A Web-based Motivation-Supporting Model for Effective Teaching-Learning

Woochun Jun[1], Le Gruenwald[2], Jungmoon Park[3], and Suk-ki Hong[4]

[1] Dept. of Computer Education, Seoul National University of Education, Seoul, Korea
E-mail: wocjun@ns.snue.ac.kr
[2] School of Computer Science, The University of Oklahoma, Norman, OK 73069, USA
E-mail: ggruenwald@ou.edu
[3] Dept. of Computer Education, Seoul National University of Education, Seoul, Korea
E-mail: gatepak@orgio.net
[4] Dept. of Business Administration, Konkuk University, Chungju, Korea
E-mail: skhong01@kku.ac.kr

Abstract Web-based Instruction (WBI) has been adopted in many educational systems. However, due to WBI's lack of face-to-face communication existing in a traditional classroom, their effectiveness is minimal. One way to lessen this problem is for these systems to implement a model that provides motivation to students. In this paper, we present a model to support motivation based on constructivism, which is known to be very suitable for WBI. The model is developed according to the four types of interactions: students-teachers, students-students, students-contents, and students-experts. We then describe the implementation of our model and its application to a third-grade science course for demonstration purposes.

Keywords: Web-based Instruction, Motivation, Instruction model

1 Introduction

Rapid development of the Web technology has changed not only the initial role of the Web as the medium of information communication but also the ways of life in various ways. Especially, the Web has affected the traditional teaching-learning method. Web-Based Instruction (WBI) has rapidly become an important method for effective teaching-learning. It has the following unique characteristics that are different from those of traditional off-line teaching-learning, and thus requires the changes in its application to teaching-learning [2]. WBI overcomes the limitations of time and space, and enables rich information to be utilized as study materials through multimedia such as text, graphics, sounds, and animation. It makes interactions feasible [2, 4, 12, 13]. That is, it enables dynamic interactions between teachers and students as well as among students themselves. In addition to efficient communication, problem solving and learning abilities can be improved through the dynamic interactions.

Although WBI has the above advantages, it has some drawbacks. It may weaken students' motivation due to lack of face-to-face communication. It is reported that 30 to 50% of all students who start a distance education course drop out before finishing [15]. Supporting constant motivation to students is a crucial factor to achieve success in WBI. In this paper, we present a model to provide motivation to students. There has been some research in the literature on this topic [3,10,17]. Most of the research includes psychological effects that are subjective and are not easily measurable. Our model is based on the principles of constructivism [6,16]. Our model provides students' motivation according to the four types of interactions: students-teachers, students-students, students-contents, and students-experts.

One of the main characteristics of our model is that teaching-learning is directed by students themselves. That is, students gather materials for themselves, determine the study subjects, and share information with each other. Further, diverse real and non-real time interactions can yield better teaching-learning processes. Teachers can respond to the requirements of students, and insufficient responses can be supplemented by cooperative work through the interactions between teachers and students. Also, for students to share information with each other and supplement their insufficient ideas, bulletin board systems (BBS), resources centers, chatting, and e-mails are utilized. Finally, study processes and relevant information are stored, and feedbacks are given to both teachers and students.

We implement our model and, for demonstration purposes, show how it can be used in a third grade science course.

This paper is composed of five sections. In Section 2, we present theoretical background, and in Section 3, we explain our motivation-supporting system design. Section 4 describes the system implementation and its application to a subject in elementary school. Finally, we conclude our work and discuss future study in Section 5.

2 Theoretical Background

2.1. Motivation

Motivation is an essential factor to students' actual study process. Specifically, motivation is crucial because education is planned to change students' values and to modify their pattern of behavior [5]. The factors that affect motivation can be classified as internal (individual) or external (environmental). Examples of internal factors are students' interests, curiosity, and desire to study. On the other hand, external factors include extrinsic rewards, such as privileges or tokens.

