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Incorporating Digital Badges and Ontology into Project-based Learning

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Abstract—The rapid development of technology makes learning goals much more complex, diverse, and keeping changing. In reality, each product of design must be 'ultimately particular', which complicates the holistic learning objectives of a technology training class in the school setting, and, in turn, it runs the risk of becoming disconnected in the minds of learners and teachers. In order to address this issue, a solution named DBOPBL (Digital Badges, Ontology & Project Based Learning) is put forward in this paper.

Keywords-digital badges; ontology; web2.0; project-based learning

I. INTRODUCTION

The project approach to learning is a method of teaching in which an in-depth study of a particular topic is conducted [1][2]. It integrates knowing and doing. Students apply what they know to solve authentic problems and produce results that matter. These cannot be taught in a textbook, but must be activated through experience" [3].

However, the rapid development of technology makes the learning goals much more complex, diverse, and continuing updated. Plus, the complicated real situation needs each product of design to be 'ultimately particular' [4], which complicate the holistic learning objectives of a class in school setting to greater extent and "run the risk of becoming disconnected in the minds of learners and teachers" [5]. In order to address this issue, a solution named DBOPBL that combines digital badges, ontology and project-based learning cycle is put forward to in this paper.

II. RELATED WORK

A. Digital Badges

Like physical badges, digital badges are emblems to give members to display the accomplishment of various achievements. In learning environments, digital badges could be used to encourage alternative, peer-based assessment [6], and function as transformative assessment that shape existing learning or allow new ones to be created [7] [8].

B. Ontology

"An ontology defines the basic terms and relations comprising the vocabulary of a topic area, as well as the rules for combining terms and relations to define extensions to the vocabulary" [9]. The four related features:

conceptualization, explicit, formal and share [10]. Some famous ontology systems or tools include WordNet [11], Protege [12] and Hownet [13].

C. Project-based Learning Cycle

Schwartz and his colleagues designed a project-based learning model called Star.legacy to organize the students' learning, in which students will obtain each learning objective progressively by experiencing a learning cycle including Generate Ideas, Multiple Perspectives, Research & Revise, Test Your Mettle and Go public [14] [15].

III. DIGITAL BADGES INFRASTRUCTURE BASED ON ONTOLOGY

From the definition of digital badges and ontology, some common points between them can be found:

- Both them have a directed graphic infrastructure, which includes nodes and relationships between nodes.
- For both them, the nodes in the graph could represent the concepts in the knowledge structure.
- For both them, the relationships between nodes could include "is part of", "is kind of" and "is prerequisite of", see table 1.

TABLE I. BASIC RELATIONSHIPS BETWEEN NODES

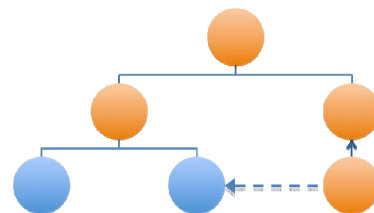| Name	Present	Description
PartOf	PO(A,B)	Node A is a part of Node B
KindOf	KO(A,B)	Node A is a Kind of Node B
PrerequisiteOf	PRO(A,B)	Node A is prerequisite of Node B

Figure 1. The directed graph containing both badges and ontology

These features in common provide a possibility to combine the infrastructure of digital badges and ontologies

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into the same directed graph, see figure 1, in which yellow nodes represent both badges and knowledge units, while blue nodes represent just knowledge units. Moreover, the regular line means 'PartOf', the arrowed line means 'KindOf' and the dotted arrowed line present 'PrerequisiteOf'.

IV. INCORPORATING DIGITAL BADGE AND ONTOLOGY INTO PBL CYCLE

As mentioned above, in DBOPBL, students are encouraged to continuingly improve their projects based on other's comments and change of situation. Thus, the whole project-based learning process can be broken down to many phases. In each phase, students need to experience a learning cycle to obtain a deeper understanding on a technological module.

- Attraction
  The first step in each cycle is attracting students to explore what the technology on a badge can do. This step can be conducted by providing demonstrative products or projects on each badge.
- Selection
  This step students need to make choices to choose corresponding badges to complete their tasks in this cycle. This can be conducted by recording the students' selection online.

