

Construction and Evaluation of a Blended Learning Platform for Higher Education

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Abstract. The design of a platform for blended learning is dependent on the educational and didactic theories. We discuss behaviorism, cognitivism, and constructivism and the impact of these theories on the elements of learning platforms. We describe the construction of a learning platform (of the Dept. of Information Science at the University of Düsseldorf, Germany), developed from the results of the didactic theories. The InfoCenter consists of elements of face-to-face teaching, of multimedia mediation (text books, slides, classic texts, interactive videos, FAQ lists, video glossaries), of Web 2.0 tools (wikis, weblogs, social networks, social bookmarking and folksonomies) and of the use of a learning management system (with learning units and tests). The platform was evaluated by its users (university students) by means of SERVQUAL. According to the evaluation, students are satisfied with the InfoCenter and are willing to use it for their exam preparation.

Keywords: E-Learning, Blended Learning, Higher Education, Web 2.0, Didactic Theories

1 Introduction

„With the emergence of Internet technologies, there has been an explosion of nontraditional learning opportunities during the past few years“ [25, p. 299]. E-learning uses information technologies to disseminate and convey knowledge [49], [56]. The benefit of e-learning, according to Moriz [38], is the possibility of using multimedia content. Another important factor in terms of self-directed learning is place and time independence. Also, the flexible pace of learning plays a major role in successful learning. Each student can work through their courses individually without considering the progress of other students [38]. E-learning can also be a relief for teachers. For example, updating documents and courses that are available online is much easier and faster than updating printed material [49].

In addition to the benefits of e-learning there are also some disadvantages to be identified. According to Moriz [38], there is a lack of social interaction. Mandl & Kopp [32] show further disadvantages, such as the high resource and financial cost and the fact that some content is not suitable for a virtual presentation.

For these reasons, so-called „blended learning“ is at the center of attention. The concept of blended learning is based on the integration of classroom and e-learning phases [14], [15], [5]. Blended learning also means that the content is integrated in different media and methods [4]. The difficulty in developing a blended learning platform is an effective combination of different elements. It is important that the individual components in a blended learning platform be not only next to each other but also embedded and integrated in a social environment [32], [2]. The elements of a learning platform should incorporate all ways of communicating electronically: text, audio, static graphic and video [55].

This mixture of various e-learning elements and classroom phases at the university has been implemented by employees of the Department of Information Science at Heinrich-Heine University in Düsseldorf. In addition to printable teaching materials and short educational films, various Web 2.0 elements were integrated into the platform, which gave students the opportunity for collaborative work. In addition, interactive lecture recordings as well as learning control and learning items were created.

In this paper, we will discuss three Research Questions (RQs):

1st RQ: Which educational and didactic theories are important for blended learning?

2nd RQ: On the basis of the results of the educational and didactic theories, which elements should a blended learning platform employ?

3rd RQ: How will such a learning platform be evaluated by the students?

2 Didactic Theories

According to Moriz [38], e-learning and blended learning require an educational foundation. He identifies three main educational trends that are important for e-learning and blended learning: behaviorism, cognitivism and constructivism.

As we shall see, these theories cannot be used to the same degree, as they employ very different approaches. However, it is important for the preparation of blended learning environments to deal with the various theories, so that their associated applications can be reasonably integrated into the platform [39].

2.1 Behaviorism

Representatives of behaviorism assume that learning consists of the linking of stimuli and reactions [50]. The classical conditioning [43] leads to the designated reflex. Reuter [47] highlights that, according to the behavioral learning theory, learners can only learn via reward and punishment. Here, however, rewards would be more effective because they reduce barriers to motivation and stress. Moriz [38] considers that a pure behavioristic foundation for blended learning is not very promising, as the passive memorization concentrates on the reproduction of specified learning content and the transferability of knowledge is neglected. Nevertheless, some important aspects of this theory can be applied to e-learning programs. Following Webb and

Powis [57], Moriz [38] considers that the principle of behaviorism can be implemented by mediating and testing factual information. Here, a direct feedback would be important.

2.2 Cognitivism

In contrast to behaviorism, in cognitivism the learner can be seen as an individual [39]. External stimuli should be actively used [47]. The students should not be controlled by external stimuli, but turn them into knowledge. This increases the motivation of learners. Unlike behaviorism, cognitivism prizes not factual knowledge but a comprehensive problem-solving ability [39]. While designing educational software, it must be taken into account that not only memorized facts are requested, but the capacity to develop solution strategies will be encouraged [38].

