

A Distance Learning Support System Based on Effective Study Method SQ3R

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Web-based distance learning systems have widely developed in recent years. Since various types of learners use these systems, providing learners with a personalized support system becomes important. Researches on designing support systems and personalized learning are sorely needed. Current research activities on designing and providing personalized learning support system can be outlined: (1) according to the learner's progress and relations of materials, to give a set of personalized contents; (2) contingent on the learner's responses to quizzes, a personalized advice is given; (3) provide an adaptive user interface. However, it is difficult to discover the learner's weak points of the learning process in these researches, because there is little research that considers the learners' psychological status, to provide more detailed and flexible personalized learning support. Educational psychology theories and methods have supported teachers to instruct (supervise) the students at more higher levels. If we analyse learner's actions using these theories, we can give more reasonable support. In this paper, we propose a personalized learning support system based on the study method known as the SQ3R, and design a group of tools. Depending on the learner's patterns in using the tools, and the learner's learning situations, we offer a navigation function solving flexible personalized learning support problems. We have also implemented a web-based learning support system, and implemented these designed tools. The usability and the validity of the system have been evaluated.

1. Introduction

In recent years, computer and network technologies have rapidly developed. In Japan, the e-Japan strategy¹⁾ has prompted computers and networks into everyone's life, and enabled lifelong learning²⁾ to become a reality. The advancing new hardware technology satisfies the user's needs. In the aspect of software, web-based distance learning systems supply abundant, rich contents to suit learner's needs.

Furthermore, the development of IT³⁾ has changed the definition of school. From the viewpoint of the Internet, education (including web-based distance education) is no longer restricted to a certain time, and in a designated place. Again, the web-based distance learning systems make it possible to extend educational resources, such as the teacher resources, and the classroom resources etc. Even students who

refuse to go to school can easily study via the WWW. So, web-based distance learning, as a new medium of learning, is becoming more attractive and valued.

Many researches on the design of web-based distance learning systems have been done. For example, a typical approach directly inputs traditional school courses onto the WWW⁴⁾, providing sequential, systematic, and complete courses. But this approach is not dynamic enough for a learner to search for related knowledge, and can not provide different learners with a personalized support. Wu⁵⁾ designs WWW course contents directly by using links to connect related areas of knowledge. By using this system, learners obtain related information and knowledge by visiting the linked pages. But a beginner may lose his/her way in the linked pages, and lose study time. It also may be hard for a learner to obtain the whole view of the course. Several research projects^{6)~8)} not only organize the course contents well, but also give a personalized learning support. For example, according to the pattern of quiz answers, Zhu⁶⁾ highlights the parts that have not been learned enough by the learner, and gives advice for learning the weak parts. Kuwabara⁷⁾ provides several types of support messages ac-

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cording to results of tests. Hasegawa⁸⁾ gives an index of the course contents, and a navigation function for contents that need to be learned systematically. However, while the learner is learning, it is difficult to point out a learner's weak actions, and to give a specialized support like an instructor does in a traditional school.

As we mentioned above, the web-based learning brings benefits to everyone's lifelong learning instead of traditional school learning. The traditional school education background on the educational psychology theories. Many effective study methods have been developed based on these theories, such as the PORPE strategy (Simpson & M.L., 1986)^{9),10)}, the KWL-Plus strategy (Carr & Ogle, 1987)^{11),12)}, the REAP method (Manzo, 1972; Eanet & Manzo, 1975)^{13),14)}, and the SQ3R method (Robinson, 1961)¹⁵⁾, etc.

The educational psychology focuses on human learning mechanism as its primary theme, it scientifically analyses the recognition and memorizing algorithms. Many teaching and individual learning activities use principles from educational psychology-based study methods. By using these study methods, it has been proven that learning efficiency can be improved and the latent potential of learners can be expanded.

On the other hand, the web-based learning is a new field; methods in this domain are still being developed. So our research focuses on how to utilize the existing effective educational psychology-based study methods for web-based learning.

Because the medium is different, the learning support methods on the WWW should be different from those in a traditional school. We contrasted learning through the WWW and learning at traditional school in **Table 1**.

The learning support methods used in traditional education cannot be translated into the web-based learning activities. So, how to apply these study methods, which are used in the traditional education, into the web-based learning becomes an essential task.

Next, we compare the above mentioned study methods: PORPE, KWL-Plus, REAP method, with the SQ3R method. PORPE (Predict, Organize, Rehearsal, Practice, Evaluate) is a reading method, usually used for preparing examination. KWL-Plus (Know, What to Know, Learned) is a teacher-lead study strategy. REAP (Read, Encode, Annotate, Pon-

Table 1 Comparison of WWW based learning and traditional education.