2.2. Web-based Instruction

Recently, diverse teaching methods that use new media or knowledge have been applied in the field of education. The application of multimedia and the Internet to education is a representative example. WBI is to link abundant potential of the Internet to education. Also, WBI is to apply the positive characteristics of the Internet for effective and efficient education [9,11]. According to planned ways of study, intended interactions are conducted through the Web for developing students' knowledge and learning abilities. Specifically, WBI can provide educational environments that accommodate rapid social changes, beyond traditional repetitive studies for predefined contents and curricula.

2.3. Constructivism

In this Section, we introduce constructivism and argue why constructivism is easily adapted for WBI.

The basic principles of constructivism include three principles: learner construction of meaning, social interaction to help students learn, and student problem-solving in "real-world" contexts [1,6]. The first principle implies that learners construct their own meaning based on their experiences. That is, each person has a unique mental structure that allows him or her to derive meaning based on his or her experiences. According to constructivism, the course objectives and ways to reach them are not provided in advance. In this case, the Web can provide enough information easily. The second principle means that social interaction provides mediated interpretations of experiences among individuals. Constructivism encourages both self-directed work and cooperative work. The Web can provide both synchronous and asynchronous communication tools to support cooperative work. The third principle implies that students can increase problem-solving ability when they are faced with real-world problems. Students can get various experiences via WBI. WBI helps students participate in "real-world" problem solving.

2.4. Related Works

In the literature, there exist the following works on providing motivation.

In [3], they argue that the following may cause a lack of student motivation: family illness, students' unwillingness to deal with the content being delivered, funding problems at home or school, lack of interpersonal communication skills, no connection between what is being taught via the Web and his or her goals, etc. For possible solutions, they suggest the following: first, get to know the students. In order to do this, let students provide their photos and e-mail addresses at the beginning of semester. Also, if a student is experiencing a motivation problem, communicate with students immediately.

In [10], their motivational-design model has seven categories as follows: variation and curiosity, relevance, challenge level, positive outcomes, positive impression, readable style, and early interest. "Variation and curiosity" refer to maintaining curiosity and providing different learning styles to students. "Relevance" refers to linking the learning process to the goal or desire of the student. "Challenge level" refers to providing challenging problems to students in various manners. "Positive outcomes" refers to extrinsic rewards to hold students' motivation. "Positive impression" refers to organizing course materials in various ways to hold students' attention. "Readable style" means that providing readable expression in writing or speech. Finally, "early interest" means that interests must be supported in the instruction as early as possible.

In [17], their model for supporting motivation includes the following elements: attention, relevance, confidence and satisfaction. "Attention" is to provide interests or curiosities to students. Also, “relevance” refers to the applicability of the content to real life or other subjects. “Confidence” is to describe student’s understanding ability through the course or instruction. Finally, “satisfaction” is to provide any kinds of satisfaction to students after the course. The typical example includes fair grade and any positive rewards.

In [8], a motivational-design model is presented. The model includes 4 stages for a given course module: Define, Design, Develop, and Evaluate. In the “Define” stage, study objectives are developed. Also, students are analyzed for their background. In the “Design” stage, strategies to provide motivation are to be selected. In the “Develop” stage, course contents are actually developed. Finally, the “Evaluate” stage is to test students’ achievement and efficiency of the entire course module.

3 Design of a Web-based Motivation-Supporting System

3.1. Basic Principles

Constructivism in teaching-learning assumes that students are active and positive in the learning process [6]. In addition, since constructivism emphasizes the students’ close interaction with their study environment, web-based teaching-learning is fit to constructivism [12]. Therefore, constructivism can be the theoretical foundation of teaching-learning model design. Since education activities are dependent on how teachers and students behave, communicate, and interact, interaction is considered a key concept in education activities [14]. As in education activities, interaction is also an essential factor in Web-based teaching-learning. Interactions in constructivism can be classified into four types as follows [7].

