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An Inquiry of Constructs for an e-Learning Environment Design by Incorporating Aspects of Learners' Participations in Web 2.0 Technologies

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The major concern of e-learning environment design is to create and improve artifacts that support human learning. To facilitate effective and efficient learning, e-learning environment designers focused on the contemporary information technologies. Web 2.0 services, which empower users and allow the inter-transforming interactions between users and information technologies, have been increasingly changing the way that people learn. By adapting these Web 2.0 technologies in learning environment, educational technology can facilitate learners' abilities to personalize learning environment. The main purpose of this study is to conceptualize comprehensively constructs for understanding the inter-transforming relationships between learner and learning environment and mutable learning environments' impact on the process through which learners learn and strive to shape their learning environment. As results, this study confirms conceptualization of four constructs by incorporating aspects of design that occur in e-learning environments with Web 2.0 technologies. First, learner-designer refers to active and intentional designer who is tailoring an e-learning environment in the changing context of use. Second, learner's secondary design refers to learner's design based on the primary designs by design experts. Third, transactional interaction refers to learner's inter-changeable, inter-transformative, co-evolutionary interaction with technological environment. Fourth, trans-active learning environment refers to mutable learning environment enacted by users.

Keywords : Learner-designer, Transactional interaction, Trans-active learning environment

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Introduction

Over the last years, needs for e-learning have been evolving accordingly with more and more demanding technological requirements as well as educational requirements. Educational institutes' needs currently involve extending and moving to highly customized instructional strategies and methods, each institute's needs incorporating its own pedagogical approach, each institute's needs targeting a specific instructional goal, and each institute's needs incorporating its specific technological environments in timely fashion. Current system developments based on User-Centered Design (UCD) focus on verifying the requirements of users (e.g., learners, instructors, instructional designers, and institutes' managers) during the early stages, and then go through the whole process to generate the perfect products. Nevertheless, users may don't know their needs in analysis phase as an early phase in design processes, even though they know clearly their needs, their needs may be successively changed through whole phases in design processes. So, UCD approach is not suitable when the requirement cannot be clearly defined at the early stages in design processes and users' needs are unceasingly changed. Additionally, elaboration of user's needs would be difficult to user himself as well as expert in learning environment design and developmental process (Baek, Cagiltay, Boling & Frick, 2008; Carr-Chellman & Savoy, 2004; Fischer, 2007; Shin, Tsjeng & Yang, 2007).

In information system engineering fields, traditional UCD approach treats the user as a recipient of a pre-defined task and technology, rather than an active player who is capable of modifying technology in the context of use (Germonprez & Zigurs, 2009). In accordance with this approach, information systems are highly customized and matured based on the specific institute's needs. However, in one perspective, users are active players who are tailoring technology in the changing context of use, reflecting how a technology might be used in a new context, and then acting on that reflection (Germonprez, Hovorka & Collopy, 2007; Hovorka & Rees, 2009). For examples, Web 2.0 services as contemporary information technologies, which empower users and

allows these inter-transforming interactions between users and information technologies, has generated an enormous amount of online user-generated content as well as a great number of applications.

Web 2.0 and user-generated content and applications have been, and will likely be, increasingly changing the way that people search, find, read, gather, share, develop and consume information. Through the Web 2.0 services, individuals can make their own artifacts based on ideas and opinions more easily accessible to other users. By adapting these Web 2.0 technologies in learning environments, educational technology can facilitate learners' abilities to personalize learning environments with technology. With increasing maturity of applications, and the general availability of technologies in everyday life, interest in understanding how learners' educational experiences can be enhanced with technology is growing.

Some studies on inter-transforming relationships between learners and technological environments would help educational practitioners to understand better the importance of current Web technologies for their practices (e.g., Krajcik & Blumenfeld, 2006; Scardamalia & Bereiter, 2006; Stahl, Koschmann & Suthers, 2006). However, it is too difficult to find relevant studies in the existing teaching-learning literature on the impact of inter-transforming relationships between learners and technological environments and these mutable learning environments can be designed by learners.

