Design and development of a collaborative learning platform supporting flipped classroom

Guangran Liu, Yucai Zhang & Hongfang Fan

Tianjin University of Technology and Education
Tianjin, People's Republic of China

ABSTRACT: Networks mean that there are no time and space limits, and abundant resources are available to effectively promote collaboration and communication. This study takes full advantage of networks by integrating collaborative learning and learning platforms into a flipped classroom. It improves on the present learning model provided by the flipped classroom, in which learners study after class and communicate in class; it designs and develops a collaborative learning platform to support the learning model. The platform gives full play to the teacher's guidance function, motivates learners' enthusiasm, and improves instructional effectiveness. Taking a *Multimedia Education Software* course as an example, this study reports on some trial applications and provides useful suggestions for other researchers.

INTRODUCTION

Traditional instruction now finds it increasingly difficult to keep pace with technological developments. More and more educators are focusing on quality learning. To some extent, a flipped classroom, that is, a form of learning in which students watch lectures on-line and work on problem sets with other students in class, can be considered to be an improvement over traditional instruction. Many case studies have verified the effectiveness of the flipped classroom [1].

This study analyses the current flipped classroom learning model, and finds that it is hard to make comprehensive use of many of the available technologies, and instructional effectiveness is low. Although social software tools, such as instant messaging tools, learning platforms and blogs, are powerful, and can provide part of the learning support services, they have poor compatibilities, and there are many functions that are not required for instruction.

This study proposes an improved model and presents a collaborative learning platform to support the whole flipped classroom learning process. The platform makes a small semi-structured learning environment for teachers and learners with no restrictions of space and time, in order to motivate the learners' enthusiasm and improve flipped classroom instruction.

FLIPPED CLASSROOM

Origin and Concept of the Flipped Classroom

In 2007, two chemistry teachers Jonathan Bergmann and Aaron Sams, posted their own courseware and video lessons on-line for absent students who appreciated the opportunity to see what they had missed, and the first prototype of the flipped classroom had arrived [2].

Experts and scholars have explained the concept of the flipped classroom from multiple viewpoints. Bill Tucker thinks that it overturns traditional instructional methods, imparts knowledge outside the classroom through the network and leads to discussions about homework inside classrooms [2]. Strayer holds that the flipped classroom is an innovative classroom structure that moves lectures outside the classroom via technology, and moves homework and practice with concepts inside the classroom via learning activities [3].

Gonzalez thinks the flipped classroom has many advantages. It makes the process of imparting knowledge outside the classroom, gives students more freedom and allows students to choose the most suitable way to acquire new knowledge [4]. Conversely, the process of knowledge internalisation is inside the classroom. Professors and students have more opportunities to communicate, produce thought collisions and even enter into deeper levels of study.

Flipped Classroom Cases

Flipped classroom techniques have been widely applied to subject teaching fields, such as mathematics at the Stone Bridge Primary School, Minnesota in the United States, calculus at Bristol School, Maryland, also in the United States, and Chinese at Brown North Primary School. The flipped classroom concept has also been used in Chengdu, China, for digital engineering lectures [5]. This study reflects on these typical cases and makes some reflections, and attempts to use a collaborative learning platform to support the idea of flipped classroom instruction.

IMPROVED LEARNING MODEL FROM THE FLIPPED CLASSROOM

The Present Flipped Classroom Learning Model

In the present flipped classroom learning model, learners undertake independent learning by watching instructional videos before class. By contrast, in class, teachers answer the learners' questions and guide them towards solving them. In this way, learners have more opportunity to communicate and argue with each other, and can also improve their abilities, as shown in Figure 1.

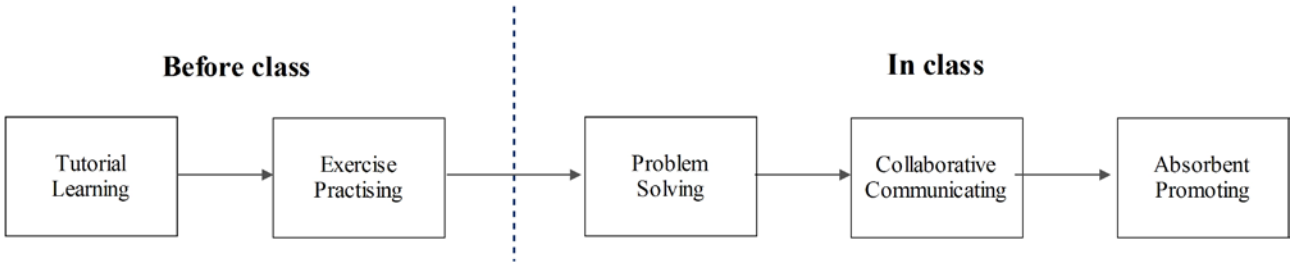

Figure 1: The present learning model of flipped classroom.

