to communicate privately and will use the platform only, when it is guaranteed, that their communication will be kept private.

In Fig. 1 we can see the two different settings for projects and lectures. On the left side, a lecturer and individual students are involved. This is typical for lectures. The right side depicts a project setting, where students work in groups, and where members of an external company may be involved.

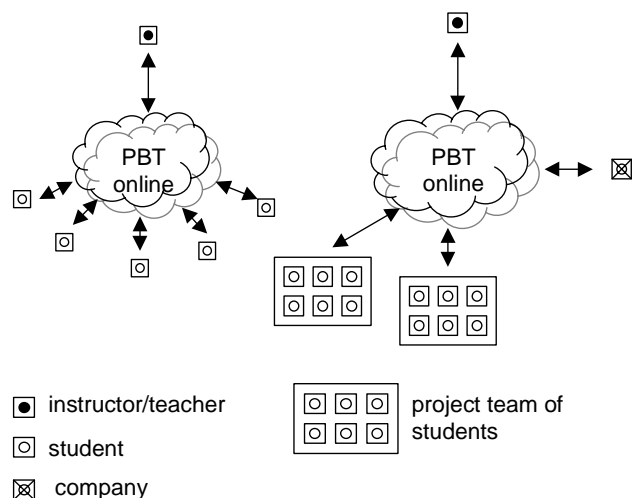


Figure 1: PTB scenarios

### 3. Web-based Communication and Project Management

We have developed a web-based project management and communication modeling kit WORM (we offer real modularity). Subsequently, we describe WORM's functionality, provide an example of its use and also give some information about the implementation. WORM is the result of an attempt to provide a web-based architecture for collaborative work over the Internet, that is often found in time-constraint projects.

## Overview

Project management means the continuous and goal oriented planning, supervision and control of all relevant project parameters. In this context, a project is a nonrecurring, complex and new intention with scarce resources and defined deadlines. It is performed with participation of various departments or companies. Projects can be viewed as a sequel of logically linked and time consuming procedures that result in state modifications. They can be divided into phases which are described by major milestones at the beginning and at the end of a phase.

A web-based project management and communication system has to comply with various requirements in order to integrate the concepts of groupware as well as workflow management and distributed project management. WORM can be used for various forms of project collaboration, e.g.,

- business-to-business (b2b) project management between companies organized as virtual enterprises,
- vertical hierarchic b2b project management between a prime contractor and its legally independent subcontractors, or
- business-to-consumer project management between companies and clients creatively interacting in the process of developing a customized product.

The main focus in developing WORM has been to support middle-class marketing and photography agencies that both easily wanted to present their drafts and project progresses to their customers and wanted to give them the opportunity to be integrated in the process of the project by providing feedback to the agency.

WORM's modular structure allows customization of layout, offered functionality, menu options and company interaction. Thus, the user interface can be restricted to a subset of functions depending on the organizational relation among interoperating parties. Each involved project member will be faced with an application screen that had been designed by the organization responsible for the project. Additionally, companies can be embedded in the project structure at any level of the hierarchy. Thus, they may not see projects and companies that belong to upper levels in the hierarchy. Based on this flexibility it is possible to realize different project management setups.

## Implementation

WORM has been written as a pure server-sided Java-based web application running both on UNIX and WINDOWS® servers. It is compliant to SUN's Model 2 architecture by separating presentation and business logic using three servlets, about 50 JavaBeans and currently about 40 Java Server Pages with an overall size of about 2.5 MB without resources, see [1] for more information on the implementation technology. The system requirements for a client include Internet access, a monitor resolution of at

least 800\*600 pixel and a browser that supports JavaScript, i.e., MS Internet Explorer version 4 or later respectively Netscape Navigator Version 4 or later. We have implemented a Java-based modular web application using a standard SQL database interface, see Fig. 2. The underlying core business objects provide the basic prerequisites for security, scalability, robustness, performance and modularity. The modules in Fig. 2 are depicted and arranged according to the previously presented examples of various project environments, i.e., b2c, b2b and hierarchical b2b. The current modules, i.e., workflow management, message client, resource management, discussion forum, roll concept, document management, polls editor and cost accounting, combine the features that are necessary for intra-corporate project management. Adding the customer interface comfortably allows the setup for customer integrated project management with defined customer access to the system. The hierarchic company organization module is used to implement multi hierarchical project management like in the case of public offerings and construction projects.

