DEVELOPMENT OF WEBSITE "CHECK-AND-REVISE YOUR MOTIVATIONAL DESIGN" BASED ON THE ARCS MODEL

Katsuaki Suzuki*, Akiko Nishibuchi*, Masayuki Yamamoto*, John M. Keller**

* Iwate Prefectural University   ** Florida State University
JAPAN   U.S.A.
<ksuzuki@soft.iwate-pu.ac.jp>   <jkeller@mailer.fsu.edu>

ABSTRACT

Website that contained motivational design strategies for various instructional setting, including face-to-face lectures and self-paced learning materials, were designed and developed to help lecturers/designers improve their instruction based on the result of user reaction questionnaire. The Website has capabilities of collecting questionnaire data, analyzing them, and suggesting weak areas, based on Keller's ARCS motivational design model. Strategies to improve instruction are then suggested by retrieving from motivational strategy database, that are suitable for a given instructional setting (teaching mode, target audience, characteristics of learning objectives, etc.). Formative evaluation studies were conducted to revise the Website for usability and practical effects, where the lecturers/designers worked through the Website to come up with a set of their own motivational enhancement strategies by referring to the weak areas the system analyzed and the motivational strategies the system proposed.

KEY WORDS
Educational Software, Instructional Design, Evaluation and Assessment in WBE, ARCS Model, Formative Evaluation, Motivation

1. INTRODUCTION

Formative evaluation that is conducted by developer of instruction is a critical step in the systematic design of instruction, in order to ensure the quality of instruction. This step is of value either in face-to-face lectures, or self-directed learning in e-learning environment. Various methodologies for creating better quality instruction have been suggested by Instructional Design (ID) models[1], but they are not always utilized in practical situations. One of the burdens that prevent from using such models has been the implementation cost associated with the application of rather abstract concepts to a particular set of practical situations. There has been a gap between the potential usefulness of ID models and the actual or perceived difficulty for applying the models. There is a need for a computer-based tool to bridge this gap.

The purpose of this study was to bridge such a gap so as to make it easier to apply ID models in practical settings. It was to be done by providing a semi-automated strategy selection mechanism based on one of ID models for motivational enhancement of instruction, i.e., Keller's ARCS motivational design model[2]. It was aimed to provide a Web-based tool to collect evaluation data, analyze them, suggest motivational enhancement strategies that fit the given instructional setting, so that the users could come up with a set of ideals to improve their instruction.

2. OVERVIEW OF THE WEBSITE

The Website "Check-and-Revise Your Motivational Design" was designed to have the following features:

1) Reaction Questionnaire Collection
2) Data Analysis
3) Motivational Strategy Database
4) Strategy Suggestion
5) Strategy Selection and Idea Plotting

1) Reaction Questionnaire Collection
Based on Keller's ARCS categories (Attention, Relevance, Confidence, and Satisfaction) and subcategories (3 for each of the ARCS), Kogo and Suzuki developed a Japanese version of reaction questionnaire to ask motivational characteristics of instruction using 12 items of 9-point Likert scale[3]. Items use Semantic Differential scheme by asking how much the respondent felt about the instruction, by placing a mark in between two adjectives opposite to each other, such as (the instruction was) boring vs. interesting, useless vs. useful, etc. Web version of this questionnaire was placed as a part of this system as shown in Figure 1. As the instructor or developer of the instructional material sets up an account for each of the course titles, the system will create a file to store the data collected on the 12 items, together with open-ended comments and suggestions.

2) Data Analysis
Means and Standard Deviations are calculated for each item on Reaction Questionnaire. The system then will

Figure 1. ARCS Reaction Questionnaire

Figure 2. Strategy Suggestion

show the results in descending order of means, so as to highlight the weak area of instruction. Three items with the lowest mean scores are determined as the areas that need focus in revision, so that the effort in revising instruction will be concentrated in the area that are expected the largest improvement, as suggested in the ARCS motivational design procedure.

3) Motivational Strategy Database
One hundred and fourteen motivational strategies, written in Japanese, were included in the prototype of the Website's database. They were taken from various resources that explain the ARCS model and its strategies by paraphrasing them to relatively easy to understand wording. Each strategy is identified as to which of the ARCS subcategories that it should be used, together with its applicability in terms of instructional settings (lecture, self-regulated learning, etc.), target group's ages, instructional objectives (knowledge, skills, attitudes, etc.). All the strategies can be examined by the Website users, by calling all strategy at glance function.

4) Strategy Suggestion
By linking Data Analysis section of the Website with Motivational Strategy Database, the system has a function of displaying only the suitable strategies by the ARCS subcategories. When the user select to see the best strategies for a certain instruction, the lowest three items are examined through the database to show only those strategies fit the ARCS categories as well as instructional setting. This function is to help the user concentrate on the weak areas depicted by the questionnaire analysis, although the user can select to further see the suggested strategies in other relatively problem-less areas. Figure 2 shows a result screen showing a set of strategies selected by the system based on the questionnaire results.

