Evaluation of a Web-based Support System for Material Analysis Based on Goal-based Scenarios

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Abstract: We report, in this presentation, the result of the evaluation of an instructional design support system based on Goal-based Scenarios (GBS) that we developed. The concept of the system comes from the authors' material analysis method in which educational practitioners reconsider improvements of existing educational materials through instructional theory. The Web-based support system consists of three functions: a self-assessment tool of the existing learning material, a GBS glossary, and a GBS sample gallery. The system enables the user to access the three functions freely and independently, according to the user's needs. We conducted the evaluation in two phases: a cognitive walkthrough test and formative evaluation for confirming the clearness of the instruction and navigation of the system, determining the percentage of questions answered correctly when users analyzed material with an analytical function in the system, and discovering the relationship between the use of the system and motivation about instructional design. Given various comments and suggestions, we improved the system to be used by novices. We will complete a small-group evaluation before the presentation and present the findings.

INTRODUCTION

Educators and designers are always facing challenges to create effective learning designs. From traditional teaching styles, which are called teacher-centered designs, to learner-driven or learner-centered designs (McCombs & Whisler, 1997), new methods have been appearing, and the integration of these methods and technologies have provided new learning styles and support systems. Various practices, by practitioners and researchers, have produced new instructional theories that will guide other practitioners to successful educational outcomes (e.g., CTGV, 1990; Hannafin, Land, & Oliver, 1999). This study aims to promote the use of instructional design theories (Reigeluth, 1983, 1999; Reigeluth & Alison, 2009) for educational practitioners and instructional designers who have had difficulty using instructional design theories that should support their instructional activities.

Taking Goal-based Scenarios (GBS) (Schank; 1994; 1996; 1998; 1999) as a way of providing a learner-centered environment with an instructional design theory, the authors proposed a material analysis method that includes a checklist (Nemoto & Suzuki, 2004; 2005) to assist using of an instructional design theory of active learning. This method is to find a way of support in which educational practitioners reconsider improvements of existing educational materials through instructional theories of active learning. The developed checklist is a tool to implement learning design support based on an instructional design theory of active learning; the investigators decided to develop a Web-based support system based on the developed checklist. There are a wide range of studies on GBS such as theory, material development, and development support systems. This study is a development support system, which includes an analytical method to revise existing scenario-type materials and to promote GBS. That the author pursued a material analytical method to revise existing materials and promote the use of GBS, differentiates this study from others. Nemoto & Suzuki (2005)found that the checklist, extracted from GBS components, provides fundamental information in instructional design, such as goals and evaluation methods, which educational practitioners who design scenario-type materials can improve and reflect on the quality of the analyzed materials (. Also, the formative evaluation of the checklist implied that it is necessary to use the GBS material analytical method, when the users use the checklist, to receive effective results. Although the evaluation result of the checklist showed that there are advantages to using the checklist, there are areas to reconsider to add and strengthen functions such as feedback.

GBS INSTRUCTIONAL DESIGN SUPPORT SYSTEM

The authors designed and developed an instructional design support system, based on GBS, to show how to use the proposed method with the checklist (Nemoto, Miyazaki, & Suzuki, 2008). The Web-based system was aimed to expand the number of users, to enrich resources for material analysis, and to enlarge the analytical function with depth and clarity. The Web-based support system consists of three functions: a self-assessment tool of the existing story-type learning material that the user has used, a GBS glossary, and a GBS sample gallery. The system enables the user to access the three functions freely and independently, according to the user's needs (Figure 1).