This study intended to explore theoretically this inter-transforming relationship between learners and learning environments, and mutable learning environments by combining the prescriptive perspectives of educational technology with the concept of technology tailoring in the context of Web 2.0 services. The key research goal is to conceptualize comprehensively constructs for understanding these inter-transforming relationships and mutable learning environments' impact on the process through which learners learn and strive to shape their learning environment. Combined with the transformation of learners from passive recipients to active participants, this study investigates the needs for conceptualization of constructs for designing an e-

learning environment with Web 2.0 technologies.

More specifically this study will focus on the examination of major constructs such as learner-designer, learner's secondary designs, transactional interaction with environment as learning activity, and trans-active learning environment by incorporating aspects of learners' designs in an e-learning environment with Web 2.0 technologies. This study will contribute to enhancement of the educational technology for researchers, instructors, instructional designers, and learners to help them understand how e-learning environments can evolve by active user involvement in addition to what challenges remain to make this a reality.

Backgrounds of Needs to Conceptualize Constructs for Designing e-Learning Environments

It will be shown how to overcome a limitation of current systematic design approach to contribute to educational technology practice. Designers overestimate the power of systematic approach and the proportion of design experts who can realize its potential. Further discussion centers on the lack of pedagogical perspective to use a technological platform for empowering learners in designing their personal learning environments and how to encompass learner's design activities as inter-transforming interactions with technological artifacts in Web 2.0 Environment.

How to Overcome a Limitation of the Systematic Approach to Analyze the Learners' Needs

The systems approach views a system as a set of interrelated parts, all working toward a defined goal. The current systematic Instructional Systems Design (ISD) approaches are a process comprised of a series of phases (Dick, Carey & Carey, 2005; Gustafson & Branch, 2002). Over the past four decades, a variety of sets of

systematic ISD procedures or models have been developed, and have been referred to by such terms as the systems approach, Instructional Systems Design (ISD), and Instructional Design (ID). Although the specific combination of procedures often varies, most of the models include the analysis of instructional problems, and the design, development, implementation and evaluation of instructional procedures and materials intended to solve those problems. As an example of ISD, the ADDIE model contains the five major phases: analysis, design, development, implementation and evaluation. Each phase receives input from the previous phase and provides output for the next phase (Dick et al. 2005; Heinich, Molenda, Russell & Smaldino, 2001; Reigeluth, 1983; Spector, 2004).

ISD generally begins with a needs analysis focused on what learners need to learn or instructors need to teach in a particular context. The instructional designers and/or their clients believe that instruction is required to fill gaps caused by deficiencies of knowledge and skill. In that sense, ISD is based on the prescriptive, user-centered perspective because it aims to produce optimal outcomes to fulfill specific needs in specific contexts (Reigeluth, 1983). For example, Dick and Carey's model, one of the most popular systems-approach models for designing instruction, describes the phases of an iterative process that starts by identifying instructional goals and ends with evaluation. This model includes analysis, design, development, formative evaluation and needs assessment in a nonlinear relationship (Dick et al. 2005). The ASSURE model developed by Heinich, Molenda, Russell, and Smaldino (2001) provides an acronym to help practitioners remember the steps they must work through. The ASSURE model applies these six processes that teachers and trainers can use to design and develop the learning environment for their students: Analyze learners, State objectives, Select instructional methods, media, and materials, Utilize media and materials, Require learner participation, Evaluate and revise.

Some claim that the systems approach that formed the core of ISD is outdated and inappropriate for instructional system design and development (e.g., Spector, 2001; 2004). Current system developments based on a systematic approach focus on

verifying the requirements during the early stages, and then go through the whole process to generate the perfect products. Learners' needs provide necessary and sufficient knowledge bases upon which to build an e-learning system, and to validate whether the design process was successful in providing a solution that solves the problems are settled in front side phases in ISD. The analysis of learners' needs formerly provided a starting point for the treatment of the design and development in ISD. However, construct of learner's need is based on some assumptions. Researchers in information system engineering and design strategies have identified questionable assumptions of natures of learners' needs as one of project risk drivers that lead to difficulties in estimating project performance (Baek et al., 2008; Carr-Chellman & Savoy, 2004; Fischer, 2007; Schmidt, Lyytinen, Keil, Cule, 2001; Shin et al. 2007). This study, based on these studies, presents three assumptions.