2.3 Constructivism

The central thesis of constructivism is that „perception is construction and interpretation, [...] and objectivity, subject-independent thinking and understanding are impossible“ [20, p. 868]. Representatives of constructivism believe that learning is an individual process and that each learner has his or her own way of learning [3]. From a constructivist perspective, learning in groups is especially important because it allows for an exchange between students and a change of perspectives [27]. According to Moriz [38] and Bruns & Gajewski [8], the following aspects of constructivism are important for blended learning:

- Learning must take place in authentic situations.
- The learner must be motivated so that they actively deal with the subject matter.
- The teacher encourages individual learning processes, but does not control them.
- The learner must be allowed to determine their time and place of learning.
- The curriculum must be presented from different perspectives and in different contexts.
- Learning should take place in groups.

For Höbarth [22], collaborative services are especially applicable with regard to constructivistic learning. This includes Web 2.0 services, which are described in detail below. Interactive videos also fulfill the specifications of this theory. Students can choose their own way of learning by deciding what information and topics they need.

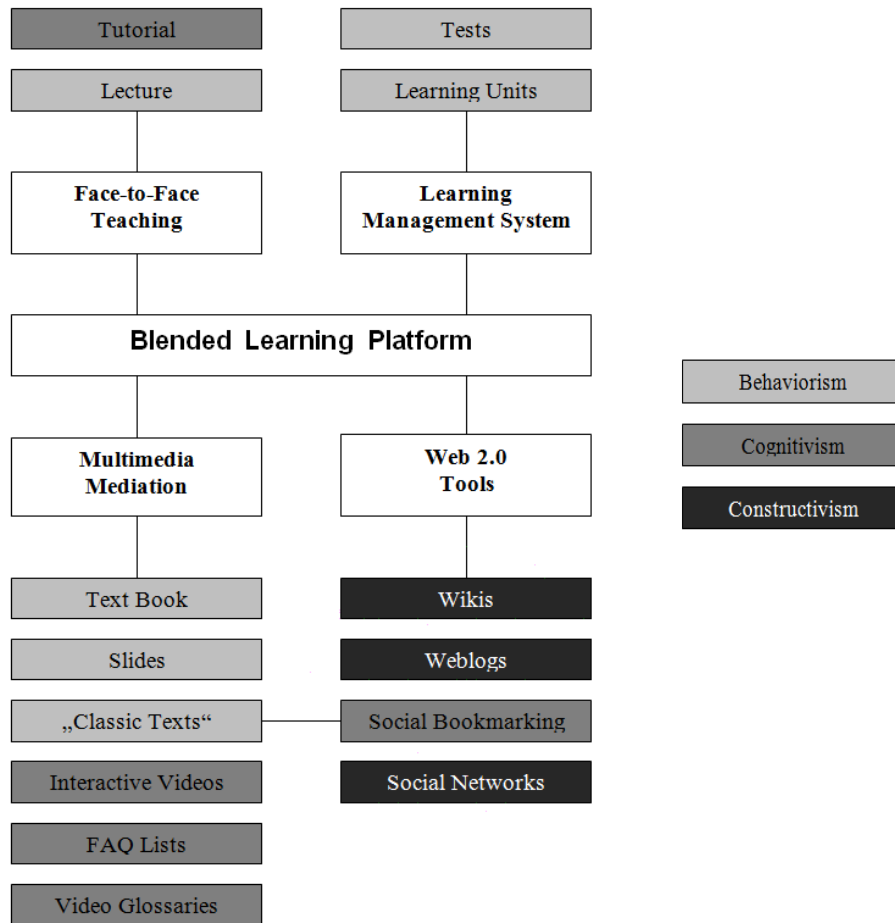


Fig. 1. Elements of the InfoCenter.

3 Construction of the Learning Platform

The concept of blended learning has been implemented by Isabella Peters, Sonja Gust von Loh and Katrin Weller, of the Department of Information Science at Heinrich-Heine-University in Düsseldorf, Germany. The resulting learning platform „Info-Center“ integrates various multimedia and collaborative services that allow students to repeat what they have learned, to ask questions and exchange information among themselves or with the teachers. It provides an ideal complement to classroom teaching, as themes and issues from the lecture can be taken up again and explained. The development of the platform has been implemented in seminars by the staff and students of the department of information science [45]. Through this cooperation, the

students learn to handle information, prepare them for fellow students and make them searchable.

3.1 Concept

The InfoCenter has been included on the website of the Department of Information Science, so it is easily accessible for the students. Figure 1 shows all elements of the learning platform and the appropriate learning theories. The learning platform is designed so that students can choose their own time and place of learning individually. The wide range of different media and services and the interactive lecture recordings shall ensure that the students can choose their own learning path.

