The Design of a Web-based Support System
for Material Design/Evaluation Based on Goal Based Scenarios

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Abstract: This paper describes a design process of a Web-based support system for material design/evaluation based on the Goal-Based Scenarios theory (GBS). The system is based on a paper-based checklist developed by the first and third authors; it is intended to support designers/educators to develop or revise learning contents using GBS, and includes four elements: a self-assessment tool of the existing learning material, a GBS glossary, a GBS sample gallery, and a development support tool. This paper focuses on a grand design of the system and the first element, which is a self-assessment tool design.

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, 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.

The authors have studied how to promote the effective use of a learning theory by taking the Goal-Based Scenarios theory (GBS) as a case study. The authors started developing a tool for evaluating an existing material, which is simple and handy for expected users who are involved in designing and developing GBS-oriented or GBS-like learning materials (Nemoto & Suzuki 2004; Nemoto & Suzuki 2005). GBS is one of problem based learning (PBL) approaches that uses cases, examples, and problems (Jacobson 2008). The

developed GBS checklist is based on seven factors of the theory: Goal, Cover Story, Mission, Role, Scenario Operation, Resources, and Feedback (Schank 1998; 1994; 1996; 1999).   The users are able to know how much a selected learning material follows the theory by filling in the checklist.

The advantage of the use of the checklist is to provide a place to reflect on the applied instructional strategies by reviewing a developed material with the checklist.   This reviewing process would help users to revise and improve their existing materials.   In addition, the interview conducted for formative evaluation in the authors' previous studies showed extra advantages to use the checklist.   An interviewee answered that the checklist helps to reconfirm the material objectives, evaluation method, and instruction as well as understand the differences of the examined material design from GBS's theoretical perspectives (Nemoto & Suzuki 2005). Using the checklist is not only for revealing an application level of GBS, but also for confirming the strengths and weaknesses of the strategies used in the material's design.   The feedback from using the checklist can become a useful resource, if the user has an access to it.   But the formative evaluation showed that there are some weaknesses in using the list.

First, the checklist is paper-based so that it is not easily accessible for potential users.   Handling of the checklist is not easy, because the checklist consists of some supplemental documents.   Second, filling in the checklist is not simple for the users; the checklist includes GBS jargon and requires the user to spend time to understand the questions on the checklist.   Although the checklist has glossaries, for the keywords, and descriptions to learn what GBS is, users who encounter GBS for the first time will have difficulty to use the checklist appropriately.   Therefore, the authors find that it is advantageous to create a web-based system that expands the strengths of the checklist and mops up the weaknesses of the paper-based checklist.

The purpose of this study was to design a Web-based support system for GBS-based material design and evaluation, by expanding the existing paper-based GBS checklist.   In addition to making the checklist easier to use, by adding features that cannot be done on paper, The study was intended to expand the application scenes of the checklist from evaluating existing learning materials to designing new materials.   The aim was also for the new support system to be designed to serve as an opportunity for novice designers to learn GBS, by showing GBS examples and critical points when incorporating the notions of GBS-based designing principles.   This paper focuses on a grand design of the system and the first element, namely, a self-assessment tool design.

The Grand Design of the Web-based Support System

The web-based support system for material design and evaluation is intended to offer learning designers and educators to reconsider the learning strategies that they have been using.   Therefore, we have developed a checklist for the learners to use for their own benefit.   The concept of the web-based support system is to raise the awareness of learning designers and educators by providing a resource for them to self-assess their abilities and discover how to make improvements on the developed material.   The users, as result, deepen their knowledge and skills of learning design by experiencing the system.

The web-based support system consists of four functions, as shown in Figure 1: a self-assessment tool of the existing learning material, a GBS glossary, a GBS sample gallery, and a development support tool.   The system enables the user to access the four functions freely and independently, according to the user's needs.

The first function is a self-assessment tool of the existing learning material that was developed based on the existing paper-based checklist.   This part has a diagnostic function to indicate the application level of GBS for the target learning material.   The user receives feedback 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 the results shown after answering questions provides a diagram feedback about the material.   Because the self-assessment tool includes a feedback sample that users will obtain when they use this function, they can 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.

