

A study on the evaluation and effectiveness analysis of web-based learning portfolio (WBLP)

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Abstract

This research evaluates a Web-Based Learning Portfolio through practical teaching process to understand if the WBLP system helps students to grasp the learning process and enhances learning outcomes. The questionnaire includes four aspects: system functions, interface, system use, and its impacts on learning process. The questionnaire has gone through the processes of pre-test and pilot-study to verify its validity. The Cronbach's alpha coefficients are all above 0.75, and thus show that the reliability level of the questionnaire has attained a rather reliable level. As many as 85.84% of the users regard the functions of the WBLP system appropriate, 80% regard the system interface easy to operate, 48.3% perform very well in system, 88.84% feel the system has benefited their learning. The evaluation results reveal there is still a room of improvement, eg, the system has not yet established a complete mechanism for scoring. The insufficiency in terms of dynamic management functions for supporting users is yet to be improved. Then will we be able to extend the WBLP to a more powerful system that can truly support the assessments and auto-management work. We will conduct a further experimental study in terms of learning effectiveness for the system.

Research background

Portfolio has been used to gather the learning activities of students in various aspects as well as the works of students with one purpose in mind. It allows the teachers, students, or their parents to understand and evaluate the learning process, improvement situation, and academic achievement of students. It may also be used as evidence for the pupils to reflect on their learning and the changes in their comprehension during the study process. Portfolio incorporates the following functional areas (Hewitt, 1995):

1. It may demonstrate students' growth and improvement situation.
2. It may encourage students to set up learning goals.

3. It may provide the hard evidence concerning students' efforts.
4. It may show students' performance or works.
5. It may serve the purpose for job application or school application.
6. It may help the faculty to review students' learning progress.
7. It may serve to inspire the teacher and understand students' performance.
8. It stimulates students' introspective thinking and enhances self-assessment. (Smith and Tillema, 1998; Wade and Yarbrough, 1996; Carroll, Potthoff and Huber, 1996; Vavrus, 1990)
9. It encourages students' learning interest, builds up students' self-confidence, and assists students to know more about themselves, and develops writing skill as well.
10. It encourages students' participation in cooperation, and increases their self-esteem (Mullin, 1998).

The contents gathered by portfolio may include the various works or activities that students have accomplished during a course or curriculum, such as written reports or homework, the video or audio tapes of various learning activities, pictures or drawings, discussion records, tests or examination scores/results, etc. In order to reveal the learning processes, results, and progress of the students completely and effectively, it is essential for the teachers and students to concurrently discuss so as to determine and choose the contents and information that need to be incorporated into the portfolio during the development of the portfolio.

A portfolio may contain the following major items:

1. The works or learning results/achievements chosen by students.
2. The reflection on learning by students.
3. A clearly defined learning goal.
4. The works completed or developed in the process.
5. Concrete examples of growth or progress (Cole, Ryan and Kick, 1995).

Fischer and King (1995) suggest that the general contents of a portfolio may embrace:

1. The sampling process or the works in progress.
2. The concrete examples of complete works.
3. The observation or evaluation materials of teachers.
4. The opinions of parents or guardians.

Some scholars also include students' pre-tests, work sheets, formative assessments, and the records of student participation in discussions and activities in their portfolio researches that have been used as the tool for conducting assessment. To sum up the previous viewpoints and other scholars' proposals (Barrett, 1998; Carroll, Potthoff and Huber, 1996), the contents of a portfolio may incorporate the following essential elements: learning goals, the guidance for choosing contents and materials, the work samplings chosen by teachers or students, the uncompleted rough draft or the records taken during the process, the introspective records of students, the clearly defined and appropriate evaluation guidelines, the standard and standard examples of excellent works, teachers' feedback or assessment records, the suggestions of parents or peers.

Portfolio method emphasizes that a learner participates actively and thus establishes the learning results of his/her own concern. Therefore, its development process whether it be instructed by teachers or established by students' own accord, shall both attain the goal of encouraging the learners to be responsible for his/her own learning and to grasp all the goals of learning activities. Furthermore, portfolio assessment was originally designed as an authentic assessment approach meant for the improvement of the traditional pencil-paper tests. Thus, the assessment is real and active. In contrast with the traditional way of assessment, portfolio assessment pays attention not only to the results but also the processes involved. Since learning, teaching, and evaluation comprise of the integrated activities that shall go hand in hand, the portfolio approach is actually a better way to grasp the complexity of learning processes. It also allows the learners' or teachers' introspection to take place. It may also help to reflect on the overall learning and teaching process, so as to give feedback and offer suggestions, thus to benefit the learning in the genuine way. In general, portfolio possesses the following characteristics or features (Wade and Yarbrough, 1996):

1. **Developmental:** portfolio represents a certain period of students' growth and learning. Portfolio is the long-term accumulated learning results, not meant for short-term goals. Hence its development is actually an on-going process.
2. **Dual-valued:** portfolio offers both the teachers and students the value of two-way interaction. It allows a learner the opportunity to reflect and record his/her own learning process. It also offers teachers a good approach or method to evaluate students' growth and achievements.
3. **Selective:** portfolio offers students the opportunity to choose, so that students may self-determine what kind of contents that they want to put in the portfolio and how to organize the whole portfolio. It also allows students to set up the standard or basis for evaluation/assessment.
4. **Authentic:** portfolio incorporates the genuine works or performances of students. Traditional tests normally cannot reflect a student growth or potential in all aspects, but portfolio may demonstrate solid learning results and thus offers an authentic way of learning.
5. **Reflective:** portfolio may reveal the evidence of self-reflection. Thus learners may review their own work, then set further goals through such a reflection. It may also help to review the previous efforts, and compare them with the actions afterward, for better understanding of their improvements or growth.
6. **Individual:** portfolio is a personal learning and growing record based on individual ways of choices and organization. Consequently, it reflects personal contents and style in students' personal portfolio.
7. **Interactive:** a learner may share with his/her teachers and peers through personal portfolio, and thus seeking guidance and suggestions. In this way the development and establishment of portfolio may be regarded as the process of cooperative interactions.

Beyond that, portfolio also possesses the characteristics of self-regulated learning and self-directed learning (Fischer and King, 1995; Smith and Tillema, 1998). This is because a portfolio allows the learner to self-determine his/her learning goals, strategies, and

contents and then records them. Thus the role of scholars is merely to assist and provide feedback. That is why the development of personal portfolio encourages a learner to become an independent, self-directed person.

Following the booming development of Internet technology in recent years, and through the integration of computer and communication technology, the real-time and interactive features of world wide web (WWW) has achieved the effective breakthrough in terms of time and space limitation that used to be a problem in establishing a traditional portfolio. Consequently, the establishing and maintaining of data has become more real-time in nature. Also, through the integrated function of database and WWW, it does not only enhance the recording, sorting, searching, and analyzing of portfolio data, but also provide the function of allowing a learner and his/ her teachers to share and browse others' portfolios as well. This leads to increased opportunities for interactions and emulation of learning. Nevertheless, the development and relevant researches targeting for web-based portfolio with WWW as the interface have been so few in Taiwan. We also lack the authentic information concerning the results of its implementation. Therefore, it turns out to become an area of interest worthy of our research in depth.