3.2 Interactive Video Lectures

Lecture recordings offer students the opportunity to become independent of time and place to watch a lecture [34], [36]. This may on the one hand be used for the repetition of a difficult and complex subject matter, but can also be of interest to students who have to reduce their presence at the university because of jobs or parenting [62].

Before the rise of the Internet, recording information via television or CD-ROM was characterized by a passive viewing by the user [30]. There were hardly any possibilities of intervening into the program or getting more background information. The Internet offers new opportunities for obtaining information that the user may also want to apply to videos [29]. He or she steps out of the role of a passive observer and wants to select information actively, to give or receive immediate feedback [30]. With the help of new formats and new software for video processing, it becomes possible to realize these wishes via so-called „interactive video“ [62].

For these reasons, the idea of interactive videos has been included in the learning platform of information science. Interactivity is ensured through a clickable table of contents, by jumping directly to the topics the students are interested in and through the use of context-sensitive links to full texts and other important information. The recordings show not only the teachers but also students who can always ask questions during the lecture. This allows active discussions between students and teachers [6].

3.3 Web 2.0 Services

For Tsang [54, p. 575], the internet „provides a giant open-access ‘virtual lab’ for learners.” In Web 2.0, users are not just readers, but may participate with little effort even in the creation and distribution of content [40]. Web 2.0 services such as blogs, wikis or social networks offer an easy and cost-effective way of online communication [10], [23], [61]. In Web 2.0, students are encouraged to generate their own content for other students [48]. Due to the easy handling of the collaborative services, it is possible to „teach” independently of time and place. The boundaries

between teachers and learners become blurred. Both are the architects of the learning environment [24].

In the following, we will introduce the Web 2.0 services which were integrated into the learning platform of information science. The focus here is on collaborative content creation and development and on the communication between students using wikis, blogs, social bookmarking and social networking [13], [60]. According to Dahl and Vossen [12], the location of blog entries or articles in Web 2.0 is one of the most important factors in terms of e-learning. Therefore, the reasonable allocation of tags is to be noted in particular [12], [44].

3.3.1 Wikis

The use of a wiki requires only a little knowledge of the functionality and design of the World Wide Web [16]. Each user can create or change any content. Different priorities of students and discussions about difficult issues are integrated into one system. Wikis also allow one to link to websites and to embed multimedia objects [45]. This may cause a broad knowledge base that can be used by other students to search for information or discussion topics.

The students who were concerned with the creation of the wiki were faced with the task of designing a suitable structure and of populating the Wiki with initial information [45]. The main page of our wiki is divided into four areas. First, it gives general information about the curriculum. Here prospective students can find information about information science in general as well as about career opportunities or requirements. The help section contains, among other things, FAQs (Frequently Asked Questions), information about the Heinrich-Heine-University or the city of Düsseldorf. In the „formalities“ section, important information about exam registration, term papers and study regulations have been assembled. The fourth area is the work area. This area provides collected information about information science topics. It also provides an overview of the courses and seminars in which the students worked on the wiki. Encyclopedia articles on selected topics help students to find specific information.

3.3.2 Weblogs

Weblogs (short: blogs) become increasingly important in blended learning [1], [35]. For writing a blog entry, no HTML knowledge is required, which makes participation easier. Blogs with education background, so-called Edublogs [1], are particularly useful for presenting research results and study-related issues [35]. Also, reviews of courses and internships can be easily applied to other students and interested parties. The comment feature allows one to make comments on each blog entry. This encourages discussion between the participants [1].

The Information Science Blog was established on the basis of the platform Wordpress¹. Students and employees can present reports on their internship, experience, comment, get new research results or read up on current events [45]. Individual articles can be tagged, which makes them easier to retrieve. Tag Clouds

¹ <http://wordpress.com/>

facilitate additional browsing [12]. Moreover, it is possible to search not only for specific tags, but also for users or groups [45].

3.3.3 Social Bookmarking and Folksonomies

Social bookmarks are web bookmarks that can be created and developed collaboratively by users. Social bookmarking services like Delicious² or BibSonomy³ are browser-based and users need no programming skills or additional software. The literature can be accessed by using so-called „tags“. These tags are not predetermined. All tags of an information service together form a folksonomy [44], [46], [52], [59]. This has the advantage that the vocabulary is not given by only a single indexer, but that a knowledge base is created with different vocabularies. Due to the collaborative content development, it is easier for students to find scientific works. Knowledge representation facilities can be improved via indexing [37]. Students can manage their bookmarks and references and make them available to other students [53]. In our platform, „classic texts“ such as articles or conference proceedings were collected and tagged in BibSonomy. No registration is required for searching the literature. This is only necessary if the students themselves want to bookmark any literature. In a seminar, students tagged and included all cited references of an information science textbook in BibSonomy.