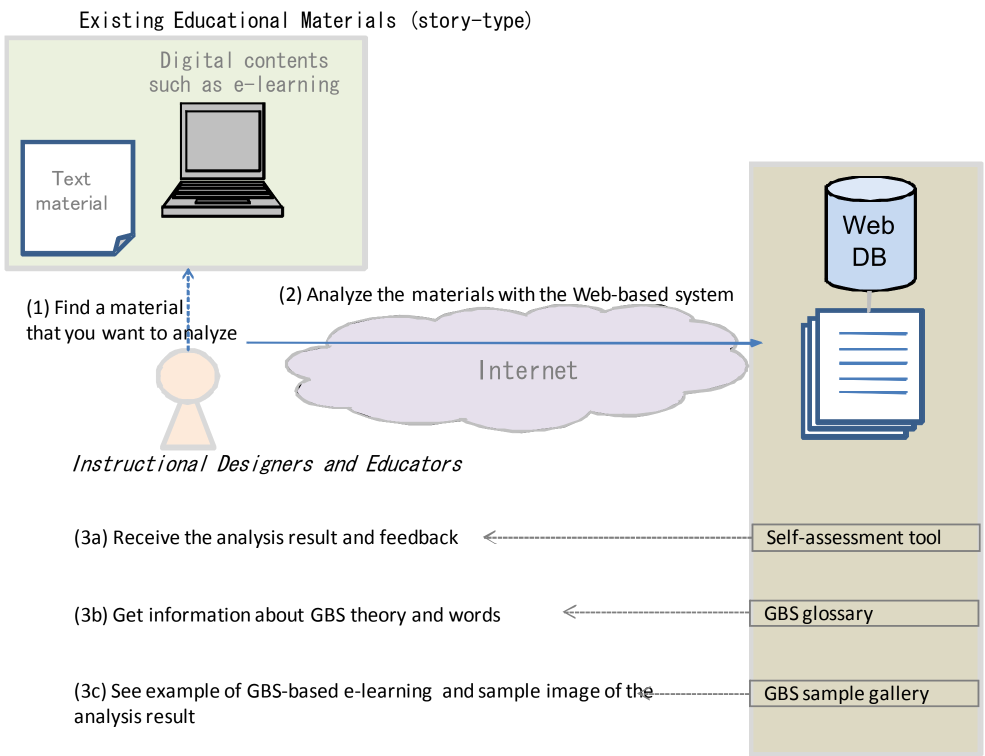

Figure 1: An image of how to use the system

The first function is a self-assessment tool for existing learning materials, which was developed based on the existing paper-based checklist. This part has a diagnostic function to indicate the application level of GBS in the target learning material. The user receives a result that shows how much the analyzed material has apply to GBS with advices for improving the material, which is called as feedback in this tool, after filling out the questionnaire provided. Answering the questions gives the user a chance to reflect on the instructional strategies of the target material and provides diagramatic analysis result that includes advice for improvement (feedback) about the material. The self-assessment tool includes a sample result to help users easily grasp the idea of the assessment.

The second function is a GBS glossary that provides a place for users to learn about GBS. The users are not required to use this function; they can use it when they feel the necessity. This is a supplemental resource to improve the user's knowledge that we assume it helps people who want to deepen their academic knowledge.

The third function is a GBS sample gallery in which users can see examples of materials developed on the basis of GBS. This part meets the users' "SHOW ME" request so that they are able to see what GBS-oriented materials would look like. Also, this part has exercises to practice using the assessment tool (checklist) with a guideline. By providing the GBS material example and the guideline to use the checklist, users can find the relationship between the checklists and the examined material without reading a manual. This would encourage and attract more users to use the checklist.

EVALUATION METHOD AND RESULT

In the evaluation of the developed system, the authors conducted the evaluation in two phases: a cognitive walkthrough test that included specialists' opinions in the test operation environment and a one-on-one evaluation with five participants from the target users. After the two evaluation phases, the authors modified the system so that its operability and analytical function were improved. As a result, the systemized GBS material analytical method allowed the users to analyze materials more easily, which was an advantage over the paper-based checklist. The authors are now operating a small-group evaluation in an online environment. All evaluations will be completed before the presentation.

Cognitive walkthrough

The cognitive walkthrough method was developed by Lewis et al (Lewis, Polson, Wharton, & Rieman, 1990; Polson, Lewis, Rieman, & Wharton, 1992; Wharton, Rieman, Lewis, & Polson, 1994). It is a usability test focusing on how easy it is for new users to accomplish tasks with the system. This method has been considered a good method for evaluating the "walk-up-and-use" approach of the target system because it emphasizes an ease of learning (Hori & Kato, 2007). In this study, the authors chose the third and most recent version of this method, proposed by Hori and Kato, which includes several examples and forms.