The Web-Based Learning Portfolio (WBLP) has been structured through web interface and has also gone through the different stages of analysis, design, development, and testing is now being established. The practical applications of the WBLP in students' learning, its functions and effects, its impact on students' learning, etc are the issues worthy of our analysis and investigation. Through the evaluation of WBLP, other than to identify if the system has achieved its original purpose in development and also has met its functional needs, we may also propose revising of the system based on the results of evaluation, and establish the evaluation standard for web-based portfolio. With the above pre-requisite in mind, this research hopes to achieve the following goals:

1. To evaluate the functions and results of the WBLP, and analyze its impact on students' learning process.
2. To propose the suggestions for system revision, and future research direction based on the results of evaluation.

Web-based learning portfolio

This WBLP is mainly used to provide students with a web-based user environment. It helps students to complete their individual portfolios through simple, easy-to-use interface for necessary guidance. It also allows the teachers and students to browse their classmates' portfolios, and to give their feedback or assessment opinions. The contents of this WBLP include the following seven major items:

- the basic information of students,
- the learning goals of students,
- the works of students in a course,
- the records of students' self-reflection or self-assessment,
- records of teachers' feedback and assessment,
- records of peer feedback and assessment,
- the student's personal web page.

In addition to these, in order to support students to create and browse the portfolios, as well as to facilitate and meet the needs for teachers to inspect and evaluate students' portfolios, the functional areas of WBLP system consists of the following eight major items: *Portfolio Browse*, *Portfolio Creation*, *Portfolio Guide*, *Portfolio Discussion Board*, *Portfolio Bulletin Board*, *Portfolio Suggestion Board*, *Student Data Maintenance*, *System Management* (Chang, 2000). These functional areas mainly provide the following functions to the portfolio (as shown on Figure 1):

1. The function for students to conduct the various productions of portfolio contents.
2. The function for teachers and students to browse the portfolios of other students or peers.
3. The feedback and assessments of teachers as well as the feedback and mutual assessment mechanism among students themselves.
4. The on-line guidance and illustration for students to create portfolio contents.
5. The searching and management function of students' personal information.
6. The asynchronous discussion channel of portfolio creation process.
7. The opinion feedback channel for students in using the system.
8. The updated system announcement or course information concerned.
9. The function for teachers to manage student information and announcement information.

Research design

Research method

This research utilizes an established Web-Based Learning Portfolio (WBLP), and has been applied on a course in college/university. Through the practical teaching process, we may evaluate and understand if the established WBLP system serves its intended purpose, if it helps students to grasp the learning process, and if it enhances the learning outcomes. The evaluation work involves formative evaluation and summative evaluation. Summative evaluation incorporates the elements of user evaluation, user in-depth interviews, and expert evaluation. It was necessary to conduct the final summative evaluation work of system through user evaluation and expert evaluation over roughly one and half months of implementation. This was in addition to system design and the implementation process that we incorporated to improve users' feedback or suggestions. In order to carry out the formative evaluation of system via an on-going process it was necessary to evaluate the appropriateness of this system in terms of its functions and contents based on the questionnaire analysis results of user evaluation as well as the opinions of students' in-depth interviews and that of expert interviews. They then become the useful references for system revisions and improvements. The process also helps to understand the difficulties and problems of this system in its application and implementation as well as its possible impact on students' learning.

Since it takes a rather long time for each student to produce personal portfolio, the implementation time for this system must be long enough (the time for system implementation of this research is about one and half months) to reflect the genuine usage of the system. During the period of system implementation, teachers would encourage students to log in and browse after class in order to go with the teaching schedule of

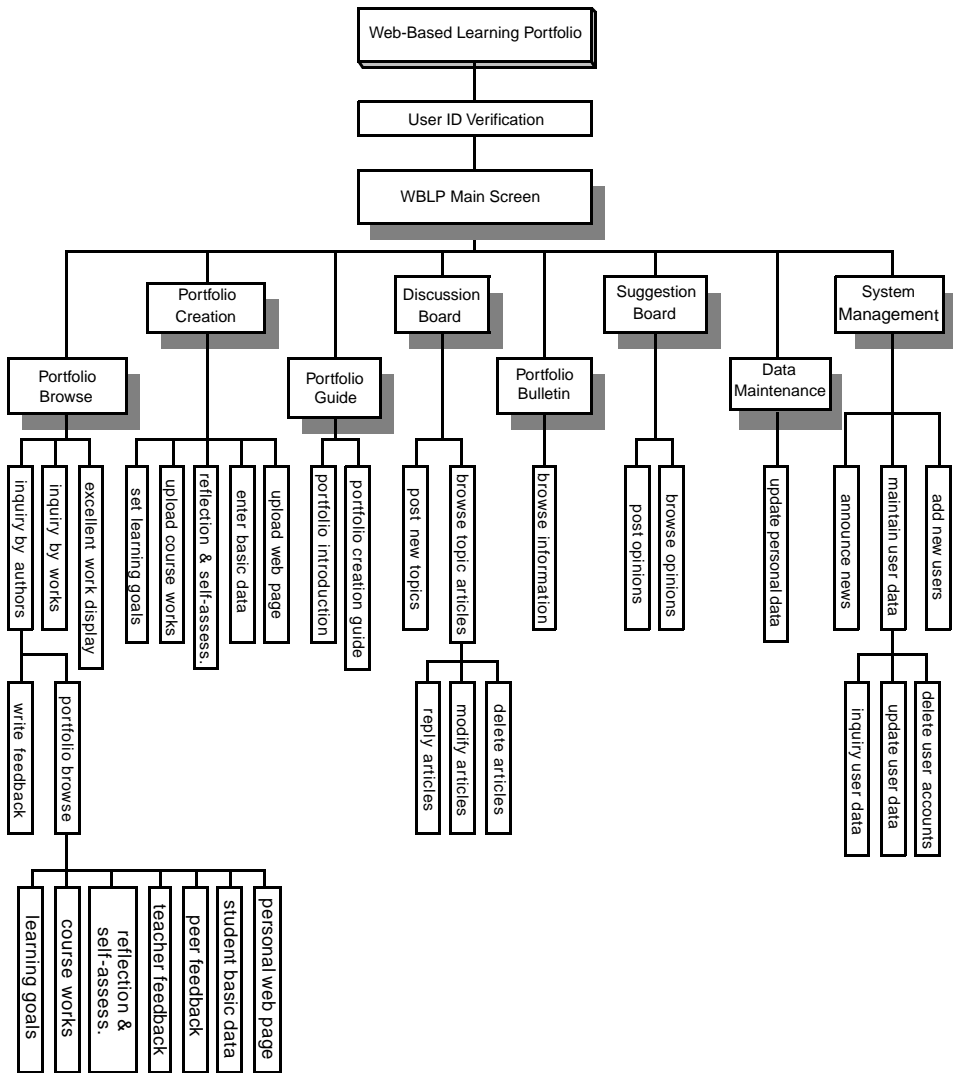


Figure 1: The functionalities of the web-based learning portfolio system

the course or curriculum. Then the students' individual portfolios were completed in a step by step process.