① Students and Contents

Interactions between students and contents are similar to interactions of hypermedia under constructivism. The principles that can be applicable to hypermedia forms belong here. Some examples are learning objectives, exercises, feedbacks, and interface environments.

② Students and Teachers

Interaction channels are more diverse and effective in Web-based teaching-learning than in any traditional teaching-learning. These types of interactions include interactions through e-mails, BBSs, resource centers, and discussion rooms. These types of interactions play an important role in facilitating study subjects and learning processes.

③ Students and Students

Web-based teaching-learning should provide communication channels among students that can promote cooperation in solving homework and assignment problems. Examples include synchronous channels (chatting, e-mail etc.) as well as asynchronous channels (bulletin board, resources center etc.). These channels will promote Web-based teaching-learning.

④ Students and Experts

The interactions with external experts can promote the effectiveness of completing homework. That is, when students confront difficulties in solving problems or need advices, they can contact with external experts through e-mail and BBS. Interactions with external experts can facilitate problem solving, and develop ways of thinking.

3.2. Web-based Motivation-Supporting Model

The model has three phases: "before-class activity", "in-class activity", and "after-class activity". Each phase is explained as follows.

Interaction / Activity	Student-contents	Student-teacher	Student-student	Student-experts
Recognize subject	Provide subject	Exchange ideas on subject	Exchange ideas on subject	Exchange ideas on subject
Search information	Read contents	Ask references	Exchange information	Ask for information
Share information	-	Exchange information	Share information	-
Decide subjects	Read contents	Ask if the subject is proper or not	Exchange ideas if the subject is proper or not	Exchange ideas if the subject is proper or not
Ask questions	-	Ask questions	Ask questions	Ask questions

<Table 1> Before-class activity model

Interaction / Activity	Student-contents	Student-teacher	Student-student	Student-experts
Check if the necessary information is ready	Read materials provided	Ask teacher if necessary information is ready	Ask each other if necessary information is ready	-
Identify study objectives	Read contents	Identify study objects	Identify study objects	-
Read materials	Read materials	Ask questions	Exchange opinions	-
Discuss	-	Exchange ideas	Exchange ideas	Exchange ideas
Present	-	Present opinion	Present opinions	Present opinions

Save results	Put results in BBS	Put results in BBS	Put results in BBS	Put results in BBS

<Table 2> In-class activity model

Interaction / **Activity**	Student-contents	Student-teacher	Student-student	Student-experts
Decide the best presenting group	-	Promote students' votes	Decide best presenter	-
Evaluate	Solve the problem in the study materials	Evaluate student performance	Evaluate colleagues' performance	Evaluate student performance
Further study	Read further study subjects	Provide directions for further study	Share information for further study	Ask questions for further study
Reflect	Read summary and review questions	Examine processes and outcomes	Examine processes and outcomes	Examine processes and outcomes

<Table 3> After-class activity model

3.3. System design

The system consists of two modules, one for students and the other for teachers. After a participant logs in the student module or teacher module, the system is operated in different manners according to participant rooms. Participant rooms consist of three stages (before-class activity, in-class activity and after-class activity), and contents provided in each room are different. The systems structure is shown in Figure 1.