The third function is a GBS sample gallery, in which the user 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) that comes with a guideline.   The purpose for providing the GBS material example and the guideline to use the checklist, the user finds the relationship between the checklists and the examined material without reading any manual or guide.   This would encourage and attract more users to use the checklist.

The last (fourth) function is a development support tool that aids the user to create GBS-oriented contents. The user can develop simple GBS contents by using this tool.   Like the other functions, this one includes examples.   The user has actual experiences to develop the GBS-orientated contents.   As mentioned above, each function has examples so that a text-based manual is not necessary.   Throughout the function trials, the users are expected to get used to the idea of GBS and deepen their understanding of it.

Figure 1: The Grand Design of the System

The Self-assessment Tool Development with the Checklist

Figure 2 is an example of an assessment result that a user receives.   Among the three functions, the top part is a description of the contents filled in by the user.   This result is merely what the user answered in the self-assessment tool; this is a summary of the material analyzed.

The quadrilateral chart in the second part shows the result of the GBS analysis of the learning material; this chart is created automatically from the answers to the questions on the checklist.   The four items of the chart

are derived from GBS's seven factors that are embedded in the developed material.   Because designers usually do not need to know the name of GBS's seven design factors, the chart does not show them explicitly.   Instead, the chart uses four perspectives to express what designers and educators should check to see if they are included in designed materials: (1) sufficiency of objectives, (2) sufficiency of learning support, (3) sufficiency of learning activities, and (4) sufficiency of scenarios.   The user receives feedback from four perspectives along with the chart and documents.   This design allows the user to look at the overview easily see the result; the description is in plain words that novice designers can usually understand.   When the user wants to know more detailed feedback on each perspective, more comments, that correspond to each question, will be provided by clicking "read details" link.

How sufficient the objectives are will show in the result of the questions about Goals of the GBS's seven factors. The sufficiency of objectives is general information about the objectives, but includes questions to confirm the relation to the other GBS factors.   The sufficiency of learning support includes the feedback and resources of the seven factors; this result implies how the user considers learner support mechanisms and how much they are built into the mechanism of the material.   The sufficiency of learning activities is composed of scenario operations, which indicates the degree of the learning activities, in the content, and helps the user recognize how much the learning activities relate to the goals.   Last is the sufficiency of scenarios from the cover story, the role, and the mission of GBS's seven factors.   The context expands throughout the stories so that setting a cover story and providing a role and mission is necessary.

The last part of the feedback window is the input from the users.   The questionnaire has two types of questions: descriptive and multiple choice.   The descriptive questions are listed at the end of the feedback as the users confirm their self-analysis with other results.

■ General Information of the Material

Title	Case Studies – Management Ability
Target Users	For Managers
Objectives	The participants of the course will: - able to describe a position as a manager - able to respond and coach to the subordinates
Evaluation Methods	- Participate in discussion, and - Submit a final report

■ Quadrilateral Chart of the result

Sufficiency of scenarios

Sufficiency of learning support

Sufficiency of learning activities

Sufficiency of objectives

Factors	Achievement
Sufficiency of scenarios	%
Sufficiency of learning support	%
Sufficiency of objectives	%
Sufficiency of objectives	%
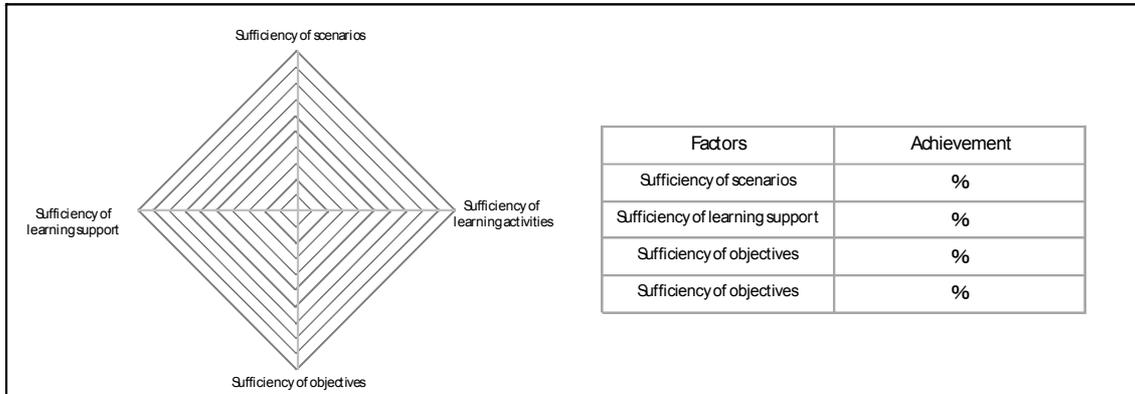
● Sufficiency of scenarios   (Item : Goals) See details