First, *learners' needs are treated as something can be taken or pre-existing that can be recognized and met*. This is not compatible with the terms of "requirements uncertainty" in information system engineering (Cheng & Atlee, 2009; Hansen, Berente & Lyytinen, 2009). The notion of "requirements uncertainty" has been the focus of research for decades (Barki, Rivard & Talbot, 1993; Moynihan, 2000; Nidumolu, 1995). Many empirical research studies provide evidence that "requirements uncertainty" has a negative relationship with project management performance (Eva, 2001; Jiang & Klein, 2000). According to these studies, educational design researchers should consider learner's need as a something to be addressed during e-learning system development by choosing an appropriate strategy to moderate the uncertainty. Partially due to increasing "requirements uncertainty," system flexibility has been in the focus of many software development activities for many years.

Second, *learners' needs are treated as something can be taken as freezing states*. This is not compatible with the terms of "dynamics of requirements evolution" in information system engineering (Ernst, Mylopoulos & Wang, 2009; Reymen & Romme, 2009). Requirements frequently changes over the processes of the project and may evolve during using phases as well as analyzing and design phases (Fischer, 2007).

Requirements evolution implies the need for e-learning systems to adapt continually to the changing needs of their users and their contexts. Requirements may be changed all throughout a system's lifecycle. Therefore, the analysis of learners' needs either one point approach in starting, or experimentally in use of prototype is too narrow an approach. Learners' needs should be understood both historically and as something to be constructed collaboratively in the process of the design and using processes.

Third, *learners' needs are treated as necessary inputs into the design process that may be obtained during the analyzing process by experts.* As users, learners are emerging as a viable new resource for ISD product design (Hyysalo, 2004). Learners' needs should be understood as something resources to be managed personally as well as supported by experts in the process of the design and using process (Baek et al., 2008; Carr-Chellman & Savoy, 2004; Cheng & Atlee, 2009). However, elaboration of learner's needs would be difficult to learner himself as well as expert in learning environment's design and developmental process (Baek et al., 2008; Carr-Chellman & Savoy, 2004; Fischer, 2007). According to these studies, learners' needs should be understood as a gradually emerging relation between the environment and the user. Indeed, adequate support must be provided for learners to articulate their needs.

Unfortunately, this uncertainty and unceasing change in the learner's needs in an e-learning system development projects are not yet incorporated into constructs for empirical research as well as theoretical research in educational technology. Therefore, to cope with limitations of systematic approach especially user-centered approach, a conceptualization of constructs for learner's nature is necessary. This study, to conceptualize constructs for designing an e-learning environment, proposes a concept of "learner-designer" as an end-user that design or re-design the actual learning environments to achieve their learning goals.

How to solve the Lack of Pedagogical Perspective to use a Technological Platform for empowering Learners to design Their Personal Learning Environments

Today, learners have more choices about how and where to spend their learning time than they did 10 years ago. Today's youth use Web 2.0 technologies in their everyday lives and believe that more use of such technologies in school would lead to increased preparation and engagement (DeGennaro, 2008; Lenhart, Arafeh, Smith & Macgill, 2008; Solomon & Schrum, 2007; Spires, Lee, Turner & Johnson, 2008). In the past decade, many studies have addressed research questions relating to Web 1.0 issues, such as Web access and selection and interpretation of information and media (Kuiper, Volman & Terwel, 2005; Livingstone, van Couvering & Thumin, 2008), and have conceptualized Web as an information repository and learners as recipients rather than active designers of information. Few studies have focused on learners' production of content for the Web and their participation on the Web through artifacts they design, create, and share (Krajcik & Blumenfeld, 2006). These studies have focused on collaboration and learner creation and co-evolution of digital artifacts in e-learning environments (Scardamalia & Bereiter, 2006; Stahl et al. 2006).

Literatures of Web 2.0 Technologies as Cases of Technological Platforms to Empower Learners to Design Their Artifacts

There is quite a lot of hype about the potential of the phenomenon for producing and sharing innovative artifacts designed by users. As one of the most popular Web 2.0 services, Wikipedia engages users in the coproduction of an online encyclopedia. Collaborative activities in Wiki service give rise to, for example, the production of the world's largest online encyclopedias, called Wikipedia since every internet user is allowed to participate in this undertaking (Korfiatis, Poulos & Bokos, 2006). In addition, an increasing number of technologies (e.g., Firefox add-ons, smart phone applications) are intended to support the users' design of information environments

where they tailor the technological environments to suit their own use patterns and needs (Germonprez et al. 2007). In each case, design-in use enables pragmatic human action through an inter-transforming interaction with technological environments. In terms of these characteristics, Web 2.0 services refer to the technological platforms to empower learners' design their personal learning environments.