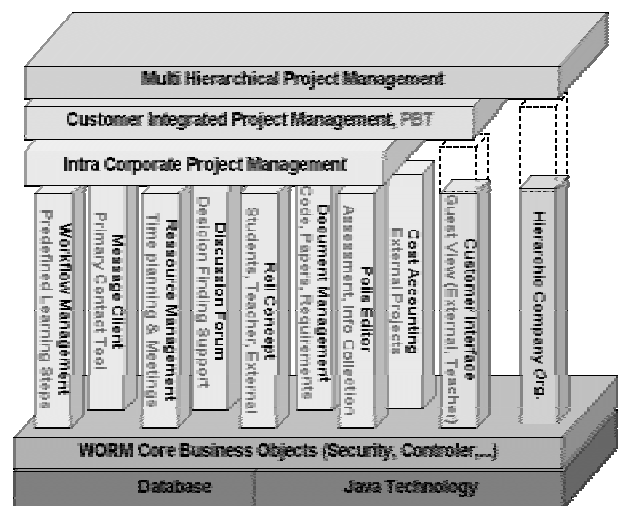


Figure 2: Software Architecture

## Usage

Our platform is general in nature and can be used in many domains. We have successfully applied it in the context of digital photography and marketing companies [2], and also for customer relationship management purposes[3]. There are more specific and more extensive platforms available for certain purposes, for example for project management, monitoring and collaboration in scientific projects [10], or a free service to bring together family, friends, and associate through a web site and email group [15]. Our platform is much simpler, yet can be used for various objectives. For example, we have used our platform for the writing of this paper, as one of the authors is in Austria, whereas the other two reside in Germany.

## 4. PBT in eLearning Practice

The PBT platform provides the technological foundation for course administration like document delivery and communication. There is no extra need for e-mail systems, HTML generation, etc. The platform also supports thin clients, e.g., mobile phones can be used to access information. There is also an individual view for course members on documents, communication, calendars, etc. Individual forms can be generated and saved as templates that can be used for polls and tests. All project-specific information, including documents and communication is available on a single location.

### Lectures

For lectures, the PBT platform can be used as a repository to provide any teaching material like slides, assignments, solutions, source code templates. The instructor does have access to all the students' documents, but the students can only access their own documents and the documents provided by the instructor. For group assignments, a group of students can share folders.

A similar access mechanism holds for e-mail messages. Communication with the students and among the students is supported by automated mailing lists and chat rooms. The instructor can communicate with any student or group of students individually. Students can communicate among each other, having a choice whether the instructor should be able to see this communication. Any questions can be sent to the instructor, who can choose to respond to a student individually, or to have her response sent to all or a group of students.

Students can have meetings in chat rooms with or without the instructor. Chat protocols are automatically generated for later use. A lecture calendar is provided to schedule meetings, assignment due dates, document deliveries, and whatever seems important in a specific lecture.

### Project Work

The same technology that we use for lectures is applicable for project assignments. The crucial difference to regular lectures is, that the information flow turns from a hierarchic and centralized form to a decentralized form, that is mostly regulated within autonomous groups of students. The instructor's role changes from an information and document provider to an observer and consultant. The students' role changes from a more or less inactive information and document consumer to a proactive member in a project group. Similar to the lecture setting, groups can administer their project work with the PBT platform, i.e., they can deposit documents, exchange messages, have chats, contact the instructor, etc. Additional to the lecture calendar that contains basic milestones, groups can have separate calendars with additional milestones, meetings, etc.

## Comparison

Course administration can be done by means of many technologies, or without any technological support at all. An innovative use of electronic mail for course administration has been proposed in [8]. E-mail communication can not only be used for communicating with students, but also for organizing documents, scheduling events, planning course activities, and handling student requests [8]. This can be achieved by using email guidelines, automatic message classification, automatic assignment receipts, scheduled delivery of course documents, and automatic document retrieval. Assuming students have a web-based e-mail account, they can access documents and retrieve information from the instructor both easily and from any place. Web-based delivery of course material is quite common. In this scenario, the instructor makes any information and documents for a course available, typically via her home page. Communication with the students is also done via e-mail, but instructors do not always have contact information like e-mail addresses of their students. Web-based solutions provide better transparency and a better overview than a mere e-mail-based solution. Students can see the available documents and do not have to store and/or request them from the instructor.

Another approach of course administration is provided by virtual universities [11]. Online training includes courses taken via the Internet or via television, where assignments and examinations are completed at one's home computer. Student-instructor contact occurs electronically through on-line discussions and e-mail. Typically, students enrolled in online education courses are required to meet the same course objectives and requirements as students who are enrolled in on-campus courses. Technological support varies among virtual universities. Typically, course descriptions, syllabi, etc. are provided online.

Compared to an electronic mail system, the PBT approach is not only easier to administer, but also enhances the use of multimedia resources. Moreover, by centralizing the team's work on a single web address, the navigation through a collection of project related information, the linking of project topics, and the reflection of the complete material is significantly easier. Add-ons like chats or project calendars provide further possibilities of coordination and communication. Whereas the simple web-based delivery of course material just offers the information flow from instructor to student, PBT enables the reverse flow and the communication between students, with all the convenient features like chats, calendars, file repositories, etc. Virtual universities greatly vary in terms of offered information, web-based technology, and communication tools. Only few of them reap the full benefits of the potential that the Internet provides as communication and information platform. The presented PBT platform is a suitable add-on for virtual universities in courses that are based on project work or where communication between students and instructors is to be improved.

