

Usability Issues of Web-Based Assessment System for K-12 and Implementation of PAS System

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Abstract: - Web-Based Assessment (WBA) System for K-12 needs to support the educational assessment according to the process-oriented learning and instruction. Usability issues of the Web-Based Assessment (WBA) System for K-12 refer to how to make questions efficiently, and how to control the access to the final Html test files from unauthorized people. In this paper, we study the usability issues of the antecedent WBA system and additional attributes based on PBA model (offline paper-based assessment); changing the current test class, applying Html access key value, and using student's school identification such as individual name, class, an examinee's number for logging into the WBA system. Finally, we design and implement web-based online evaluation system, called PAS (PBA-based Assessment System), according to the usability issues discussed in this study. As a result, an instructor can make assessments more frequently and conveniently.

Key-Words: - Examinations and Tests via Internet, Web-Based Assessment System, Usability and Accessibility

1 Introduction

The use of technology-based assessment continues to increase as systems become more practical and cost-effective [1]. Actually, many Web-Based Assessment (WBA) Systems have been developed, helping an instructor to collect formative assessment data, and reflecting the effectiveness of learning and teaching. That is, with the evaluation of assessment results, instructor can judge learners' learning efficiency and ability; students also can find out whether they acquire the learning material completely or partially [2].

Even though WBA has lots of advantages given above, there are some constraints on practical use in school, especially in case of classroom equipped with computers per each student; how conveniently teachers can make questions and control access to the web documents for test, and how easily students can get authentication to the web pages. Accordingly, usability issues of WBA can be one of the significant attributes as it can offer satisfaction and facilitation to users [7].

Usability, as one of the key system features of WBA, is primarily concerned with making a system easy to learn and to use [10]. Yet, most of usability issues on prior WBA researches mainly focused on user interface (UI) related to designing web pages and facilities; such as building questions and

resulting statistical test to give instant feedback for students electronically. However, there exist more additional usability issues based on the modeling of traditional test-processes, which is the main idea of this study; paper-based assessment (PBA) model.

PBA model is based on the paper-based assessment process; teacher distributes papers to the students, and then students write their school identification on the paper; individual name, class, an examinee's number. Moreover, teacher can get the paper without worry about security, and thus access to the paper can be managed naturally. Namely, there is no at least security and privacy problem that stands as some of the main problems of existing e-learning systems [12]. Given the WBA following the route based on PBA model, then extent to the usability could be increased.

In this paper, three usability properties are studied according to the PBA model; adopting Html access key for restricting to the web page, assigning current test class for controlling, and applying student identification data for logging. As an example, after a teacher designates some class as current target class for testing, and then students of the class can access the web page by inputting accurate Html Access Key (defined in this paper) as well as individual identification data. Immediately

on being verified, students can take a test and obtain test results on their monitor as soon as the paper is submitted to the server. Also, teachers can see the total statistical result as well as student's individual one. Accordingly, teacher can easily protect the web page by altering either the Html Access Key or current target class on the spot after test is over and students can easily log in the page by using their familiar personal information.

This paper firstly provides a survey of usability issues in WBA for K-12, including more additional attributes based on PBA model; Html Access Key, setting current target class and logging with student's individual information. Finally Web-Based Assessment Systems based on PBA, called PAS (PBA-based Assessment System), is designed and implemented.

2 Usability Issues of WBA System for K-12

Most of WBA systems studied previously allow students to access and take the assessment on the Internet, which is similar to questions found in PBA tests. And the results of these assessments can be evaluated; some even suggest study materials and directions. That is, a rich reporting section, to permit learners to properly self-assess and tutors to evaluate learner's results and test effectiveness [13]. Yet, WBA system for K-12 needs to be elaborately designed in order to become more effective, efficient and satisfactory for using at K-12 according to the more additional usability issues.

