가정의학과 전공의를 위한 웹 기반 포트폴리오 평가시스템의 설계 및 구현

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= Abstract =

Design and Implementation of a Web-based Portfolio Assessment System for a Family Medicine Residency Program in Korea

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Purpose: Evaluation and feedback are fundamental components in a residency program. A portfolio assessment system is an appropriate option for making formative assessments, particularly for a family medicine resident whose training includes rotations through various disciplines at multiple locations. However, a paper-based portfolio assessment system has limitations when applied to a clinical environment due to how it is managed and cared. This study assessed the satisfaction and utility of a paper-based portfolio assessment system, and then designed and implemented a web-based portfolio assessment system for family medicine residents.

Methods: A self-administered questionnaire focusing on the satisfaction and utility of a paper-based portfolio assessment system was given to 23 family medicine residents. A web-based portfolio assessment system was then designed using the component-based development approach.

Results: The overall satisfaction and utility with the paper-based portfolio assessment system were low. Fifteen residents (62.5%) reported that following a paper-based portfolio assessment system was sometimes a waste of time and only three (13.0%) reported having no problems. The web-based portfolio assessment system was successfully designed to be easy to implement and user-friendly.

Conclusion: The web-based portfolio assessment system is expected to overcome the shortcomings of a paper-based portfolio assessment system and improve the level of satisfaction of medical residents. It is expected that the web-based portfolio assessment system designed in this study will be an additional tool for family medicine residencies.

Key Words: Educational measurement, Education, Medical, Computer-Assisted Instruction students

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Introduction

Evaluation and feedback are fundamental components of graduate medical education including those in family medicine residency education. In Korea, the formal evaluation of the competences of residents depends largely on an in-training examination or board-certificate examination as a formative and summative assessment. Over the last 30 years, there has been increasing awareness of the need to develop new assessment tools and use them in a way that ensures a high degree of validity and reliability (Roberts et el., 2002). That is why medical education has moved from traditional lectures towards experience-based methods i.e. from teacher-centered to learner centered strategies, from a rigid curriculum towards a flexible one with core subjects and electives; and from a focus on knowledge to performance and outcomes (Huba & Freed, 2000). From this point of view, a portfolio approach may be an effective alternative, even though it remains unproven in the training of residents. The portfolios have been demonstrated to be an extremely useful tool for assessing the ability of a student to acquire skills and attitudes, presumably by stimulating their self-reflection, offering constant feedback and documenting their progress (Gordon, 2003). However, a traditional paper portfolio not only introduce additional paper work for both students and tutors but also have some limitations on their interactivity in terms of immediacy and effectiveness of feedback (Carraccio & Englander, 2004). Other problems can involve compliance, confidentiality, as well as the compilation and reporting of evaluation data. Therefore, we designed and implemented a World Wide Web-based electronic evaluation system for a family medicine residency.

The aims of this study were to assess the satisfaction and utility of a paper-based portfolio assessment system (PPAS) from family medicine residents and to design and implement a new web-based portfolio assessment system (WebPAS).

Methods

The satisfaction and utility of a traditional paper-based portfolio assessment system was determined by sending a self-administered questionnaire to the family medicine residents at Samsung Medical Center, Seoul, Korea. Based on the results, database architecture was designed logically with system integration. Finally, prototype of WebPAS was implemented and tested. Fig. 1 shows the framework of study.

1. Survey

The self-administered questionnaire consisted of 27 items examining the level of satisfaction and utility of the portfolio assessment process. Each item was assessed using a five-point scale ranging from 1="strongly dissatisfied" or "strongly disagree" to 5="strongly satisfied" or "strongly agree". In October 2005, the questionnaires were sent to all 24 family medicine residents and 23 replied.

