A Meta-Language for Portfolio Assessment

Yasuhiko Morimoto[1], Maomi Ueno[1], Nobuyoshi Yonezawa[2], Setsuo Yokoyama[3], Youzou Miyadera[3]
[1]*Nagaoka University of Technology, 1603-1, Kamitomioka, Nagaoka, Niigata 940-2188, JAPAN*
morimoto@mis.nagaokaut.ac.jp, ueno@kjs.nagaokaut.ac.jp
[2]*Kogakuin University, 2665-1 Nakano, Hachioji, Tokyo 192-0015, JAPAN*
ct72058@ns.kogakuin.ac.jp
[3]*Tokyo Gakugei University, 4-1-1, Nukuikita, Koganei, Tokyo 184-8501, JAPAN*
yokoyama@u-gakugei.ac.jp, miyadera@u-gakugei.ac.jp

Abstract

This paper examines accumulation methods for effective use of portfolios and develops a meta-language ("MelaPass") for describing the framework of portfolios for making a portfolio assessment. The purpose of MelaPass is to describe the structure of portfolios which have "soundness" and "exhaustiveness" features, and the language can be used in cooperation with existing meta-models (i.e., it has an "affinity" feature). The paper also develops a portfolio assessment support system called "Passports" that is based on MelaPass. By using this system, users can design portfolio assessments based on MelaPass and use and manage portfolios.

1. Introduction

Portfolio assessment is receiving increasing attention as the ideal method of educational evaluation for teachers making authentic assessments of students. It has come to be mostly used as an evaluation method in performance assessments. Moreover, the use of "Electronic Portfolios" (also called "Digital Portfolios") in which the portfolio is saved electronically is spreading with the computerization of the education system [1].

Recent years have seen the development of systems for treating electronic portfolios. (see, for example [2]-[5]). Although these systems support creation of electronic portfolios, portfolio accumulation, and others on a computer, they have a problem in that the support they offer cannot be easily connected to a portfolio assessment. In other words, although the system can accumulate portfolios, teachers can't actually use the accumulated portfolios to carry out a portfolio assessment. Moreover, such systems cannot share or refer to portfolios which are accumulated on different systems.

On the other hand, although some modelings in the educational field have been made as E-learning has spread, there is no modeling for portfolio assessment. For example, Morimoto *et al*. developed the meta-language (*MelaTep*) for describing teaching plan documents [6]. However, *MelaTep* does not have a framework that describes learners' portfolios. Moreover, there are PAPI Learner [7] and IMP LIP [8], which are meta-models about learner information. Although each model has a framework to specify data models which are relevant to the learners' portfolios, it is difficult for teachers to make a sufficient portfolio assessment by only using the model.

The aim of this study is to define a standardized framework for describing the structure of portfolios required for the portfolio assessment, and to develop a portfolio assessment support system.

This paper examined portfolio accumulation methods with an eye to effective use of portfolios, carried out "formalization" of a framework that describes a portfolio structure suited to making portfolio assessments, and developed a meta-language, based on Formal Language, for portfolio assessment (We call it "*MelaPass*": Meta-language for Portfolio Assessment). In this paper, "formalization" means to generalize rules which describe the structure of portfolios for the assessment and expresses them by using formal language. The significance of the formalization is to describe the structure of portfolios which have "soundness" and "exhaustiveness" features and to make easy development of the processing system which treats the portfolios mechanically.

We also developed a portfolio assessment support system whose operation is based on *MelaPass* (We call it "*Passports*": Portfolio Assessment Support System based on *MelaPass*). In this paper, we mainly describe the development of *MelaPass*.

2. Present Problems

In recent years, there have been studies on systems treating electronic portfolios (see, for example [2]-[5]).

Although these systems can accumulate portfolios, it is almost difficult to use effectively matching the accumulated portfolios with portfolio assessment (Problem (1)).