In this evaluation, one participant participated who is involved in the system development. The questions we developed that were based on a Hori and Kato questionnaire (2007), consists of five operational procedures in which each procedure included nine subquestions (forty-five questions in total). The participant followed the procedures and answered all the questions. All questions required yes-no answers with a comment space for a "no" answer. After the evaluation, we did a debriefing with the participant to obtain complementary information.

The participant answered "yes" (i.e., could use with no problem) to 73.3 percent of the 45 questions. All the questions to which the participant answered "no" (i.e., had problems using it) were about operability. In all five operational procedures, he made two consistent points: ambiguities in the each of the succeeding procedures and no clues how close or end of the session. To resolve the two problems, we added supplemental descriptions showing how to proceed to the next step, icons to show progress to the end, and clarified any instructions that needed changes. After the modification of the system, we asked if all the points made by the participant were improved. We improved the system through ~~was improved~~three iterative reviews.

Formative evaluation

In the real operational environment, we conducted formative evaluation including a one-on-one evaluation and a small-group evaluation in which three points were focused on when users analyzed material with an analytical function in the system: 1) clarity of instruction, 2) percentage of questions answered correctly, and 3) relationship between the use of the system and motivation of instructional design (Keller & Suzuki, 1988), . For this evaluation, the authors categorized the six types of users, according to their knowledge about GBS as well as their experiences in learning design. Table 1, 2 and 3 show three participatory ranking of knowledge and experience; in total, there were six types of users for this investigation. We employed the same procedure in both the one-on-one and the small-group evaluation.

Table 1: Experience in Learning Design

Experience	Description
Advanced Learning Design	Over 3 years of experience
Intermediate Learning Design	1 to 3 years of experience
Elementary Learning Design	Less than 1 year of experience

Table 2: Knowledge Level of GBS for the Participants of the Evaluation

Knowledge Level	Description
Knowledgeable in GBS	The person will can explain GBS's seven components with an example.
Knows basic information of GBS	The person can explain the basic idea of GBS, but cannot specifically describe the seven components precisely.
Novice in GBS	The person does not know what GBS is.

Table 3: A Matrix of Users for a One-on-one evaluation

Knowledge about GBS	Experience in learning designs.		
	Advanced Learning Design	Intermediate Learning Design	Elementary Learning Design
Knowledgeable in GBS	○	×	×
Knows basic information of GBS	○	○	×
Novice in GBS	○	○	○

Note: ○ is the target of the evaluation

One-on-one evaluation

To complete the one-on-one evaluation, the first two points of the three focus points in this formative evaluation, are 1) clarity of instruction and 2) percentage of questions answered correctly; we used questionnaires, analysis result, and debriefing.

There were five participants participated in this one-on-one evaluation: one experienced, one intermediated, and three novices. Table 4 shows the procedure that all participants followed: the participants took pre-questionnaire to determine the level about GBS knowledge; they use the target system for obtaining the analysis result with advices; they answered post-questionnaire and debiting. The each participant analyzed the same e-learning During the evaluation process, the author took notes memos based on the participant's answers to the questions and the attitude, such as the point where the participant pausedbecause he or she was lost. After each participation completed the evaluation, we implemented a debriefing to elicit additional responses and feelings from the participant; that information obtained we used to modify the system and to confirm whether the investigators can proceed to the next step, the small-group evaluation