Research instruments

User evaluation questionnaire: This research has designed its own questionnaire for user evaluation (as shown from Table 3 to Table 6) to examine the practical contents, functions, user interface, etc. of the WBLP system. There are four major components for the contents of this questionnaire: system functions, screen and interface design,

system use, impact on the learning process. The contents of this questionnaire are based on relevant literature and discussions of scholars and experts. They have gone through the process of examination for validity and reliability. The questions have been presented based on Likert's five-point scaling method—strongly agree, agree, average, disagree, and strongly disagree.

Questions for In-Depth User Interviews: In order to understand the relevant questions and suggestions for the WBLP system in depth especially in terms of its function designs, implementations, and portfolio productions, it was necessary to supplement the study through the researcher self-designed "Questions for In-Depth User Interviews" after the completion of user evaluation questionnaire analysis. Interviews in-depth would then probe the opinions and suggestions of the users concerning the unresolved answers and controversial issues that could never be revealed through the previous questionnaire.

Questions for Expert Interviews: In terms of expert evaluation, interviews were conducted for system evaluation based on the researcher's self-designed "Questions for Expert Interviews". In this way that we got to understand the expert opinions in regarding to the appropriateness of this system in terms of its functions and contents, the convenience of screen design and interface operation, the opinions and suggestions for system revision in terms of its impact on learning and teaching. The data or information collected was then used as the reference for future system revisions and improvements.

Validity and reliability of questionnaire

Validity test

Validity refers to whether a tool for measurement/survey may achieve its intended functions or purpose. The user evaluation questionnaire has gone through the processes of pre-test and pilot-study to verify its validity.

Pre-test

To attain the goal of questionnaire validity, it was necessary to consult two expert/scholars of portfolio assessment and web technology, and one teacher who instructed the course after the completion of the questionnaires. They were asked for their opinions on revising the framework of said contents, words and expressions relating to the issues, etc. The suggestions for revising the questionnaire include: increasing the contents of the questionnaire, more articulation in the expressions of questions, word polishing, etc. This improved the questionnaire so that it was able to attain the goal originally intended for the effectiveness in measurement/survey. Through this method of expert validation, this research meets the needs of measurement/survey tool efficiency.

Pilot-study

We may achieve more complete validity verification through the further process of pilot-study. We picked five students at random for the purpose of this research at that time to conduct pilot-study based on the rough draft of the questionnaire. We hoped to go through such a pilot-test and give the results to the researcher to confirm whether the questionnaire could effectively measure/survey the purpose intended for this

research, and to revise any inappropriateness necessary. The opinions or feedback for revision include the clarification of some questions and word polishing, etc., so as to present the questions better to the students.

Reliability test

Reliability refers to being consistent and steady in terms of measurement/survey method. In order to attain the reliability goals for this questionnaire, we calculated Cronbach's alpha coefficient from the results of the pilot-study and thus determined the extent or degree of consistency within the questionnaires. Then we determined if the research measurement tool was sufficiently reliable. The test results are shown in Table 1 and the reliability of formal questionnaire after revision is shown in Table 2:

Table 1: Cronbach's alpha coefficients of questionnaire from pilot-study (n = 5)

<i>Part Number</i>	<i>Evaluation Parts</i>	<i>Cronbach's Alpha Coefficient</i>
Part I	System Functions	0.8443
Part II	Screen and Interface design	0.8440
Part III	System use	0.8507
Part IV	Impacts on Learning Process	0.7592
All Part		0.7738

Table 2: Cronbach's alpha coefficients of formal questionnaire (n = 35)

<i>Part Number</i>	<i>Evaluation Parts</i>	<i>Cronbach's Alpha Coefficient</i>
Part I	System Functions	0.8326
Part II	Screen and Interface Design	0.8742
Part III	System Use	0.9000
Part IV	Impacts on Learning Process	0.8346
All Part		0.8226

The Cronbach's alpha coefficients in the questionnaires of this research are all above 0.75 showing that the reliability level of this research is high.

Research limitations

Limitation of research target

This research hopes that WBLP system can serve the general needs of college/university students in their curriculum. Nevertheless, due to the limited time and manpower of this research, the primary research target of this research was limited to those students who were taking the course of "Computer and Instruction" within the Pre-service Teacher Education Program in some University. As a result, it cannot take into consideration the special needs of other disciplines.

Limitation of Research Method and Interpretation

The user evaluation of this research in terms of its impact on learning process was designed to understand that if WBLP system could enhance the learning process and outcomes of students. However, since a questionnaire method had been used for users' self-evaluation, it led to a higher degree of subjective recognition of the learners involved in this research, and lack of a more objective standard to determine learning effect. Consequently, it can only be used to explain and deduce the learners' recognition of learning effect based on the results of questionnaire data collected. That implies we can only attain the goal of subjective feeling level in terms of learning effects evaluation.

Evaluation process

The evaluation work of this research includes two major categories:

Formative evaluation

The primary purpose of formative evaluation is to gather the relevant data for system revisions and improvements. Since the development method of WBLP system covers the development method of prototype, the formative evaluation process of this research had been conducted concurrently with the reviewing and revising process for establishing the prototype system. Therefore, the data sources of our formative evaluation were derived from the system problems found by the developer during the process of system development, or the shortcomings and problems found by course teachers and consulting experts during on-line testing process of the prototype system. Furthermore, since the implementation time of the WBLP system had lasted roughly one and half months, the opinions or suggestions reflected on the Suggestion Board of the system as well as the difficulties and problems encountered in its use, have all been incorporated.

Summative evaluation

The purpose of summative evaluation is the understanding of whether the WBLP system serves the needs of the intended learners, if it is user-friendly, and the conditions and results of use. This includes conducting the following aspects of evaluation work: system functions, screen and interface design, system use, and its impacts on learning process, etc.

There are three major components for summative evaluation: user evaluation, user in-depth interviews, and expert evaluation.

1. User evaluation: The evaluation method was conducted one and half months after the system implementation. It was carried out through the system evaluation questionnaire designed by the researcher. The questionnaire was distributed in several copies to a class of 35 students who were taking the course of "Computer and Instruction" in a Pre-service Teacher Education Program.
2. User in-depth interviews: Targeting the unresolved questions and the controversial issues of the previous questionnaire of user evaluation, in-depth interviews were then conducted on 5 students selected randomly after the completion of questionnaire analysis work in order to understand the users' opinions and suggestions in more depth.

3. Expert Evaluation: Three experts (including the course instructor, a portfolio assessment expert, and a web technology expert) were invited to conduct the expert evaluation by using this WBLP on-line. The evaluation work was then conducted through interview method after one week.