	Learning at traditional education	Learning through WWW
Course organization	Contents are given in systemic manner. Lessons are organized section by section in sequential order.	Links among various kinds of related web-based materials can be made. By hyper linking, enormous information and abundant knowledge is obtained.
Background	Supported by experienced teachers; teaching and learning is based on educational psychology theories.	Supported by informal, dynamic multimedia content, Internet technology.
Location	School (university)	Anywhere
Times	Class time	Anytime
Duration	A certain period	Continual
Contents	What have been prepared by teachers	Unlimited resource in internet can be used
Scope	Systematic study	Practical and applied study
Target user	Students, beginners	Beginners, professionals, and experts

der) is a note making strategy for experts. The SQ3R method (Survey, Question, Read, Recite, Review) is suitable even for beginners, and is widely used for reading.

The importance of providing web-based tools to support those effective study methods has been recognized.

Some web-based tools have been developed to support learners/teachers to use the study method SQ3R and KWL¹⁶⁾. In the research¹⁶⁾, WWW pages, which can help learners/teachers to make checking sheets according to the SQ3R and KWL, are given. In these sheets, the tasks at each learning step are listed out. While learning, learners can fill in every fields of the sheets. The sheets help learners remember important concepts from their reading. Using these sheets is helpful when learners read a long reading material. However, the functions provided by these tools are inadequate to make good use of these study methods. More support functions are necessary. Moreover, gathering the learner's responses, and giving appropriate advice have not yet been considered.

Considering that reading is the main action used in learning process, in our research, we employ the effective study method SQ3R into web-

based distance learning system. We have proposed a method¹⁷⁾ to use the SQ3R into web-based learning system. In this paper, based on that method¹⁷⁾, we give a further discussion about the design and implementation of the SQ3R. We develop a group of tools to utilize the SQ3R more adequately. We gather the learner's data in using these tools. According to the learner's data and learning situation, an appropriate advice is given to the learner. Then, an evaluation based on the experiment using the SQ3R in web-based learning system is given in this paper.

This paper is organized as follows: Section 2 introduces the study method SQ3R and the policy for applying SQ3R to web-based distance learning system. Next, the model of the web-based system is described in Section 3. The design of the SQ3R-based supporting tools and the SQ3R-based navigating algorithm are described. The implementation of the system is shown in Section 4. In Section 5, the experiment and the evaluation of the implemented system are described. Finally, Section 6 concludes this paper.

2. Applying Study Method SQ3R to Web-based Distance Learning System

2.1 Outline of Study Method SQ3R

In traditional school systems, the SQ3R is accepted as an effective study method. SQ3R stands for *Survey*, *Question*, *Read*, *Recite*, and *Review*. They are five stages (skills) used for learning. The study method SQ3R is based on the research results of educational psychology and considers the mechanisms of memorizing, forgetting, and cognitive processes of brain.

A brief description of the five components summarizes SQ3R based on the articles^{15),18)~22)}.

Survey: In order to help learners to get a whole view of the learning material (e.g., a book or a chapter), psychologists advise learners to skim over the title, headings, charts, graphs, introductory and concluding paragraphs, and summary, to find the core ideas in the material in a short time.

Question: In order to arouse learners' curiosity, and help them to understand the learning material, psychologists advise learners to ask many questions. One technique mentioned is to change titles or headings into questions using "how", "what" or

"why" and so on.

Read: From an educational psychologist's point of view, it is useful to read material carefully, seeking the answers to questions asked in the *question* stage. Making notes or underlining important words or sentences is also useful.

Recite: Psychologists suggest learners recite the material after reading, and answer the questions without referring to the material. When the recitation cannot be continued, psychologists advise re-reading the forgotten part and immediately recite, then continue with re-reading and reciting to the end.

Review: After learning the material, psychologists suggest learners look over the headlines and notebooks, and recall the knowledge according to the SQ3R schedule.

2.2 Policy for Applying SQ3R to Distance Learning System

The SQ3R (*survey*, *question*, *read*, *recite*, *review*) stages intergrated for optimal learning. In order to sustain learning, motivation and learning strategies are most important. The study method SQ3R addresses these two points. In 1800's, psychologist H. Ebbinghaus^{15),23)} researched on the memorizing algorithm and found the forgetting curve of memorizing, and concluded that as time elapses, so does the memorized content. In addition to that research, psychologist Robinson found that learners who reviewed regularly compensated for the forgetting. Applying that research, he developed the study method SQ3R.

The relationship between the SQ3R stages and memorization is shown in **Fig. 1**.

In the *survey*, *question*, *read*, and *recite* stages, learner learns and memorizes more and more information. Although, after each stage, the learned knowledge is easily forgotten as time passed, but this can be redressed soon since the intervals between every two stages are not so long. After learning, if the learner reviews the material in time reinforcing memory, so the learner maintains memorized knowledge as the curve 2 shows. On the other hand, If without reviewing, the memorized knowledge will elapse as show in curve 1.