3.3.4 Social Networks

Social networks are platforms on which users can network with each other and form communities. Each user creates his or her own profile page with personal or (depending on platform) professional information that they can thus pass on to their virtual contacts [28]. In the private sector, these platforms have been around for several years, with great success. But social networking is gaining in importance in e-learning and blended learning as well [9], [11], [31]. Mason and Rennie [33] believe that the casual atmosphere in such networks is a good foundation for learning. It can help form learning groups, which meet independently of time and place and can discuss problems and difficulties. Another advantage of social networks, according to Mason and Rennie [33], is the option of students meeting virtually even before the start of a course.

The Department of Information Science has created its own Facebook⁴ profile. Any Facebook user can become a „fan“ of Information Science in Düsseldorf. On the profile page, the students can find updated information on the department and the discipline. As a fan of the profile it is possible to find other fans to contact. This creates a network of students and staff. As many students already know Facebook from their private lives, the environment is a familiar one, which allows for a relaxed working atmosphere.

² <http://www.delicious.com/>

³ <http://www.bibsonomy.org/>

⁴ <http://www.facebook.com/>

3.4 Learning Management System

Important elements of blended learning platforms are Learning Management Systems, e.g. Moodle⁵ or ILIAS⁶ [21], [19]. The open-source system ILIAS (Integrated Learning, Information and Working System) allows teachers to include and create learning content and provide this to their students.

With the help of ILIAS learning items, students have the opportunity of revising and deepening the contents of a lecture. The learning items are, like the lecture, the accompanying text book [51] and corresponding films, divided into chapters, allowing for an easy navigation between topics. This approach follows the theory of behaviorism. The learner absorbs factual knowledge in itself, with the aim of being able to reproduce it.

Behaviorism requires information to be queried periodically [39]. This is offered by the test function of ILIAS, which asks for students' current state of knowledge. The questions are closely related to the textbook, the lectures and the ILIAS learning items. As required by the behaviorist learning theory, students get their scores and the right solutions directly after responding to a question block.

3.5 Further Learning Material

Main topics of the lectures have been selected and filmed as video glossaries, which are hosted by YouTube⁷. These videos are organized in the form of a dialogue, where an employee takes on the role of the questioner, while another gives the answers. The videos are each about 3 minutes long, and explain the main facts of a topic.

In close cooperation with the examiner, typical exam questions were included in the learning platform. Students can get a picture of what they could expect in their oral exams. The answers are not given, in order to encourage students to solve the problem independently, as they would in an actual exam situation.

The reading of literature is very important for students so they can find their own interests and priorities. Therefore the InfoCenter provides links to articles and research literature for each topic.

The pre- and post-processing of lectures is important for the students' learning process. Here blended learning is of particular relevance. The InfoCenter provides the lecture slides, so that students are able to print out and learn from the slides. InfoCenter also provides summaries of each chapter in the book. These short summaries of a topic make it easier for students to get an overview of the curriculum.

⁵ <http://www.moodle.de/>

⁶ <http://www.ilias.de/>

⁷ <http://www.youtube.com/>

4 Evaluation

4.1 Method

The learning platform was evaluated in the summer term 2009. The 19 participating students of information science were at the end of their second semester. For the evaluation, the SERVQUAL („SERVice QUALity”) method was applied. This is a questionnaire that works with two scales on each question [42]. On the one hand, SERVQUAL captures the expectations of the test persons of a service (in our case: the students’ expectations of the learning platform) and, on the other hand, the specific experiences while using the service (with our learning platform). The two scales are important not only for the purposes of evaluation, but also to show the difference between the expectation value and the experience value. The participants had the opportunity of rating their expectations and experiences on a Likert-scale from 1 (worst) to 7 (best). All aspects of the learning platform were controlled, in order to identify strengths and weaknesses.

Table 1. Results of the evaluation of the blended learning platform.