In general, usability means designing a user interface that is effective, efficient, and satisfying [4, 11]. Also, ISO 9241-11 [14] defines usability as an extent to which a product can be used by specific users to achieve specified goals with effectiveness, efficiency and satisfaction in a specified context of use. Thus, if a user perceives that a system is very difficult to use, the perception may influence their ability to absorb material provided by the system [3]. Usability, as one of the key system features of WBA, is primarily concerned with making a system easy to learn and easy to use [10]; what is more important point is to make users feel convenient and satisfactory while using WBA systems for K-12.

Accordingly, the usability issues of WBA for K-12 could be described as following important requirements:

- Reducing teachers' time for test preparation, administration, scorings, reporting and management. Especially, WBA needs to facilitate high re-

usability of the authored content. So teachers can find what they need and accomplish their goal in a reasonable amount of time.

- Offering a flexible access control to the test web pages, in order to inhibit learners from wrong paths, by denying him/her to the current test web page [13]. By the way, on-line assessment has been largely debated because of difficulties with properly authenticating the students and making their submissions non-repudiable [12], which is an important concern with WBA. Therefore, this security strategy reduces the likelihood of draining the current tests or previous materials [1].

- Using student's individual information for logging the test web pages; individual name, class, an examinee's number, which is familiar to students. If a student is one of lower grades at K-12, then the reason for using them is evident.

Recently, assessment is regarded as an integrated process with instructions instead of a final step. Also, Process-oriented Assessment (POA) is being underlined in 'Information Education'. Thus, we need WBA system that is adapted to concerned users, and supports educational assessment according to the process-oriented learning and more convenient learning [8, 9].

3 Usability Attributes based on PBA Model

3.1 Steps of Paper-Based Assessment

PBA(Paper-Based Assessment) refers the traditional use of a printed questionnaire instrument in a stable format, given in individual hard copy to each research participant, completed using a conventional writing implement (pen or pencil) and returned to the researcher in its original paper form [2].

Typically, the steps of PBA have three processes as described in Table 1; before, under, and after test. These steps are primarily related with teachers; then, some steps are time-consuming and irritating; others are efficient in comparison with WBA, especially in terms of security.

Table 1 Steps and Contents of offline PBA

Steps	Contents
-------	----------

Before Test	To decide contents and class for test To make questionnaire To prepare test papers
Under Test	To distribute papers to each student To write student's identification on the paper such as name, grade, class To take an examination in the classroom for an appointed time.
After Test	To withdraw the papers To deal with papers and scoring To inform results to the class

3.2 Usability Attributes based on PBA model

PBA model comes from offline PBA assessment steps; each step is controlled by a teacher. Moreover, test is being conducted in a classroom for a limited time. Thus, the access to paper could be managed by teacher completely. If these attributes based on PBA model are designed and implemented into WBA for K-12, the degree of usability will be improved further since instructor can deal with the governing of testing. Thus, those features could be important usability elements as well as including applied attributes pre-studied such as making question before testing and informing test result after testing.

Table 2 Usability elements on PBA Model

Object	Elements
Teacher's control	To control place To control period To control class
Student's login data	To use student school identification to enter the testing place and receive paper.

In offline PBA, there is no other additional process for students to get paper like an online test; id, password. They only write their personal identification on the paper, which is very familiar to them. In case of children, if a WBA compels them to use id and password, problems might happen frequently because the lower grades is apt to forget id and password, thus managing them will be irritating to the teacher. As a consequence, the accessibility and usability of the web page will be lower.

In this paper, two elements for increasing the usability of WBA for K-12 are shown in Table 2.

Firstly, teacher can effectively control the test steps while using web-base online assessment system. Secondly, students can use their personal school data for logging into the test page on the web.

By the way, these features may be regarded with some weak points such as improperly accessing into the test paper on the web and misappropriating identification on other students. However, we have studied some strategies for supporting these new attributes of usability. This paper focuses on the strategies to support new attributes for usability while acknowledging the weaknesses of the system.