Research results and discussion

Since formative evaluation process was mainly conducted concurrently with the development of the system prototype and during its reviewing process, we do not intend to describe the details here. The following describes only the necessary explanation for our summative evaluation results:

Result of user evaluation

This incorporates survey and interviews. Tables 3 to 6 list the results of each evaluation item within the questionnaire. The evaluation items of the questionnaire include the following four major aspects: system functions, screen and interface design, system use, and its impacts on learning process.

System functions

Table 6 shows the results of 18 evaluation items surveyed for the six major functional areas (*Portfolio Browse, Portfolio Creation, Portfolio Guide, Portfolio Discussion Board, Portfolio Bulletin Board, Portfolio Suggestion Board*). Item 1.14 shows low agreement (mean = 3.57) for uploading personal web page in the *Portfolio Creation* area being appropriate and easy to use. 20% of the users do not regard the uploading method for the files of their personal web page appropriate and easy to use. The result reveals the uploading method planned by this WBLP system still needs further improvement, but we find a mean of above 4 (most of the users are either agree or very much agree) for the other items. Hence, the functional aspects of this WBLP system should be able to meet the needs of the users, and they are also easy to use or user-friendly. The possible reason for the low score of web page uploading function was because the uploading component applied for this system cannot support the uploading of files by means of the directory of data file (folder). As a result, files can only be uploaded one by one and this has caused inconvenience. The low score may also be due to the insufficient web page production ability of students. This led to mistakes in the access paths for several linkage files after the uploading of the web page and resulted in the frequent web page display problems. This may well be the reason for the low appraisal of this particular function by the users.

On average, 85.84% of the users regard the overall functions of the WBLP system appropriate and easy to use. Only 1.5% regard the system functions as inappropriate. Such results reveal that the six major functions of the system have met the needs of the users very well. Of course, it may also be because that most users are not very familiar with the full functions or operations of portfolio and hence did not demand that much from the system. As a matter of fact, we also believe that there is much room for improvements, such as: improving the automatic computing and statistics functions of the scores for self-assessment, peer assessment, and teacher assessment. Figure 2 shows the distribution of means for student agreement percentages in WBLP system functions.

Table 3: Percentages and means of student agreement in WBLP system functions

System Functions	Percentages of Agreement (%)					Means
	5	4	3	2	1	
Portfolio Browse						
1.1 Operation illustration is clear and easy to understand	50	37	13	0	0	4.37
1.2 Provide the search method that meets the needs	40	37	23	0	0	4.17
1.3 Popdown menu provides convenient searching method	50	43	7	0	0	4.43
1.4 Appropriate and convenient method to browse students' portfolios by means of student names	57	40	3	0	0	4.53
1.5 Appropriate and convenient method to browse by means of the titles of the works	53	43	4	0	0	4.50
1.6 Appropriate and convenient method for selecting portfolio contents	30	60	10	0	0	4.20
1.7 Appropriate and convenient method for browsing contents of portfolio	33	60	7	0	0	4.27
1.8 Appropriate and convenient method to fill out the feedback opinions of the peers	43	43	14	0	0	4.30
Portfolio Creation						
1.9 Operation illustration is clear and easy to understand	43	43	14	0	0	4.30
1.10 Appropriate and simple method for filling in learning goals	50	37	13	0	0	4.37
1.11 Upload method of course works is appropriate and easy to use	33	50	14	3	0	4.13
1.12 Filling-in method be appropriate and easy to use for self-reflection and assessment records	47	43	10	0	0	4.37
1.13 Personal basic information be appropriate and easy to set up and maintain	53	40	7	0	0	4.47
1.14 Upload method for personal web page files be appropriate and easy to use	30	20	30	17	3	3.57
Portfolio Guide						
1.15 The information provided helps portfolio production	30	60	10	0	0	4.20
Portfolio Discussion Board						
1.16 Provide convenient and appropriate discussion environment	27	50	23	0	0	4.03
Portfolio Bulletin Board						
1.17 The information announced helps my understanding of this course	43	43	10	4	0	4.27
Portfolio Suggestion Board						
1.18 Provide appropriate and convenient opinion communication and feedback channel	47	37	16	0	0	4.30
Total Mean	42.17	43.67	12.67	1.33	0.17	4.27

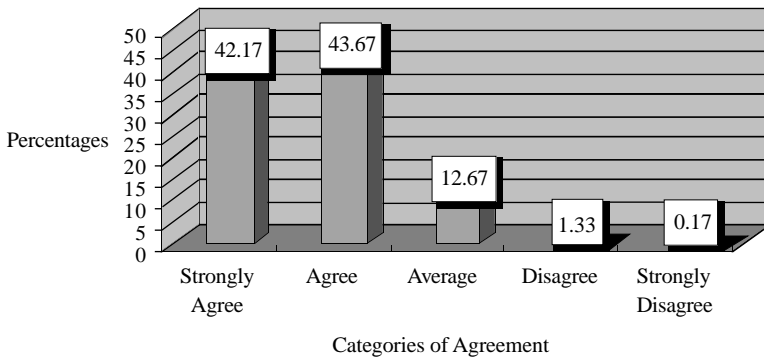


Figure 2: The distribution of means for student agreement percentages in WBLP system functions

Screen and interface design

Table 4 reveals the four evaluation items of the system in terms of screens and interface. The agreeability mean of the users is also quite high at above 4. We did not find any one disagreeing. Based on the results of our survey, we may deduce that the appropriateness in terms of the overall framework, the overall configuration of colors and background, the overall layout of screen and window design, and overall interface operation method, has high appraisals. Also, the appraisal of the appropriateness of screen design, and ease of use of the interface operation both score highly and evenly.

On average, 80% of the users regard the system screen design to be appropriate and interface easy to operate. Only 11.63% regard it as mediocre and only 0.38% of the users thought it inappropriate or not easy to use. We shall pursue a better system regardless of the these favorable survey results. Figure 3 shows the distribution of means for student agreement in WBLP system screen and interface design.

System use

The aspect of system use are shown in Table 5 Items 3.1–3.7. The means of are between 3.0 and 3.57. We can tell that the users tended to browse more (mean over 3.5) in terms of the works of courses and personal web pages when they were browsing the portfolio contents of the other classmates. This might have happened because in order to finish the work within the limited time, students did not have much time nor effort to browse through others' portfolios except for the works of peers for which may be emulated to improve the quality of their own works.

Items 3.8 and 3.9 concern the feedback of teachers (57%) and peers (53%). There were 57% and 53% respectively of users who sometimes browse teachers' and peers' feedback. Most of the users had browsed this part (all the means are higher than 4) for the purpose of understanding others' suggestions and opinions, so that they might improve accordingly. Nevertheless, there were still a few users (9% and 10% respectively) who did not care much about teachers' and peers' feedback. This revealed there were some students who lack motivation to discover the opinions of teachers and peers.