You have prepared a cover story and used scenarios that the learners purse their learning. You have also provided role and mission, but the scope of the role and mission is not clear enough. Review again the scenario and role that are appropriate to the target learners.

● Sufficiency of learning support (Items: Feedback and Resources) See details

There is a scenario in the material, but decision making scenes are lucking. If the learners don't have opportunities to make actions through the activities, the meaning of providing a scenario doesn't work. The advantage of using GBS is that the learners and make actions with own thoughts. Add learning activities and consider the strength to use a scenario.

● Sufficiency of objectives (Items: Scenario Operations) See details

In GBS environment, learners can confirm the result of decision making with feedback and deepen their understanding with resources. Resources can be provided as references, web-links, paper-based documents and so forth. Discuss various types of feedback that are suit for implementing method.

● Sufficiency of objectives   (Items: Cover story, Role, and Mission) See details

The learning objectives are set. However, this assessment tool does not show how much your set objectives correspond to the scenario provided. If there are several objectives, you needs to create various learning activities to cover the all objectives.

■ Material Analysis on your own
   ● The number of the scenario : 6
   ● The cover story used in introductory phase of learning

   ● Relationship between given role and scenario operation

   ● Types of feedback

   ● Methods of feedback
      ◆ as a result of the action
      ◆ from a coach
      ◆ Story from professionals
      ◆ Others (Details :   )
   ● Learning objectives

   ● Situation in which the learner learn

Figure 2: An example of the result of the self-assessment tool

The Algorithm of the Feedback

The feedback system is critical to attract users, and the amount of feedback must be appropriate for users. If the user gets too little feedback, they will not be satisfied with the result. But a heavy volume of feedback can deter the user from reading the details. Therefore, the system employs a two-step feedback about the results in the self-assessment. As shown in Figure 2, the results of the assessment include feedback from four perspectives. The first feedback for improving the target materials is the visualized chart presents the assessment score, and the four comments in a few lines, and follows each perspective.

The type of feedback that the user receives varies depending on the user's answer to the assessment. Each group of questions in each perspective has two or three categories, and the feedback changes according to the number of categories in which the user has selected the right answer. That is to say, each perspective has four to twenty-eight feedback messages, and the user receives feedback from forty-six, in total. This is an automated response system with a variety of feedback. When the user wants to get more detailed feedback, h/she can obtain a full report with responses to each question.

The Development Process of the Self-assessment Tool (to be completed before presentation)

The first author depicted the grand design of the web-based support system as well as the design of each function. The second author regularly provided advice and comments to the design from a system developer's point view, and will develop the system. The third and forth authors reviewed the idea and examined the possibility of implementation. In the presentation of this paper, the presenter will show a prototype of the system.