3 Scheme for supporting new Usability Attributes

3.1 Regulation on Target Class

A strategy was developed for making regulations on target class by simply supplying a function that changes the current target class.

Imagine a classroom equipped with computers for each student. When a teacher is going to have an online test, the teacher may want to set target class with the present class in order to allow them to access the web test page. Also, the teacher may want to change the current target class to prohibit the access after the test. These are all accomplished by clicking a related item in WBA and this target class data can be obtained from student's login identification, i.e. student's class data.

3.2 Html Access Key

Html access key intensify security of the test paper on the web. For a student to get a final paper, he needs to input his personal identification together with Html access key. That is mainly because these data can be used to isolate from both inner and outer trial to access.

For instance, when a teacher forgets to alter the target class item unconsciously, then someone may try to get access to the test paper. However, he never accesses the paper because of not knowing the Html access key. Let's image other case. If a student who know the Html access key try to access the page after test. But the test paper can be easily protected by changing the Html access key value.

On the other hand, it may seem to be troublesome that teacher should change Html access key repeatedly and inform the revised information to the student. However, teacher can give users accessibility by changing the value of use flag item, which forces a student to input the Html access key

value or not. That is, what is important point is not the actual Html access key value but the fact that Html access key be changed and set by the flag.

3.3 Control Access to Html document itself

This paper concerns with worst case scenario. When someone willfully tries to steal Html document of test paper, i.e. exposure of test web paper's URL and source code in Html document. There exist two possible methods to counter this problem.

Firstly, immediately on receiving the Html test document at client side, the file at server will be immediately deleted. Therefore, no one can acquire the Html test document through URL.

Secondly, JavaScript can be used to hide the source code; functional key event interrupt.

4 Design and Implementation of PAS

In this section, we present the design and implementation of web-based assessment system based on PBA model, PAS [5] that supports prior attributes on usability issues, and additional features discussed in this study.

4.1 Algorithm of PAS

PAS System consists of 3 steps in order to make final Html document for the test [Fig.1.]. These steps are based on the PBA model to increase the effectiveness of usability.

• Before-Test: Step 1

An instructor should prepare questionnaires before the test. Also, the teacher must inform the entrance URL to the students.

When a student attempts to access entrance URL for testing, PAS system check client cookie at user's computer, which was saved after submitting the answer. If it is found, then student receive messages stating, "You have already submitted paper at this computer." Therefore, the student can not use the computer any further.

If not, a student must input their personal school data and correct Html access key. These input data are transferred to the server.