Table 4: Percentages and means of student agreement in WBLP screen and interface design

Screen and Interface Design		Percentages of Agreement (%)					Means
		5	4	3	2	1	
2.1	The overall framework and operation levels of the system are clear and smooth	37	47	16	0	0	4.20
2.2	The overall configuration of color and background is normal and harmonious for the system	33	47	20	0	0	4.13
2.3	The overall screen layout and window design of the system is appropriate	43	43	14	0	0	4.30
2.4	The overall interface operation method is appropriate and easy	47	47	6	0	0	4.40
2.5	Portfolio Browse interface is clear and easy to operate	40	47	13	0	0	4.27
2.6	Portfolio Browse screen design is appropriate	30	67	0	3	0	4.23
2.7	Portfolio Creation interface is clear and easy to operate	37	43	20	0	0	4.17
2.8	Portfolio Creation screen is appropriate	33	50	14	3	0	4.13
2.9	Portfolio Guide interface is clear and easy to operate	30	57	13	0	0	4.17
2.10	Portfolio Guide screen is appropriate	40	50	10	0	0	4.30
2.11	Portfolio Discussion Board interface is clear and easy to operate	40	53	7	0	0	4.33
2.12	Portfolio Discussion Board screen is appropriate	30	67	3	0	0	4.27
2.13	Portfolio Bulletin Board interface is clear and easy to operate	30	60	10	0	0	4.20
2.14	Portfolio Bulletin Board screen is appropriate	27	53	20	0	0	4.07
2.15	Portfolio Suggestion Board interface is clear and easy to operate	40	50	10	0	0	4.30
2.16	Portfolio Suggestion Board screen is appropriate	47	43	10	0	0	4.37
Total Means		36.5	51.5	11.63	0.38	0	4.24

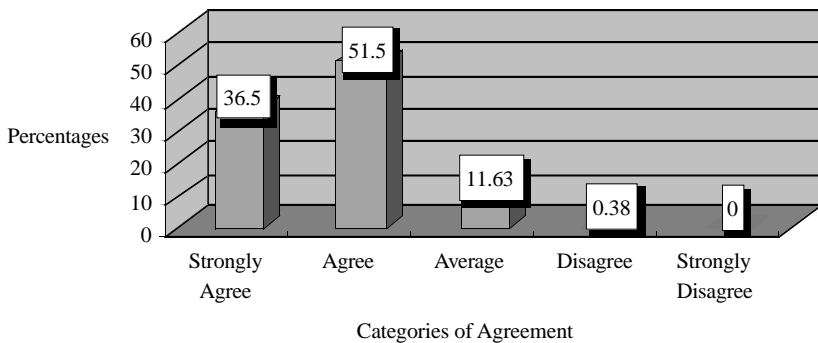


Figure 3: The distribution of means for student agreement in WBLP screen and interface design

In terms of creating personal portfolio (Item 3.10), over 90% of the users would browse the relevant information (mean = 4.27) in the guidance area prior to their creating personal portfolio. This shows that the guidance information was useful for this task. Most of the users expressed the view that the production of personal portfolio had been a time consuming and difficult task for them (Item 3.11: those who agree or very much agree comprise a total of 44%, compared with the mean of 3.37). However, some students (23%) disagreed. As for ease of writing the statement of learning goals, self-reflection, self-assessment, and peer-assessments, (Items 3.12–3.14), there was little disagreement among users. Each comprises of about $\frac{1}{3}$ of the total, and the mean is only a little greater than 3. This shows that although some students might not have found it difficult to work on personal portfolio, other students might have found it somewhat difficult to do so. Among the three, work on self-reflection and self-assessment records was more difficult than work on learning goals and feedback opinions of peer students.

Also, in terms of the other functional areas of the system, as many as 84% of the users often browsed the information (the mean of Item 3.17 = 4.33) in the *Portfolio Bulletin Board* thus justifying the facility. However the means of agreeability for Item 3.15 *Portfolio Discussion Board* and Item 3.16 *Portfolio Suggestion Board*, are both under 3.0. This shows that the users were not motivated to engage in the discussion or to give feedback opinions. This result might not be due to the improper functions of the system itself, but caused by the later debut of *Portfolio Discussion Board* (it came out only one week prior to the evaluation). Therefore, the users did not have the time to get acquainted with it and to use it. In addition, the lack of appropriate discussion themes or the mechanism to initiate the discussions might also be responsible for the result. In reflecting on these results, we do need to consider the issues of how to increase the motivation and the interest of users in the *Portfolio Discussion Board* and the *Portfolio Suggestion Board* so that they use it effectively for the opinion feedback and expressions of the issues.

Turning to the overall performance of the system use (Table 5): on average, 48.3% of the users perform very well while 20.47% of the users do not perform well in this area. 31.82% of the users regard themselves as ordinary in terms of system use. The low total mean 3.44, reflects the fact that the status of system use appears to be rather low. This average for system use is lower than the previous items of system functions, screen and interface design (Table 3 and Table 4). This shows that even if the system is a rather good one, the users may still encounter other practical difficulties in using it. These difficulties might be the key factors decreasing the successful possibility of portfolio assessment and indicate an issue worthy of further research and investigation. Figure 4 shows the distribution of means of student agreement percentages in WBLP system use.

Impact on learning process

Because the *Discussion Board* came out only about one week prior to the evaluation the insufficient understanding and use of its function has resulted in the means of Item 4.16 (the articles of *Portfolio Discussion Board* enhance my growth in learning) and

Table 5: Percentages and means of student agreement in WBLP system use

System Use	Percentages of Agreement (%)					Means
	5	4	3	2	1	
3.1 I have browsed the learning goals of most of my classmates	14	20	53	10	3	3.30
3.2 I have browsed the course works of most of my classmates	17	33	40	10	0	3.57
3.3 I have browsed the self-reflection and assessment records of most of my classmates	7	23	47	23	0	3.13
3.4 I have browsed the teacher feedback of most of my classmates	3	27	50	13	7	3.07
3.5 I have browsed the peers' feedback opinions of most of my classmates	7	30	37	20	6	3.10
3.6 I have browsed the personal basic information of most of my classmates	7	37	37	16	3	3.27
3.7 I have browsed the personal web page of most of my classmates	20	37	24	16	3	3.53
3.8 I have browsed the feedback opinions from my teacher	57	17	27	6	3	4.17
3.9 I have browsed the feedback from my peers	53	20	17	7	3	4.13
3.10 I would browse the relevant information within the <i>Portfolio Guide</i> prior to my portfolio production	47	43	4	3	3	4.27
3.11 Portfolio production is a time consuming task and with much effort	20	24	33	20	3	3.37
3.12 It is easy to write learning goals	20	20	33	20	7	3.26
3.13 It is easy to write self-reflection and assessment records	17	20	30	20	13	3.08
3.14 It is easy to write the feedback for peers	10	33	33	20	4	3.25
3.15 I enjoy participating in the discussions of <i>Portfolio Discussion Board</i>	3	17	33	40	7	2.70
3.16 I enjoy leaving messages in <i>Portfolio Suggestion Board</i>	7	27	33	27	6	3.00
3.17 I often read the information in <i>Portfolio Bulletin Board</i>	57	27	10	6	0	4.33
Total Means	21.53	26.77	31.82	16.29	4.18	3.44

Item 4.17 (the feedback on the *Portfolio Suggestion Board* have been helpful for me to overcome the difficulty in producing personal portfolio) are both less than 4 (3.83 and 3.87 respectively). As for the other 23 items of survey, the agreeability mean is greater than 4, and most users are either agree with the statement or very much agree with it. The means of 6 items (Item, 4.12, 4.18, 4.19, 4.20, 4.24, 4.25) are above 4.5, and 90% of the users regard them very helpful for their learning.