Learning stages are not independent. There are inseparate relations among the stages, especially, relation between *survey* stage and *review* stage, and relation between *recite* stage and *question* stage.

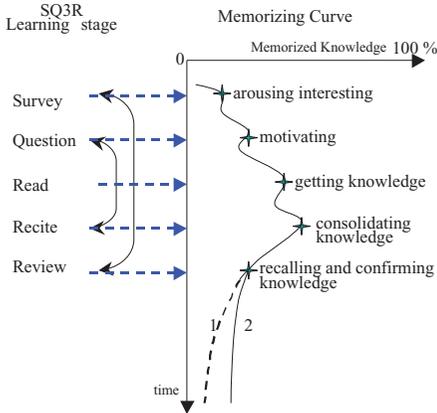


Fig. 1 Relationship between the SQ3R stages and memorization.

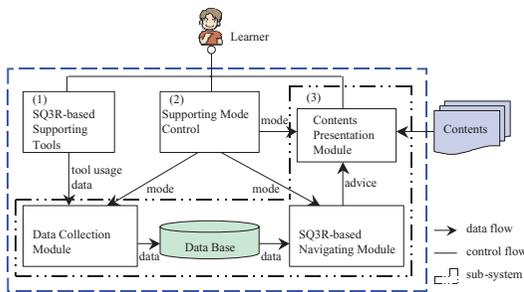


Fig. 2 SQ3R-based learning support system.

- (1) The *survey* stage is related to the *review* stage. In the *survey* stage, a whole picture of the learning material is seen and the highlights of each subsection are noted. These main points should be checked in the *review* stage.
- (2) Questions, which are developed or given in the *question* stage, should be confirmed during the *recite* stage to remind the learner to verify the answers. So the *recite* stage should connect with the *question* stage.

3. Design of SQ3R-based Learning Support System

3.1 Outline of the System

The learning support system is composed of the following sub-systems as shown in **Fig. 2**.

- (1) SQ3R-based learning supporting sub-system
According to the applying policy of the SQ3R mentioned in last section, and in order to fulfill the requirements of each stage, a group of tools are provided in this sub-system. These are the query

tool, memo tool, marker tool, glossary tool, search tool, quiz tool, material map and progress confirming tool. The details will be discussed in the next sub-section.

- (2) The SQ3R-based navigating sub-system

In this system, the learner's learning trace is detected and recorded. According to the learner's actions, a navigating function is given. This sub-system consists of the following modules:

- (a) Data collection module: In this module, the learner's learning actions and progress at each stage are detected. Then, the detected data will be stored in the learner's database. These data will be used in SQ3R-based navigating module.
- (b) Learner's database module: This is a storehouse for the detected learner's data. It's the basis of SQ3R-based navigating module.
- (c) SQ3R-based navigating module: In this module, based on the detected learner's actions and the learner's learning progress, the weak stage or the omitted stage of SQ3R is identified, then an instructional advice is given by the system to the learner.
- (d) Contents presentation module: According to the solutions of the navigating module, the contents presentation module re-organizes the contents and the subset of SQ3R tools together, then presents them to the learner.

- (3) Supporting mode control sub-system

In the web-based learning support system, two supporting modes are given. These two modes are on-line mode and on-demand mode.

- (a) On-line mode means that the system provides learning material to the learner and manages the learner's progress using the SQ3R-based navigating function.
- (b) On-demand mode means that the SQ3R-based navigating function will work for the learner, but it will not force the learner. The navigating function only works when requested by the learner.

By checking the learner's understanding and progress through the material, the

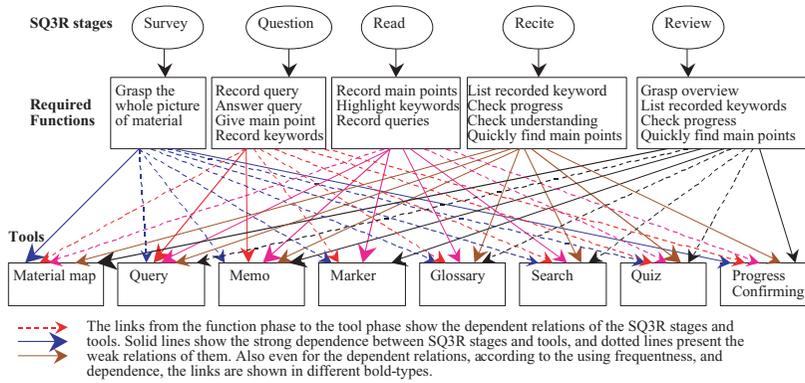


Fig. 3 Investigation of tools.

system can dynamically change the support mode for the learners. Also, learners can select various support modes by themselves at each stage of the learning process.