On the one hand, classroom time is far less than the extracurricular time in normal learning and classroom activities cannot be carried out in full. On the other hand, even using on-line communication tools before class, the communications among learners, and between learners and teachers are unsustainable, unsystematic and unable to embody the process of learners' learning. Strayer concludes that learners are less satisfied with the task driven flipped classroom structure, but they become more open to cooperative learning and innovative teaching methods [6]. Now detailed support can be provided to reduce a learner's uncertainty, so it is time to blend flipped classroom and collaborative learning platform.

Improved Learning Model of Flipped Classroom

On-line learning platforms have the features of abundant resources, sharing, convenience, and so on, and all of these characteristics make it into one of the more powerful learning tools. On-line learning provides good functionality for supporting students' learning and prompts positive attitudes in students and teachers, so it also can be defined as a *second classroom*. The on-line collaborative learning depends on the Internet and uses collaborative learning methods. This model takes full advantage of Internet resources, and cultivates the learners' abilities to self-learn, communicate and coordinate their activities with others and to solve practical problems.

From what has been discussed above, one may reasonably arrive at the conclusion that a flipped classroom and a collaborative learning platform can support each other, and even blend together. The improved learning process of the flipped classroom can be divided into three main stages: before class, in class and after class. The collaborative learning platform supports the whole learning process, as shown in Figure 2.

Before class, it is used to assist in transforming knowledge. In class, based on the platform, teachers and learners conduct emotional communication activities. After class, students locate materials that will enable them to make up for the deficiencies in their own knowledge system; and teachers provide pertinent distance guidance. Therefore, it truly makes knowledge delivery successful, and improves a student's comprehensive capacities.

Before Class: In the majority of the present flipped classroom cases, teachers provide video tutorials, other assisted learning resources and examine the results through related tests after study. This pattern is similar to individual inquiry learning and lacks the necessary learning support for communication and collaboration. Based on the analysis of the six processes (introduction, task, process, resource, evaluation and conclusion) of traditional WebQuest [7], and collaborative learning, the platform takes advantage of the task-driven teaching approach, uses an electronic portfolio to save the learner's learning path, connects and improves the various stages of the learning phase. Teachers use the platform to impart knowledge, arrange learning tasks, provide related resources (tutorials, links, etc), answer learners' questions and assist their learning. Meanwhile, according to the learning tasks provided by the platform, learners search for relevant resources, and raise their questions to complete their self-learning.