From the survey results, it appears to be that most of the users agree that this system has been helpful for their learning process or learning outcomes, and thus have come out with positive appraisal for this system. As for the questions regarding whether the

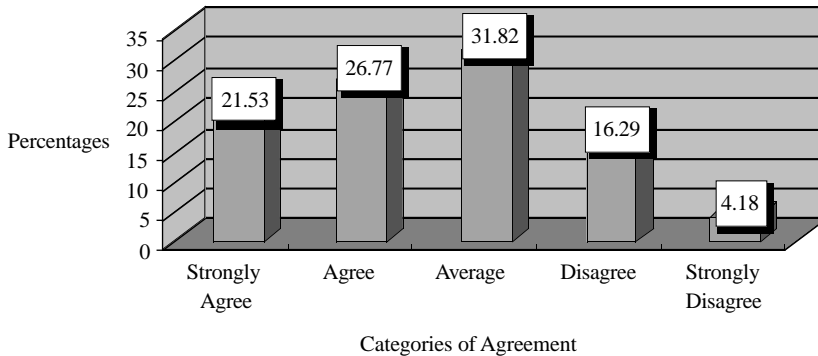


Figure 4: The distribution of means for student agreement percentages in WBLP system use

browsing of other students' portfolio, learning goals, works, basic information, personal web page, etc. may help them in some way (Items 4.6 to Item 4.14), most students regard that it has been most helpful for them to browse other students' works. The mean for this question is as high as 4.53. 93% of the students feel that the quality of their own work can be improved by emulation through the browsing of others' works (Item 4.12). 94% said that it helps to understand the merits and shortcomings of other students' learning by browsing other students' portfolio (Item 4.8). 97% of the users said that browsing other students' portfolios enhances their own academic growth and improvement (Item 4.8). All these survey results revealed that the use of portfolio has really helped the users in learning.

The most positive feedback comes out in terms of the overall benefit in using this system (from Item 4.18 to Item 4.24), most of the students agree that by using this system, it helps them to better understand other students' learning achievements (the mean for Item 4.18 = 4.67), allowing them to obtain the feedback and suggestions of other students (mean for Item 4.20 = 4.57), and learning benefit from the portfolio (mean of Item 4.24 = 4.67). All of the users regard it useful to utilize the portfolio to get to know the learning achievements of other students (Item 4.18). 97% regard it helpful to obtain the feedback and suggestions of other students through this system (Item 4.20). 97% of the users said that using this system helps them to learn the course (Item 4.24).

One very interesting phenomenon is the response to Items 4.19 and 4.20 (whether using this system helps them to obtain the feedback from teachers, mean = 4.53—or from the other students mean = 4.57) where the results show that this system has been more useful for them to obtain the feedback from other students than from their teachers. We deduce that one of the reasons may be that students generally have higher expectation for feedback from teachers. Or it may be that the content of teachers' feedback is not as much as that from other students since the teachers have to feedback to all students while the students only need to feedback to a few selected peers. The

results reflect the fact that the feedback from other students has been helpful for them and has thus become a necessary component to help them in learning.

Table 6: Percentages and means of student agreement in WBLP impacts on learning process

Impacts on Learning Process	Percentages of Agreement (%)					Means
	5	4	3	2	1	
4.1 Set up learning goals may help with the direction in self-learning	27	53	20	0	0	4.07
4.2 The uploading and gathering of course works helps to reveal my genuine learning outcomes	37	60	3	0	0	4.33
4.3 The writing process for self-reflection and assessment records help me to grasp and reflect on genuine learning process	37	53	10	0	0	4.27
4.4 Teacher feedback helps me to reflect on my merits and shortcomings in learning	53	40	4	3	0	4.43
4.5 The feedback from peers help me to reflect on my merits and shortcomings in learning	47	43	7	3	0	4.40
4.6 Browsing classmates' portfolios helps me to reflect on the merits and shortcomings in my learning	47	43	7	3	0	4.33
4.7 Browsing classmates' portfolios helps me to understand the merits and shortcomings of my classmates in learning	47	47	3	3	0	4.37
4.8 Browsing my classmates' portfolios helps me to grow and improve in academic achievements	38	59	0	3	0	4.31
4.9 Browsing my classmates' portfolios helps to motivate me for the learning of this course	43	50	7	0	0	4.37
4.10 Browsing my classmates' portfolios helps me to increase the communication and exchanges with my classmates	37	43	17	3	0	4.13
4.11 Browsing classmates' learning goals helps me to understand classmates' work effort, and thus enhances that of my own	57	33	7	3	0	4.43
4.12 Browsing my classmates' works helps to upgrade the quality of my works	63	30	4	3	0	4.53
4.13 Browsing my classmates' basic information helps me to understand my classmates better	50	33	14	3	0	4.30
4.14 Browsing my classmates' personal web page helps me to better understand my classmates and thus enhances relationships with them	40	40	13	7	0	4.13
4.15 The information in <i>Portfolio Bulletin Board</i> helps me to better understand this course	57	33	7	3	0	4.43
4.16 The articles of <i>Portfolio Discussion Board</i> help my academic growth	17	57	20	6	0	3.83
4.17 The message feedback in <i>Portfolio Suggestion Board</i> helps me to solve the problems that I have encountered in portfolio creation	30	43	10	17	0	3.87

Table 6: Continued

Impacts on Learning Process	Percentages of Agreement (%)					Means
	5	4	3	2	1	
4.18 It helps me to know about the learning outcomes of my classmates by using this system	67	33	0	0	0	4.67
4.19 It helps me to know about my teacher feedback and suggestions by using this system	63	27	10	0	0	4.53
4.20 It helps me to know about my classmate feedback and suggestions by using this system	60	37	3	0	0	4.57
4.21 It enhances my interactions and exchanges with my classmates by using this system	40	47	7	6	0	4.20
4.22 It helps me to better understand my growth and improvements in the course by using this system	44	43	13	0	0	4.31
4.23 It helps me to better understand the growth and improvements of other classmates in this course by using this system	43	40	14	3	0	4.23
4.24 It helps me to learn this course by using this system	70	27	3	0	0	4.67
4.25 I hope to use this system in other courses as well	60	33	7	0	0	4.53
Total Means	46.96	41.88	8.4	2.76	0	4.33

88.84% of the users feel that the system has been helpful in their learning process and outcome. Only a small percentage, 2.76% think otherwise. This shows that the implementation of portfolio truly helps most of the students in academic growth and improvement with great efficiency. Thus it has created a positive impact on the learning process and outcome. Figure 5 shows how the WBLP impacts on learning process.