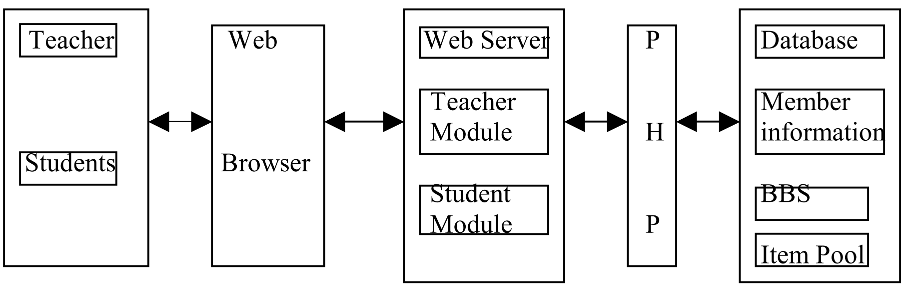

Fig. 1. System structure

1) Teacher Module

Teachers log in the system and can access the teacher module through authentication. In the *before-class* stage (preparation stage), teachers present study subjects and their relevant contents, and take an initial role as assistants. In addition, teachers, as guiders or supporters, motivate students to keep interests and curiosity through interactions. In the *in-class* stage (participation stage), learning objectives and study materials necessary to teaching-learning are provided through linking with the database. Teachers take a role of managers for the harmonious teaching-learning process. In the last stage, *after-class* stage (reviewing stage), the teachers review the teaching-learning process, and examine the possible problems or insufficiency in the process. Teachers, as encouragers or supporters, encourage students to share information, and to interact in synchronous or asynchronous manners.

2) Student Module

Students log in the system and can access the student module after attaining the authentication. Similar to the teacher module, the student module has three stages, *before- class*, *in-c*lass, and *after-class*. In the *before-class* stage, students search and examine the subjects presented by teachers. Students can share gathered information, and ask each other questions. In the *in-class* stage, students participate in the class, and study the subjects and discuss those subjects among themselves. Materials presented by teachers are used as a supplementary means. In the last stage, *after-class* stage, students review what they have studied, and examine their drawbacks and future study subjects.

4. Implementation of the Web-based Motive-Supporting System

The system is developed to support effective teaching-learning. Our system has the following characteristics.

First, students' participation tools are reflected for the self-directed study. Further, in the stage of participation, the system induces students to recognize problems for themselves in addition to the subjects provided by teachers.

Second, overcoming the limits of time and space, the system provides participants' access anywhere and anytime. Beside the participation stage that is in class, log-in provides system access to help solve problems.

Third, the system enables students to supplement insufficient materials. For example, the system provides relevant reference sites in a navigation menu, in which students can find necessary materials with minimizing navigation errors.

4.1 System Development Environment

The system is developed using PHP and My-SQL. When students access the Web, the necessary processes are linked with the server through the system designed with PHP. In addition, databases are designed using My-SQL. The system development environment is shown in Table 4. The system is implemented in http://comedu.snue.ac.kr/~gatepark in Korean. Its English version will be available soon.

Items		**Specification**
Server	Operating System	Linux
	Web server	Apache
Client	Operating System	Windows 98
Database linkage software		PHP 4.0
Database server		MY-SQL
Web Browser		Internet Explorer 5.0
Web site construction Tool		Dreamweaver 4.0 Flash 5.0 PhotoShop 6.0

Table 4. Development Environment and tools

4.2 Interface Screen and Other Major Screens

1) Introduction Screen

The initial introduction screen is designed to let students select various menus as shown in Figure 2.

2) Interface Screen

Clicking the menu for “Let’s participate” from the introduction screen, users can access the interface screen as shown in Figure 3. In this menu, Students can log in to the system.

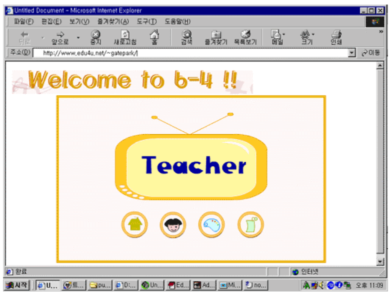

Fig. 2. Introduction Screen

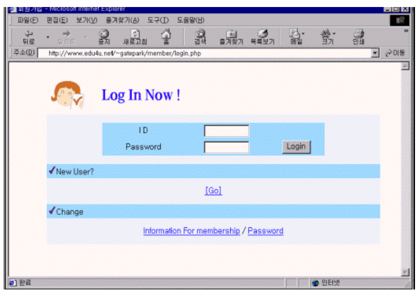

Fig. 3. Interface screen

3) Main Screen of before-class activity

After completing log-in, the main screen of preparation can be accessed. *Preparation* is the stage before the class. In this stage, study subjects are selected and necessary materials are searched through navigation. Also, gathered information is shared. The screen is shown in Figure 4.