Figure 3: An example of the Web Page Design (Top)
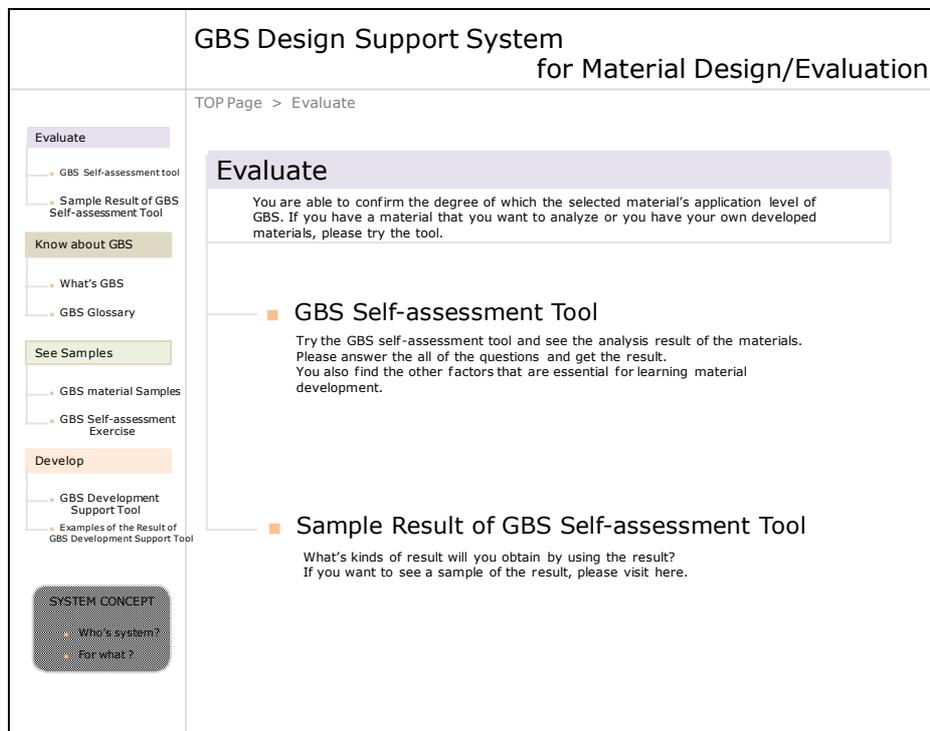
Figure 4: An example of the Web Page Design

The Future Plan of this Study

The next step of this study is to complete the assessment function in the four functions of the web-based system. To enhance the quality, a formative and usability evaluation of the self-assessment tool need to be conducted. Several users, who have different levels of knowledge about GBS, will participate in the evaluation to use the web-based support system.   In addition, two other functions of the system, a GBS glossary and a GBS sample gallery, will be used to enable the system to be released.   The last function to be completed is the development support tool, which the authors will need to create it from scratch; a literature review will be provided. Planning the development phase and conducting the evaluation are critical steps for the completion of the system.

Evaluation Phases

Through three evaluation phases, the investigators plan to evaluate the developing self-assessment tools for six types of users.

The first phase is to determine if, indeed, the system works as an independent tool that scaffolds the users' use; the system was designed for users to use without the assistance of a another person.   The observation method will be used in this phase.   The learners' level of metacognition and prior knowledge have been proven to be critical factors in hypermedia-assisted learning (HAL) (Shapiro 2007); we need to establish if the support system adequately works for all types of users.

In the second phase, the investigators evaluate whether all types of users are able to receive the same analytical results when they use the same learning materials as an assessment target; this is to verify the reliability.

Having several types of users use the system, the analytical results, provided by the system, reveals if the various types of users get the same results.

The third phase is to evaluate the degree to which the system contributes to the users' motivation for learning the design based on GBS. The investigators plan to use the ARCS model that categorizes into four motivations, namely, Attention, Relevance, Confidence, and Satisfaction (Keller & Suzuki, 1988). We expect users to obtain the knowledge and skills about GBS in the learning design and have confidence in it throughout their use of the system.

Observation is the method used in the first phase; the method in the second phase is comparing the results that the users obtain; and, the questionnaire survey is the method in the third phase.

Participants of the Evaluations

For the evaluation, the authors set six types of users, anticipating them to have knowledge about GBSs as well as experience in learning designs. The investigators categorized each classification into three ranks, and chose to use six types of users (Tab. 1). Although the maximum number of types of users is nine, six of the nine types are practical (e.g., none knows the GBS well unless the person has advanced experiences in learning design). Therefore, six types of users will participate in one-on-one evaluation.

Knowledge about GBSs	Experience in learning designs.		
	Advanced Learning Design	Intermediate Learning Design	Elementary Learning Design
Knowledgeable in GBS	○	×	×
Knowing Basic information of GBS	○	○	×
Novice in GBS	○	○	○

Note: ○ is the target of the evaluation

Table 1: A matrix of users for one-on-one evaluation

Regarding the first classification, the knowledge level of the GBS, the authors will create a scale with several journals about GBS (Tab. 1). The second classification, the experience in learning design (Tab. 2) will be assessed by referring to the ID competency advocated by ibstpi (2006).

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

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

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

Table 3: Experience in Learning Design

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