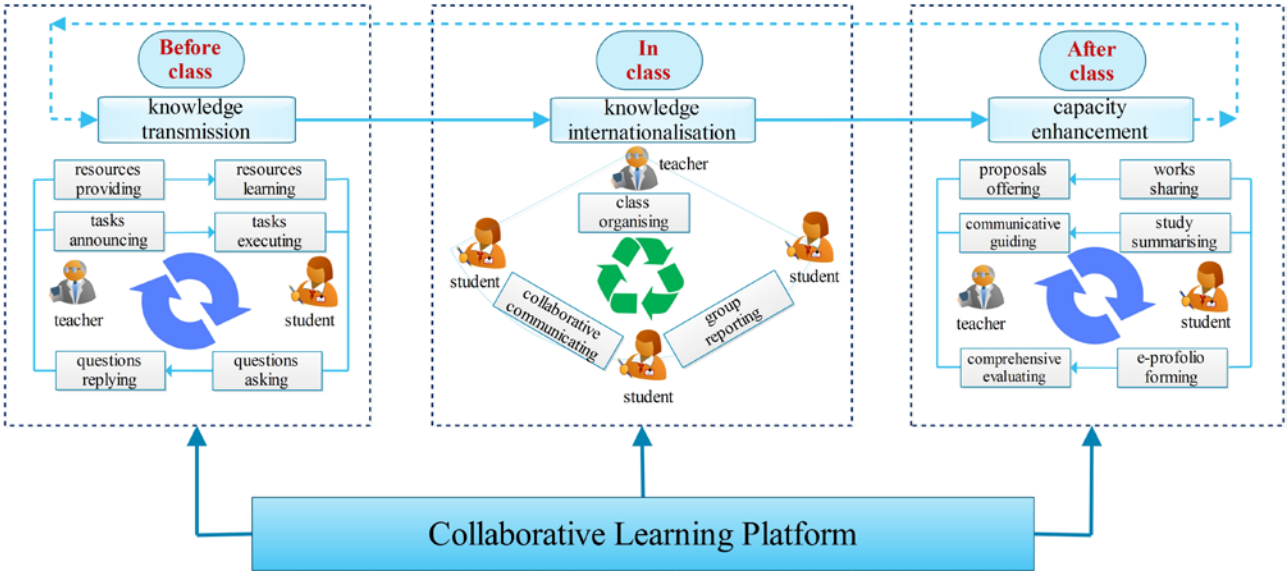

Figure 2: The improved learning model of flipped classroom.

In Class: Chandra and Fisher find that the classroom community is positively related to quality learning [8]. The classroom is the place for knowledge-internalisation, students are the main participants in the learning process and teachers are the organisers of classroom instruction. Students acquire positive emotions and experience by reporting, collaborating and communicating in groups. Teachers guide students in accordance with their problems and offer pertinent suggestions. In this way, doubts would be cleared up very quickly, and students can further reinforce what they have learned. Teachers or students use several of the resources provided by the collaborative learning platform to support classroom activities.

Gradually, as classroom activities are further developed, the confusions in students' learning are filtered out and common problems will be emphasised in the next round of learning. In addition, teachers can give individual guidance for the individualised problems on the collaborative learning platform after class.

After Class: Students absorb knowledge, transfer knowledge and improve their capabilities. They post blogs to analyse, reflect on the learning process and view electronic portfolios, which are sum of their learning activities. The portfolios are also the basis of students' evaluation from the perspective of teachers. According to students' blogs and their learning e-portfolios, teachers can guide students in accordance with their problems and give an overall, objective and effective evaluation of their learning. This cooperative learning platform, providing necessary learning situations, is a helpful tool for communicating and promoting explicit knowledge and tacit knowledge.

DESIGN OF THE COLLABORATIVE LEARNING PLATFORM SUPPORTING A FLIPPED CLASSROOM

Design Principles

To support flipped classroom learning better, this study looks at the traditional platform and uses three principles to improve the design of the platform. It should have clean and tidy user interface. In this article, the collaborative learning platform is there to support the flipped classroom learning process, and contrary to other learning platforms, it should be small and concise. The user interface should be clean, and the navigations should be clear and well-organised.

It should support both instruction and study. The role of teachers' assisted instructions remains unchanged in the improved flipped classroom and the collaborative learning platform should also provide related functions to assist teachers' instruction.

The architecture should be easy to extend. The platform should reserve the external system access interface to make it convenient to extend. When the platform is extended with new features, it should not affect the original functions and try to reuse the existing functional modules as far as possible.

Functional Requirements

In order to support the improved flipped classroom learning model, the learning platform should include at least the following basic functions:

- an extensible repository for learning resources;
- various types of resources, such as video tutorials, learning materials and students' works, etc;
- blogs for self-reflection and learning summary;

- FAQs for raising questions in the process of learning;
- e-portfolios for helping learners view learning curves and providing data support for evaluation, and
- learning evaluations for supporting the formative evaluations and the outcome evaluations.

Taking all these factors together, the function module architecture of collaborative learning platform can be shown in Figure 3.