Web 2.0 is both a platform on which innovative technologies have been built and a space where users are as important as the content they upload and share with others (Cormode & Krishnamurthy, 2008). Web 2.0 includes social networks, such as MySpace, Facebook, and Cyworld; media sharing, such as YouTube and Flickr; social bookmarking, such as Delicious; collaborative knowledge development through wikis (e.g., Wikipedia); creative works, such as podcasts, blogs, and microblogs (e.g., Twitter, Blogger, Naver Blog); content aggregation and organization, such as RSS (Really Simple Syndication) feeds and tagging tools; and remixing or mash-ups of content from different content providers into new forms, such as combining geographical data with transportation (Greenhow, Robelia & Hughes, 2009).

According to Greenhow, Robelia & Hughes (2009), Web 2.0's affordances of inter-connections, content creation and remixing, and interactivity might facilitate an increased research interest in learners' creative practices, participation, collaboration, sharing, articulation, and externalization that are helpful in designing technology-enhanced learning environments. As Cormode and Krishnamurthy (2008)'s discussions, Web 2.0 technologies promote users and their interconnections through the following affordances: (a) user-defined linkages between users and content (e.g., Trackback in Blog, posting on others' pages), (b) simple mechanisms to publish and share multimedia content (e.g., blogs), (c) prominent personal profiling (e.g., mini homepage in Cyworld, displaying user preferences on customized profile pages), and (d) inter-technology applications (e.g., open Application Programming Interface), enabling interfaces with services and features on other applications, for example, add-ons that offer alternative functions for Web browsers or widgets that plug information from one site into another.

With respect to technological platforms to empower users in designing their Web environment, the potential for teaching and learning is twofold. First, individual creativity can take place at a level higher than content. Just as new content is created by combining other content, new functionality is created by assembling other software applications. This is called mash-ups. Secondly, the syndication of functionality by widgets allows extending existing learning environments. This way, Personal Learning Environments (PLEs) can be developed at a very low cost. A PLE (van Harmelen, 2006) is not a pre-build collection of tools and content but a framework that allows a learner to assemble his own suite of applications and content sources. It is built on Web 2.0 technology and uses Web 2.0 services, such as blogs, wikis and social bookmarking. Various content sources, applications, such as e-portfolios, and information from social networks are integrated by the learner with the PLE.

However, these technological platforms to empower users in designing their Web environment are not yet incorporated into constructs for empirical research as well as theoretical research in educational technology. Therefore, to realize the potential for teaching and learning, a conceptualization of constructs for these technological platforms is necessary. This study, to conceptualize constructs for designing an e-learning environment, devises and proposes a concept of "trans-active learning environment" as an environment with making inter-transforming relationships between learners and learning environment possible.

How to Encompass Learner's Design Activities as Transactional Interactions with Technological Artifacts in a Web 2.0 Environment

While, agreements with research which places active interaction as fundamental to learning, rather than passive exposure to information, defining interaction between learners and environments becomes a central principle for design a learning environment. In Web 2.0 services as read/write Web services, users can design their

own artifacts. Such design activity is a new way of thinking about the information technology-based learning environment in the educational field. It redefines the human-computer interaction to include interaction between information technology-based learning environments and learners. Design activities are one class of activities that fall under the broader category of project-based activities that has learners design complex artifacts to be used for learning a particular subject (Kafai, 2006). Design-based projects have involved the development of presentations, instructional software, simulations, publications, journals and games (Kafai & Resnick, 1996). With such projects, learners learn about both design and a variety of subject matters through the process of developing complex artifacts.

Vygotsky (1978) emphasized the role of interplay in learning — as the individual acts on the environment, the environment also acts upon the individual. Design activities bring this interplay directly into focus. It is fundamentally about ideas and transforming oneself and the world through the process of working with those ideas. That is, the environment constrains and thereby acts upon the artifact, and the introduction of new artifacts changes the environment. Research and theory suggest that design-based activities provide a rich context for learning. Within the context of social constructivism (Vygotsky, 1978) or constructionism (Kafai, 2006), design projects lend themselves to sustained inquiry and revision of ideas. Other scholars have emphasized the value of complex, self-directed, personally motivated and meaningful design projects for students (Blumenfeld et al. 1991; Kafai, 2006). As one might imagine, adapting such open-ended problem solving situations into the design and development of personal learning tools, personal learning environments is possible.