## 5. Experiences

We have successfully used the project management platform of WORM for industrial co-operations, i.e., projects of a digital photography agency and a middle-class marketing agency [2]. The PBT variant of our platform had been used as an eLearning environment in a programming course. We will briefly describe experiences we made in this setting. The programming course consists of two parts. The first part is a mere introduction into Java programming with a total of 30 lecture hours. This introduction is then followed by a project, in which students have to apply their programming knowledge in an extensive project during a period of four months, with a total effort of about 100 hours.

Supporting the lecture part is rather trivial. We had not used PBT to its full extent yet for the lecture part, because at that time, the implementation was not mature enough yet. In the programming project, the students had to develop a web-based advertised bidding platform for construction projects and facility management. The platform had to include a wireless application protocol interface (WAP) for damage reports during the project execution phase. The main task of the student project included the design of a MySQL database and the development of software written in the Java programming language. The following tasks had to be performed:

1. *Clarification of the technical terms, laws and regulations of advertised bidding*  
With a short list of references from the instructor, students did searches (mostly) on the web and had their results posted on PBT. Discussion over PBT played only a minor role in this phase.
2. *Creation of requirement specification and use cases*  
As real meetings had been scheduled on a weekly basis, discussions were mostly done in these meetings. The results and instructions as of what to do until next week were posted on PBT.
3. *Development of activity charts*  
The use cases created in step 2 were distributed among the students using PBT. They had to work on activity charts and deposit the results on PBT, such that all of them were eventually visible for all members and open for discussion.
4. *Derivation of GUI dialogs based on activity charts*  
After the instructor had approved the activity charts, GUI dialogs were written in HTML code. The same process had been used as in step 2 and 3, i.e., individual members wrote code on their own and then made it available for discussion.
5. *Architectural design*  
The instructor provided constraints for the architectural design, i.e., a time limit for the implementation, and a choice of Java Server Pages/Servlets with or without an application server running Enterprise Java Beans (EJB). The decision finding process was based on a installation

of some sample EJBs. The experiences made in this installation were posted on PBT and then lead to the decision to use EJB.

### 6. *Definition of components and interfaces*

The previous steps have made the student groups more and more independent of the instructor. In step 6, the instructor was solely needed as a consultant to answer a few questions of minor importance. Within the groups, discussions and document exchange was done over PBT and had been observed by the instructor.

### 7. *Development of class model, implementation, testing*

Again independent work of students without significant input from the instructor.

### 8. *Presentation of results*

The results of the project had to be presented in front of a bigger audience. PBT had been used to work on the presentation slides. At that time, the number of actual meetings increased again.

The WAP pages and functionality were simultaneously developed by one group of the students. Weekly meetings were held with the instructor, in order to discuss major problems or concerns. Besides, the necessary information, documents and communication between the students and the instructor was done via PBT. The project was running over six month and could be successfully completed and presented in July 2001.

After the end of the project, the students had reported their experiences with the project platform. The students positively mentioned the user-friendly design, the centralized repository for all project-related material, the suitability for distant working, the web access, especially from their homes. Drawbacks included insufficient functionality of the integrated email client as well as the notification agent, e.g., notification messages contained a hint about new messages and documents on PBT, but had no extra information about what had been changed or added. During the entire project, we had one breakdown of the server with one day without services. There was no loss of information, but mirroring the site would be a definite plus. We do need a high-performance server and back-bone connection. To sum up, it was a successful test for using a project management tool in the teaching environment of the university.

## 6. Future work

Some possible improvements had emerged while using PBT in practice. We intend to implement them in the next version of our platform and will briefly mention the most important ones. Given the situation that a project is completed, it would be helpful if concluding information of a project could be preserved in a summarized, efficient and clearly arranged manner. Such concise project information is invaluable for supervisors, for project members and for any people involved in follow-up projects. This would also allow to present project results to people that were

not directly involved in the project, but merely want to get information about it.

We plan to implement an integrated module that creates a synopsis of running or finished projects in form of HTML files with hyperlinks to the original documents, e-mails, discussions and other project resources. The creation will be done semi-automatically, because it will be necessary to tell the system, which elements to select for the overview. Another aspect that we regard to be useful in the context of project-based training is an extended milestone concept that includes questionnaires in order to test the knowledge and skills of the project team.

## 7. Conclusion

In this paper we have introduced computer-based training, web-based training, and what we call project-based training. We have implemented project-based training on top of a web-based communication and project management platform, that we had built and used earlier in industrial projects. This platform has been implemented as a server-side Java-based web application and can be used with any regular web browser like MS Internet Explorer and Netscape Navigator. We have then demonstrated the use of the extended version of this platform in learning settings, i.e., for regular lectures and for projects that are typical at universities. First experiences have motivated us to extend both the use of our platform and its functionality. As the most important next step, we see the necessity to automatically make information about both current and finished projects available in a more efficient and easier way, as well as to provide more information like statistics.

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