- Scaffolding
  In this step, the teacher and the learning system will facilitate the students' learning. Due to the diversity of learning objective, it is more important to provide them some project starter and relevant learning resources, such as video tutorial, some free technology-learning websites, and communities.
- Badge Claim
  After students complete the corresponding tasks, they can claim the badge by providing instructor with the corresponding evidences, such as the source code, screenshot, and web address.
- Evaluation
  In this step, a teacher needs to make a judgment if the student is eligible to earn the badge by checking their validity and legality of the evidences.
- Badge Grant
  Once a student has passed the evaluation, s/he can get the badge. The student can show the new badge to others and earn the corresponding credits on the badge. If the student fails to earn it, s/he needs to draw back to the step of scaffolding to redesign the project feature or even get back to the 'attracting' to reselect another badge s/he want to earn.
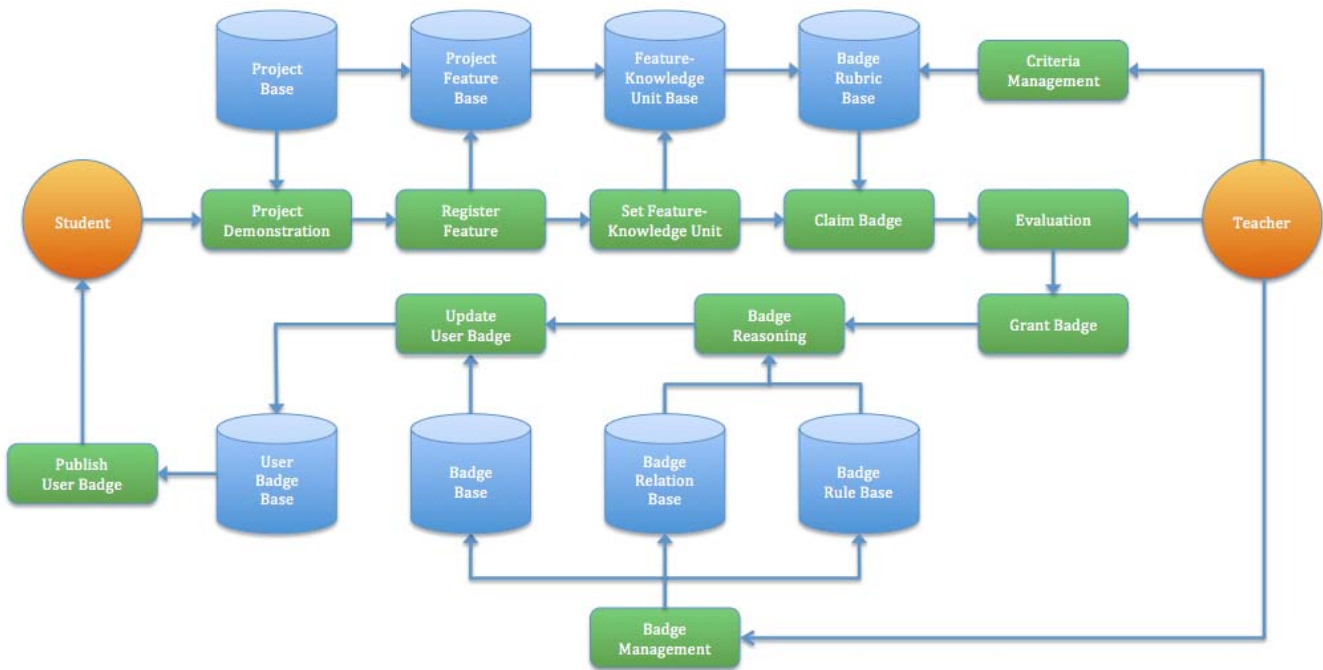
V. THE SYSTEM FRAMEWORK OF DBOPBL

Figure 2. The System Framework of DBOPBL

Figure 2 shows the system framework and data flow of a DBOPBL system. In this framework, student can browse the project demonstration, register new feature of project, set the relationship between feature and ontology, and claim badges, while a teacher can evaluate students' evidence, grant badges and manage the badge ontology. Here is also

an automatic reasoning process after the teacher has decided to grant a badge to a student, the system will replace the current badges automatically according to the badge rule base.