Scale	1	2	3	4	5	6	7
	Low rating			High rating			
Multimedia Mediation	Element	Expectation		Experience		Difference	
	Video Lectures	5,89		5,67		-0,22	
	Jump Lables in Video Lectures	6,11		6,00		-0,11	
	Context Sensitive Links in Video Lectures	5,33		5,00		-0,33	
	Textbook	6,06		5,78		-0,28	
	Slides	6,39		5,56		-0,83	
	FAQ Lists	6,56		6,56		0,00	
Video Glossaries	5,58		4,83		-0,75		
Learning Management System	Element	Expectation		Experience		Difference	
	Tests in ILIAS	5,56		5,67		0,11	
Learning Units in ILIAS	6,74		5,94		-0,80		
Web 2.0 Tools	Element	Expectation		Experience		Difference	
	Blog	4,00		3,82		-0,18	
	Social Bookmarking	3,84		4,05		0,21	
	Social Network	4,79		3,95		-0,84	
Wikis	5,63		5,53		-0,10		
„Infocenter“ in general	Are you planning to regularly use the learning platform for your test preparation?	What is your assessment of the usability?		Should other lectures be integrated into the platform?			
	6,28	6,28		6,5			

4.2 Results of the Evaluation

The evaluation results are shown in Table 1. Generally speaking, the expectations of students were very high, and were mostly fulfilled satisfactorily.

In the field of Multimedia Mediation, very large differences between the expectations of students and the actual experience of the InfoCenter can be observed. In particular, the experiences of the lecture slides differ by -0.83 in contrast to the expectations. Many students consider video lectures to be a useful complement to conventional teaching. The experiences of the lecture recordings of information science are lower than the expectations, but still satisfactory with a value of 5.67. The lower value may result from the fact that the videos are very long and exceed the attention span of many students. The rating of the context-sensitive links is very low. Here an appropriate approach would be to improve the description of links and to point out their relevance in order to increase the motivation of students. The use of typical test questions preparing students for the oral examination meets the expectations.

The clear questions of the tests and the immediate feedback from the students seem to raise motivation. The ILIAS learning modules have been rated relatively well, but do not meet the expectations. The reason for this may lie in the extent of the learning modules.

The students are very critical of the use of collaborative media for blended learning. A study by Klein et al. [26] found out that almost all students use Web 2.0 services. The most popular are Wikipedia, social networking and social media platforms like Facebook or YouTube [58], [18]. It seems to be difficult for the students to involve these services in the learning process. The worst results in terms of expectation and experience were found in social bookmarking. According to Freimanis & Dornstädter [18], only a quarter of German information science students know about social bookmarking. Although platforms such as YouTube and Facebook are fully exploited in the private sector, it is difficult for students to see those services as a part of their studies. The students have to be encouraged to integrate these platforms in their learning process.

Due to the wide range of offered learning materials, it is possible to address all types of learners. Students are thus able to select the one learning method that best fits their learning style and their personal information management. The fact that many students have to do with Web 2.0 services both in private and as part of their studies, there are few problems with using the learning platform, even if their use in the learning process is not sufficient so far.

Many students think that more courses need to be included in the InfoCenter. Here we must consider to what extent this can be rectified, keeping in mind the very high effort involved in preparing some of the materials. Creating the collective knowledge base is less expensive, because all students and staff can participate.

It is worth considering whether a better alignment of the individual materials may be promising [7]. Another important point that has been neglected is the publicity of the learning platform among the students. Although first-year students were made familiar with the InfoCenter via short training courses, these efforts should also be applied to older terms. This may motivate the students to participate in collaborative content generation.

5 Conclusion and Outlook

As it turns out, there are three educational theories that are suitable for use in blended learning platforms. First, there is behaviorism, which is marked by a passive memorization of facts. Here tests and traditional teaching media, such as textbooks or lecture slides can be offered. Cognitivism is also an important theory for blended learning. The problem-solving ability of students and the possibility of determining their own learning path is important. Elements that are offered for the implementation of this theory in particular are the presentation of typical exam questions and the interactive video, in which students choose their own way of learning. The third theory is constructivism. Especially important in this theory is group learning. Here the use of Web 2.0 elements such as blogs, wikis and social networks is very promising.

According to the evaluation, students are generally satisfied with the platform and are willing to use it regularly for their exam preparation. A majority of the respondents say that more courses should be integrated into the learning platform.

As the evaluation of the InfoCenter has shown, the platform needs to be adjusted in a couple of places. A particular difficulty that has occurred during the test phase is the acceptance among students, particularly with respect to Web 2.0 services. Furthermore, Ersoy [17] writes about his study results: „The results of the study revealed that students had positive perceptions about Web-based instruction and online instructor, while they were uncertain about their perceptions about online cooperative learning.”

In further project steps, we will include more Web 2.0 services (such as microblogs via Twitter⁸, serious games, virtual worlds and educational apps) into InfoCenter in order to measure the services' acceptance by their users.

Despite these problems with blended learning environments, Page et al. [41] suggest that the numerous advantages, including the ease of updating information as well as location and time independence, blended learning will be even more popular in the coming years.

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⁸ <http://twitter.com>

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