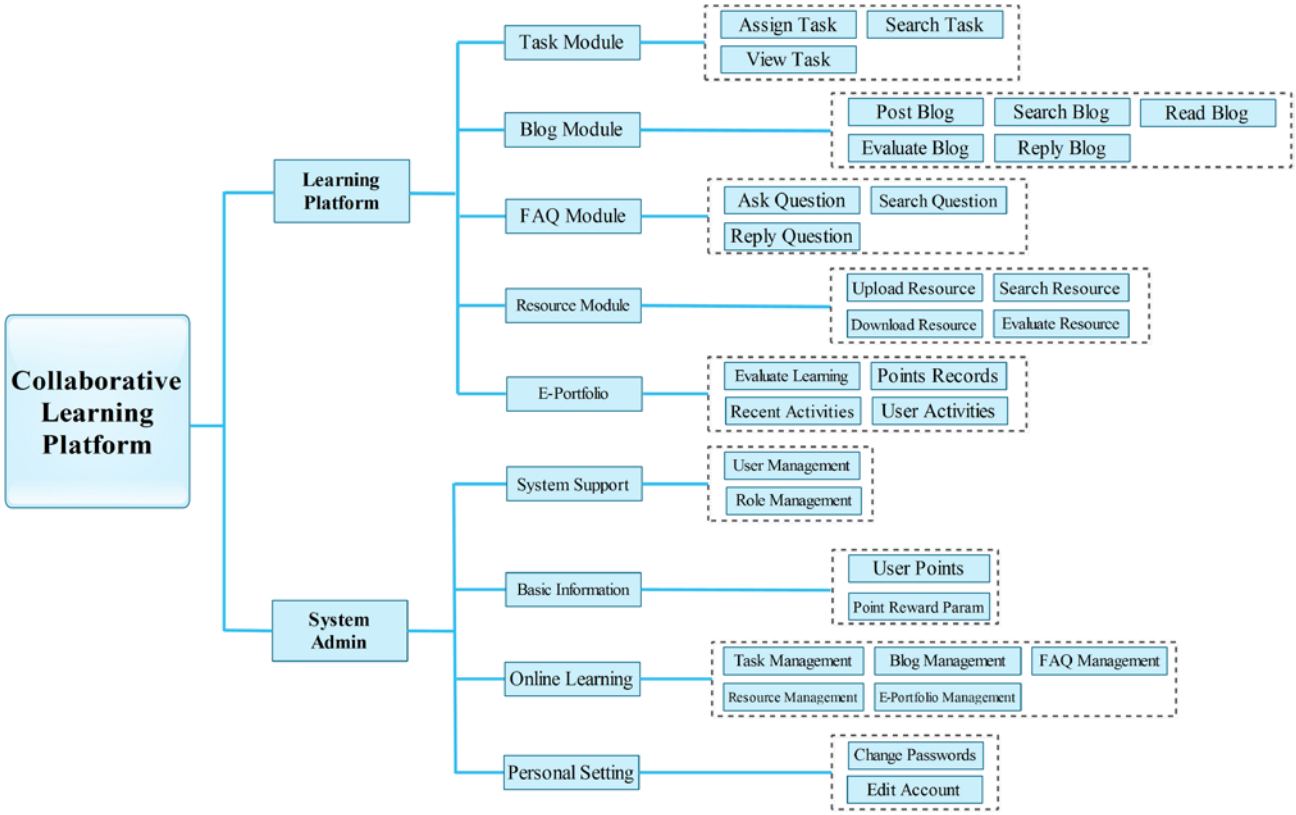

Figure 3: The function module architecture of the collaborative learning platform.

System Architecture

The platform adopts the browsersServer model, and is hierarchical; therefore, the coupling degree between the server-side and client-side is small, and the platform is easy to extend. It contains five core components. These are a presentation layer, a business logic layer, a data access layer, a service layer and common components, etc. The presentation layer is responsible for system interaction with users. The business logic layer is responsible for the business processing system. The data access layer is responsible for data's CURD operations: that is creating, updating, reading and deleting. The service layer is responsible for data exchanging with other systems and business integration. The platform exposes Web service to set aside interfaces for the integration of mobile client in the future. Common components include public class libraries and general pages, which can provide support for the other layers.

DEVELOPMENT OF THE COLLABORATIVE LEARNING PLATFORM TO SUPPORT THE FLIPPED CLASSROOM

This study has adapted an object-oriented approach to guide development of the platform, first of all building the model object, and writings the business operation method according to the model, and combining the down-up and the up-down method to implement software development. Then based on feedback from users, the object model is improved again and again until the final system meets the requirements.

Based on the Microsoft's ASP.NET Framework 2.0, this study used Microsoft Visual Web Developer 2008 as its development tools, C# as the program language, MySQL Community Server 5.1 as the database administration tool and Internet Information Server 7.5 to deploy the Web site. In order to enhance user experience, Jquery Ajax was applied to promote local renewable pages and save Web bandwidth. For the sake of the application's extensibility, CSS and DIV were applied to design the platform interface and separate the function realisation from page display.