By selecting an experienced first participant and reviving advice from him at the early stage of this evaluation, we deleted fatal errors and improved the quality of the system. The two novice participants followed the same procedures that the first person did and completed the entire evaluation process. All three could use the system by themselves and obtained analysis result that includes advices to improve the analyzed material in the future, but suggested some points to be modified, which helped us to improve the system before the small-group evaluation. For example, the novices had difficulty understanding the meaning of each category in the analysis result and feedback; therefore, we added supplemental descriptions to explain how to interpret the feedback obtained by the system. On the one hand, the third participant's analysis result was very different from the other two. From her debriefing, we found that the language used in the questions was not adequate for novices, which mislead her to interpret wrongly; therefore, she was not able to analyze the target material appropriately but she could grasp the overview of the target e-learning. To solve this problem, the first author and the experienced participant improved the questions together based on their agreed analysis result. We asked the two novice participants, whether they agreed with the interpretation of the result by the first author and the experienced.
At the next step of the evaluation, the rest of the participants, one intermediate and one novice, joined the evaluation. During this part of evaluation process, we used the revised version of the system, and these participants asked fewer questions than the first three participants did, and completed the analysis with less questions to the observer.. The participants analyzed as we expected and received almost all appropriate analysis result; we found those points needed to be checked were improved. In the post-questionnaire with five likert-scale that asked about their experience in using the system, the responses from all five participants showed that they enjoyed the evaluation process (the number of questions=10, M=3.95, SD=2.13). The result of the second part of the questionnaire about motivation for learning design (M=3.0, SD=2.72) showed that the novices had a lower relevance in the ARCS model (M=3.73, SD=2.09). This implies that

the developed system helped various types of users to analyze existing materials, but the affect on motivation toward instructional design may be weaker for people who are not interested in instructional design than for those who are interested.

Table 4 One-on-one Evaluation Process

	Process	Resources
Before evaluation	1. Determine the knowledge level of GBS for participants	・ Pre-questionnaire
	2. Explain to the target participants about the evaluation purpose and procedures	・ Evaluation manual ・ GBS material analysis support system ・ An e-learning product (used with the system)
During evaluation	3. Participants use the system	・ Memo (time the participants spent, questions the participants asked, and points that the user lost)
	4. Participants answer the pre-questionnaire	・ Pre-questionnaire (side A: about usability, side B: motivation for leaning design)
	5. Debriefing	・ Semi-structured interviews
After evaluation	6. Modify the system based on the comments and analysis result	・ All data collected at the evaluation process (result of the analysis, interviews, memo, and so on)
	7. Participants review the modified system Confirm if all modifications are completed with the correspondence table	・ Correspondence table: participants' suggestions, and modification of the system ・ Comment sheet for additional suggestions ・ GBS material analysis support system

Small-group evaluation

The small-group evaluation was designed as an online evaluation to collect a certain number of participants. The participants can use the same procedure as the participants of the one-on-one evaluation did. They are required to fill in the same pre and post questionnaires as well as use the system. To enable the online evaluation, the authors developed a portal website for providing all required information. The first three participants took charge of reviewing the portal website. In addition to the system evaluation, they gave comments and suggestions regarding the usability of the portal website. Now we are improving the portal website based on their comments and suggestions. After confirming that the portal website is ready, we will invite participants and complete the evaluation. In the presentation, at the conference, we will report the details of the final results of the evaluation.

DISCUSSION

For educators, knowing how to analyze and evaluate within the instructional design process is essential, but it is a difficult process to learn. We confirmed that the system provides a framework, for educators who are less experienced, to analyze material adequately. The one-on-one evaluation also showed that a glossary and explanations about GBS, in the system as well as in the system navigation, would be helpful for using the system. The feedback function of the system enables users to obtain support on the basis of need, which implies that in the future there is a possibility to provide users with useful information for improvement in instructional design, based on feedback.

Furthermore, this study suggests that using instructional design theories in the evaluation phase has new possibilities for developed materials. By developing a new approach in which to use instructional design in the evaluation phase, this study proposes further discussion about a new utilization of instructional design theories. The next step in this study is to conduct a small-group evaluation to prepare to be used in practice. Additionally, the authors suggest further research to discover new usages of the developed instructional design support system within the whole instructional design process.

References

CTGV. (1990). Anchored instruction and its relationship to situated cognition. *Educational Researcher, 19 (5)*, 2-10.