2. Methodologies of system development

This study adopted a component-based development (CBD) approach, which is ideal for developing web applications (Turban et el., 2001). The components were self-contained packages of functionality, which have clearly defined, open interfaces that offer high-level application services. The components can be distributed dynamically for reuse across multiple applications and heterogeneous computing platforms (Turban et el., 2001). This study used a structure systems analysis and design method (SSADM) as well as Rapid Application Development (RAD) for the information system development flexibility. RAD

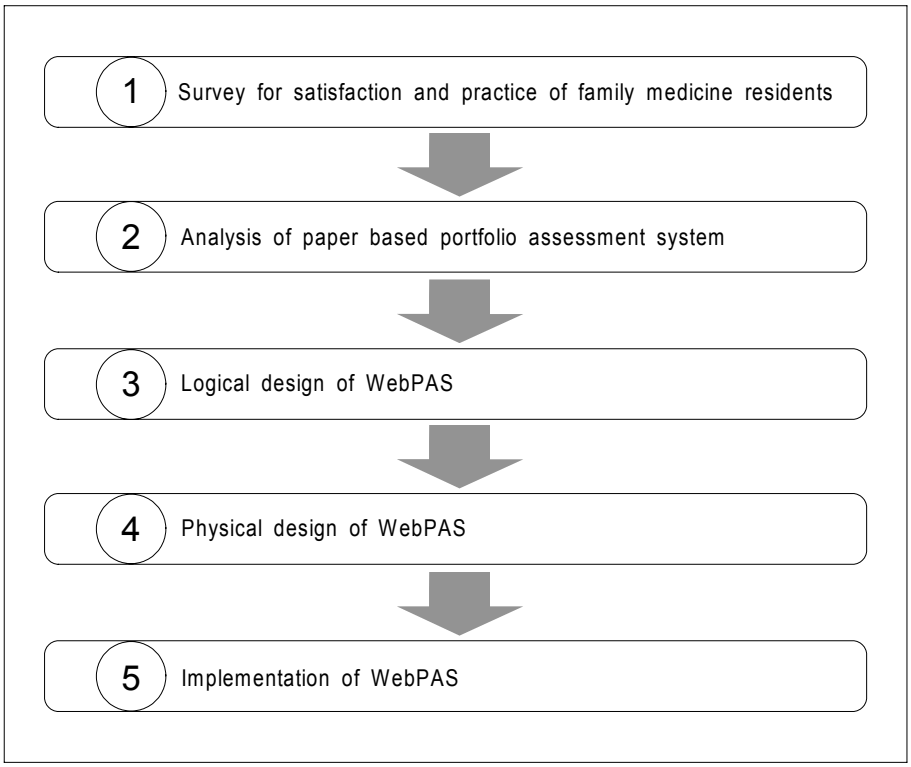

Fig. 1. Study framework.
* WebPAS: Web based Portfolio Assessment System

is also known as a Dynamic Systems Development Method (DSDM). The RAD method was used to speed up system development. RAD is actually a combination of techniques and tools (Avison & Fitzgerald G, 1995).

3. Technologic issues in designing and implementing WebPAS

Web based technologies such as databases, database management system (DBMS), programming languages, and server programs, were used to design and implement the WebPAS. The database was constructed using My SQL as the database management system. My SQL is an open source relational database management system that relies on SQL (Structered query language) for data processing. The authors used JAVA language as the programming language, LINUX as the operating system, APACHE as the web server program.

Results

1. Overview of the PPAS

The PPAS in the family medicine residency program at Samsung Medical Center, Sungkyunkwan University School of Medicine, Seoul, Korea was implemented in 2003. The residents were oriented to the process of a monthly portfolio assessment. They received a workbook and reviewed some examples as a benchmark. They set their own learning objectives according to their learning needs that could be revised during a meeting with their faculty or tutor.