Development Process of the Platform

The development process of the platform includes: Conceptual Structure Design, Logical Structure Design, Physical Structure Design, Coding, System Deployment, Trial Test and Formal Operation, as shown in Figure 4.

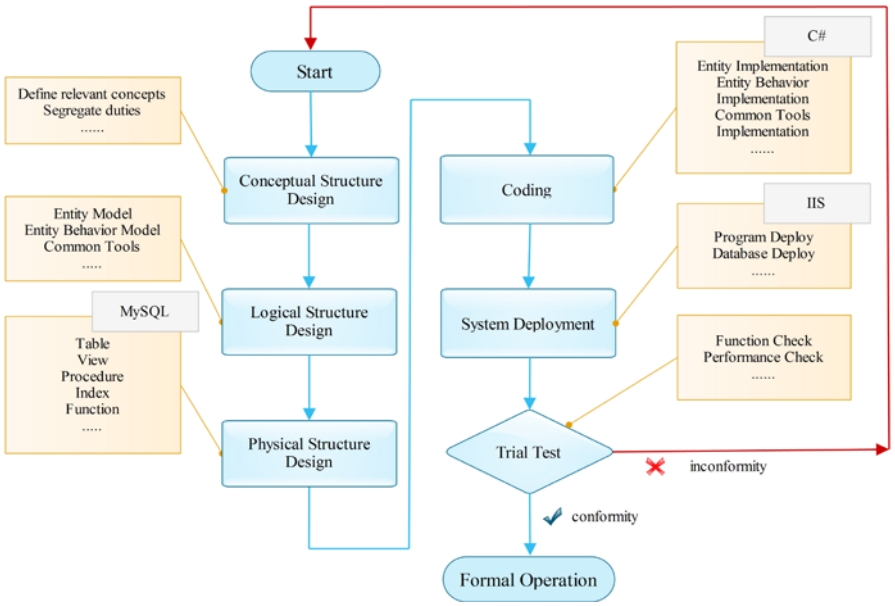

Figure 4: Development process of the platform.

Implementation of Main Functions

On the whole, this study used the method of object-oriented development to program each module, extracted each entity class - *Object* from the platform, used *ObjectService* as the class of action object, used the instance of *Object* to transfer data, and applied the relevant methods of *ObjectService* to implement business logic.

Log-in and Log-out. Used the *UserService* to implement the log-in and log-out actions. The business logic of log-in action can be described as following: get the input parameters of *userid* and *passwords*, and call the log-in method of *UserService* to authenticate user's log-in. After successfully log-in, save the user information to cookies and record the information about the user's current log-in, such as log-in time, hostname, etc. If the log-in fails, give a friendly message to the user. The business logic of log-out action can be described as following: get input parameters of *userid* and, then, apply the log-out method in the *UserService* to set *usercookie* information to *expired*.

Blog, Resource, FAQ and E-Portfolio. They have similar implementation ideas. Now, taking blog module as an example, the function implementation process of each module is shown below. As can be seen from Figure 3, user's behaviours are as follows: posting blog, searching blog, reading blog, replying blog and evaluating blog. *BlogService* and *BlogCommentService* contribute to the implementation of blog module, and the instances of *Blog* and *BlogComment* work as the carrier to transfer data, as shown in Figure 5.