Hori, M., & Kato, T. (2007). A Modification of the Cognitive Walkthrough Based on an Extended Model of Human-Computer Interaction: Its Effectiveness in Web Usability Evaluation checklist development for Goal-Based Scenario fitness. [HCI no kakucho model ni motozuku ninchiteki walkthrough hou no kairyou] *Transactions of Information Processing Society of Japan*, 48(3), 1071-1084, 2007

Hannafin, M., Land, S., & Oliver, K. (1999). Open learning environments: Foundations, methods, and models. In Reigeluth, C. M. (ed), *Instructional-Design Theories and Models: A New Paradigm of Instructional Theory Volume II.* Mahwah, NJ: Lawrence Erlbaum Associates. .

Keller, J. M., & Suzuki, K. (1988). Use of the ARCS motivation model in courseware design. In D. H. Jonassen (Ed.), *Instructional design for microcomputer courseware* (pp. 401-434). Mahwah, NJ: Lawrence Erlbaum Associates.

Lewis, C., Polson, P. G., Wharton, C., & Rieman, J. (1990). *Testing a walkthrough methodology for theory-based design of walk-up-and-use interfaces*. Paper presented at the Proceedings of the SIGCHI conference on Human factors in computing systems: Empowering people.

McCombs, B. L., & Whisler, J. S. (1997). *The learner-centered classroom and school: strategies for increasing student motivation and achievement*: San Francisco: Jossey-Bass.

Nemoto, J., & Suzuki, K. (2004). GBS checklist for training application. A paper presented at the International Symposium and Conference on Educational Media in Schools, Kansai University, Osaka, August 3-4, 2004 (Proceedings, 75 - 82)

Nemoto, J., & Suzuki, K. (2005). A checklist development for Goal-Based Scenario fitness. [Goal-based Scenario (GBS) Riron no tekioudo checklist no kaihatu] *Journal of the Japan Educational Society*, 29(3), 309-318, 2005

Nemoto, J., Miyazaki, M., Suzuki, K., & Abe, A. (2008). The Design of a Web-based Support System for Material Design/Evaluation Based on Goal Based Scenarios. A paper presented at ED-MEDIA 2008, World Conference on Educational Multimedia, Hypermedia & Telecommunications, Vienna, Austria June 30 - July 4, 2008.

Reigeluth, C. M. (1983). *Instructional-design Theories and Models: An Overview of Their Current Status* (Vol. I): Lawrence Erlbaum Associates.

Reigeluth, C. M. (1999). *Instructional-Design Theories and Models: A new paradigm of instructional theory* (Vol. II): Lawrence Erlbaum Associates.

Reigeluth, C. M., & Alison, A. C. (2009). *Instructional-design Theories and Models: Building a Common Knowledge Base* (Vol. III). New York, NY: Lawrence Erlbaum Associates.

Schank, R. C. (1996). Goal-Based Scenarios: Case-Based Reasoning Meet Leaning by Learning by doing. In D. Leake (Ed.), *Case-Based Reasoning: Experience, Lessons & Future Directions.* AAAI Press/The MIT Press.

Schank, R. C. (1994). What We Learn When We Learn by Doing. *Technical Report #60*, Evanston, IL: The Institute for the Learning Sciences, Northwestern University.

Schank, R. C. (Ed.) (1998). *Inside multi-media case based instruction*. Mahwah, NJ: Lawrence Erlbaum Associates.

Schank, R. C., Berman, T. R., & Macpherson, K. A. (1999). Learning by Doing. In Reigeluth, C. M. (ed), *Instructional-Design Theories and Models: A New Paradigm of Instructional Theory Volume II.* Mahwah, NJ: Lawrence Erlbaum Associates.

Wharton, Bradford, J., Jeffries, R., & Franzke, M. (1992). *Applying cognitive walkthroughs to more complex user interfaces: experiences, issues, and recommendations*. Paper presented at the Proceedings of the SIGCHI conference on Human factors in computing systems.

Wharton, Rieman, Lewis, & Polson. (1994). The cognitive walkthrough method: a practitioner's guide. In J. Nielsen & R. Mack (Eds.), *Usability Inspection Methods*. New York, NY: John Wiley and Sons.