3.2 SQ3R-based Learning Support Tools

The functions for every SQ3R stage is described, and a set of tools is built to realize these functions. The tools for each SQ3R stage are shown in Fig. 3.

The process for designing tools is first to identify the goals and needs of each stage. Then the tools to accomplish these needs and functions are designed.

The specific steps are:

- *Survey* stage:
 - Goal: to help learner to comprehend the whole picture of the reading material, and inform the learner about his/her learning situation and learning progress.
 - Needs: to give several kinds of maps of the learning material in a clear way. From the maps, the learner can get an abstract or concrete information of all learning materials.
 - Tool: the material map represented by text format and graphic style are designed, and a tool showing the learner’s learning progress is created.
- *Question* stage:
 - Goal: to help the learner to get the main points in the reading, and to help learner to ask questions about the title and headlines.
 - Needs: to create an environment, which promotes question asking. These questions should be referred to and an-

swered when the learner obtains more knowledge from the material.

- Tool: query and memo tools are designed for this stage. A query tool presents an environment for learners to make and answer questions. A memo tool can take memos on the material (web pages), and it is used in conjunction with the query tool. By changing the attributes of a memo, a recorded memo can be translated into a question, and vice versa.
- *Read* stage:
 - Goal: the *read* stage is the main stage, where the learner processes text and acquires knowledge. The goal at this stage is to help the learner understand and memorize the main points of the material, and to search pertinent knowledge for understanding the topic.
 - Needs: to create an environment to record and mark the main points or learner’s comments, and to search pertinent knowledge.
 - Tool: at this stage, the memo tool is used to record thoughts, comments, and important parts of the learning material; The marker tool highlights the selected lines in the learning material; The glossary tool and search tool are used to help learners to find associated knowledge.
- *Recite* stage:
 - Goal: to help the learner to check his/her understanding level, and to help the learner to find the weak points or the parts in the material that have not been comprehended.
 - Needs: to make an environment to

monitor the learner's comprehension level of each part of material, and to assist the learner in mastering the information.

- Tool: the quiz tool is provided for the learner's comprehension checking; When the learner has trouble, the search tool searches the learning material and a glossary tool assists the learner to find related knowledge. Also, these tools list recorded memos and check the main points.
- *Review stage:*
 - Goal: the goal of *review* stage is to consolidate the learned knowledge by revising the material and selecting the parts that have not been comprehended enough.
 - Needs: the needs of this stage are to give the learner an overview of the reading material, and to display the recorded or marked main points to the learner again. Also, it is necessary to provide feedback to the learner about his/her progress.
 - Tool: a material map is given at the *review* stage. In the material map, the learned and partially learned parts are marked. Simultaneously, recorded memos and highlighted lines can be utilized.

In summary, eight kinds of tools in the learning system were presented. The learners can select the tools to use at each stage.

3.3 SQ3R-based Navigating Algorithm

In the learning support system, we utilize a rule-based reasoning technique to navigate learners through appropriate learning stages based on the learner's performance.

The detected learner's data is associated with three types of actions.

- Learner's trace information of using tools: Not only the tools are designed for supporting the learners to study the material, but also the learner's trace of using the tools at each SQ3R stage is an important data helping the system to grasp learner's learning activities, to assist the system to give an appropriate navigation to the learner. That trace information includes time-related information and count-related information, e.g. page reading timer is time-related information, and page access count is count-related information.

- The learner's progress situation: The learner's progress situation includes reading information such as if the pages have been learned, the rates of correct answers to quizzes, and so forth.
- The information about the learner's psychological status: It includes the learner's characteristic tendency, and the learner's feeling etc. This information is determined by questionnaires embedded in quizzes.

In this web-based learning support system, when a learner finishes a quiz, the accomplishment situations of the quiz are pointed out, and an interactive navigating window pops up. The window will present appropriate advice to the learner. Also, the learner can request navigation on demand at any time.

To give course navigation, the following items are checked.

- (1) To check the rate of correct answers.
- (2) To check the learner's tools' usage. The frequency of using query tool at *question* stage, the frequency of using memo and marker tools at *read* stage, the frequency of using search and glossary tools at *recite* stage are mainly checked.
- (3) To check the learner's psychological status. The psychological status includes learner's confidence and satisfaction for his/her answers.
- (4) To check the combination of wrong answers. According to the combinations of wrong answers and the relations of materials, the learner's weak points and the related useful material are given.