• During-Test: Step 2

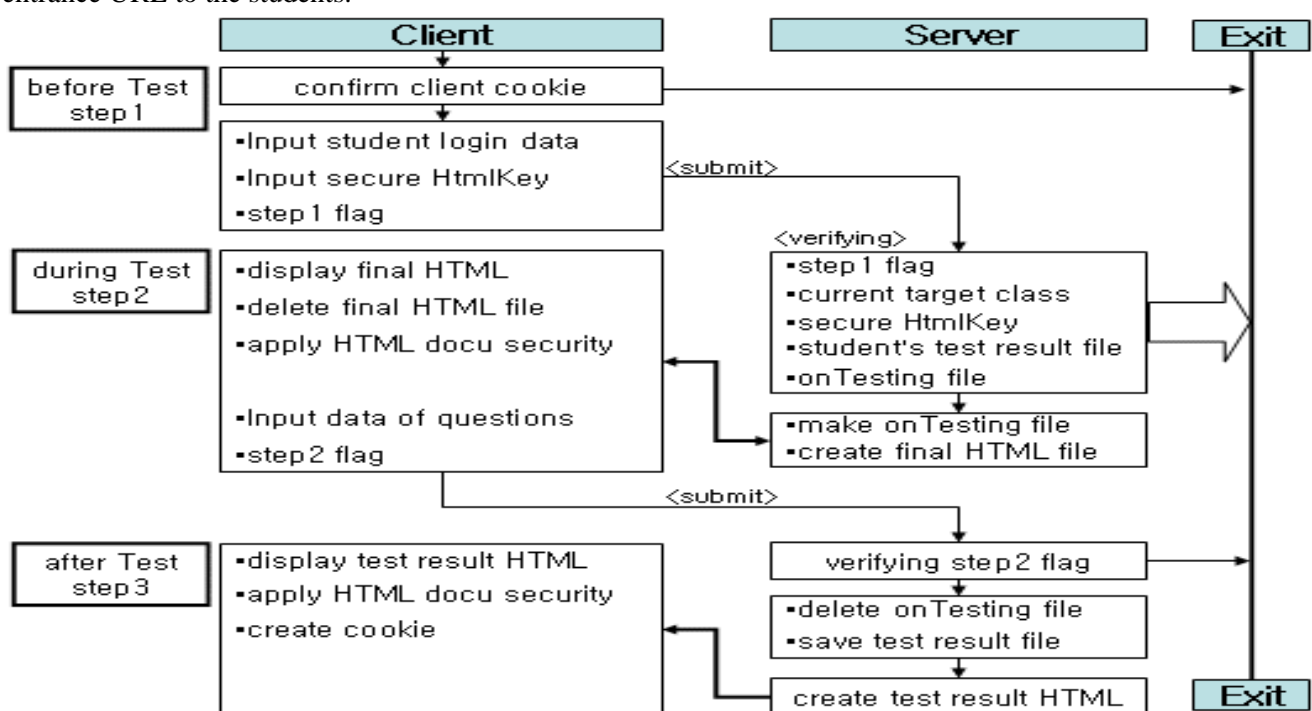
As soon as the data arrive at the server through HTTP protocol, sever start to identify its approval. Especially, this process checks step 1 flag that guarantee its route from step 1. If failed, then current page will be closed within 3 seconds. Subsequently, system checks out various values at sever depending on the situation.

Firstly, system identifies user's on-testing file which means a student is currently conducting a test. If not, this file is created at the server so that it operates in secure condition to prohibit someone from misappropriating other's person school identification. Furthermore, it is deleted after a few times being passed or by removing the flag intentionally by a teacher.

Secondly, system examines class data whether it is current target class or not. If not, user's window will be closed automatically.

Thirdly, PAS secures Html access key.

Finally, PAS examines user's result file which was saved as soon as user submitted the answer. If it exists, the student will never get access to the test paper on the web.



Users can get final Html test page. But the html file for test has no sooner arrived at the client-side than the original Html file at the server is deleted. In the long run, users can take an examination, and by submitting the paper, the answer data is sent to the server together with step 2 flag.

• After-Test: Step 3

This step also checks step 2 flag initially. Since the examination is over, current on-testing file is deleted and student's answers are saved as file at the server. Finally, result Html is created and transferred to the client.

User can get the test result and begin reflective thought. Teacher also can identify simple but various statistical data.

Finally, system generates cookie file into user's computer.

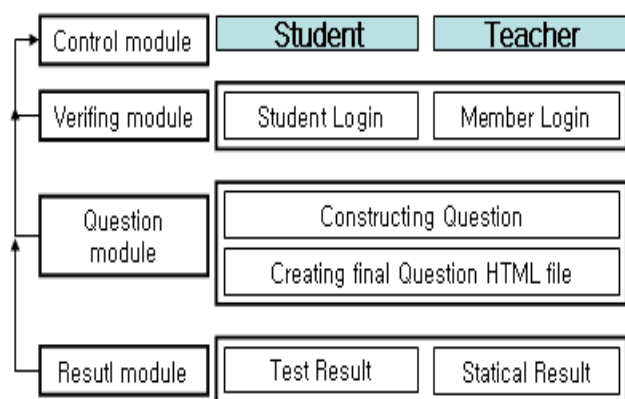


Fig. 2 Module of PAS

4.2 Module of PAS

Fig 2 show PAS system module consisting of four modules: verifying module, question module, result module, and control module. The control module has an influence over all other modules.

