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A Pedagogy-driven Framework for Integrating Web 2.0 tools into Educational Practices and Building Personal Learning Environments

Ebrahim Rahimi
PhD candidate
Delft University of technology
Netherlands
e.rahimi@tudelft.nl

Jan van den Berg
Full Professor in Cyber Security,
Delft University of technology
Netherlands
j.vandenberg@tudelft.nl

Wim Veen
Full Professor in eLearning,
Delft University of technology
Netherlands
w.veen@tudelft.nl

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Abstract

While the concept of Web 2.0 based Personal Learning Environments (PLEs) has generated significant interest in educational settings, there is little consensus regarding what this concept means and how teachers and students can develop and deploy Web 2.0 based PLEs to support their teaching and learning activities. In this paper a conceptual framework for building Web 2.0 based PLEs is proposed. The framework consists of four main elements, including (*i*) student's control model, (*ii*) learning potential of Web 2.0 tools and services, (*iii*) project-based teaching approach, and (*iv*) technology-enhanced learning activities. The main purpose of the framework is to assist teachers to design appropriate Web 2.0 based learning activities. Students then can accomplish these learning activities to develop their PLEs and complete their learning projects.

Introduction

In recent years innovations in web technologies along with the new learning requirements laid down by the knowledge society have led to the emergence of three fundamental shifts in technology enhanced learning (TEL) including: (*i*) a shift from a focus on content to communication, (*ii*) a shift from a passive to a more interactive engagement of students in the educational process, and (*iii*) a shift from a focus on individual learners to more socially situated learning (Conole, 2007). There is overwhelming evidence corroborating the notion that Virtual Learning Environments (VLEs), as the mainstream in TEL initiatives, despite some successes, have failed to address these shifts (Chatti, Agustiawan, Jarke, & Specht, 2010; Attwell, 2010; Downes, 2006). These systems mainly follow and support the *learning from technology* approach (Jonassen & Reeves, 1995) manifested in technology-push, course-centered, content-based, and teacher-driven

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educational processes (Chatti et al., 2010; Attwell, 2010). As a result, the underlying assumption of these systems presumes a passive and controlled role for students in their educational practices (Dron, 2007).

Personal Learning Environments (PLEs) have been suggested as a solution for the challenges mentioned above (Attwell 2007; Downes, 2006; Valtonen et al. 2012; Dabbagh & Kitsantas, 2012). An overwhelming number of authors contended that PLEs, as rooted in socio-cultural and constructivist theories of learning and knowledge building as well as facilitated by the popularity of Web 2.0 tools and social software, have potential to support collaborative learning, communities of practice, personal development, self-directed and lifelong learning (McLoughlin & Lee, 2010; Wilson et al., 2009; Johnson & Liber, 2008; Drexler, 2010). According to Attwell (2007), PLEs are activity spaces in which students interact and communicate with each other and experts the ultimate result of which is the development of collective learning. As argued by McLoughlin & Lee (2010), the conceived goal of PLEs is to enable students, not only to consume content, but to remix, produce, and express their personal presentation of knowledge. Furthermore, it has been argued that PLEs presume and support an active role for students by placing them in the center of their learning processes, corroborating their sense of ownership of learning, and enhancing their control in educational process (Downes, 2006; Buchem, 2012).

Knowing the potential of PLEs, the question how to develop Web2.0-based PLEs in educational settings to address these challenges is posed. Indeed, while there is an increasing number of suitable Web 2.0 tools, robust theoretical-based technological and pedagogical roadmaps to build PLEs are unavailable. As a result, educators at different educational levels are forced to adapt and rethink their teaching approaches in conjunction with the advent of new web technologies and the learning requirements of the knowledge society “without a

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clear roadmap for attending to students' various needs" (Kop, 2008). Furthermore, while supporting student's control appears to be an essential aim of PLEs (Attwell, 2007), there is little consensus regarding what this concept means and how it is to be attained by developing Web 2.0 based PLEs (Väljataga & Laanpere, 2010; Buchem, 2012).

