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Building an e-Portfolio with a learning plan centric approach[#]

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Abstract: A portfolio records achievements in the personal growth process. A personal development e-Portfolio assists an individual in planning his/her development path and reflecting upon his/her own learning. In this article, we propose an approach to constructing a personal development portfolio. An abstract information model is presented to support such a portfolio. The information model is proposed based upon and according to IMS standards. The use of this approach is illustrated by way of a prototype e-Portfolio system. The usage scenario and limitations of such a portfolio are also discussed.

Key words: E-Portfolio, Educational technology system, Lifelong learning
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1 Introduction

Learning may happen anytime and anywhere, consciously or unconsciously. A person's mind may be triggered by watching an occurring event, participating in discussions or activities, reading, or simply listening to others. It is always a difficult task to measure what a learner has learnt or achieved, especially when it occurs to skills and knowledge that are beyond the curriculum. However, such skills in communication, collaboration with others, learning, etc. are frequently looked for when one is looking for a job. Managing learning in these aspects is thus an important process in whole person development (Kwok and Chan, 2009).

Outcome-based learning (Harden, 1999) is a learning paradigm that focuses on defining the learning outcomes at the beginning of the learning process, designing the curriculum and linking its associated learning activities to the defined outcomes, and measuring achievements of students according to the defined learning outcomes. Although outcome-based learning is initially considered for these courses with a set of definite goals, it does provide a structured approach for the whole person development of a student, which refers to the development of a variety of skills and knowledge beyond regular courses. The challenge of such a process lies in not only the provision of a structured approach, but also a structured template with great flexibility to organize work from students at different times and places, for reflection and assessment.

Portfolios have been used in certain disciplines, including education, to organize and present works, to provide a context for discussion, review, and feedback from teachers, mentors, colleagues, and friends, and to demonstrate progress and accomplishments over time (Barker, 2006). Traditional paper-based portfolios are bulky and hence not readily portable or accessible when needed. In contrast, electronic portfolio systems can be used to organize artifacts in different media to demonstrate what a student has achieved.

In this paper we discuss the situations where current e-Portfolio implementations do not meet the requirement of whole person development, explain how the concepts of learning design may help, propose a new approach to building a portfolio to record

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the whole person development, and illustrate the usage of the system with examples.

2 Review of current e-Portfolio systems

2.1 Whole person development

Setting learning goals, planning learning activities, executing the learning plan, and reflecting on the learning outcomes are essential parts of personal development. A learner sets up learning goals and plans a series of learning activities to achieve the goals. After the plan is executed, a learner adjusts the goals and refines the plan based upon reviewing and reflecting on one's own learning.

Personal development can be regarded as a learning process of a person. According to Kolb's experiential learning theory (Kolb, 1984), learning is not conceived in terms of outcomes. Learning is an experience-based continuous process that requires interaction between a learner and the environment. Knowledge is created through the interaction that resolves the conflicts between abstract concepts and concrete experience under certain situations. For example, two persons may experience the same issue differently when the issue occurs in different situations. In other words, different persons participating in the same learning activity may have different kinds of learning experience. However, this does not necessarily mean that the learning experience of a person is immutable. Learning experience may be mutated when some situations apply to it. That is to say, learning is not a single execution process. The learning process, according to Kolb (1984), "can be described as a four-stage cycle involving four adaptive learning modes—concrete experience, reflective observation, abstract conceptualization, and active experimentation".

The learning process cycle according to the experiential learning theory is visualized in Fig. 1, where abstract concepts are transformed into concrete experience through experimentation in certain situations. Concrete learning experience is gathered and transformed into new abstract concepts through reflection and observation. To apply this theory to personal development, an example from the Quality Assurance Agency for Higher Education (QAA), UK is shown in Fig. 2. From the QAA guidance (QAA, 2009), abstract conceptualization refers to the process of identifying learning goals and creating development plans. Through executing the plan under different learning situations, concrete experiences and achievements are obtained, based on which reflection and observation are carried out to identify new learning needs.