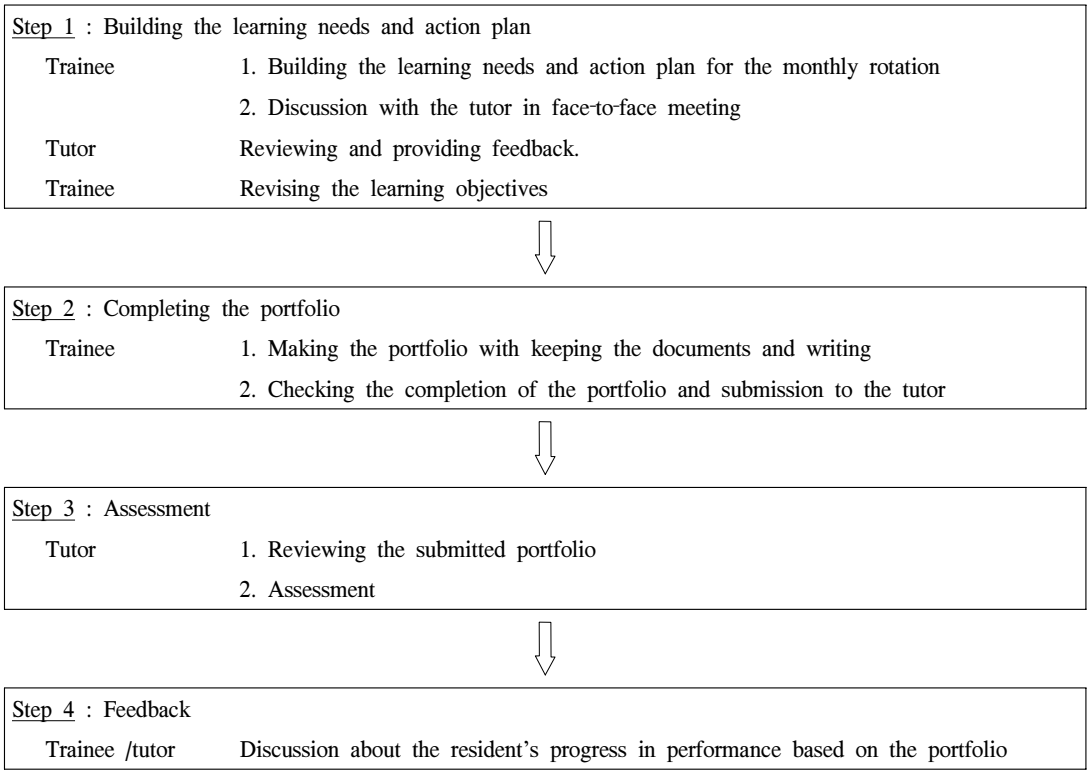

Fig. 2. Process of the paper based portfolio assessment system.

Each portfolio entry consisted of learning objects, actual works, a brief essay of reflection, problematic cases, a list of patients whom they cared for, and a self assessment of the achievement made during the month. The residents submitted copies of their actual documentation regularly, and the tutor in charge reviewed them and provided feedback. All the feedback was made through a face to face interview. Fig. 2 shows the overall process of a paper- based portfolio assessment system.

2. Satisfaction and utility of PPAS

Table 1 shows the overall satisfaction with the PPAS to be quite low. Only 2 out of 12 items scored above 3. All the processes in the PPAS except for keeping the patient's log and discharge notes earned low scores in terms of the level of satisfaction felt by the residents. In utility assessment, four out of 13 items in the PPAS process scored above 3. In open-ended questions, fifteen residents (62.5%) reported that the following the PPAS was sometimes a waste of time and only three (13.0%) reported having no problems. Surprisingly, four residents (17.5%) reported that the PPAS was too complicated to understand.

3. Logical and physical design of Web-PAS

The system flow is based on the paper-based system. The main users of the WebPAS are trainees (residents) and their tutor(s). Fig. 3 shows the logical system flow along with a conceptual diagram of the

Table I. Satisfaction and Practice of the Paper-based Portfolio Assessment System in Family Medicine Residents

	Questions	Score (Mean± SD)
Satisfaction	Overall are you satisfied with the paper- based portfolio assessment system (PPAS)?	2.4±0.8
	Building learning needs	2.0±0.8
	Structuring action plans according to each needs	2.1±0.5
	Keeping Patient log	3.1±0.8
	Documenting what I learned while listing up patients list	2.6±0.8
	Copying/keeping discharge notes	3.4±0.9
	Copying /keeping reading materials	2.2±0.8
	Reporting the accident or surprise	2.9±0.5
	Writing out newly mastered knowledge	2.3±0.6
	Writing out the error story	2.6±0.6
	Keeping the conference attendance	2.6±0.7
	Writing out reflection essay	2.7±0.6
	Checking completion of portfolio	2.8±0.6
Practice	I determine my learning needs and action plans in advance before rotation?	2.5±0.5
	I modify my learning needs and plan during the monthly rotation.	3.0±0.8
	I ascertain the completion of my learning needs after rotation.	2.6±0.7
	I plan to supplement any unaccomplished learning needs.	3.3±0.7
	I keep a log of the patients I cared for.	3.0±1.0
	I document what I have learned whilst making a patients list.	2.8±0.8
	I copy and keep discharge notes.	3.5±1.4
	I copy and keep reading materials.	2.3±0.8
	I report any accidents or surprises in the rotation schedules.	3.3±0.8
	I write out newly mastered knowledge.	3.0±0.7
	I write out the error story.	3.4±0.8
	I keep the conference attendance.	2.6±0.9
	I write the reflection essay.	2.9±1.1

activity according to the users.