Inspired by these observations, in this paper we develop a framework to support teachers in facilitating the main dimensions of student control by designing appropriate learning activities using the learning potential of Web 2.0 tools and services.

Framework for developing Web 2.0 based PLEs

Supporting the personal development of students and enhancing their control in educational process by using web technologies are the main objectives of building and deploying PLEs (Johnson & Liber, 2008; Drexler, 2010). Scardamalia and Bereiter (2006) argue that in order to help students to acquire the required skills for learning and working in the knowledge-based society, they should participate in designing and developing their learning environments. Along similar lines some authors remarked that the participation of students in designing and developing their learning environment can strengthen their control in educational process (Valjataga & Laanpere, 2010; Drexler, 2010). Applying this approach to developing and deploying PLEs requires adopting a constructivist-based *learning with technology* concept (Jonassen & Reeves, 1995). From the perspective of this concept, instead of leaving technology to the hands of instructional designers to "predefine and constrain learning process" of students, it should be given to students to use as constructing tool to support their personal development and learning by building their learning environments and expressing what they know.

In an attempt to formulate a solution to support student's control in educational process by developing and deploying Web 2.0 PLEs, we proposed a conceptual framework shown in

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Figure 1. The framework illustrates how Web 2.0 technologies, the student's control model and the teaching process should interact with each other in order to define appropriate technology-enhanced learning activities to be accomplished by students to build and apply their PLEs. According to this framework, by facilitating the student's control through student-centric instructional approaches (i.e. project-based learning), it is likely that students will start to engage in several learning activities by means of Web 2.0 tools. As a result, it can reveal the ways that they employ technology to manage their learning process providing the teacher with opportunities to acquire a deep understanding and knowledge about students' learning process as a means to improve their teaching process. Moreover, the engagement of students and teachers with Web 2.0 technologies can help them to explore the affordances and learning potential of these technologies and operationalize these affordances to enrich their educational practices.

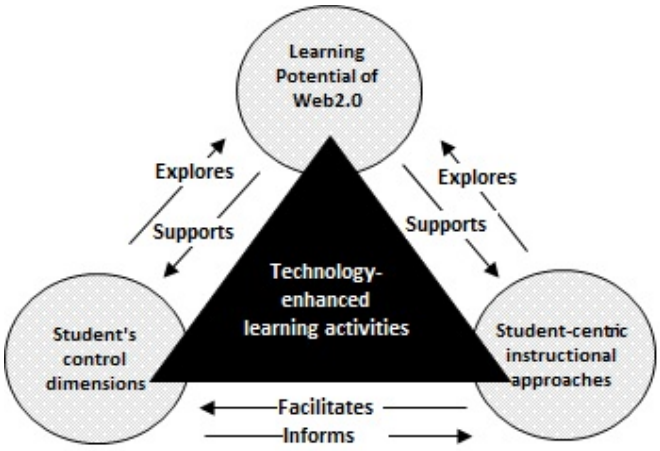

Figure 1: A conceptual framework for developing Web 2.0 PLEs

Student control model

Supporting students to achieve more control over their learning process and become autonomous learners is pivotal to the learner-centric learning theories such as self-regulated

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and self-directed learning theories (Dabbagh & Kitsantas, 2012). Student's control over the learning process is concerned with the degree to which the student can influence and direct her learning experiences and it relates to several aspects of the educational process, including the selection of what is learned, the pace and strategies of learning, the choices of methods and timing of assessments, and choosing learning resources such as online communities and networks, web tools, and content (Kirschner, 2002; Dron, 2007; Valjataga & Laanpere, 2010; Buchem, 2012). As stated by Kirschner (2002), strengthening of student's control over the educational process will place the student in a "position of importance" and by giving them the feeling of more control over their learning experience, it will be more rewarding for the student. Along similar lines, Buchem (2012) demonstrated that there is a significant relationships between perceived control, sense of ownership and uses of a learning environment. Accordingly, Buchem (2012) argued that supporting student's control opens her an opportunity to make choices during the learning activity to effect certain learning outcomes and perceive the learning activity with more personal meaning.