Moreover, since there is no standard framework for portfolio assessment, users of these systems cannot share/refer to the accumulated portfolios of other systems (Problem (2)).

Teachers need to build their own framework for making portfolio assessments (In this paper, we call this work *portfolio design*). Sharan *et al*. gave eight guidelines for *portfolio design* [9]. Jasmine divided *portfolio design* into seven steps and explained them [10]. Thus, although teachers must make a unique *portfolio design* for each

Proceedings of the IEEE International Conference on Advanced Learning Technologies (ICALT'04)
0-7695-2181-9/04 $20.00 © 2004 **IEEE**

learner, corresponding to the learning contents and the learning environment based on an instruction plan and an evaluation plan, it is rather difficult for teachers to make an adequate *portfolio design* with their intention, by using the existing systems (Problem (3)).

Therefore, since the existing systems cannot coordinate the different portfolio assessment activities i.e., design, use (registration, editing, browsing and so on), management, and others, it is difficult for teachers to carry out portfolio assessment activities based on their *portfolio design* (Problem (4)).

Although some meta-models for the educational field exist, these are not meta-models for portfolio assessment, and it is difficult to carry out a portfolio assessment with them (Problem (5)).

3. Requirements for solving problems

To solve the five problems pointed out in the previous section, it is necessary to satisfy the following requirements.

(1) To have a framework which promotes effective use of portfolios by connecting accumulated portfolios and the assessment using them according to the methods of accumulating portfolios. (Corresponds to Problem (1))
(2) To describe the structure of portfolios under a standard framework so that portfolios can be mutually shared/referred to between different systems. (Corresponds to Problem (2))
(3) To support teachers in designing the portfolios which they desire. (Corresponds to Problem (3))
(4) To support the use of portfolios, such as registration, editing, browsing, selection, deletion and others, according to the learning situation. (Corresponds to Problem (4))
(5) To support development of rubrics and promote the learners' self-assessment, assessment of others, and reflections. (Corresponds to Problem (4))
(6) To support management of portfolios. (Corresponds to Problem (4))
(7) To make a standard model of portfolio assessments. (Corresponds to Problem (5))

To satisfy these requirements, we examined accumulation methods that make possible effective portfolio assessments.

By examining different accumulation methods, generalizing rules that describe portfolios for portfolio assessment, and defining *MelaPass* as a meta-language for portfolio assessment, *MelaPass* has a standard framework for describing the structure of portfolios for accumulating portfolios that will be used in making an assessment. That is, the accumulated portfolios based on *MelaPass* are used effectively for portfolio assessments (this satisfies Requirement (1)), and evaluators can share/refer to the portfolios of different systems (this satisfies Requirement (2)).

Requirements (3)-(6) can be satisfied if we have a system to carry out design, use, and management of the portfolio assessment according to rules based on *MelaPass*. The portfolio assessment support system (*Passports*) is designed, therefore, with these requirements in mind. For a given teacher evaluation plan, *Passports* can automatically determine portfolios needed for the portfolio assessment according to the rules of *MelaPass*, and supports the teacher's *portfolio design* (this satisfies Requirement (3)). Since the *portfolio design* follows the rules of *MelaPass*, *Passports* will help the teacher to carry out the evaluation activities, reflection activities, and others based on the *portfolio design* (this satisfies Requirements (4) and (5)), and carry out unified management of portfolios (this satisfies Requirement (6)).

Moreover, the development of *MelaPass* satisfies requirements (7) in itself.

4. *MelaPass*

4.1. Specifications of *MelaPass*

In the development of *MelaPass*, the following features have to be considered.

- Soundness
  This feature can describe the consistency of intentionally accumulated portfolios by defining the structure of portfolio assessment as a systematic grammar.
- Exhaustiveness
  Since portfolios considered for assessments (henceforth, we call them "portfolio items") are carefully selected and formalized, this feature can describe all portfolio items that may be used for making an assessment.
- Affinity
  This feature can be coordinated with existing meta-models and has prospective extendibility.