The communication between the tutor and trainee was made through the web-server, which is a server-client system that became available in the web-based system. A Web-server and four Database servers exchanged data including the member information data, learning activity related data, assessment data, and portfolio collection data.

Relational database architecture was produced in order to avoid overlapping with My SQL and the database management system (DBMS). There are two kinds of tables framed with the database table. One is the tutor-trainee relationship and the other is the planning assessment. The tutor-trainee relationship consists of three entities, the tutor, trainee and assignment. The tutor and trainee entities include the user information of the WebPAS users. The tutor entity includes the tutor ID, password and name attributes. The trainee entity includes the trainee ID, password, grade (PGY 1, 2, 3), e-mail address, cell phone number, and preference. The trainee's preference consists of evidence based medicine, geriatrics, hospice palliative medicine, nutrition, sports medicine, and alternative medicine. The trainee can select whatever they prefer. The administrator assigns the trainee to the tutor. The learning activities entity

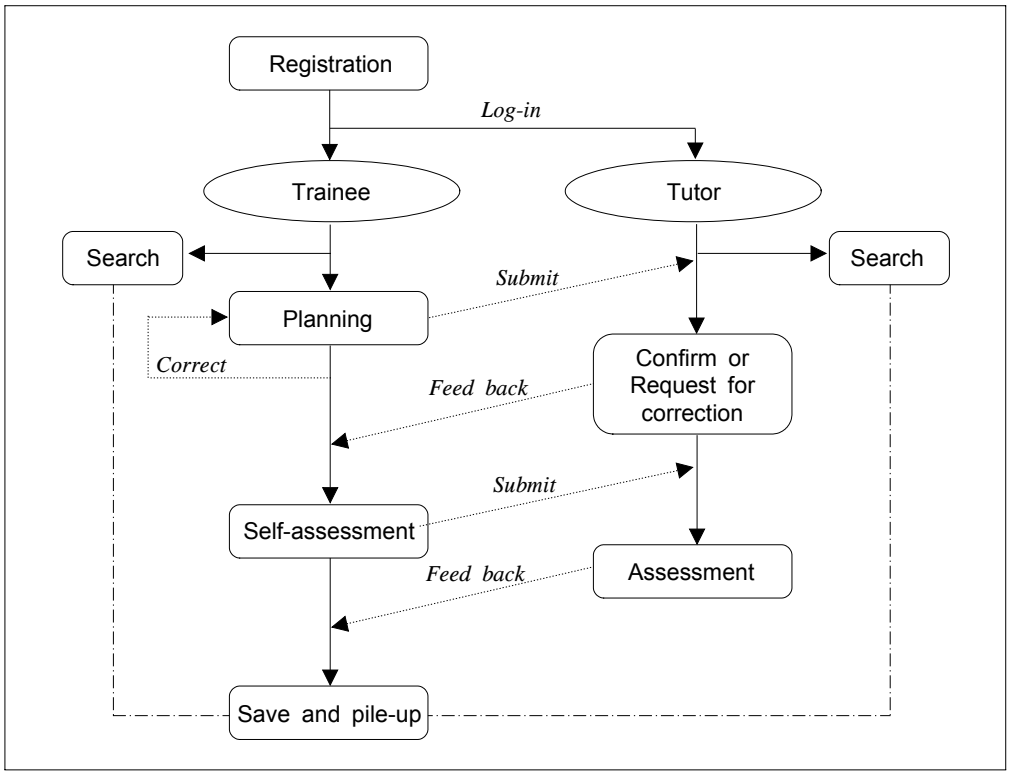

Fig. 3. Logical flow of Web-based portfolio assessment system.

consists of a title, learning objectives, learning attitudes, knowledge of learning, skills to learn, a concrete way to learn, actual files, upload files, and self assessment attributes. The assessment result entity contains a tutor assessment, trainee name, tutor name, date of assessment, and tutor comment. Fig. 4 and 5 show the entity relationship diagram (ER diagram).