Figure 2 presents the suggested model to support student control in PLEs. We developed this model by adopting and appropriating the learner's control dimensions model proposed by Garrison & Baynton (1987). According to Garrison & Baynton (1987), learner control is not achieved simply by supporting their independency. Rather than it can be attained only by establishing a dynamic balance between *independence* (i.e. learner's freedom to choose what, how, when, and where to learn), *power* (i.e. cognitive abilities and competencies) and *support* (i.e. learning resources the learner needs in order to carry out the learning process and keep control over learning process) through the process of communication between teachers and students.

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To support the active and constructing roles of students in PLEs, we translated power, support and independence dimensions into the active roles a student should undertake in PLE-based learning, namely knowledge producer, socializer, and decision maker, respectively. The student's control model is based on the assumption that students in order to be in control of their learning process should act as (*i*) knowledge producers to *achieve control* by acquiring relevant cognitive capabilities, (*ii*) socializers to *keep control* by learning skills needed to seek support, and (*iii*) decision makers to *practice control* through the personal endeavors to manage web technologies for enriching their learning experiences. The model also explains how to make a balance between these roles by supporting and encouraging activities for *co-producing knowledge*, *developing personal knowledge management strategies*, and *developing personal learning network*. Furthermore, by considering the PLE as output, not input, of the learning process, the model underscores the constructivist-based nature of the PLE-based learning.

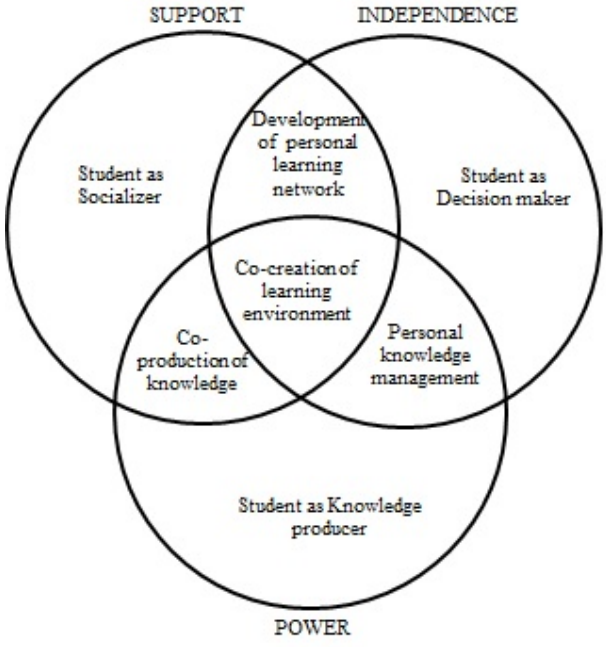

Figure 2: The proposed model for supporting student control in Web 2.0 PLEs

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Student-centric instructional approaches

To support and corroborate student control, teachers should adopt a more activity-oriented and student-centric rather than lecture-based teaching approach. Project-based learning (PBL) is an appropriate approach to support student control model. Firstly, PBL can support the knowledge producer role of students through involving them in knowledge building and higher-level cognitive activities such as engagement with more complex problems and pursuing solutions to them, asking and refining questions, collecting and analyzing data, knowledge and idea presentation, drawing conclusions, and creating artifacts (Blumenfeld et al., 1991; Chen & Chen, 2007). Secondly, through participating in designing and doing learning projects, students can acquire personal and metacognitive skills needed to improve their decision making skills such as designing plans or experiments, time and project management, making predictions, selecting appropriate content and, choosing relevant web tools (Chen & Chen, 2007). Thirdly, PBL can develop the social skills of students through collaborating with peers and experts, communicating their ideas and findings to others, improving their willingness to accept peer critiques and revise their projects, and promoting them to work collaboratively in groups to achieve the projects objectives (Blumenfeld et al., 1991; Chen & Chen, 2007). Finally, the involvement of the students in defining and completing the project "can create a sense of accomplishment and control for students which is absent in traditional classroom instruction" (Kearsley & Shneiderman, 1998).