4) Main Screen of in-class activity

This is the stage of in-class. During the class, teachers provide learning objectives and study materials, and students discuss and make a presentation for the completion of the assignment. The screen is shown in Figure 5.

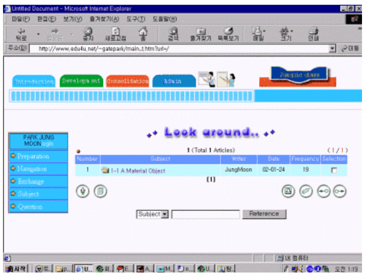

Fig. 4. Main screen of before-class activity

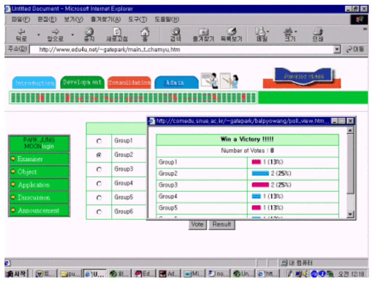

Fig. 5. Main screen of in-class activity

5) Main Screen of after-class activity

After class, discussion and review about the process of solving the assignment are performed. Teachers can find insufficient parts, and encourage students to express the desirable subjects and contents for the next class. The screen is shown in Figure 6.

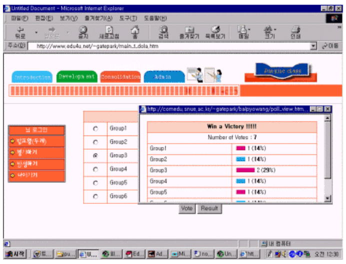

Fig. 6. Main screen of after-class activity

4.3 Trial Implementation

In this section, we show that our system can be applied to a third grade science course of an elementary school, although the system can be applied to any course. Each activity is explained as follows.

1) Before-Class (Preparation)

The guidance for teaching-learning before class is related to preparation of the class as shown in Table 5.

Title of study unit: Substances in our surroundings		
Activities	Recognize subjects	What are common characteristics of substances?
	Search information	-Students are supposed to search relevant information through the Internet and put some reference sites in BBS. -Students also look for sites recommended by other students
	Share information	Based on information searched, exchange ideas on the common characteristics of substances for in-class participation
	Decide subjects	-Let students decide what kinds of topics to be investigated and put those topics in BBS - Teachers are supposed to provide their opinions on possible topics
	Exchange ideas	-Let students contact each other or ask experts for any questions on common characteristics of substances - Teachers need to assist students when they need help

Table 5. Examples of before-class activity

2) In-Class (Participation)

The guidance for teaching-learning in class is related to participation as shown in Table 6.

Title of study unit: Substances in our surroundings		
Study theme: Common characteristics of substances made of the same materials		
Study objectives: - find substances made of solid - find substances made of glass - find substances made of other materials		
Activities	Check if the necessary information is ready	Let students decide who gathered the most useful information
	Identify study objectives	Identify the common characteristics of substances made of the same materials
	Read materials	Compare the information searched by both students and teachers
	Discuss	-Make groups -Read references and exchange ideas by group -Put summaries of each group in BBS
	Present	Present the results by each group
	Save results	Save the final results after presentation and put those results in BBS

Table 6. Examples of in-class activity

3) After-Class (Review)

The guidance for teaching-learning after class is related to review as shown in Table 7.

Study theme: Substances in our surroundings		
Activities	Decide the best presenting group	-Decide the best presenter based on students' votes -Provide rewards to groups
	Evaluate	Evaluate processes and outcomes
	Further study	Let students decide further themes to be studied or their requests on BBS
	Reflect	Students and teachers are supposed to look back the study progress and discuss matters to be improved

Table 7. Examples of after-class activity

5. Conclusions and Further Work

Even though motivation is critical to teaching-learning success, it has been neglected for quite some time. The main reasons of the motivation deficiency in the ordinary classes are limitations of space and time, that is, classroom as a closed space, and fixed class time for, say, 40 minutes. Further, since learning motivation is not a simple but rather complex process, it is difficult to develop motivation strategies with detailed tactics and tools.