4. Implementation and operation of Web-PAS

WebPAS was implemented from November 2005. The participants were all family medicine residents and faculty members at the Samsung medical center, Seoul, Korea. The JAVA language, which is an object oriented programming language, was used to implement WebPAS. The website of WebPAS can be found at http://epas.guideline.co.kr.

Trainees build an action plan according to their learning needs. The planning items consist of four parts; attitudes, knowledge, skills, and actual practice plan. The trainee can refer to the learning objectives made by the Korea Academy of Family Medicine. The planning interface is shown in, Fig. 6A. After the planning process is complete, the trainee saves the objective plans and submits the saved plans to their tutor. The tutor reviews these objectives and comments on the learning plans and provides feedback to the trainee (Fig. 6B). The tutor can request revision or resubmission by clicking the button, 'request correction'. If the trainee is asked for 'request correction', he/she must resubmit the revised learning plans to their tutor.

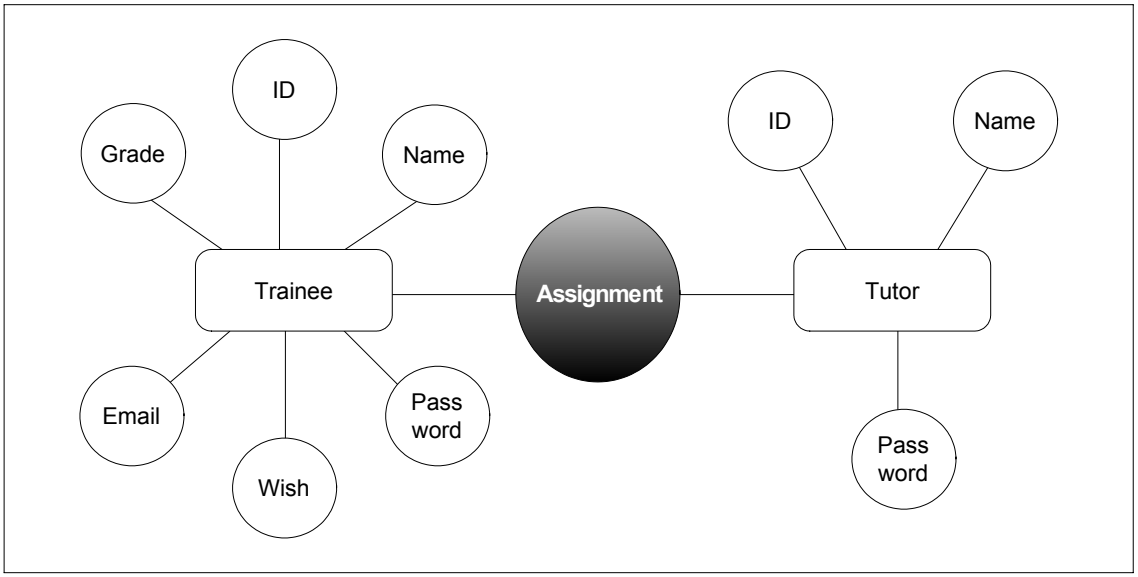

Fig. 4. Entity relationship diagram of relationship between the tutor and trainee.