Learning potential of Web 2.0 tools and services

Web 2.0 tools and services are receiving intense and growing interest across all sectors of the educational industry as means for facilitating the transformation of learning (Alexander, 2006; Couros, 2010; McLoughlin & Lee, 2010). These tools and services can support creative and collective contribution, knowledge producing and the development of new ideas by

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students (Nelson, Angela, & Clif, 2009). Furthermore, they can provide students with "just-in-time" and "at-your-fingertips" learning opportunities in a way that typical learning management systems cannot (Dunlap & Lowenthal, 2011).

In order to investigate the ways that Web 2.0 technologies can support student control model, we need to elicit their learning potential. Due to the steadily increasing heterogeneity of Web 2.0 technologies and ambiguousness of Web 2.0 concept, it is difficult to reach consensus about the meaning, notion, and borders of Web 2.0 technologies. Hence, we need to consider the gravitational core and underlying concepts of Web 2.0 to depict a picture of their learning potential and map them to the elements of the student's control model. Alexander (2006) enumerated the gravitational core and underlying concepts of Web 2.0 as below:

- *Social software*: a software application which provides an architecture of participation for end users to support collaboration and harnessing of collective intelligence by extending or deriving "added value" from human social behavior and interactions (O'Reilly, 2005).
- *Micro-content*: a metaphor for the nature of user-generated content in Web 2.0 including blog posts, wiki conversations, RSS feeds, podcasts, vodcasts, and tweets, compared to the page metaphor of Web 1.0.
- *Openness:* refers to the free availability of web tools and user-generated content.
- *Folksonomy:* user-generated taxonomies which are dynamic and socially or collaboratively constructed, in contrast to established, hierarchical taxonomies that are typically created by experts in a discipline or domain of study (Dabbagh & Rick, 2011).
- *Sophisticated interfaces:* refer to the drag and drop, semantic, widget-based websites created by using AJAX, XML, RSS, CSS, and mashup services (Bower, Hedberg, & Kuswara, 2010).

The potential of Web 2.0 to support students as knowledge producers

Web 2.0 is drawing several new perspectives to knowledge development within educational settings, which were not possible before. Firstly, as asserted by Mejias (2005), the openness nature of Web 2.0 makes it possible for social software applications to impact knowledge building process within classroom by connecting the classroom activities "to the world as a whole, not just the social part that exists online". Indeed, by considering the knowledge building as a "civilization-wide" process, these technologies afford students to

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"connect with civilization-wide knowledge building and to make their classroom work a part of it" (Scardamalia & Bereiter, 2006).

Secondly, in recent years, affected by increasing attentions towards social approaches of learning and knowledge building, a fundamental shift in technology enhanced learning from a focus on content to a focus on co-constructing knowledge and communication around the content has been emerged (Conole, 2007). Gunawardena, Lowe and Anderson (1997) illustrated five developmental stages for co-constructing knowledge in collaborative learning environments including (*i*) sharing and comparing of information, (*ii*) discovering of inconsistency among the information, (*iii*) negotiating the meaning and co-construction of knowledge through social negotiation, (*iv*) testing and modification of co-constructed knowledge, and (*v*) agreement and application of newly constructed knowledge and meaning. Arguably, the architecture of participation and openness aspects of Web2.0 can facilitate the communicational process and information needed to support the co-construction of knowledge by students.