Based on the above checks, a subsequent guidance is given. The navigation is presented

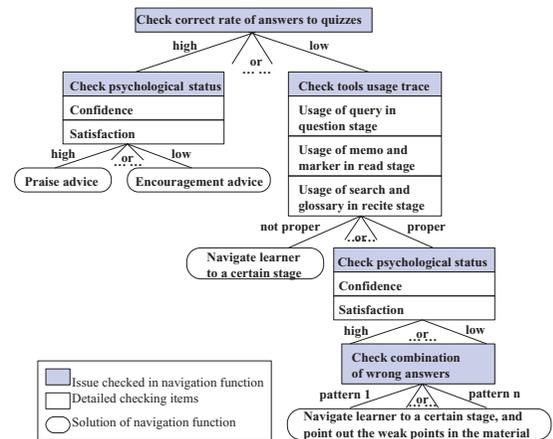


Fig. 4 Part of navigating algorithm.

by advices or hints.

Figure 4 shows a part of the navigating algorithm represented by a tree.

In Fig. 4, each path from the root to each leaf of the tree represents one rule for navigating. Samples of the rules are:

Rule 1: IF the rate of correct answers is very low and the learner have written too many questions and memos, but no memo listing action and no question answering action.

Then the system will suggest the learner to go to *question* stage to answer the asked questions, and check recorded memos.

Rule 2: IF the rate of correct answer is high and the learner is satisfied and confident.

Then an encouraging message and invitation to next part of the learning material is given.

4. Implementation

The above-mentioned tools and SQ3R navigating function have been implemented in the distance learning system. We mainly describe the implementation details of the memo tool and the material map. For implementation of other tools, we present an outline due to our page restrictions.

4.1 Implementation of the Memo Tool

The memo tool is mainly used in the stages of *question*, *read*, *recite*, and *review*. The implementing structure of memo tool is given below (refer to **Fig. 5**):

Memo tool provides the following functions.

- Memo recording: The learner writes a memo, and saves it to database.
- Memo listing up: The learner can list memos, which have been saved.
- Memo editing: For stored memos, the learner can edit and remove it.
- Memo representing: By clicking on a memo icon on the page the learner is reading, a recorded memo can be shown in a pop-up window.
- Jumping from memo list to material: From the list of memos, by clicking “jump to page” button, the linked page where the

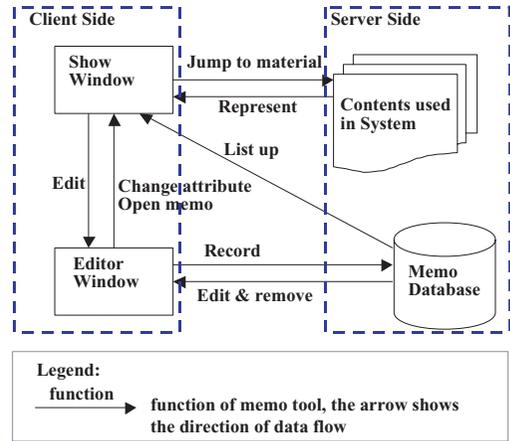


Fig. 5 Structure of the memo tool.

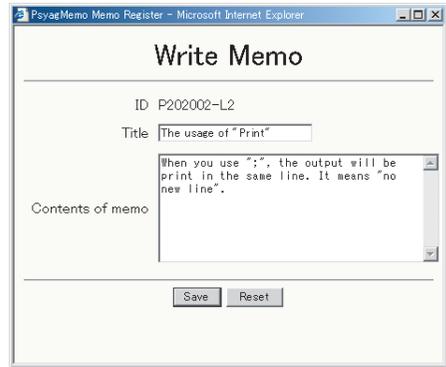


Fig. 6 Sample of a new memo recording.

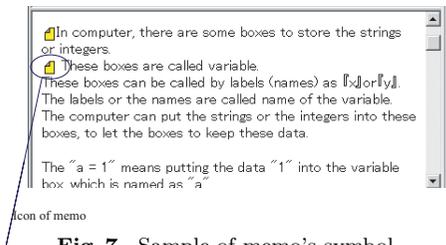


Fig. 7 Sample of memo’s symbol.

memo was taken can be moved to the forefront.

- Memo opening: Usually, a recorded memo can be accessed by its owner, but it is invisible to others. By changing the memo’s attributes, a learner can share memos with others.

When a memo is recorded using the interface shown in **Fig. 6**, some additional information is recorded into a database with the memo data. The additional information includes pageID, lineID, memo’s title, and so on. When a learner

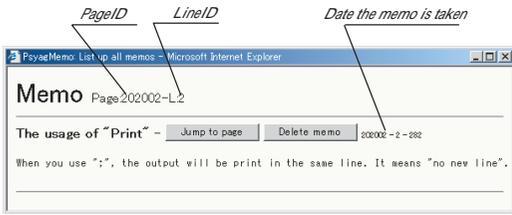


Fig. 8 Sample of all memos listing.