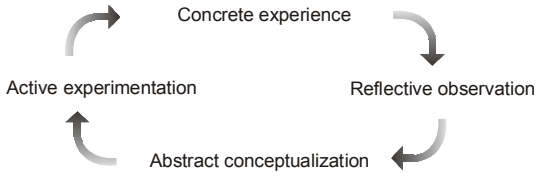

Fig. 1 Experiential learning cycle

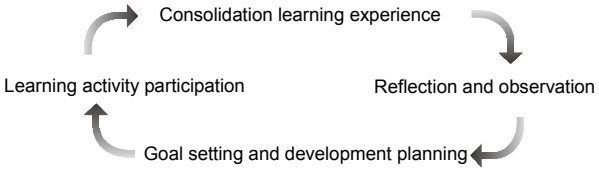

Fig. 2 Personal development cycle

2.2 The learning process represented in knowledge space

Knowledge space theory is a mathematical framework to model knowledge using set theory (Doignon and Falmagne, 1999). A piece of knowledge or concept in a specific domain is an item in the universal set of knowledge. A knowledge state represents the subsets of items in some domains that an individual has already acquired. For instance, a teacher prepared a set of questions, where the questions are either correct or incorrect, to ask a student; the knowledge state of the student is the set of questions that the student can solve. A learning process can thus be regarded as a transition from one knowledge state to another (Fig. 3). In Fig. 3, U is the universal set of knowledge of all domains. Before any learning process, an individual has already acquired a set of knowledge of a domain. The set of acquired knowledge is regarded as subset A (which may be an empty set). After a learning process, the individual either acquires another set of knowledge in another domain regarded as subset B or expands subset A to subset A′ within that domain. The knowledge subset acquisition and expansion are not mutually exclusive.

It is possible that someone expands a subset of knowledge in a domain and also acquires another subset of knowledge in another domain. The result after the learning process depends on the ability of the individual and the design or setting of the learning process. A chain of knowledge states is a learning path of an individual (Doignon and Falmagne, 1999; Korossy, 1999).

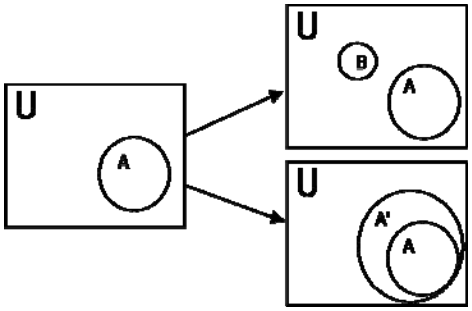

Fig. 3 Transition from one knowledge state to another which defines a learning path

Aligning to experiential learning theory, a subset of knowledge is the concrete experience that an individual has acquired. A single transition involves reflective observation based on the acquired subsets of knowledge, formulating abstract concepts from the reflection and observation, and carrying out the active experimentation in life. In other words, learning objectives and action plans are derived at the beginning of the transition while concrete experience is obtained after the transition.

2.3 Categories of current e-Portfolio systems

As quoted in Stefani *et al.* (2007), Snadden *et al.* suggested that a portfolio intends to "contain material collected by the learner over a period of time", and that "the portfolio is the learner's practical and intellectual property relating to their professional learning and personal development … the learner takes responsibility for the creation and maintenance of the portfolio and if appropriate, for presentation of the portfolio for assessment". The materials collected are related to an individual's personal development like transcripts, recognitions, and certificates. There are different definitions for an e-Portfolio varying according to the context of use. Electronic portfolio generally refers to a digital form of physical portfolio that documents individual learning and personal development. A highly profiled definition of e-Portfolio was suggested by Educause NLII in 2003 that an e-Portfolio is "a collection of authentic and diverse evidence, drawn from a larger archive, that represents what a person or organization has learned over time, on which the person or organization has reflected, and designed for presentation to one or more audiences for a particular rhetorical purpose" (IMS GLC, 2005a). Strictly speaking, an e-Portfolio is a particular perspective of the personal development archive for a specific context for which the portfolio is in use. There are some example contexts:

'Assessment e-Portfolio' aims to demonstrate an individual's learning outcome by relating evidence to certain defined learning objectives. The assessment is made based on defined rubrics (IMS GLC, 2005a). It is used for assessing the degree of learning.

'Presentation e-Portfolio' is used to show an individual's learning, achievement, and recognition to anyone in general (IMS GLC, 2005a). It can be in any form and the most common one is a resume.

'Learning and development e-Portfolio' is a lifelong portfolio, which helps to document, guide, and advance an individual's learning over time. There are planning and reflection modules (IMS GLC, 2005a). A personal development portfolio is one of this type. According to QAA (2009), personal development planning (PDP) is defined as "a structured and supported process undertaken by an individual to reflect upon one's own learning, performance and/or achievement and to plan for their personal, educational and career development".