4.2. Steps in the Development of *MelaPass*

MelaPass was developed in two steps.

1) We compiled data to be included in portfolios from books, papers, documents, and other sources, consulted with teachers, and selected those items for making a portfolio assessment. (see 4.3)
2) We clarified rules for correlating the items selected in Step 1 and formalized the framework for describing the structure of portfolios required for the assessments; we expressed it in extended BNF notation. (see 4.4)

4.3. Selection of Portfolios

Although some references discuss the portfolio items for making an assessment, they are not consistent in their recommendations [9]-[14].

Our evaluation data consisted of books (11 volumes), papers (10 papers), lessons (23 lessons), and related articles (8 articles). We grouped these into items for the "Learner Portfolio" or for the "Teacher Portfolio" (see Table 1 and Table 2).

Table1. Items in Learner Portfolio.

Items	Examples of Information and Data
Tasks	Learning Exercises, Assignments, Performance test, Teacher-made test and others.
Learning Logs	What learner learned, What learner investigated, What learner presented, Learner's thoughts and questions, Short objective description records about learning, such as a diary, etc.
Problem Solving Logs	Records of processes of problem solving activities
Reflective Journals	Reflective writings, Subjective reflection records of comments, opinions, etc.
Goals	Goals of learning, Ability and nature of learning, and others.
Rubrics	Rubric, Standard, Checklist and others, which is criteria for evaluation (assessment).
Self-evaluations	Records of self-evaluation.
Others-evaluations	Evaluation and advice from teachers, friends, family, specialists, etc.
Planning Notes	Learning Schedule, Outline of learning, and others.
Anecdotal Records	Observation records of spontaneous activities, and records containing important occurrences in the form of short texts.
Systematic Records	Records about occurrences/actions in intentional situations. For example, experiments in science, investigative learning, etc.
Interview Records	Records of Interview, Conversation, Disclosure, and others.
Works	Work Samples, Learning Products, Reports, Writings, Performances, Homework, Computer Programs, Videotapes, Audio tapes, Web sites, Graphic organizer, etc.
Collecting Materials	Prints, Copies, Photos, Information on the WWW (Computer Printouts, URL etc.), Clippings, Handouts, and others.
Images	Photos, Graphics Files, Animated Files, and others.
Learning Materials	Learning materials, Art samples, and others.
Conference Notes	Summaries of various issues raised in Portfolio Conference, such as time and contents, etc.
Narrative Reports	Memo, Comments from teacher, family, etc., and others.
Personal Information	Name, School, Class, Number, Self-introduction, Various records, such as data a showing their abilities, etc.
Portfolio Information	ID, Creation time, Creation place, Title of the portfolio, Explanation of the portfolio, Letter to readers.

Table 2. Items in Teacher Portfolio.

Items	Examples of Information and Data
Purposes	Purposes of learning, Aim of learning, and others.
Rubrics	Rubric, Standard, Checklist and others, which are criteria for evaluation (assessment).
Teaching Plans	Teaching plans, Instructional design, and others.
Evaluation Plans	Evaluation Plans, Evaluation methods, and others.
Teaching Materials	Teaching Materials, Printouts for learners, and others.
Tasks	Learning Exercises, Assignments, Performance test, Teacher-made test and others.
Scaffoldings	Concrete support for Scaffoldings for learners, questions, advice, and others.
Self-evaluations	Records of self-evaluation.
Others-evaluations	Evaluation and advice from coworkers, learners, learners' families, local people, and specialists.
Performance Records	Records of classes, activities, and other records.
Communication Records	Communication records with coworkers, learners, learners' families, and others.
Narrative Reports	Memo and other reports.
Teaching Settings	Description about the school, learners, coworkers, educational environments, and other settings.
Personal Information	Name, Affiliation, ID, Information about individuals, such as training record, and work history.
Portfolio Information	ID, Creation time, Creation place, Title of portfolio, Explanation of portfolio, Letter to readers.