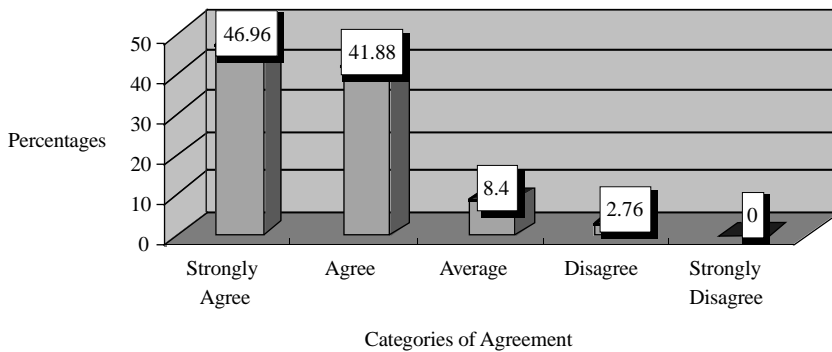


Figure 5: The distribution of means for student agreement percentages in WBLP impacts on learning process

Of the four major evaluation aspects, the appraisal of impact on learning process is the highest (mean = 4.33). The next high is screen and interface design (mean = 4.27) followed by system functions (mean = 4.24) and the status of system use (mean = 3.44). Except for the last of these, the students have high regard for these aspects. This reveals that in spite of the good WBLP system used, users may still encounter difficulties in practical use, such as time factor and Internet communication speed, etc. This affects the motivation of the students in using this system. To learn from this result, teachers should give much more encouragement to their students, and pay more attention to the difficulties that the students may come across in the implementation process of future portfolio assessment. Figure 6 show the distribution of means for student agreement in four major evaluation aspects of WBLP system.

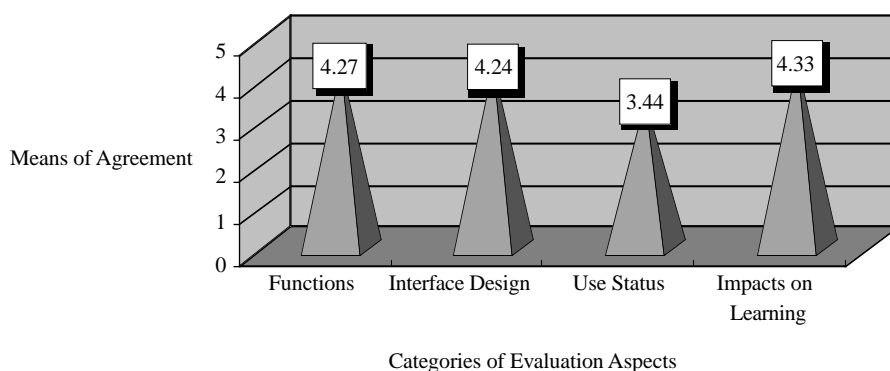


Figure 6: The distribution of means for student agreement in four major evaluation aspects of WBLP system

Results of user in-depth interviews

After analysing the results, we conducted in-depth interviews with 5 users (who were chosen randomly from the students who had been taking the course) to deduce or conclude a few important user opinions or suggestions.

Looking at system function, some students regard the uploading of web page information as inconvenient because it has to be handled one file at a time. They suggest that the method should be improved so as to upload a data folder containing several files or to provide FTP uploading in order to facilitate the process. Some students suggest that we should increase the functions of *Guest Book* for expressing personal feelings and comments. This would allow students to share their feelings or experiences in terms of course learning or portfolio production. The searching of *Portfolio Browse* area may use the multi-key method for cross searching.

On the subject of system use status, some students noted that sometimes they used the WBLP system via the Internet by dialing-up at home. Due to the limited bandwidth of the web and slow information access, this had led to the rather time-consuming

effort for browsing the works of the course. File uploading was not only slow, but also failed in many cases. The charge for Internet connection service might also affect their willingness to use the system. Also, for those students who were without a computer at home or without Internet service, the use of this system tended to be difficult for them since they had to rely on the web access for all the related activities including the handing in of homework, and relevant curriculum information, etc. In addition, most students had shown much higher interest in browsing other students' works and web pages, and their motivation was higher during the process of producing their homework.

In terms of the impact on learning process, most students regard the overall design of the WBLP system as good. They are able to get to know other students' learning processes, learning experiences, and thus enhance their learning of the course through their browsing. The WBLP system provides the gathering and browsing to access to other students' works, and thus allows one to get to know better about his/her merits and shortcomings. Some students feel that to set up learning goals may help them prepare themselves for individual learning direction. However, there seems to be no direct evidence reflected through our assessment standard to support the assumption that such a learning goal set up may help them in terms of assessing their final learning results. Its real purpose and function seems to be ambiguous. In addition, introspection and self-assessment help to review the process of students' learning or producing their works. It would allow the students to discover the areas that they may improve. Maintaining such a reviewing process enhances learning.

Results of expert evaluation

Once the system was established, we invited three experts (including a portfolio assessment expert, an Internet technology expert, and the course instructor) to use it. They were interviewed one week later. In this way we obtained the valuable opinions and suggestions of these experts.

Their responses to the questions of "Whether the contents of this WBLP system are appropriate?" and "Is there any shortcoming or inappropriateness?" indicate that the contents have met the basic needs of portfolio, but may still include some interesting materials to motivate students to use it. The contents may include interesting stories and funny events, etc. that could be shared among students in classroom or on campus. Also, the relevant literatures or interesting briefing information gathered, etc. may also help to enrich the contents of portfolio. The experts also point out that the contents of this system tend to be "teacher or instructor-directed" in its method, and lack the students' voluntary participation. Another suggestion is that inter-disciplinary curriculum or other courses may also be introduced for the future in addition to this course of "Computer and Instruction."

The experts were asked about the functions that this WBLP system might provide (such as *Portfolio Creation*, *Portfolio Browsing*, *Portfolio Guidance*, *Portfolio Discussion Board*, *Portfolio Bulletin Board*, *Portfolio Suggestion Board*, and *Student Data Maintenance*, etc.),

and further questions such as “Is there any way that the unique features or functions of portfolio can be much more manifested?” and “Which component or area needs to be improved most?” Some felt that the system management could be improved by enhancing the mechanism to support teachers’ assessments for students’ works and portfolios. It may also incorporate the relevant functions of automatic recording and statistics computing to assist in teaching and student assessments. One expert suggested that the searching method during portfolio browsing, should not only follow the titles of the works, but also may adapt to follow the contents of each item in the portfolio: that would increase the methods of “according to learning goals”, “according to students”, “introspection and assessment records”, “according to the feedback opinions of teachers”, and “according to the feedback opinions of peers”, etc. Another suggestion is that one portfolio assessment area including its score computing mechanism may be developed to provide the relevant self-assessment, peer-assessment, and teacher-assessment functions such as: production of on-line assessment tables by the teacher, self-assessment and mutual-assessment tables of students, automatic score recording and statistics computing, etc.