2.4 Identifying the essential elements of learning

As described in earlier paragraphs, an ideal learning process requires knowing the acquired subset of knowledge, reflection, observation, objective identification, planning of learning and finally undertaking the learning. It is obvious that recording every piece of information in the learning process will assist the design of the next iteration of learning. The learning process and the experience acquired provide the base foundation to undertake reflection and observation.

E-Portfolio systems are most likely integrated in a learning management system like Moodle (http://moodle.org), Sakai (http://sakaiproject.org), and Blackboard (http://www.blackboard.com). They may be able to record some of the essential elements to design the next learning process, e.g., reflection and

observation, objective, the learning activity, and the learning outcome. However, some shortcomings exist in these systems. First, a learning process may contain one or more learning activities. Although the knowledge states of an individual in a particular timestamp may be reflected by the time-axis in the recordings of learning activities and learning outcomes, there is no facility to reflect the gain of pieces of knowledge of an individual based on a learning process. Further, these systems lack a process model to record the learning process as a whole to assist the reflection, observation, and objective identification. More importantly, existing systems may not have an approach to assisting the planning of the next learning process directly, which influences the quality and outcomes of learning.

3 The proposed e-Portfolio system

3.1 Design rationale

The design of the proposed e-Portfolio system should be able to support a systematic but flexible information structure, facilitating a dynamic planning and reflective process for the development of an individual. The portfolio not only shows the static evidence of achievements of a person but is also required to demonstrate the person's growth. To facilitate turning such a portfolio development process into a learning experience, this design framework should consist of four parts matching the personal development cycle as stated earlier.

A portfolio should not only present a systematic collection of a learner's work but also include the progress of personal learning continuously. The design framework should incorporate the dynamic aspect of a portfolio reflecting various aspects of such a learning process. Learners may then assume responsibility for improving themselves through iterations of goal setting, action planning, activities participation, affirmation of achievements, self-reflection and refining the learning objectives. This process may help enhance their critical thinking and metacognitive capacity—they know what they know. Most importantly, their self-esteem could be enhanced through seeing their own growth (Ryan and Deci, 2000). The dynamic portfolio process consists of four functions:

1. Setting the learning goals. There are different learning goals for different courses or learning activities. There are also different learning goals at different stages of personal development. It is important to set up clear goals at each stage.

2. Planning the learning process. Once the learning objectives are defined, there should be an action plan to achieve the objectives. The action plan involves defining a series of activities relevant to achieving the learning outcomes. Good planning enhances the quality of a learning process. Creating such a plan requires details of the learning activities. A list of activities and their details should be provided to facilitate planning. The action plan, finally, contains a set of learning activities that contributes to the learning process.

3. Recording the activities and linking achievements to learning goals. Details of participating in activities are recorded. The time dimension of the portfolio is maintained to demonstrate the personal development history. However, information about the impact of incidences on learners, the experience gained from an activity, the feedback from peers and teachers, and the reflection details during the whole process could be lost as a result of frequent updates. The collection of this formative evaluation can help learners to know how they learn, which is useful in planning their further development. An additional aspect is to allow learners to map achievements to activities and then to the learning goals of an action plan. This aspect reflects a learner's growth in a learning process.

4. Feedback and reflection. Besides portfolio content organization and the process audit, the proposed framework should allow external comments to be captured. Portfolio sharing and peer commenting are desirable features in the reflection process. Affirmations and comments from instructors and peers would boost learners' momentum for advancement.

3.2 Information requirements of a Portfolio

An information structure is defined to guide learners to organize their learning. There are several major entities in this structure: learner profile, learning goals, learning plans, learning activities, learning outcomes or achievements, and reflections.

The learner profile provides information on the identity, preference, hobbies, etc. of a learner.

Learning goals represent learning objectives of a learner in the form of a list of focused and achievable targets or attributes. These learning objectives can be achieved only by a series of learning activities and thus, a substantial amount of information depicted in the portfolio focuses on the participation of activities. Obviously, an activity is a visible act that is indispensable in a portfolio, but we should not neglect the importance of a learning plan in a portfolio. As mentioned above, a well-organized learning plan will probably drive an effective learning process. It can reflect how much effort an individual will put into preparing his/her own learning and also reflect the relationship among learning activities in a learning process. Further, the actual evidence relevant to accomplishing a specific learning objective is the learning outcomes or achievements induced from the activities. It is important to distinguish an achievement from an activity, as the latter just provides an opportunity for the development of valuable attributes and perceptible contributions. The learning plan and achievement together help to prevent learners spending time on a lot of activities aimlessly without making any significant progress, as measured by both activities completed in the plan and achievement relevant to the objective of the plan. A plan should be time-bound while achievement could be a quantifiable performance of domain specific knowledge and skills, and generic skills. In consequence, the lifelong learning process of an individual becomes a stage-by-stage 'measurable' process.