4.4. Formalization

By clarifying the correlation of the portfolio items we had selected, we generalized the rules that describe their structure.

Bruke and Hart emphasized that process-records of how learners learned are as important as final learners' products [11], [12]. Bruke also pointed out that learners can carry out reflections, evaluations of other learners and self-evaluation as part of the learning process, and that records of these activities should be accumulated as learners' portfolios [11]. Barton and Collins proposed that the learning-product as a portfolio should include the purpose and records of reflection and an explanation about the portfolio [13]. Shores and Grace pointed out that photographs are suitable as learning process records [14].

We carried out formalization to describe the structure of portfolios in consideration of the previous sentence. Specifically, we defined a grammar for expressing the framework with the extended BNF notation like defining a grammar of a programming language (Figure 1.).

In the formalization, each portfolio has meta-information on the portfolio for every minimum unit of record. Rubrics contain purposes and criteria of assessment and are essential to the Teacher Portfolio. Based on the rubrics, learners carry out self/others' evaluations (if needed, learners can create their own rubrics). Therefore, this formalization has rubrics included in the self/others' evaluations. Moreover, it includes records for self-evaluations, evaluations of others, and reflections in all the portfolios relevant to the learning processes and learning products. The portfolio about the learning process can contain images explaining the portfolio. Thus, by defining the structure accumulated combining portfolios required for evaluation activities, evaluators can use the accumulated portfolios effectively for their portfolio assessment.

For example, when accumulating <LearningLogs> as a portfolio, <Self-evaluations>, <Others-evaluation>, and <ReflectionJournals> are accumulated with <ProcessRecords>, which is an element for recording the learning process. <Self-evaluations> consists of <Rubrics> and <Records>, which is an element for recording actual, and <Rubrics> consists of [PortfolioInfo], <Goals> and <Criteria>. Furthermore, <Criteria> consists of [Descriptor] and [Indicator]. Moreover, <MelaPass> has <MetaData>, <TeacherPortfolios>, and <LeanerPortfolios>. Meta-information recorded on <MelaPass> has compatibility with *MelaTep* (see [6] and [15]).

The description grammar shown in Figure 1 describes the accumulation structure of portfolios. We expect the cooperation between the accumulated portfolios and the evaluation method that is attained by adding both relations to the description format as a semantic description (we call this "Evaluation Semantics"). These evaluation semantics will be discussed in a later publication.