When being asked about “whether the screen and interface design of this WBLP system is appropriate and convenient to use?” and “which area or component needs to be improved?” the experts’ feedback suggested that the overall configuration of screen design and page layout is appropriate, the method of interface operation and use is rather simple and easy to use, but the explanations found in some of the guidelines of portfolio production could be more articulate to facilitate comprehension. Also, the showing of curriculum works has been too slow in pace, thus affecting the smooth flow of students’ browsing.

The experts were asked: “whether this system has been helpful for students’ learning and teachers’ teaching?” “Is it possible to provide an effective and appropriate portfolio production and browsing environment in order to allow both the teachers and the students to better understand the genuine learning processes and results of students?” Some felt that the system provides the opportunity for gathering students’ works for emulation among the peers. Consequently, the practice will certainly enhance the results of student learning. The introspection and self-assessment records would allow the teacher to understand students’ prerequisite ability better, as well as the practical issues or problems that students have encountered, and also students’ achievements in learning. This will help attain the goal of being more objective in student assessments, and it will also help the teacher to adjust his or her teaching method in the future. Some experts point out that the materials that students have presented via this WBLP system are mainly their final completed works, and that processes of such productions in terms of gathering and demonstration should also be incorporated, thus demonstrating the production processes. Finally, the system has to improve its management functions in terms of supporting teachers performing on-line assessments for students’ works, and to track the status of students through on-line records and statistics.

When asked “whether there are any other issues or areas that have not been mentioned but need to be improved?” one of the experts mentioned that the presentation of

self-reflection could be improved, and that what the students need to reflect is not limited to their work. There should be actually other learning items or activities involved during the process. Illustrations and guidance are also essential in the process of the WBLP implementation. The overall impression of the WBLP system seems to emphasize the presentation and management of portfolio itself, and lacks an assessment component. Some experts even suggest the possibility of adding an on-line assistant mechanism to moderate the discussions of *Portfolio Discussion Board* or to answer questions regarding portfolio production. This will help to release the teachers' burden in using the system. The mechanism of credit accumulation for using the WBLP system may also be developed to encourage students' mutual assessments, browsing others' works, introspection records, or discussion. Those students who participate actively in the said activities could be entitled to extra-accumulated credits, thus motivating their participation.

Revision of the WBLP system

Summarising the results of the user and expert evaluations, we can see that the various functions and services provided by the WBLP system have met the basic features and needs of portfolio. The appropriateness of system functions and the easy to use in system interface operation have also won the recognition of most users. We also have positive feedback for its impact on students' learning process and results. Given the limited time and manpower of this research, there are still some areas worthy of further revisions and improvements:

1. The contents of portfolio can be more varied in nature, such as the adding of school events, interesting stories, relevant literatures, multimedia data presentation, etc. Also, we need to allow students' voluntary participation and encourage autonomy in deciding and choosing the contents of their portfolios.
2. The presentation of introspection, assessment, and feedback records may be differentiated according to their categories in terms of student works, student numbers, etc. or according to the order of first come first served. It should also provide functions for revisions or deletions for introspection and assessment.
3. The illustrations and guidance information of *Portfolio Guide* shall be clearly differentiated into different categories. Further guidance and illustration concerning portfolio creation and production are necessary.
4. The functions of *Portfolio Discussion Board*, *Portfolio Bulletin Board*, and *Portfolio Suggestion Board* should be differentiated in order to clarify their different natures and functions, and to make them directly relevant to portfolio, so as to offer the information and help needed for portfolio creation and production.
5. The development of a *Portfolio Assessment* functional area to provide the assessment form for teachers' on-line production and a peer assessment form for student use. The function of automatic score computing and showing statistics data may also be developed, thus facilitating the supporting functions for teachers' and students' portfolio assessment work.
6. The supporting functions of portfolio creation and production should also be enhanced. There should be improvements for uploading files and new supportive on-line production functions of multiple data sources such as: simple picture drafting,

linkages and registrations of newspaper web pages, edition of literatures and briefing information, etc.

7. During the implementation of portfolio assessment, it is necessary to enhance the introspection and presentation of student work in progress, in terms of the learning process or course of learning. The presentation should not be limited to learning results or the featuring of a completed work.
8. In order to enhance the interactions between system and users, it is necessary to improve the interface design and presentation of the screens in the system and thus to make it more lively and vivid.

Conclusions and future works

The purpose of this evaluation is to ensure that the WBLP system has attained its original purpose and goals of development. It was also meant to provide an understanding of the appropriateness of Web-Based Learning Portfolio (WBLP) in terms of its functions in the system. We also tried to understand the efficiency and simplicity in screen and interface design. Other issues concerning system implementation and use as well as its impact on students' learning have also been discussed. The survey data will serve as the reference and basis for further improvements of this system.

The portfolio assessment is meant to help the teacher and students' genuine understanding of the individual learner learning process and outcome, and thus to enhance the feedback and interactions among teachers and students. Furthermore, it helps students to get to know the merits and shortcoming in his/her own learning, together with the difficulties and problems involved, and thus promote the integration of teaching, learning, and assessment.

The results have led us to realise that there is still room for improvement in spite of the fact that it has shown appropriateness in WBLP functions, screen design and interface operation, and system use. Most users and experts agree that it is easy to use, the overall functional framework is completed, it has met its original design purpose, etc. The WBLP system has not yet established a complete mechanism for assessment and grading/scoring, such as teacher and peers' scoring in the *Portfolio Browse* area (the feedback function has now been established). The dynamic management functions for supporting users are yet to be improved. This area of improvement includes: teachers' on-line production of assessment forms for teacher assessment, and student self-assessment and peer-assessment, and allowing teachers and students to use the forms for teacher-assessments or student-assessments. The teachers may thus conduct assessments and compute scores, relevant statistics and search data. We may carry out further research and investigation for this in the future. Then will we be able to extend the WBLP to a more powerful system that can truly support the assessments and auto-management work (such as portfolio browsing record analysis, credit accumulated mechanism, peer assessment mechanism, etc.).

The evaluation does not include the experiment study of system use efficiency. In order to evaluate the efficiency of system use, there are other variables yet to be controlled

and considered such as the users' Internet application ability, modes of system implementation and use in teaching, extent of teachers' participation, modes of teachers' guidance, and disciplinary differences, etc. All these factors might affect the efficiency of use. Furthermore, whether the use of web-based portfolio system will definitely enhance the features or functions of portfolio in terms of self-regulated learning, self-directed learning, enhancing the ability for self-reflection, encouraging learning motivation, etc. are all the interesting issues worthy of our further research and verification. Therefore, we will conduct the relevant future experiment study in terms of the practical applications in teaching and learning efficiency for web-based portfolio system.

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