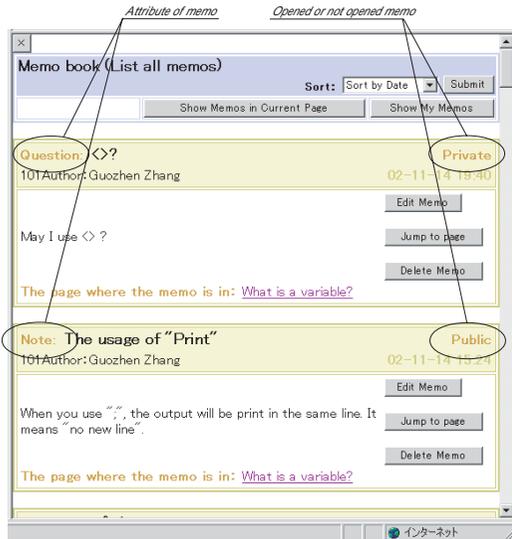


Fig. 9 Sample of memo listing.

shows a page which has a memo in it, a memo icon appears at the beginning of the line where the memo is (Fig. 7). Clicking on the memo icon, the contents of the memo will be shown in a pop-up window (Fig. 8). Also, all memos can be shown together in a list (Fig. 9), and a memo has attributes (Fig. 10). The attributes are divided into warning, comment, individual note, question, etc. Using these attributes, memos can be managed/accessed easily. The memo's additional information is shown in Table 2.

The meaning of "public field" in a memo's structure is that if the value of public field is true, it means that the memo can be used by all users, if the value is false, the memo can only be used by the owner. Using the memo opening method to open a public memo, the memo recorded by a learner can be viewed by all learners. The illustration of the memo's knowledge sharing is shown in Fig. 11.

Just using memo's opening method, the shared knowledge domain among the learners will be built, and the knowledge and information sharing can be easily achieved.

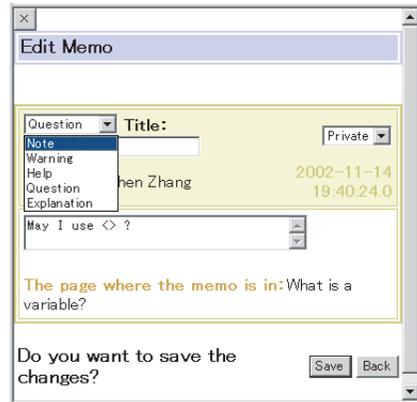


Fig. 10 Sample of memo editing.

Table 2 Additional information of memo.

UserID	PageID	LineID	Attribute	Public	...
			Note	true	
			Warning	false	
			Help		
			Question		
			Explanation		

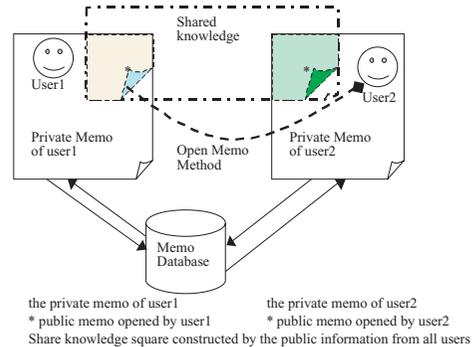


Fig. 11 Illustration of the memo's knowledge sharing.

4.2 Implementation of Material Map

We give two formats to present the overview of the learning material. One is the text format, like an index of a book. The index items in the index page are hyper-linked to the materials. The other one is graphic format. The graphical format uses a material map, which contains knowledge nodes and related links. The knowledge nodes are parts of the learning material; the related links have associated information for each pair of knowledge nodes. The map details are described in Ref. 27).

The structure of the map is hierarchical as shown in Fig. 12, the knowledge nodes in higher layers are more abstract, the knowledge nodes in lower layers are more particular. Us-

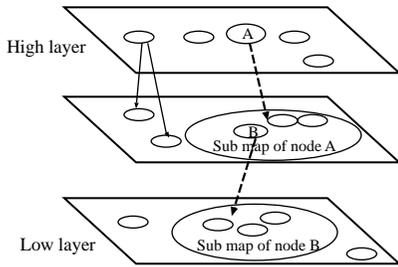


Fig. 12 Diagram of hierarchy of material map.

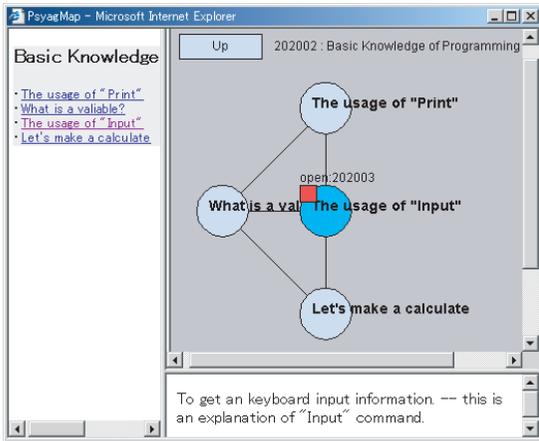


Fig. 13 Sample of material map.

ing the higher layer maps, the learner can get a zoomed out map of the material. By clicking into the knowledge nodes in a high layer map, a zoomed-in low layer map of material is shown which contains the detail knowledge of one node in the higher layer.