<MelaPass>:=<MetaData><TeacherPortfolios>+<LearnerPortfolios>*
<TeacherPortfolios>:=({<Purposes>}<Rubrics>{<TeachingPlans>}{<EvaluationPlans>}{<TeachingMaterials>}{<Tasks>}
{<(Scaffoldings>){<PerformanceRecords>}{<CommunicationRecords>}{<NarrativeReports>}{<TeachingSettings>}<PersonalInfo>}+
<LearnerPortFolios>:=({<PlanningNotes>}{<LearningMaterials>}{<LearningLogs>}{<ProblemSolvingLogs>}{<AnecdotalRecords>}
{<SystematicRecords>}{<InterviewRecords>}<Works>{<CollectingMaterials>}{<ConferenceNotes>}{<NarrativeReports>}<PersonalInfo>)+
<Purposes>:=<Records>+, <TeachingPlans>:=<Records>+, <EvaluationPlans>:=<Records>+, <TeachingMaterials>:=<Records>+
<Tasks>:=<Records>+, <Scaffoldings>:=<Records>+, <CommunicationRecords>:=<Records>+,<NarrativeRecords>:=<Records>+
<TeachingSettings>:=<Records>+, <PlanningNotes>:=<Records>+, <LearningMaterials>:=<Records>+
<PerformanceRecords>:=(<Self-evaluations><Others-evaluations><ReflectionJournals><ProcessRecords>)+
<LearningLogs>:=(<Self-evaluations><Others-evaluations><ReflectionJournals><ProcessRecords>)+
<ProblemSolvingLogs>:=(<Self-evaluations><Others-evaluations><ReflectionJournals><ProcessRecords>)+
<AnecdotalRecords>:=(<Self-evaluations><Others-evaluations><ReflectionJournals><ProcessRecords>)+
<SystematicRecords>:=(<Self-evaluations><Others-evaluations><ReflectionJournals><ProcessRecords>)+
<InterviewRecords>:=(<Self-evaluations><Others-evaluations><ReflectionJournals><ProcessRecords>)+
<Works>:=(<Self-evaluations><Others-evaluations><ReflectionJournals>{<Tasks>}<Records>)+
<CollectingMaterials>:=(<Self-evaluations><Others-evaluations><ReflectionJournals><Records>)+
<ConferenceNotes>:=(<Self-evaluations><Others-evaluations><ReflectionJournals><ProcessRecords>)+
<Self-evaluations>:=(<Rubrics><Records>+)+, <Others-evaluations>:=(<Rubrics><Records>+)+
<Rubrics>:=([PortfolioInfo]<Goals><Criteria>+)+, <Criteria>:=([Descriptor]{[Indicator]})+
<ReflectiveJournals>=<ProcessRecords>+, <Goals>:=<Records>+, <ProcessRecords>:=(<Images>*<Records>)+,
<Images>:=<PortfolioInfo><Contents>+, <Records>:=(<PortfolioInfo><Contents>+)+, <Contents>:=(PCDATA | [Target-file]+)
<MetaData>:=[Title][Language][Descripton][Maker][Date][Data-type][Aggregation-level][Resource-type][Grade-Class][Subject]
<PortfolioInfo>:=[ID][DateTime][Environment]{[Topic]}[Comments]{[Letters]}
<PersonalInfo>:=[Name][ID][School][Grade-Class]<Items>*, <Items>:=[Item]+
<*>: Non-terminal node, [***]: Terminal node, {***}: Omit-able node, +: Repetition of one time or more, *: Repetition 0 times or more**

Figure 1. Description grammar of *MelaPass.*

```
<ReflectiveJournal>
  <ProcessRecords><ProcessRecord>
  <Records><Record>
  <PortfolioInfo Process= “Working” Secret=”No” >
  <ID>student001</ID>
  <DateTime>2003-06-01T14:14:53</DateTime>
  <Environment>Interview in Fudouin Temple</Environment>
  <Topic>Preparation of Interview</Topic>
  <Comments> Records of Reflection </Comments>
  </PortfolioInfo>
  <Contents>
  Although I went to Fudouin Temple to get answers to my questions, I
  had note of the intended contents of the interview. When forming a plan
  for an would ask. </Contents>
  </Record></Records>
  </ProcessRecord></ProcessRecords>
</ReflectiveJournal>
</ReflectiveJournals>
<Records><Record>
  <PortffolioInfo Process= “Permanent” Secret=”No” >
    <ID>student001</ID>
    <DateTime>2003-06-02T13:27:15</DateTime>
    <Environment>In the computer room</Environment>
    <Topics> Conclusion of investigation in the town of Ushita <Topics>
    <Comments>
    This is a file about what I investigated in Ushita. </Comments>
     <Letters> I investigated the history of Fudoin Temple. </Letters>
  </PortfolioInfo>
  <Contents>
    <Target-file digital=”Yes” Location=”Local” Path=”/users/abc/”>
      sougou001.ppt </Target-file>
  </Contents>
</Record></Records>
</Work>
</Works>
```

Figure 2. Example of the XML schema using *MelaPass.*

5. Implementation in XML schema

We implemented the description format in an XML schema, maintaining the structure between each entry in Figure 1 described by the extended BNF notation. Therefore, these entries are used as tags of the XML schema. In this way, the following benefits can be expected and affinity is guaranteed.