In terms of information structure, each of the learning objectives in a plan should be connected to multiple instances of activities. Similarly, learners can benefit from an activity in more than one aspect. An activity may link to multiple achievements and thus form a networked path echoing back to individual learning objectives. Reflection is another important factor in learning. A list of activities and achievements or even the plan alone could give only a superficial account of efforts made by learners. In a reflective process, learners integrate their experiences in various activities and achievements to match their learning objectives and search for room for improvement. Reflection is one of the essential drives of the next learning process and it bridges the stages of the entire lifelong learning process aligning to the knowledge space theory.

3.3 IMS e-Portfolio information model

Interoperability among e-Portfolio implementations is crucial in building and organizing a lifelong archive. In 2005, IMS Global Learning Consortium released a specification for e-Portfolios, IMS-EP, to enhance the interoperability among e-Portfolio implementations (IMS GLC, 2005a). This specification extended the IMS-LIP information model (IMS GLC, 2001) and resulted in 18 types of generic portfolio data. This specification covered data requirements from different applications of the Educause National Learning Infrastructure Initiative (NLII) abstract e-Portfolio archive definition to include a wide range of personal development outcomes of academic and non-academic qualifications, and soft and hard skills. IMS also suggested an extensible markup language (XML) binding of the model so that different e-Portfolio implementations can import or export portfolio data with the suggested XML schema.

The IMS-EP information model consists of four major types of entities: learner profile relevant, learner objective relevant, learning activity relevant, and learning outcome relevant. These types of entities align to part of the information structure suggested in Section 3.5. One major reason for having this skewed alignment is that the construction of IMS-EP is based on the typical approach to constructing a portfolio.

A typical approach to constructing a portfolio requires an individual to define his/her learning objectives and decide the learning activities. Learning outcomes can be produced only after participation in learning activities. Records relating to learning activities, learning outcomes, and reflection will be recorded in an e-Portfolio as evidence of the achievement of the learning objectives. However, the learning plan is not included in this portfolio construction approach. According to the knowledge space theory, learning is a stage-by-stage process rather than simply a continuous process. A portfolio should be able to reflect one's growth at any stage of learning. Also, activities in a stage of learning indeed belong to a learning plan. They contribute to achieving certain objectives of the plan. Other advantages of including a learning plan in e-Portfolios have been discussed in Section 3.1.

The learning plan that links up different learning activities with the objectives is missing in the typical approach to portfolio construction; consequently,

most of the existing e-Portfolio implementations and the IMS-EP information model are missing the learning plan. It is obvious that a new approach to recording the learning process with e-Portfolios is worth considering.

3.4 Using learning design to represent a learning plan

Learning design is "the application of knowledge in designing a learning process or developing a unit of learning" (Koper, 2005). The philosophy of learning design is to record and reuse learning units designed by instructors, which represent knowledge about the learning flow in a learning unit, learning objects in a learning environment for an activity performed by a role, and the objectives of the learning unit. Any learning unit can be designed based on certain knowledge or rules. The rules can be represented as: If learning situation *S*, then use learning design method *M*. The meaning of the components in the rule can be illustrated by the following scenario when designing a learning course: "When learning a new language, the best approach is to present various common situations (e.g., transacting business in a shop or a hotel) and define different tasks for students to perform in that situation" (Koper, 2005). The learning situation *S* is 'learning a new language' while the learning design method *M* is 'present various common situations and define different tasks for students'. By having a set of rules, the design of any learning unit can be regarded as a look-up process in which the if-cause of rules is matched.

The learning design concept can also be applied to the learning plan development of a learner. A learning plan includes a learner's objective, based on which the learner plans a learning process containing a number of learning units or activities. Here, the rule for developing any learning plan can be represented as: If learning objective *O*, then use learning unit *U*. When a learner identifies his/her own learning needs, he/she can find a set of units that may help attain the objectives. He/She later organizes the learning units in a certain order of execution and then starts to execute the plan and achieves learning outcomes. Assessment and reflection will be made based on a learner's learning experience. As a result of assessment, a learner enters a new knowledge state of knowledge space theory. A learner may refine or set up new learning objectives iteratively and design a new plan for further development.