VI.   A CASE STUDY IN TECHNOLOGY EDUCATION IN HIGHER EDUCATION

A.   Context Overview

Design studio is a course opening for graduates of Learning, Design and Technology in Penn State University. It provides learners with the training of many different cutting-edge technologies. Besides, since there are many different technologies it allows learners to take this course more than once in up to four semesters. All current 16 students are adult learners. Yet some of them just graduated as bachelors or masters while others had worked for many years. The technical backgrounds of them are quite different. Some of them might have little technique skills, but others have more advanced skills. Furthermore, the learning requirements of them are various. Some of them would like to use graphic design and video editing techniques to design learning materials, while others prefer to learn coding to develop learning systems.
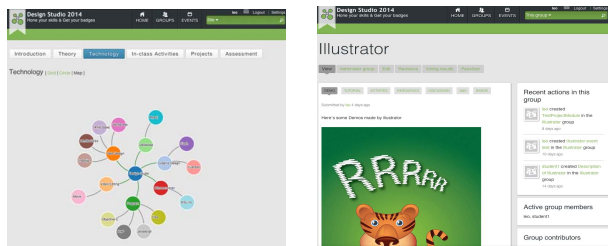
B.   System Prototype

Figure3. The prototype of DBOPBL

Figure 3 shows the prototype of a website that we have developed by using Drupal, Commons distribution and badge module of Drupal to support DBOPBL. It includes the functions of browsing and importing badge on ontology, along with the functions to support six steps in the learning cycle in DBOPBL.

C.   Discussion

By using DBOPBL, the learning objectives could be more flexible and adaptive, which is more similar to the 'authentic' situation to use certain technology to meet the demands of real world. Student would be able to decide their learning content and path according to their intrinsic interests and the 'ultimately particular' demands of their projects. From the standpoint of the instructor, the procedures of learning are fixed and easy to monitor and control, and more importantly, the design of instruction is theory grounded to improve students' understanding and improve their ability to learn how to learn.

VII.   CONCLUSION

This paper provides a model named as DBOPBL, which incorporates digital badges, ontology and project-based learning cycle to support technology training in current diverse and continuingly updating technology environment. By using DBOPBL, the learning process would make a balance between the diversity of learning goals and the degree of understanding of students on technology modules.

The next research about DBOPBL would be exploring how to use Web 2.0 mechanism to support students to create new badges and learning contents to relieve the workload of teachers and improve students' knowledge construction.

REFERENCES

[1]   Helm, H. Judy, K. Lilian. Young Investigators: The Project Approach in the Early Years. Teachers College Press, 2001.

[2]   T. Markham, (2011). Project Based Learning. Teacher Librarian, 39(2), 38-42.

[3]   N. G. Harold, S. Erik, the design way, 2012

[4]   D. Schwartz, S. Brophy, X. Lin and J. Bransford. Software for managing complex learning: Examples from an educational psychology course. Educational Technology, Research, & Development, 47(2), 30-59. 1999

[5]   E. Knight, C. Casilli, "CASE STUDY 6: MOZILLA OPEN BADGES". http://www.educause.edu/library/resources/case-study-6-mozilla-open-badgesRetrieved 3 June 2013. 2012

[6]   Hickey, Daniel, "Recognizing, Supporting, and Attracting Adult Learners with Digital Badges". The Evolllution. http://www.evolllution.com/program_planning/recognizing-supporting-and-attracting-adult-learners-with-digital-badges/, Retrieved 31 May 2013.

[7]   Watters, Audrey, "Master a new skill? Here's your badge". http://radar.oreilly.com/2011/09/open-badges-project-learning-education.html, O'Reilly Radar. 2011, Retrieved November 21, 2012.

[8]   Digital Badge, http://gaming.psu.edu/gamification/digital-badges/   , 2013

[9]   MIKAP. "Ontologies are us: a unified model of social networks and semantics" [J]. Web semantics: Science, Service and Agents on the World Wide Web, 2007, 5 (1): 5-15.

[10] G. Miller, "Wordnet: An On-line Lexical Database International Journal of Lexicography", 1990 : 3(4).

[11] Protégé, http://protege.stanford.edu/.

[12] ZD. Dong. Expression of Semantic Relations and Construction of Knowledge System. Application of Language and Character, 1998, (3):76-82.

[13] D. Schwartz, X. Lin, S. Brophy, and J. Bransford. Toward the development of flexibly adaptive instructional designs. In C. Reigeluth (Ed.), Instructional-design theories and models: A new paradigm of instructional theory (Edition III) (pp. 183-213). Mahwah, NJ: Erlbaum. 1999.

[14] D. Schwartz, S. Brophy, X. Lin and J. Bransford. Software for managing complex learning: Examples from an educational psychology course. Educational Technology, Research, & Development, 47(2), 30-59. 1999

[15] B. Leanne, L. Andrew, Design-based research for LIS, 2008