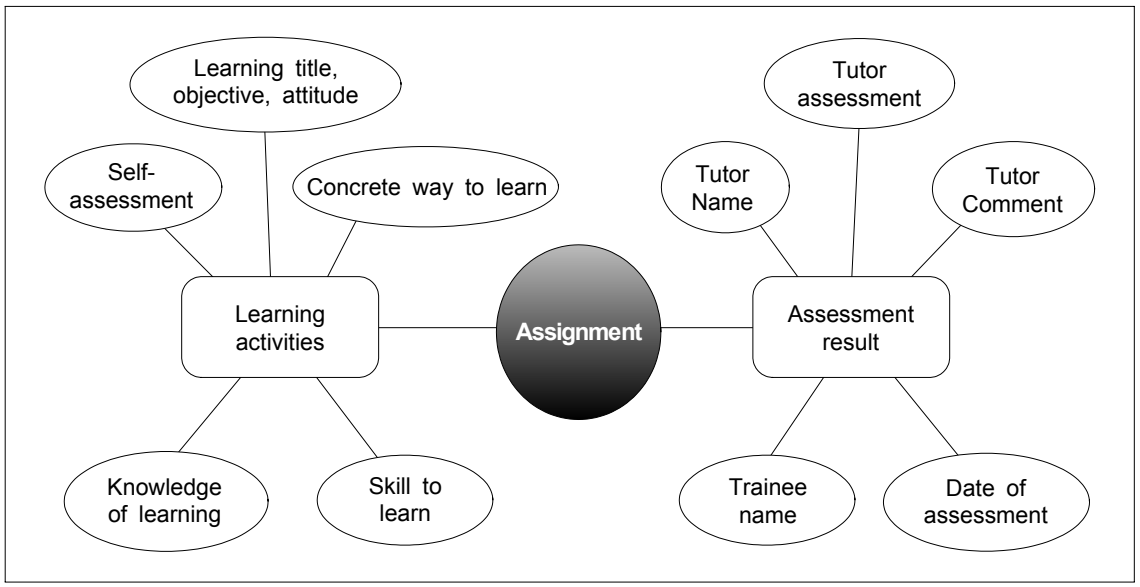

Fig. 5. Entity relationship diagram of the relationship between the learning activities and assessment.

After the tutor confirms the learning plans, the trainee carries out the learning activity according to their learning plans. In the learning activity, the trainees collect their learning activities in the form of files. They can comment by making a portfolio. Besides collecting the learning activity, they can comment in the form of an essay and episode. A self-assessment is performed by attaching the files of

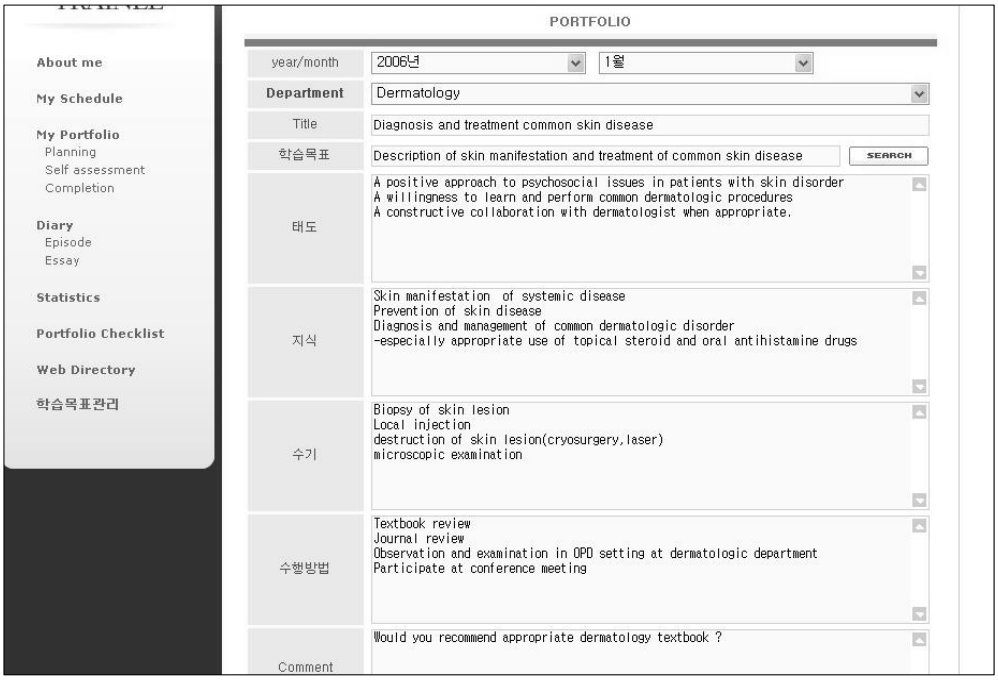

Fig. 6A. Planning interface of the Web-based Portfolio Assessment System at trainee side (http://epas.guideline.co.kr)