A screen capture of the map is shown in Fig. 13.

4.3 Implementation of the Other Tools

The implementation of the other tools is outlined as follows:

- Marker tool: Marker tools use colors to help learners to highlight the special points and special lines in the learning material (refer to Fig. 14). The marked colors and positions can be changed or removed.
- Glossary tool: In this system, a glossary organizes all useful keywords together to help learners to quickly find an illustration of every focal points (refer to Fig. 15).
- Search tool: A keyword based searching function is given (refer to Fig. 16).
- Progress confirming tool: One way to reinforce motivation is to inform learners about their progress. The system does this for each stage and the information is available

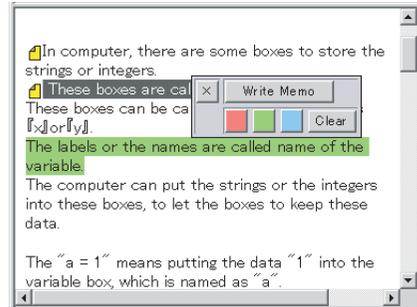


Fig. 14 Sample of marker.

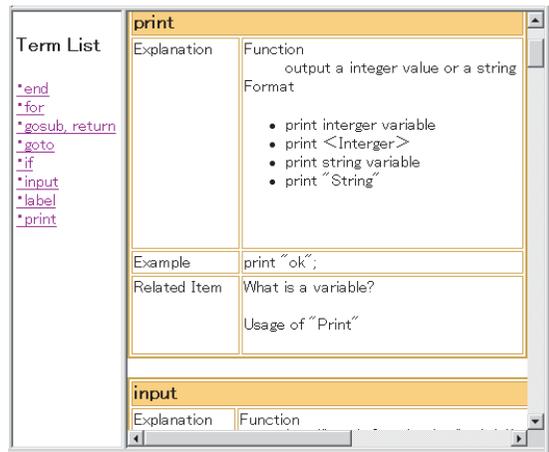


Fig. 15 Sample of glossary.

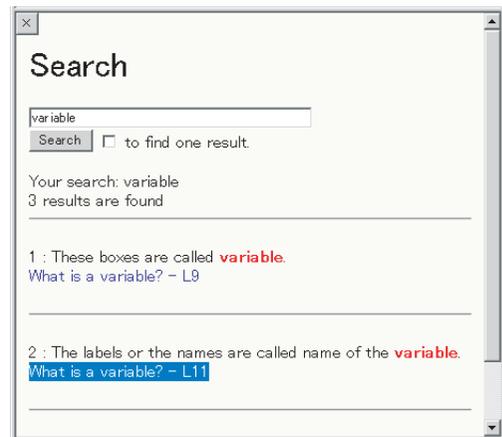


Fig. 16 Sample of searching.

- at any time (refer to Fig. 17).
- Quiz tool: The system provides two ways to help a learner to check his/her understanding level. One is using blank-filling exercises to check the learner's understanding situation, and the other one is to use a test to check the applying ability of the

Page	Challenged?	Complete Situation	Learned times	Understanding situation	Learning time	Advices	Learner's memo
How to make a text program?	Challenged	60%	7 times	No	short		
How to use the function?	Challenged	50%	1 times	No	short		Function
How to use the function?	Challenged	60%	29 times	No	short		change line
How to use the function?	Challenged	30%	34 times	yes	long		memo
How to use the function?	Challenged	100%	14 times	yes	long	confirm memos	
How to use the function?	Challenged	50%	9 times	yes	long		
How to use the function?	Challenged	30%	4 times	No	media		
How to use the function?	Challenged	60%	9 times	No	long		
How to use the function?	Challenged	40%	5 times	No	short	answer questions	

Fig. 17 Sample of progress.

Test: Usage of "Input"

Please select the correct answers.

- The function _____ is used to receive a input from keyboard.
 - print
 - variable
 - wait
 - input
- If the function _____ is run. The program will wait for a input from keyboard.
 - print
 - input
 - wait
- The input data will be put into a _____.
 - variable
 - string
 - integer
- When _____ key is pushed down, the input data will be put into a variable.
 - Tab
 - Esc
 - Return

Check answers Reset

Fig. 18 Sample of quiz listing.

Test: Usage of "Input"

Check Result

- The function _____ is used to receive a input from keyboard.
 - print
 - variable
 - wait
 - input
- If the function _____ is run. The program will wait for a input from keyboard.
 - print
 - input
 - X wait
- The input data will be put into a _____.
 - variable
 - string
 - integer
- When _____ key is pushed down, the input data will be put into a variable.
 - Tab
 - Esc
 - Return

There are 4 questions; No answer: 0; Correct answer: 3; Wrong answer: 1.