5) Strategy Selection and Idea Plotting
The system has a function of assisting the users to collect from the suggested strategies the ones they would like to incorporate in their idea generating session for the improvement of instruction. The shopping cart model was adopted to collect only the ones they liked. The users are then prompt to come up with their idea of revision by referring the strategies they selected. The final draft that contains selected strategies and their ideas for revision can be saved in the text format, or printed out for their references.

3. FORMATIVE EVALUATION STUDIES

The Website has undergone the following formative evaluation studies:

1) Usability Testing (One-to-One Evaluation)
Two young college faculty members were participated in an experiment to check and improve usability of the Website. Cognitive walkthrough method were adopted in one-to-one evaluation sessions in which a user was asked perform all the functions the Website provided: to see general description of the system, the ARCS model, the reaction questionnaire sheet, to log in, to see the questionnaire results, to check the enhancement strategies the system proposed, to select from the proposed strategies into "my list," to download and print revision ideas that the user summed up. Previously collected data for a lecture that both of the participants were familiar were used in this experiment.

Both of the two participants could perform all the tasks with no problem in 51 and 31 minutes, respectively. Overall impression of the system was favorably stated in the post experiment questionnaire. An interview session

was then conducted for about one hour, by going through the tasks that the use performed again. Comments and suggestions were noted in the interview sessions, which were categorized based on the urgency and expected magnitude of improvement.

Revisions were made and some functions were added before going on to the small group formative evaluation: Explanation of numbers 1-9 in reaction questionnaire result was added. Minor differences in wording in different parts of the system were made uniformed. Procedures that were not necessary were eliminated. Colors were added to clarify the groupings of strategies and of weakness of areas. Format for saving ideas for improvement was shifted from CSV to text.

2) Small Group Formative Evaluation

Ten undergraduate and graduate students were participated in the small group formative evaluation to check and improve the effectiveness of the Website. Participants examined six self-study print-based one-hour –long learning materials, which had been developed by six of the participants. Content of the material varied, including such topics as "How to assemble your own PCs," "Introduction to Knitting," "Let's study Piano Codes," and "How to calculate points in Mah-jongg." Expect for the one that each participant him/herself developed, they evaluated the attractiveness of each material by filling out Reaction Questionnaire Section of the Website, resulting in 9 sets of reaction data for each of the material evaluated.

Six of the participants who authored the material then reviewed the reaction data, and tried to come up with a set of revision ideas using the Website's Analysis, Suggestions, and Idea Plotting functions. As the results, all of the six participants were able to reach at least one revision idea, with an average of 3.67 ideas or a total of 22 ideas. Of 22 ideas, two were based on the comments and suggestions in the open-ended section of reaction data,

whereas 20 were based on enhancement strategies suggested by the system. Of 20 ideas based on suggested strategies, 11 ideas were based only on strategies in the three weakest areas that the system called attention to the users, 4 used strategies in the three weakest areas in conjunction with the ones from other areas, whereas only 5 ideas were based solely on strategies in less weaker areas. It was seen in this experiment that the Website successfully facilitated to generate revision ideas, especially in the area that needed improvement.

In terms of strategies selected to form the "My Lists," which were kept and used in idea plotting for revisions, the six participants selected a total of seventy strategies (Table 1). The average number of strategies selected into "My Lists" was 11.67. Of 70 strategies selected, 34 were in the three weakest areas of each of the participants, whereas other 36 were in other 9 areas. That is to say, an average of 1.89 strategies were taken from the three weakest areas, whereas an average of 0.67 strategies were taken from other 9 areas. This shows that the Website facilitated to concentrate the revision effort to the weak areas depicted by the questionnaire data.

Except one participant who selected from two of the three weakest areas, all other participants selected at least one strategy from all of their three weakest areas. Each participant selected strategies to "My Lists" from other 9 areas varied in number: from one (two participants) to 7 areas (one participant). Most (88%) of the strategies participants selected in the three weak areas were in fact used as bases of revision ideas, whereas only about a half (47%) of the selected strategies in other 9 areas was utilized in formulating revision ideas.

Ideas for further revisions were collected in the questionnaires and interviews from the 10 participants of this experiment. Several buttons and links were altered for better usability and a clearer structure of the Website.