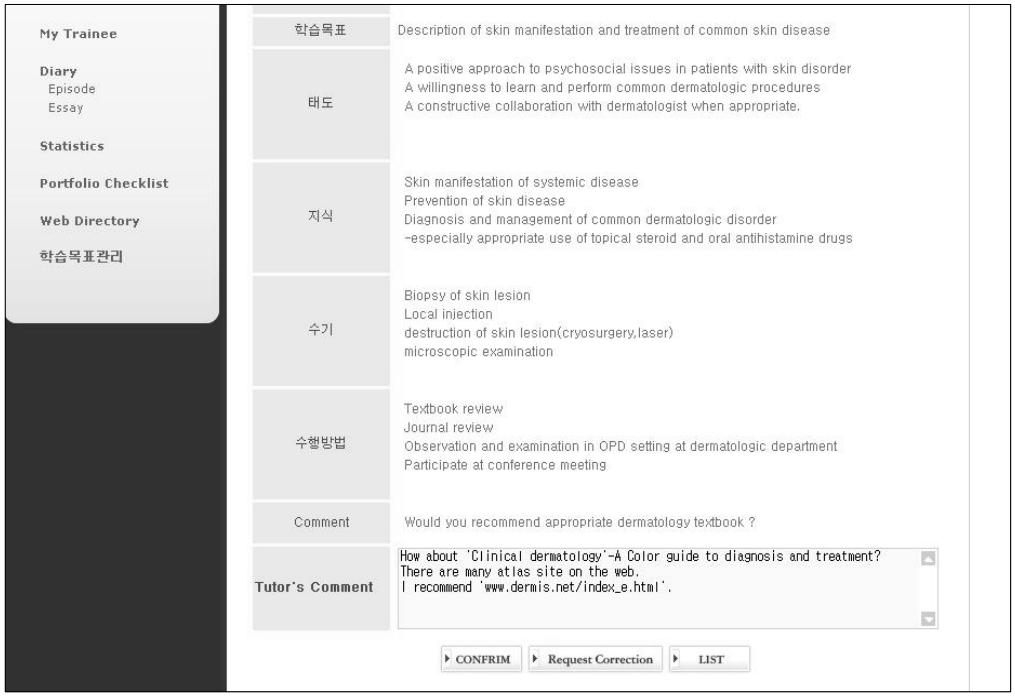

Fig. 6B. Planning interface of the Web-based Portfolio Assessment System at tutor side (http://epas.guideline.co.kr)

Fig. 7A. Self-assessment interface of the Web-based Portfolio Assessment System.

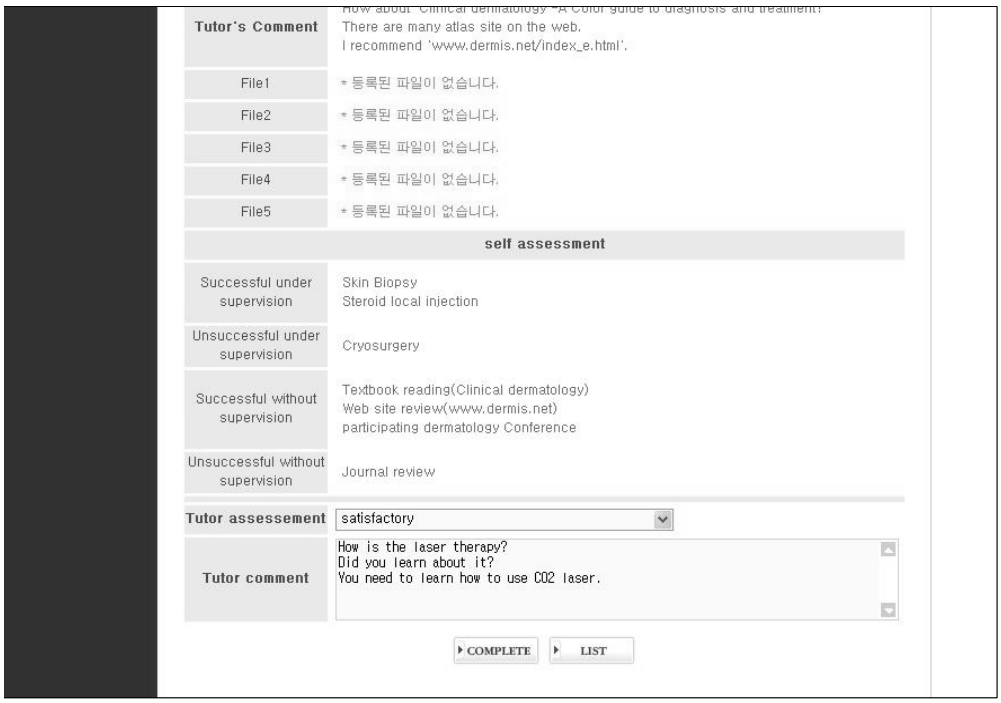

Fig. 7B. Tutor assessment interface of the Web-based Portfolio Assessment System.