Each learning plan represents a stage of learning while a collection of learning plans can be organized as a chain of stages that forms a learning path of an individual. Constructing portfolios with the learning plan approach allows the demonstration of one's growth in a stage-by-stage learning path fashion that aligns to the design rationale and information requirement of the proposed e-Portfolio system. Also, it provides an opportunity for individuals to develop skills in relation to planning one's own learning and, consequently, allows individuals to practice self-direction and ultimately to become self-directed learners.

IMS developed a learning design information model (IMS-LD) in 2003 (IMS GLC, 2003). This model records the learning process as a unit of learning (UOL), which contains the flow of learning and related details (Fig. 4). Each learning design (i.e., UOL) has an Objective and the learning flow is modeled as a Method. The building blocks of a Method consist of three main types: Role, Environment, and Activity. The two Roles are either learner or staff. The Environment refers to a conceptual learning environment composed of learning objects and

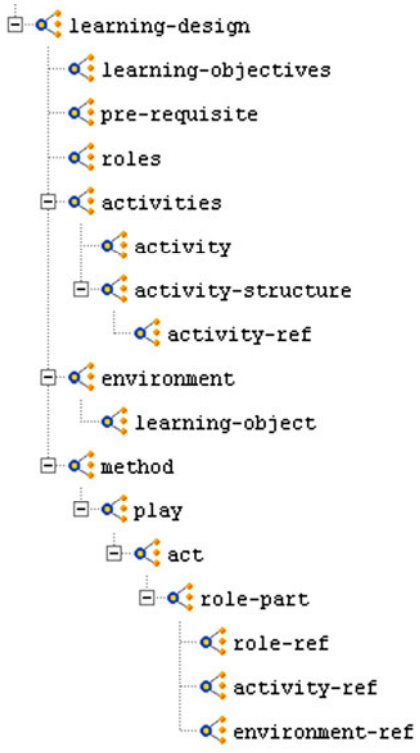

Fig. 4 Aggregation structure of a learning design (IMS GLC, 2003)

services that support the learning. The Activity is taken by a Role under a learning environment. An Activity can further be aggregated as an Activity-structure for complex learning unit design. The learning unit is designed to meet the learning objectives and consists of one or more teaching-learning processes, e.g., Play. In each teaching-learning process, a role performs a learning activity under a learning environment, leading to achievements in learning outcomes. The assessment of the degree of learning can then be undertaken.

An information model of a learning plan can be derived from IMS-LD (Fig. 5). A learning plan has several Objectives and the learning process of the plan is modeled as a Method conforming to the IMS-LD specification. The building blocks of a Method consist of Activity and Role. Although different types of Activity may deliver varying learning experiences, e.g., volunteering to organize an event versus sitting in a mathematics class, a generic Role, the learner, is used for all cases. Since IMS-LD allows the embedding of learning units as a package in any learning design, the design of the information model of a learning plan greatly utilizes this feature. An Activity mainly consists of several learning units which form an Activity-structure. These units are embedded into a learning plan structure and the Activity-structure refers to the unit packages. In contrast to a learning design, the environment is omitted as the learning environment is defined inside the embedded learning unit and it is not necessary to be repeated at the level of a learning plan. The learning process can be sub-divided and organized into several Plays, in which the order of execution of learning units is defined with the sequentially executed Acts. Each Act basically consists of a Role part.

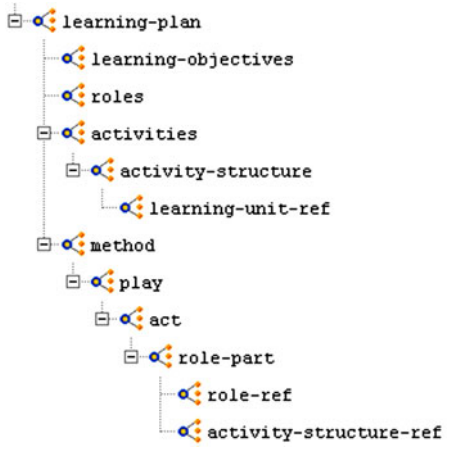

Fig. 5 Aggregation of a learning plan derived from IMS-LD

All in all, a learning process has several objectives to achieve while it is organized to have a certain execution order where learning units are consumed. A learner consumes a learning unit and thus possibly achieves the learning objectives.