In this study, the inter-changeable interaction between learners and technological learning environments will be called "transactional interaction" and these technological learning environments will be called "trans-active learning environments." This study see this inter-changeable interaction as being at the heart of e-learning, involving as it does the construction of meaning and the evolution of

understanding through a transactional process.

In the following, we shall present four basic preliminary constructs (learner-designer, learner's secondary designs, learner's transactional interaction with environment as learning activity, and trans-active learning environments) that attempts to extend theoretical boundaries for designing an e-learning environment.

Four Constructs for Design of e-Learning Environment with Web 2.0 Technologies

The learning environment should be informed by activities and contexts from the research on learning, and it can be supported by the functionalities of the educationally relevant technologies. The constructs are therefore based on both learning theories and design theories that will be used in the planned e-learning environment design. This study identify four new preliminary perspectives essential to extend boundaries of design theory incorporating aspects of designs that occur when using Web 2.0 technologies in learning environments: learner, learning outcomes, learning activities, and learning environments. Although each of these new preliminary perspectives has been identified separately, proposed constructs for design theory in this study must expand to incorporate and understand the interactions of each preliminary concept.

In this study, constructs are related to ecological and systems-based theoretical approach for conceptualizing person-activity-environment transactions. In other words, constructs are involved into ecological approach. With respect to ecological approach, interactions not only between learners and instructors and among learners, but also between learners and technological components in an e-learning environment, are inter-dependent, inter-transforming, co-evolutionary and reciprocal relationships. Therefore, in an e-learning environment, to evaluate the activities such as interactions, participations, and collaborations, should capture this ecological

nature of technological artifacts. In terms of this ecological perspective, four preliminary constructs are conceptualized as bellows.

Learners as Designers Tailoring Technological Environments

In e-learning environments with Web 2.0 services, the secondary design activities and designs enacted by learners are crucial elements in the way information systems are encountered in teaching and learning. To encompass these phenomena, design methodologies, research, and theory must extend their boundaries to include the reframing of learners as intentional designers in the design process, outside formal procedural design roles (Hovorka & Germonprez, 2011). Not only in educational technology, but also in information system engineering, the interplay or interaction of individuals with communication technology remains a fundamentally important area of study and different perspectives exist. One perspective argues that individuals continually and actively acquire knowledge for action in a dynamic, changing environment and they alter their actions, language and technology in response to that dynamism (Germonprez & Zigurs, 2009). This view treats learners as active players who are tailoring technology in the changing context of use, reflecting how a technology might be used in a new context, and then acting on that reflection (Germonprez et al. 2007). The focus on dynamism and active involvement is quite appropriate in today's Web 2.0 environments or virtual world's environment, where boundaries across users and designers continue to blur.

To develop a relevant artifact, it is necessary a systematic but flexible method aimed to improve design activities for designing the educational artifacts (Wang & Hannafin, 2005). The limitation of current systematic design approach to contribute to educational technology practice has been argued. Designers overestimate the power of systematic approach and the proportion of design experts who can realize its potential. Designers' mind too often race with thoughts of the power of systematic approach to effectively design relevant interventions and underestimate the

active and diverse learners' activities in educational practices. Nevertheless, after casting aside rigid structured strategies, meta-cognitive phases added methods or user designed methods have been shown to be beneficial (Fischer, 2007, 2009). By applying these perspectives in designing projects, individual learners and their team can use a support system tailored to meet their needs.

In the context of e-learning environments, freedom for the learner to design and negotiate their own designs throughout the entire processes of design may be very attractive and motivating. However, it can be argued that to have such control, learners need to have at least some minimal knowledge of the e-learning system to make authentic choices. Therefore, paradoxically, guiding instructions are a way of allowing learners to exercise control. To solve this problem, informed participation strategy can be used (Brown, Duguid & Haviland, 1994; Fischer, 2007, 2009). To support learners to be designers, secondary designs from peers as well as primary designs from experts are helpful. From these helpful resources, learners can acquire and learn required skills to design their own artifacts. For example, in e-learning environments with Web 2.0 services (e. g., podcasting), the secondary design activities and designs enacted by learners and experts are a crucial element encountered in teaching and learning. To realize these Web 2.0 technologies' opportunities into the e-learning environments, design methodologies must extend their boundaries to include the reframing of learners as intentional designers in the design process.