their learning activities and self-grading them. Self-grading consists of four grades, 'successful under supervision', 'unsuccessful under supervision', 'successful without supervision', 'unsuccessful without supervision'. After the self-assessment, the trainee submits them to their tutor (Fig. 7A, 7B). The tutor's assessment categories for the submitted portfolio are separated into five grades; 'unable to judge', 'unsatisfactory', 'intermediate', 'satisfactory', and 'excellent'.

Discussion

The level of satisfaction and utility with the paper-based portfolio assessment system was found to be quite low. One possible reason for this is that family medicine residents did not understand the process land meaning of the portfolio assessment system. Another might be the resident's perception of time pressure that unnecessarily hinders them adopting this form of assessment. The feedback style can also adversely affect the resident's level of satisfaction with the PPAS. A face-to-face discussion with a busy tutor, which is sometimes filled with negative feedback punctuated with many recommendations for revision, can make the residents feel awkward. Therefore, an explanation of the working process of the portfolio assessment system should be further elaborated early in the first year of residency through workshops prior to implementation. Lack of time or a feeling of time pressure can be helped by introducing an electronic system instead of paperwork. The drawback of the feedback style also can be overcome by introducing WebPAS as well as emphasizing positive, encouraging feedback. One study found that internal medicine and family practice residents gave higher satisfaction ratings when they were given a web-based module instead of the paper module (Bell et el., 2000). In the experience of Newcastle University, UK, the e-Portfolio proved to be acceptable, navigable and easy to use in the field of undergraduate medicine (Cotterill et el., 2004). This suggests that a web-based portfolio assessment system will increase the residents' satisfaction as well.

This study describes the development of a web-based portfolio assessment system to evaluate the progress of family medicine residents both comprehensively and effectively. A web-based evaluation system has many advantages over the traditional paper-based system (Turban et el., 2004). The performance, submission, feedback, and the tracking of the results are all executed on the Internet. The data collected can be automatically entered into a database and be accessed by residents and faculty. Reports can be easily distributed electronically and be accessed directly on the web. The immediate availability of easily accessible data can positively impact the residency program. The fast and regular identification of a resident's performance can allow him or her to revise their learning methods, including action plans or modification of learning objectivity. The results of such intervention can be easily followed and tracked on a real time basis using the electronic evaluation system.

Confidentiality is a key issue in information technology (Gürgens et el., 2005). However, with this system, there is no need to consider the issue of confidentiality about patient information because the web-based portfolio assessment system is not connected to electronic medical records. Nevertheless, problems may occur during the assessment process between trainees and tutors. For this reason, the system was designed to make residents enter their assessment and plans to their assigned tutor's evaluation page directly through an authentication security process.

It is possible that web-based portfolio assessment system can undermine the ability of the resident to reflect on their performance during the learning pro-

cess because of easy copying and piling-up. Therefore, special attention is needed to emphasize the importance of reflective and self-directed learning.

Extensibility and compatibility is essential in system development, particularly when upgrading the system (Tang, 1997). In designing and implementing a web-based portfolio assessment system, LINUX was used as the operating system and JAVA was used as the programming language. The system can be easily upgraded because the Linux operating system can support open source code (Ball & Duff, 2003). JAVA runs equally on several computer platforms and makes applications easier to manage and maintain than scripting-based technologies (Russel, 2001).

There were some limitations in this study. First, the main scope of this study is the design and development of a web-based system to overcome the shortcomings of PPAS. Further studies will be needed to determine the effectiveness of WebPAS in terms of the residents' improvement in self-directed learning, reflection and satisfaction. Second, the subjects of this study were all residents. Tutors are also an essential part of the portfolio assessment system. Therefore, future research is needed to evaluate their level of satisfaction and practice.

The portfolio assessment system is not widely adopted in family medicine residency in Korea. Despite the limitations of this study, the web-based portfolio assessment system can be good assessment tool in family medicine residency, particularly in those hospitals with a limited number of faculty members.

The web-based portfolio assessment system is expected to be an additional tool for family medicine training programs.

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