Table 1: Number of strategies selected for "My Lists" by Ranks of Weakness

Rank	A		B		C		D		E		F		total
1	C3	1 *	R1	1	R3	1 *	C3	1 *	S1	1 *	R1	5 *	10
2	R3	1 *	A3	2 *	C3	1 *	A1	3 *	R1	2 *	A3	3	12
3	A3	1 *	C3	0	A3	2 *	S2	1 *	R2	2 *	C1	6 *	12
4	A1	2 *			C2	2 *	A3	2 *	S2	1 *	R2	4	11
5			S2	1							C3	5	6
6							C2	2 *	A3	1 *	S1	3	6
7											C2	3	3
8									C2	1 *			1
9									A2	1 *			1
10									C1	2 *			2
11			A2	1					R3	1 *			2
12									A1	3 *	A2	1	4
total	5		5		6		9		15		30		70

Note: * represent strategy that became basis for enhancement ideas
A3, C2, etc. refer area in the Reaction Questionnaire, cf. Table 2.

3) Case Study of a University Professor
A professor who taught undergraduate level course on strategic information system used the Website to come up with a set of ideas for course improvement for the next year. This professor had no prior knowledge about the ARCS model, nor the ID models.

An announcement was given in the last class asking to voluntarily submit reaction for the course by using the Website's questionnaire. For all of the 87 junior and senior students who enrolled in the course received an e-mail with the URL of the Website, with which they could access to the reaction questionnaire with a click of a mouse. Forty-one students sent their reactions, which the professor used in this experiment.

After the professor went through the tutorial session of the Website, he saw the results of his students' reactions on the Website. Table 2 shows average point for each of the ARCS questionnaire in ascending order. First three areas were identified as weakest: (1) A1: Whether or not they felt sleepy, (2) C3: Whether or not they were able to be creative in learning, and (3) S1: Whether or not the content was readily applicable.

He then used strategy suggestion and selected his own set of motivation enhancement strategies. A total of 13 strategies were suggested for the three weakest areas, of which he selected four in his "My List." Seventy-five strategies were suggested for other area, of which he selected 25. Finally he came up with a set of seven ideas of enhancement for the next year. It took him about one hour to finish this task.

During the interview after the task was completed, he expressed that the ARCS model helped him conceptualized the weak areas that need enhancement. Also expressed was a convenience of thinking improvement directly based on students' reactions to the course. For him, the Website was a handy tool to think systematically of motivational enhancement to his course.

On the other hand, he was concerned with considerable variation of available number of strategies in each areas. It was mainly because fewer strategies were proposed in the three weakest areas than the other nine areas that he said he had selected more strategies in those areas that had more favorable students reactions. More strategies are needed especially in the areas with fewer strategies in the database, for this system to be grown out of the stage of a prototype.

4. CONCLUSION

In this study, a prototype of the Website "Check-and-Revise Your Motivational Design" was proposed with positive results from formative evaluation. When the strategies that included in the database will be enriched, this Website should become a handy tool for designers/lecturers with limited ID expertise.

REFERENCES

[1] W. Dick, L. Carey, & J.O. Carey, *The Systematic Design of Instruction* (5th Ed.) (Boston, MA: Addison-Wesley, 2000)
[2] J.M. Keller, & K. Suzuki, Application of the ARCS model to courseware design. In D.H. Jonassen (Ed.), *Instructional Designs for Microcomputer Courseware* (New York: Lawrence Erlbaum, 1988), 401 –434
[3] C. Kogo, & K. Suzuki, An analysis of the structure of course evaluation items based on ARCS motivation model, II. Proc of ICCE/ICCAI 2000, 8th International Conference on Computers in Education/International Conference on Computer-Assisted Instruction 2000, Taipei, Taiwan, 2000, 1577-8

Table 2. Results of Case Study of a University Professor

	ARCS Reaction Questionnaire: Scale (1-9)				Strategies	
	Items		Ave	SD	suggested	selected
A1	Felt sleepy	Didn't feel sleepy	4.93	1.33	3	1
C3	Not creative in learning	Was creative in learning	4.98	1.80	4	1
S1	Not readily applicable	Readily applicable	5.45	1.73	6	2
C2	Steady progress impossible	Steady progress was possible	5.56	1.73	16	4
A3	Not stimulating	Variable and stimulating	5.66	1.34	10	6
C1	Objectives were vague	Objectives were clear	5.68	1.51	11	4
R3	Learning process wasn't fun	Learning process was fun	5.71	1.43	3	2
S3	Evaluation not consistent	Evaluation was consistent	6.12	1.33	4	0
A2	Curiosity wasn't aroused	Curiosity was aroused	6.24	1.40	6	2
S2	Effort wasn't recognized	Effort was recognized	6.24	2.10	7	2
R1	No relevance to me	Relevant to me	6.63	1.78	9	2
R2	Didn't want to acquire	Wanted to acquire content	7.00	1.81	9	3

Note: number of responses=41, items are originally in Japanese.