3.5 Linking learning design to Portfolio

To use the learning plan approach to constructing a portfolio, we study the IMS-EP and IMS-LD in more detail. A learning design represents a particular learning plan in a learning path. Since UOLs are purely a conceptual design of a learning process, they do not contain physical data that an Activity in IMS-EP requires. To have a comprehensive data format for a portfolio containing learning paths, it is better to keep both entities with linkages. One way to connect two entities is to use the IMS-EP Activity definition field where the learning unit in the plan is referenced. IMS-EP Activity keeps the details of the activity while the learning unit aggregated by the IMS-LD Activity-structure keeps the execution order of activities. On the other hand, IMS-LD and IMS-EP use different learning objective formats. IMS-LD Objective uses the IMS-RDCEO specification (IMS GLC, 2002), which differs from IMS-EP Goal's definition from IMS-LIP (IMS GLC, 2001). Considering this, IMS GLC (2005b) provided an example to connect IMS-RDCEO and IMS-LIP Goal, and hence there is no conflict in linking the two models. Learning outcomes of UOL can be recorded as IMS-EP Product, and the assessment of UOL can be recorded as IMS-EP Rubric. The proposed information model for a learning plan oriented e-Portfolio is the result of linking IMS-EP and IMS-LD (Fig. 6).

To enable the linkage between IMS-LD and IMS-EP, IMS-LD (the learning plan) becomes part of the portfolio. Fig. 7 shows the semantic aggregation. The newly introduced entity LearningPlan extends PortfolioPart and LearningDesign. It is a UOL planned or designed by a learner, consisting of other UOLs designed by any institution or organization. LearningPlan is a truncated LearningDesign, since a learner needs only to design a learning process to achieve his/her own learning objectives and does not need to prepare such details as the learning environment and learning objects.

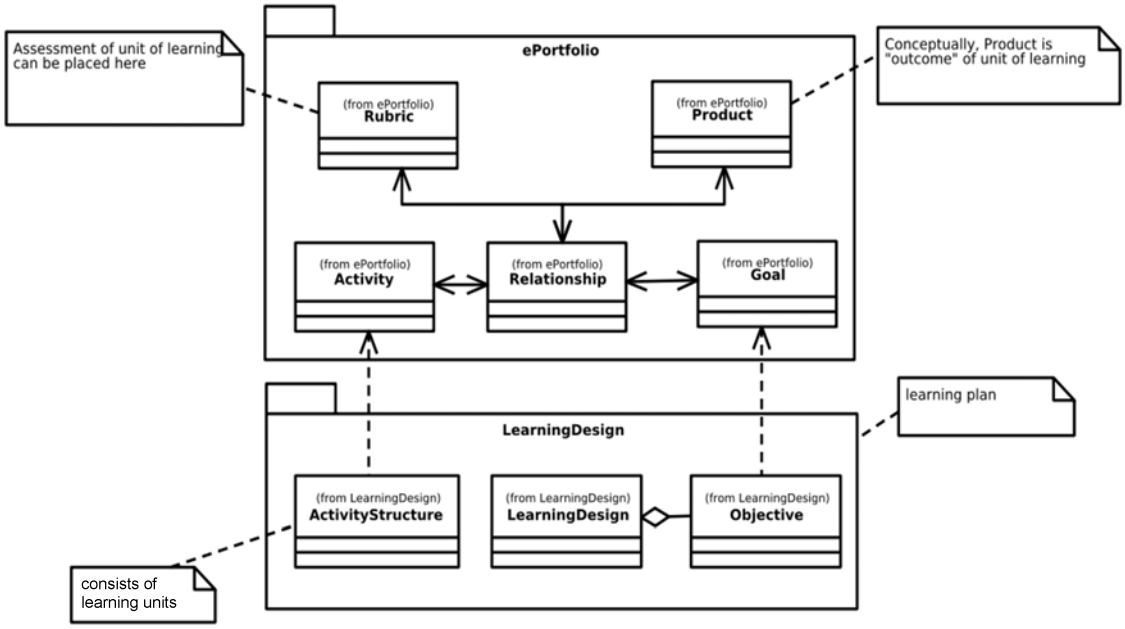

Fig. 6 The proposed information model for a learning plan oriented e-Portfolio linking IMS-EP and IMS-LD