• Verifying module

Teachers must have enrollment to enter the PES system. We simplify registration item; id, password, name, phone-number and belongings. As described above, however, students need not to have registration process, and only use their school identification as in offline evaluation test.

• Question module

Question module has two functions such as constructing each question and creating final question Html file. In order to create a full question, a teacher must fill in the blank of overview, consisting of Html access value, title, description,

and class max count. Class max count is used for listing up to max target class. For example, if max count is 5, then target class can be listed from one to five. Therefore, as a teacher alters this target class list, actual target class can be changed freely.

After this process, a teacher can create a question and choice a type between objective or subjective. A user can use image file while editing a question and this can be done very simply and easily by inserting "[[image file]]" into the question. Also, teachers can share their own questions with other members.

• Control module

This module has close relation with other all modules and effects over all steps shown in Fig. 1. To accomplish this module, key files are shown in Table 3.

Table 3 Files about control module

File Name	Aim and Role
CheckLogin	Identify user cookie Submit user input data
MakeHtml	Confirm user input data Creating final web test page
ReportResult	Save user identification Give test results Save cookie at client

Table 4 shows how to check cookie at user's computer. This was created at step3 in Fig.1 and by ReportResult file in Table 3.

Table 4 Source code for identifying coolies

```

if($HTTP_COOKIE_VARS[ "studentlogin" ]){
    echo "You have already submitted answer
        at this computer";
    exit;
}
  
```

As soon as the confirming process at step 2 is finished, final Html document for test is made by MakeHtml file. Then Table 5 code is embedded into Html document and executed. By this action, original test file can be erased at the server. What is more important is that this action takes place every time against the individual login identification.

Table 5 Source code for deleting question Html file

```

$path_delHtml =
$path_PAS.$qhakyear.$class.$num."qHtml.php";
if(file_exists($path_delHtml))
{
    unlink($path_delHtml);
}

```

Finally, control module create cookie at client and restrain source code from drawing out. JavaScript is used to prohibit the use of special key and clicking the mouse right button.

• Result module

User can get reports through this module. Namely, students receive scores and result of assessment which contains what is right and wrong together with correct answer and full test page [Fig.5]. This is one of the very important facilities as it has potential possibility for e-learning.

The report document for instructor serves three kinds of result such as total results that includes all classes, one class total result and result per each student [Fig.5]. Instructor can see other result of a class by clicking a class.