This research suggested the following for dealing with the above issues.

For the first issue, with diverse study materials through the Web, students can overcome the limitation of physical space. In addition, classes do not have to be restricted to a fixed class time of, say, 40 minutes, because *before-class, in-class, and after-class* are available through the Web. For the second issue, we resolve this issue by utilizing various types of interactions, based on contructivism, and students' self-directed study during the problem solving process.

This research is focused on the interactions between teachers and students. However, the interactions with parents and external experts will be more reinforced. For the expanding interactions, diverse motivation techniques and tools should be also developed. After the effectiveness of this system is verified, supplementary research on the interactions and motivation should be continued.

References

1. Abbey, B., *Instructional and Cognitive Impacts of Web-based Education*, Idea Group Publishing, London, UK (2000)
2. Choi, J., "A Study on Instruction Strategy to Improve Interactivity in Web-based

Instruction", Journal of Educational Technology, Vol. 15, No. 3, (1999) 129 – 154

3. Cornell, R. and Martin, B., The Role of Motivation in Web-based Instruction, in Web-based Instruction, edited by Khan, B., Educational Technology Publications, Englewood Cliffs, NJ, USA (1997)
4. Hwang, S. and Han, K., "A Design of Web-based Cooperative Learning System Supporting Effective Interactivity", The Proceedings of KAIE, Vol. 6, No. 2, (2001) 74 – 86
5. Jang, S et al., "A Study on Contents Development for Improving Learning Fulfillment", The Proceedings of KAIE, Vol. 6, No. 2, (2001) 369 – 387
6. Jonassen, D., Peck, K. and Wilson, B., *Learning with Technology: A Constructivist Perspective*, Prentice Hall, Upper Saddle River, NJ, USA (1999)
7. Jun, W. and Gruenwald, L., "An Evaluation Model for Web-based Instruction" IEEE Transaction on Education (CD-ROM Version), May, 2001
8. Jung, I. and Na. I., *Instruction Design Theories*, Educational Technology Press, 1999
9. Khan, B., *Web-based Instruction*, Educational Technology Publications, Englewood Cliffs, NJ, USA (1997)
10. Keller, J. and Burkman, E., Motivation Principles, in Instructional Message Design: Principles from the Behavioral and Cognitive Sciences (2^{nd} edition), edited by Fleming, M. and Levie, W., Educational Technology Publications, Englewood Cliffs, NJ, USA (1993)
11. Kim, J., "A Study on Web-based Instruction", Elementary Education Study, Vol. 5, No. 1, (2000), 41 – 59
12. Lim, I., "A Study on Synthetic model for the Design of Interactive Web-based Instruction", Journal of Educational Technology, Vol. 15, No. 1, (1999) 3-24
13. Lim, J., "Theoretical Bases on Web-based Instruction from a Viewpoint of Interactivity", Journal of Educational Technology, Vol. 15, No. 1, (1999) 29 – 54
14. Lim, Y. and Hong, M., "A Design and Implementation of Virtual Class Generation System Reinforcing Interactivity", The Proceedings of KAIE, Vol. 5, No. 1, (2001) 195 – 207
15. Moore, M. and Kearsley, G., *Distance Education: A System View*, Wadsworth, Belmont, CA, USA (1996)
16. Morrison, G., Ross, S. and Kemp, J., *Designing Effective Instruction*, 3^{rd} edition, John Wiley & Sons, Inc., New York, NY, USA (2001)
17. Song, S., Providing Motivation in Web-Based Instruction, in Web-Based Instruction, edited I. Na, Educational Science Press, Seoul, Korea, (1999)