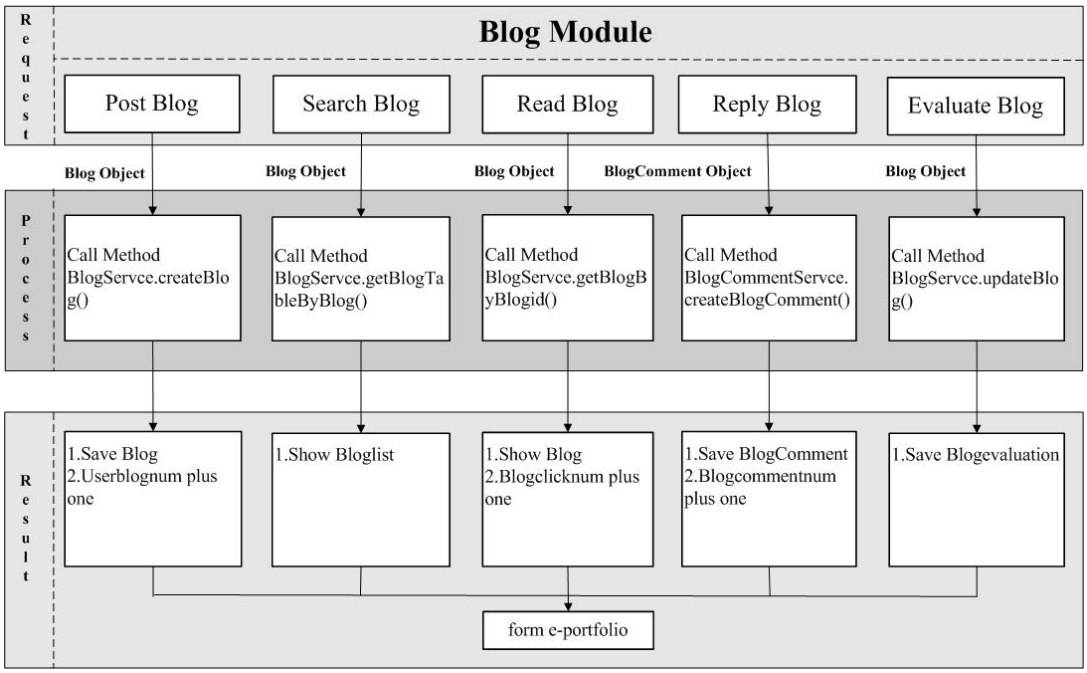

Figure 5: The implementation process of blog module.

APPLICATION OF THE COLLABORATIVE LEARNING PLATFOROM SUPPORTING FLIPPED CLASSROOM

For this study, one class was structured according to the improved flipped classroom format. The collaborative learning platform was used to support a course entitled *Multimedia Educational Software*. Because most activities were task driven, learners could set their goals and work hard to achieve them. There were thirteen tasks according to the course's specification and the cycle was one week. Outside class learners were required to post blogs, share files after they finished the assigned chapter task. When learners came to class, they undertook multiple activities, such as expressing their thoughts, interacting with others, etc, to strengthen their understanding of the content.

After four months, the desired effects were achieved: the platform improved the flipped classroom, extended learning communication and stimulated learners' interest in learning. Ninety per cent of the participants said that they could gradually adapt this approach, and they believed that the platform made the distance between teachers and learners, and learners and other learners closer, and improved the learning effectiveness.

CONCLUSIONS

The study examined the current pattern for the flipped classroom, and proposed an improved model by designing and developing a collaborative learning platform to support a better flipped classroom model. The platform was proved effective through experiments, but some limitations were evident. First, this single experimental course should be extended to three or more courses. Second, the activities are heavily reliant on computers. As more and more people own smart phones, smart-phone applications may help support communications on-line. Therefore, the next work should be to enrich and improve the platform in practice, undertake a further study on the design and development of the mobile client and try to blend the flipped classroom with mobile learning.

REFERENCES

1. Dill, E.M., The Impact of Flip Teaching on Student Homework Completion, Behavior, Engagement and Proficiency. University of New England (2012).
2. Tucker, B., The flipped classroom: online instruction at home frees class time for learning. *Education Next*, 82-83 (2012).
3. Strayer, J.F., The Effects of the Classroom Flip on the Learning Environment: A Comparison of Learning Activity in a Traditional Classroom and a Flip Classroom that Used an Intelligent Tutoring System. The Ohio State University (2007).
4. Zhou, W., The future of classroom: flipped classroom (2011), 12 April 2013, http://blog.sina.com.cn/s/blog_624 df0fc0102dtld.html,2011
5. Warter-Perez, N. and Dong, J., Flipping the classroom: how to embed inquiry and design projects into a digital engineering lecture. *Proc. 2012 ASEE PSW Section Conf.* (2012).
6. Strayer, J.F., How learning in an inverted classroom influences cooperation, innovation and task orientation. *Learning Environments Research*, 15, 171-193 (2012).
7. Zhou, Y. and Li, F., Can WebQuest promote students' problems solving? *E-education Research*, 206, 70-74 (2010).
8. Chandra, V. and Fisher, D.L., Students' perceptions of a blended web-based learning environment. *Learning Environments Research*, 12, 31-44 (2009).