Learners' Secondary Designs as Units of Analysis to Evaluate Educational Artifacts and Their Learning Outcomes

Hovorka and Germonprez (2011) emphasized the role of design theory and researchers, and suggest the needs of new terminology for 'interactionist cognitive-technical systems' and elimination of the dichotomy between 'designing the artifact' and 'using the artifact', in the following:

> We (design researchers) start by framing the initial design activities of these interactionist cognitive-technical systems in different rhetorical terms, and

> construct theories which account for actors' interactions in a life world created with these emerging technologies. Thus, we eliminate the dichotomy between 'designing the artifact' and 'using the artifact' and focus instead on designing information processes.

In this study, it is suggested 'transactional interactions' between learners and e-learning environments is the same as a term undertaken 'interactionist cognitive-technical systems' by Hovorka and Germonprez (2011). In Learning by Design perspective, design activities and designs play a central role in teaching and learning (Kafai, 2006). As designs in learning by design models, learners' designs are ultimately results in learning outcomes, but learner's secondary design outcomes are often outside the scope and purpose of the current prescriptive research framework. However, to investigate a more relevant role of Web 2.0 technologies in e-learning, design research's focus needs to shift from the measurement and management of learning process and outcomes through rigid coupling of systems to support performances, towards identification of use patterns and supports for personal use of system. In line with this perspective, educational design researchers, to identify effectively the use patterns and personal use should have focused on the secondary designs as well as design activities as units of analysis in teaching and learning process.

In e-learning environments with Web 2.0 technologies (e. g., wikis), the learner may first encounter a primary design from design experts such as professional e-learning environment designers, instructional designers and instructors, or he/she may first encounter a secondary design that was tailored and distributed by another learner. The critical issue to consider when researching with each of the e-learning environments with Web 2.0 technologies is that researcher should design not only the primary design of a tailorable technology, but they should also design the activity of learners to engage in learner's secondary design, which learners undertake intentional actions (Germonprez et al. 2007). In addition to, according to Kirschner, Strijbos, Kreijns, and Beers (2004), in the virtual world (e.g., MMORPG, Second Life), affordances of technological artifacts to facilitate social interactions must be designed

and must encompass these transactional relationships. There must be a reciprocal relationship between learners and artifacts in the virtual learning environment. If the affordance of technological artifacts must be meaningful and support or anticipate the learners' social interactions, educational design researchers should have focused on the learner's secondary designs and transactional interactions with environments as well as primary designs of experts.

Transactional Interactions as Learning Activities between Learners and Technological Environments

Interaction is fundamental to teaching and learning and it occurs increasingly often in technology-mediated environments. Understanding how interaction evolves in such environments is essential to ensuring that the right technology is provided for whatever learning task a community of learning needs to accomplish, even if it is not precisely known how the technology is going to be used. With the growing body of research on different tools for supporting computer-mediated learning communities, we still have much to learn about how interaction evolves, where potential breakdowns occur and how learners tailor technological environments during the interactive learning process (Germonprez et al. 2007; Gregor & Jones, 2007). In accordance with Germonprez et al. (2007), recent research has begun to address the co-transforming between users and technological environments, including a theoretical approach to the design of tailorable technologies. Additionally, Gregor and Jones (2007) note the system characteristic of mutability, which describes the ways in which artifacts emerge, evolve and develop interdependencies with socio-technological contexts.

Learner's "transactional interaction" with e-learning environments presented in this study, refers to inter-dependent and co-transformative interactions with each other, their technological environment as well as the learner. These interactions enacted by learners are a crucial element in the development of e-learning environments in

current information technology environments, especially in Web 2.0 technologies. To encompass these relationships, e-learning environment design research and design theory must extend their boundaries to include the reframing of interactions between learners and technological environments. Thus, educational design researchers should have attempted to eliminate the dichotomy between 'designing the artifact' and 'using the artifact' and focus instead on designing learner's activity-based learning process.