- The defined grammar can be faithfully expressed by using tags corresponding to accumulated portfolios.
- A general-purpose application independent of platforms can be realized by treating the XML schema as an intermediate information expression.
- Cooperation is possible with meta-models implemented in an XML schema, because of the standard expression method.

An example of the XML schema using *MelaPass* is shown in Figure 2. We call XML data based on *Melapass* “*MelaPass*-instance.”

6. Portfolio Assessment Support System based on *MelaPass* (*Passports*)

We will develop a portfolio assessment support system whose operation is based on *MelaPass* (“*Passports*”: Portfolio Assessment Support System based on *MelaPass*).

6.1. Use Case

All people related to learning, i.e., teachers, students, and families, are targets of the system.

The use case assumes three kinds of action: “Design”, “Management”, and “Evaluation.”

“Design”
- Carry out *portfolio design* <Design>
- Revise *portfolio design* <Revise>

“Management”
- Register (Record) portfolios <Register>

- Browse portfolios <Browse>
- Edit portfolios <Edit>
- Delete portfolios <Delete>

"Evaluation"
- Create/revise Rubrics <Rubrics>
- Carry out Self-evaluation <Self-evaluation>
- Carry out Others-evaluation <Others-evaluation>
- Carry out Reflection <Reflection>

6.2. Functions

Section 6.1 indicates that the system should have the following four functions.

Design Support Function

The function defines the structure of portfolios for making a portfolio assessment, and it is used by teachers to *design portfolios*. By specifying items interactively according to the display of the system, they make the design and create a *MelaPass*-instance.

Management Support Function

The function is used to register, browse, edit, and delete portfolios. Users can easily do this work by specifying interactively according to the display of the system.

Evaluation Support Function

The function facilitates the creation of rubrics, the self-evaluation, others-evaluation and reflection. Users can easily do the evaluation work interactively according to the display of the system.

Database Management Function

Using the database, the function manages *MelaPass*-instances and real portfolios (digital files etc.), registers them in the database, and reads-out/updates them. Moreover, it performs user authentication and controls the portfolio according to information provided in the portfolio.

6.3. System Configuration

The system has a client part on the user side and a server part, and consists of four subsystems (Figure 3). We used Java (Servlet, Beans, JSP) as the development language and used MySQL as the database.

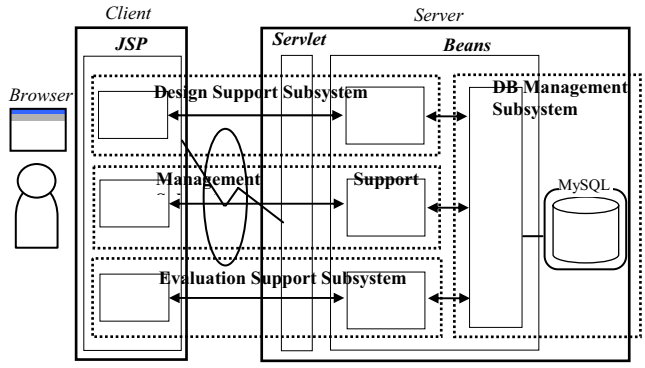

Figure 3. System Configuration.

7. Conclusion

We examined accumulation methods for effective use of portfolio assessment to formalize a framework for describing the structure of portfolios required for portfolio assessments, and developed *MelaPass*, which is a meta-language for portfolio assessment. Portfolios required for the assessment are described according to a standard accumulation structure by using *MelaPass*.

We also developed *Passports*, which is a support system for making portfolio assessments. By using this system, users can coordinate a series of activities to design portfolios based on *MelaPass*, manage portfolios, and control portfolios.

In the future, we are going to raise the quality of support for portfolio assessment by adding evaluation semantics to *MelaPass* and evaluate *Passports*.

This study is supported in part by the Grant-in-Aid for Scientific Research(c)(2)(No.14580210) From the Ministry of Education, Culture, Sports, Science and Technology of Japan.

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