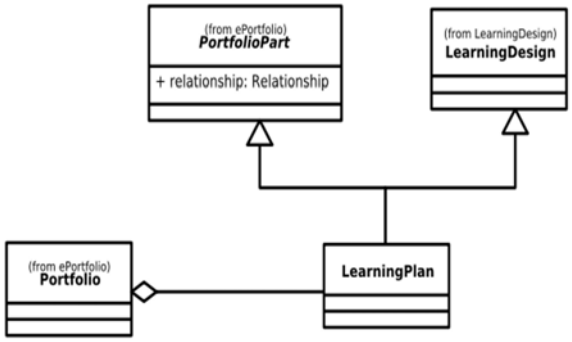

Fig. 7 Semantic aggregation of a learning plan extending PortfolioPart and LearningDesign

In addition to semantic aggregation, relationships between LearningPlan and other PortfolioPart must be maintained (Table 1), conforming to the IMS-EP specification. Product resulting from learning activities can provide evidence on the learning experience of the plan. Meanwhile, Rubric can be used to evaluate or assess the learning experience of the plan. The meaning of the relationship among PortfolioPart can be found in the IMS-EP specification (IMS GLC, 2005a) and thus is not repeated here.

3.6 Packaging the Portfolio and learning plan

The content packaging model is the foundation of IMS-EP. The changes inside the information model must also be extended to the content packaging model. The only change extended to the packaging model

Table 1 Relationships between LearningPlan and other PortfolioPart

	LearningPlan	Product	Rubric
LearningPlan		Supports	Uses
Product	Evidences		
Rubric	Evaluates		

The first column represents the source, and the first row the destination

is the newly introduced LearningPlan entity. As a result, new item type and resource type for the LearningPlan entity are introduced to the package manifest (Fig. 8). In the packaging model, the learning plan package is represented as a resource in the manifest and embedded into the portfolio package.

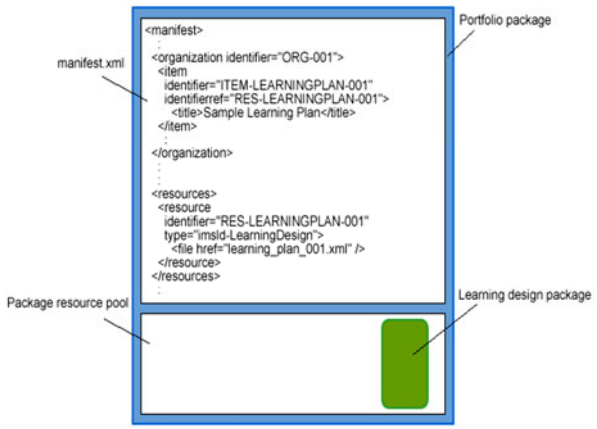

Fig. 8 Extended IMS-EP content package model

In addition to the learning plan package, units of learning are embedded as described in Section 3.5. As the information model of a learning plan is derived from the learning design information model (IMS-LD), the content packing model of the learning plan shares the same format as learning design.

3.7 Alternative model for the learning plan

Janssen *et al*. (2008a; 2008b) proposed a learning path specification that is similar to the concept of the learning plan proposed in this work. One of the rationales of their specification is to allow learners to follow a certain set of learning activities as steps to achieve a particular set of competencies. They used the term 'learning path' to represent the set of steps. This kind of learning methodology is quite close to the instructive learning model, which focuses on delivering learning plans to learners. In contrast, the learning plan model proposed in this work is constructive, focusing on helping learners to develop skills in relation to constructing plans according to personal needs. Nevertheless, Janssen *et al*.'s model may also be extended to work with the approach proposed in this paper since both models were derived from the concept of learning design.

4 Scenarios

A prototype Web-based e-Portfolio system was developed to illustrate the learning plan centric portfolio construction approach. Consider the case in which Alice, our learner, wants to enhance her English language speaking and writing abilities and at the same time maintain physical fitness. Alice may create a learning plan by checking out the intended learning objectives from the prototype system as shown in Fig. 9. A list of available learning units will be proposed to her based on the selected learning objectives (Fig. 10). These learning units are pre-defined activities in the format of IMS-LD, designed by various activity organizers. Alice may find the details of each unit, check out whether these units fit her own schedule, and add these units to her learning plan. During her learning process with this plan, records of learning activities participation with outcomes and assessment rubrics contribute to the rest of the portfolio related to this stage of learning. During or after the execution of a process, Alice may add self-reflection or receive peer comments in the system. By looking into previous stages of learning rooted by past learning plans, Alice further ascertains any room for improvement and prepares the next learning plan. The prototype system covers only learning unit and learning plan constructions as the entire scenario involves integration with course management systems or any like mechanism.