The relationships seems to be bi-directional processes, not cause-effect directionality, as learners engage with different learning environments, different learning material aspects of the technology, and reflect on different subjective meanings and experiences (Fischer, 2009; Germonprez et al. 2007; Gregor & Jones, 2007). Learners' transactional interactions with technology may be initiated through either action or reflection. Reflective action towards the e-learning environment may lead to tailoring, which then leads to additional reflection on the newly configured technology. On the other hand, tinkering without a specific learning goal in mind may lead to a desirable design state, which then engenders further reflection (Germonprez et al. 2007).

Based on users' participation, these Web 2.0 services (e. g., wikis) realize the idea of inter-transformative relationships and learner's transactional interactions with environments on the Web. These Web 2.0 services are intended to support emergent and unforeseen activities rather than well-defined processes or particular performance outcomes, and their inherent flexibility allows learners to continuously modify the information generated (Dohn, 2009; Germonprez et al. 2007). New terms of learner's "transactional interaction" with technological environment contributes understanding learning processes and activities in technology-mediated learning environments, developing and applying tools for interactive learning environments, and enhancing theorizing on e-learning environments, in this study, called terms as a "trans-active learning environment."

Trans-active Learning Environment as a Platform to Build Personal Learning Environments

The Wikipedia example will be applied in this study in order to figure out the concept of "trans-active learning environments" more concrete. In Wiki software, people work jointly on one artifact and a multitude of people around the world are able to participate in collaboratively working process anywhere and at any time. After a user externalizes his or her knowledge in a Wiki, the Wiki exists independently from the individual person's knowledge. The individual person's knowledge can serve as an environment for other peoples' learning (Kafai, 2006; Scardamalia & Bereiter, 1994). These "trans-active learning environments" contribute to not only allow learners to create their own learning environments, it can also lead to individual learning processes in learning environment designed by the contributors as well as design experts.

Wiki's potential as a "trans-active learning environment" lies in their ability to facilitate shaping of the learning environment according to learners' needs (Reinhold, 2006). Strengths of Wiki software as "trans-active learning environments" are to support learner-centered e-learning due to their ability to facilitate collaboration (Notari, 2006), to allow for design-based learning (Rick & Guzdial, 2006), and to support inquiry learning and the co-construction of knowledge (Yukawa, 2006). Overall, Wiki can be generally considered to support social constructivist learning (Bruns & Humphreys, 2005). However, recently research has begun to figure as technological mediators in the activity of theoretical analyses of teaching and learning, and the effort to explore its role as technological mediators has been limited. Indeed, despite the fact that the important role of environments is convincingly argued by some authors, the importance of the "trans-active learning environment" as well as learner's "transactional interaction" with technological environments is rarely discussed.

Conclusion and Discussion

The purposes of this study were to theoretically explore the inter-transforming, inter-changeable relationship between learners and learning environments and mutable learning environments, and conceptualize constructs to understand and design an e-learning environment by incorporating learner's designs and design activities in e-learning environments with Web 2.0 technologies. To examine the needs to conceptualize constructs in this study, the limitations of current systematic design approach in contributing to educational technology practice was discussed broadly.

In accordance with these discussions, new perspectives of learners' needs presented as follows. The learners' needs usually unceasingly evolve throughout the entire processes of the design and development of an e-learning environment; learners' needs should not be treated as something pre-existing; learners' needs should be understood as resources to be managed personally as well as analyzed by experts in the process of the design and using process. Additional discussion focused on emerging technological platforms to empower learners in designing their personal learning environments and emerging design activities as transactional interactions between learners and environments in Web 2.0 environments.

Based on these discussions about backgrounds of needs to conceptualize constructs, this study offers conceptualization of four constructs by incorporating aspects of designs that occur in e-learning environments with Web 2.0 technologies.

First, learner-designers refer to active and intentional designers who are tailoring an e-learning environment in the changing context of use, reflecting how a technology might be used in a new context, and then acting on that reflection to meet their needs.

Second, learner's secondary designs refer to learner's designs based on the primary designs from design experts.

Third, transactional interaction refers to learner's inter-changeable, inter-transformative, co-evolutionary interaction with technological environment.

Fourth, trans-active learning environment refer to mutable learning environment enacted by users included by learners, instructors, and instructional designers.