Look Advice

Fig. 19 Sample of checking the correctness of answers.

learner (refer to Figs 18 and 19). At the time of exercise and test, the learner's response data is recorded as original data of navigation (refer to Fig. 20). Furthermore, the learner can consolidate the learning by doing quizzes.



Fig. 20 Sample of navigating advice.

5. Experiment and Evaluation

5.1 Method of Experiment

The experiment of the effective study method SQ3R based distance learning support system was carried out. The contents were basic language. The learners are students at the University of Aizu. The learners were requested to learn the text contents freely. The text contains explanations, samples, and tasks. A learner learns the text through a web browser, tests the samples using the VLB environment, then tries to do the tasks. In the learning process, the learner can utilize the tools at any time.

The experiment was arranged for two hours, after learning using the web-based learning system, a questionnaire sheet was given, and answers are collected.

5.2 Results of the Experiment

In the questionnaire, the frequency of using the supporting tools', the validity of tools, and convenience of the tool usage is asked.

The results regarding the frequency of using the supporting tools are shown in Fig. 21. As shown in the figure, the quiz tool, material map, marker tool, and memo tool are initia- tively used by over half of learners, especially, about 90% of learners used the quiz tool.

The validity of tools is shown in Fig. 22. About over 70% of learners thought that the tools were valid to support the learners.

The convenience of tools is given in the Fig. 23. Over half of the learners thought the tools were convenient.

Beyond the above mentioned results, we also

VLB means Visual Legacy Basic, it is an visual basic language editing and compiling environment.

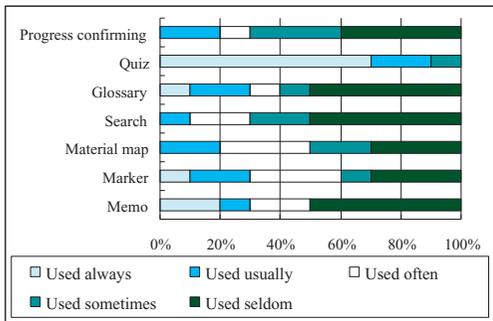


Fig. 21 Diagram of the tool's usage results.

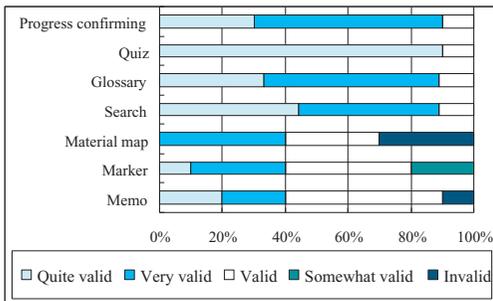


Fig. 22 Diagram of the tool's valid results.

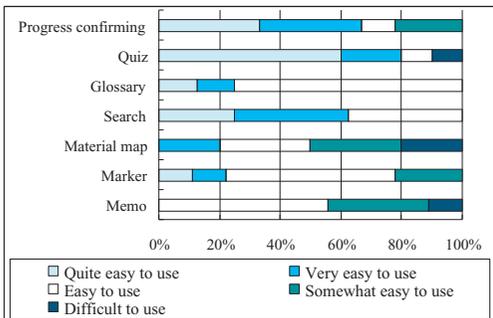


Fig. 23 Diagram of the easy-use results.

obtained the following results by asking the learners to freely write their comments:

- Since the support tools can assist the learner in solving problems and finding answers and hints, the worries in the learning process have been dispelled, so that the learners can concentrate on learning. Especially, the advice and praises in the learning process, improved the learner's confidence and satisfaction.
- The confirming of learning progress shows the learner's achievements and tasks, many learners said that they can self-control the learning process with a clear direction by using the progress confirming tool.

On the other hand, some learners pointed out some shortcomings, such as, the layer construction of material map was not so clear, and the edit function of memo tool was not easy to use etc.

Many other valuable suggestions were given by learners. For example, when presenting the learner's progress, if the other learners' scores could be shown at the same time, the learner's competition would be stimulated and the learner's learning motivation can be improved. These comments and suggestions will be considered in future versions of the distance learning support system.

6. Concluding Remarks

In this paper, we proposed a learning support method and developed a set of learning support tools based on the effective study method SQ3R, which was developed on the principles in educational psychology. Also, the set of tools and a SQ3R-based course navigation function have been implemented in a web-based distance learning system. An experiment of the web-based system was performed, and the validity and convenience of the system have been proved. In the future, we will do further experiments, to get more detailed learner's data, and to validate the navigation method and tools. Also, analyzing and considering learner's psychological factors at a more detailed level, and provide learners with a flexible support based on those psychological factors are the tasks remained in the future.

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