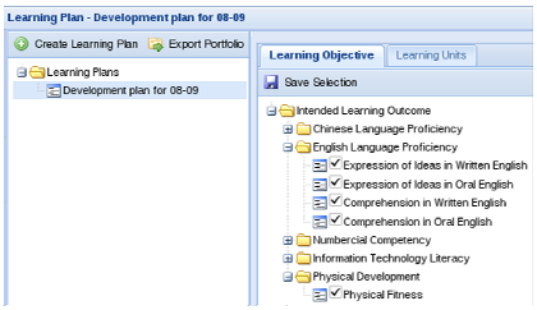

Fig. 9 Defining objectives in a plan

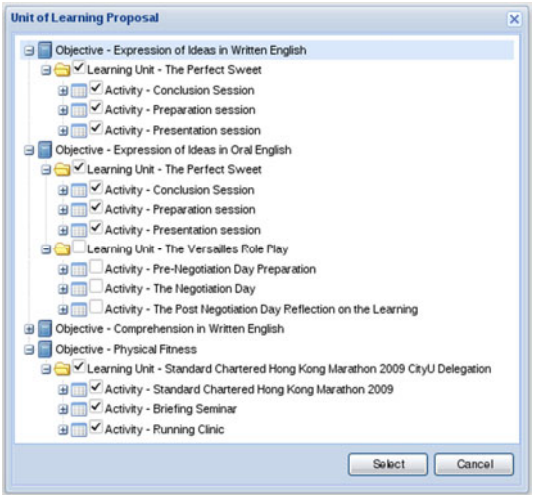

Fig. 10 Learning unit proposal

5 Discussions

There are several limitations in using the proposed learning plan centric approach to constructing e-Portfolios. They are:

1. The requirement of having a learning design repository. The design of a learning plan information model is derived from the IMS-LD information model. A learning plan embeds and refers to units of learning in the IMS-LD format. That is to say, the primary limitation of this approach is the requirement of having a learning design repository before a learning plan can be created.

2. The requirement of having a learning management system. From the design of the learning plan approach, a learning management system or any like system is also required to provide details of the learning plan like activity, learning outcome, and even mechanisms to receive comments from peers. This is a requirement shared with existing e-Portfolio implementations in which the e-Portfolio module is part of a learning management system.

3. The support of ordered execution of learning plans. In the learning plan information model, the sequence of executing the learning plans is not yet defined. Two or more learning plans can be executed in parallel or in sequence according to the view of a learner. This execution order of plans can be constructed in a sequencing model.

4. The support of incidental learning. Learning can occur anywhere and anytime. There is a case, incidental learning, in which learning does not require any planning. It is obvious that the proposed approach does not support recording incidental learning as a stage of the lifelong learning process. Learning can be recorded only after the activity.

Despite the limitations of the proposed approach in constructing the e-Portfolios, this approach encourages learners to plan their own learning by suggesting a structured and relatively simple method for constructing learning plans and then portfolios. Once more learners become self-directed and own their portfolios, they have a better chance to improve their learning by reflection. Institutions may help move in this direction by building a learning design repository adopting the IMS-LD. Such a process can be speeded up by converting existing course design using available techniques and tools (Chan and Kwok 2010). This learning design repository may also include the modeling of personal development activities in the form of a course design.

6 Conclusions

The current approach to e-Portfolio construction is focused on the outcomes or achievements, which is insufficient to assist the entire personal development process. In this paper we propose an approach to constructing personal development portfolios under the learning plan centric approach, which assists individuals in designing and planning their learning processes, resulting in a structured portfolio. The construction of such a portfolio is focused on designing the learning plan rather than collecting the outcomes only. An information model for this approach was designed and a prototype of the e-Portfolio system using this approach was implemented for illustration. By using the learning plan model in constructing personal development portfolios, individuals would find that the portfolio might align with the planned personal development process. Individual learning can be planned and visualized on a structured stage-by-stage path. A learner may then carry out learning activities according to the learning plans and reflect on the outcomes to identify weaknesses and room for improvement. The contributions of this article are: (1) introducing a learning plan centric e-Portfolio model using learning design, and (2) proposing an information model to bridge learning activities as a stage of learning to e-Portfolios.

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