This study contributes not only the researchers' and practitioners' practice in designing and development of an e-learning environment, but also extends the boundaries of the e-learning environment design theory in a more timely manner.

This study contributes to the presence of opportunities to solve the problems of learners' needs uncertainty and evolutionary change by conceptualization of constructs. In an e-learning system development projects, controlling the evolution of user's needs is very important for the success of the entire e-learning system development project because every step in the evolutionary path of requirements can introduce undesired changes or lack of information (Berente, Hansen, & Lyytinen, 2009). In the development of an e-learning system as a one of the most popular information system, learners' needs may evolve during using phases as well as analyzing and design phases (Fischer, 2009). Therefore, continuous managing these transformations is a crucial task for the success of every e-learning system development project. However, in accordance with Berente, Hansen & Lyytinen (2009), requirements are the most difficult part of the design process. Moreover, they emphasized that "the notions of a design as a linear, predictable activity that underlie many methods and tools of software development are too simplistic to provide a good understanding of design and its requirements" (p. 6). Designers' mind too often race with thoughts of the power of systematic approach to effectively design relevant interventions and underestimate the active and diverse learners' activities in educational practices.

Second, all three aspects of the constructs proposed by the author are novel and have contributed to building educational technology design theory. The first aspect is in recognizing the role of learners in design process as active, intentional designers. To support the learner-designers, secondary designs from peers and primary designs and their design principles from experts can be seen as serving a communicative or instructional purpose in the design-based learning process. The second aspect is in

recognizing the degree to which an e-learning environment design theories deal with mutable, co-evolutionary, inter-changeable, and trans-active artifacts. E-learning environment design theories can deal with mutability in a number of ways. For example, it can be achieved by a design expert's agile efforts. However, it should be recognized that this is an important component of an e-learning environment design theories in line with the growth of learner's competencies as time goes by. The third aspect is in recognizing the precedence of design theory for knowledge building about learners' active and intentionally participating in the construction of learning environments. By observing the current Web 2.0 trends and participatory culture, as time goes by, learner's active engagement to build learning environments will be widely adopted in teaching and learning contexts. From Simon (1996), several descriptions can be found of how the construction of an artifact can precede the knowledge of why it works in socio-technological contexts. The extreme complexity of modern information technology means that the design and building of systems is an iterative process, and the documentation of how and why a system works is likely to occur after the emerging. E-learning system design theory articulated after the emerging is by no means less of a theory, so long as it still satisfies the requirements of being abstract and general.

When reflecting on the construction of a trans-active learning environment, one would need to represent the important principles underlying its construction in such a way that they are applicable to other systems yet to be constructed. A number of applications in various case studies may need to be studied before the general principles enabling them to function can be extracted.

Further Study

Design activities are knowledge-intensive work, and the knowledge and skills required for solving complicated design problems rarely resides in the head of learners as design novices. Effective designers need to find their way around the

world, through interaction and collaboration with tools and peers in their socio-technical environments. Design, therefore, is inherently collaborative. The success of many Open Source Software systems and open content environments such as Wikipedia has demonstrated that given the right socio-technical conditions, design through the collaboration of many can flourish as a distributed knowledge system. However, it remains a great challenge to understand what the right socio-technical environments for learner-designer are, what the important functionalities and principles of trans-active learning environment are and how to design such socio-technical environments as trans-active learning environment in a systematic way. To foster understanding of these problems, the term of "trans-active approach" is used to articulate the meaning of inter-dependent co-transformation of each other, their technological environment as well as the learner. However, there is still a lack of a comprehensive theory of understanding the essences of learners' design activities and guidelines for creating a trans-active learning environment to approach complicated design problems of co-transforming relationships between learner-designers and technological artifacts in e-learning environments.

To develop a relevant trans-active learning environment on educational view points, it will be necessary to focus on conducting a design strategy that allows a learner to design and develop one's own learning applications, and the development of an e-learning system with this design approach. Based on these empirical studies, it should be proposed that an alternative design strategy to effectively integrate learner's needs and the educational research designer's needs into trans-active learning environment development, and design principles and functionalities of a trans-active learning environment, adapted with principles of this design strategy will be needed. A trans-active learning environment, adapted with principles of learner-designer, secondary designs, transactional interactions, and trans-active environments will be necessary to be used as laboratories for educational researcher's primary designs as well as secondary designs from learners.

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