5 Conclusions

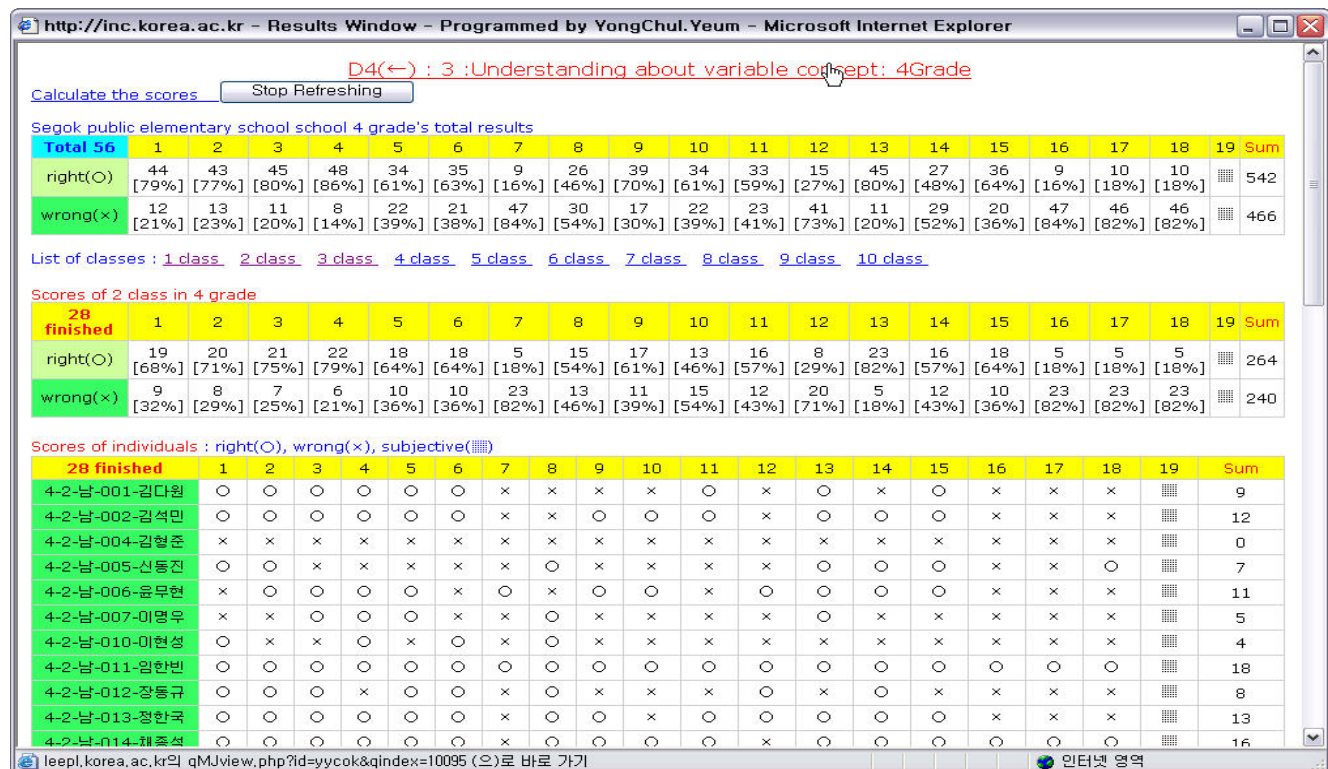
Assessment activities play an important role in substantiating a learning process [6] and the process

assessment may be used instructively, in other words providing the students with feedback on how they are performing and what could improve [15]. Thus, Web-Based Assessment system that can control the whole process of the test is required to integrate the process-oriented assessment with classes and evaluations.

Up to now, many WBA have been developed, helping an instructor to collect formative assessment data, and reflecting the effectiveness of learning and teaching. In spite of the fact that there are many advantages of antecedent WBA systems, however, most of them concentrate on system, not for users' usability on the whole. Therefore, to be more efficient and convenient WBA, we need to design and implement them on the basis of the usability attributes for K-12.

In this paper, we studied attributes of the offline PBA processes, and described usability properties suitable to K-12 on the basis of PBA model; changing the current test class, applying Html access key value and using student's school identification. Also, we design and implement PAS system according to the usability factors on the PBA model as well as on the existing PAS system's advantages.

Changing the current test class refers to offering a flexible access control to the test web pages, in order to inhibit learners from wrong paths. Html authentication key can be applied as a safety, cutting

**Fig. 5 Result screen for an instructor**

off the access on the assessments through easy control. After test finished, this value needs to be altered by teacher, and then the test web pages are protected from unauthorized users. Student's school identification means individual name, class, an examinee's number. These items are very familiar to students, so conveniently they can enter the pages. In particular, if a student is belong to lower grades at K-12. The reason for using them is more apparent.

Above all, PAS system prevents duplication of source codes or drain of questions by URL at the testing time or after. When someone access to the assessments through URL, the system automatically deletes the assessment file used for presenting for the students in server. Moreover, clicking right button of mouse or functional key is also not allowed.

In conclusion, by applying usability features into WBA for K-12, teacher can reduce times for test preparation, administration, scorings, reporting and management. That is, teachers can find what they need and accomplish their goal in a reasonable amount of time.

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