Thirdly, Web 2.0 can support the appropriation of content by students. Appropriation as the "ability to meaningfully sample and remix media content" (Jenkins, 2006) makes student simultaneously as the producer and consumer of content and can be understood as a learning process in which students learn through picking several content (sampling) and putting them back together (remixing) to produce new content and knowledge objects such as ideas, discussions, conversations, comments, replies, concept maps, webpages, podcasts, wikis, and blog posts (Jenkins, 2006). Appropriation as a student-driven knowledge producing strategy is in line with the new knowledge development approaches which underscore the importance of increasing the students' capacity to know more rather than what currently they know, through equipping them with competencies required to engage with social and technological

changes. Combining the participatory, micro-content, and openness aspects of Web 2.0 facilitates a unique sort of participatory appropriation process known as "collaborative remixability" that recombines the information and micro-content generated by students to create new content, concepts, and ideas (McLoughlin & Lee, 2010; Chen & Chen, 2007; Alexander, 2006).

Taken together, different aspects of Web 2.0 can enrich the learning experiences of students and nurture their cognitive skills by providing them opportunities to practice "learning by doing" (Brown, Collins, & Duguid, 1989), to experience "learning with technology" (Jonassen & Reeves, 1995), and construct a personal presentation of knowledge and share it with others. In addition, by involving students in active construction of knowledge, teachers can achieve a comprehensive understanding of the ways that students learn, the sorts of content and technology they use, and the patterns of interactions they establish as a means to improve their teaching practices.

The potential of Web 2.0 to support students as socializers

The value and real power of Web 2.0 technologies is in their sociability aspect. This sociability aspect has changed the way that "participations" spread and people behave by making it feasible to build connections and networks between them (Boyd, 2007). From a learning perspective, the sociability aspect of Web2.0 offers students learning opportunity that is in line with their normal ways of learning and can enable them to integrate the explicit and tacit dimensions of knowledge (O'Reilly, 2005). On this basis, as stated by Dabbagh & Rick (2011), the inextricable link between "learning as a social process" and sociability aspect of Web 2.0 is transforming learning spaces, perspectives and interactions.

Web 2.0 can support the socializer role of students in three levels. Firstly, it can facilitate student-centered instruction. Indeed, Web 2.0 can trigger deep and active interactions

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between teacher and students through supporting conversational interactions; social feedback; and social networks. As a result, it can improve the negotiated control between teacher and students and raise levels of students' engagement and motivation (McLoughlin & Lee, 2010; Attwell 2007). Secondly, Web 2.0 can foster interaction and social learning between students. By getting help of social software, students can participate collaboratively with each other to the "authorship of content", obtain support and guidance from others, work together as a learning community, and share their resources, knowledge, experiences and responsibilities (Bower et al., 2010). Social bookmarking and RSS services can provide a great way to support students to bookmark, tag, and disseminate information, people, and learning experiences. These tags then can be arranged to develop tag clouds to visualize the ways that students are working and learning (Alexander, 2006). Being able to have access to other students' tags cloud provide the opportunity for students to see each other experiences and competencies resulting in being aware of the new streams of information, supporting vicarious and social learning and triggering students' reflection (Dabbagh &Rick, 2011). Additionally, as pointed out by Dabbagh & Rick (2011), folksonomy as a context-based mechanism for supporting social tagging and sharing the personal experiences of people can be seen as the "language of a community to form connections" between the members of the community. In classroom settings students can use this language to communicate and support "socio-semantic networking" and create learning environment through tagging, annotating and sharing web resources and learning experiences. Thirdly, the social and openness aspects of Web 2.0 make it possible to connect students to "More Knowledgeable Others" outside of the classroom boundaries (Attwell, 2010). As claimed by Peña-López (2012), this possibility can broaden the horizon of students' personal development by making a close link between PLEs and Zone of Proximal Development, or ZPD, (Vygotsky, 1978) concepts. According to

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Peña-López (2012), PLEs could be understood both as the ZPD and the full set of More Knowledgeable Others in terms of "people of flesh and blood", open educational resources, and all sorts of digital content. Accordingly, he contends that PLEs can extend the borders of students' ZPD by providing them with more developmental opportunities and support.

The potential of Web 2.0 to support students as decision makers

As the locus of control is shifting from institutions and teachers to students, the decision making abilities of students as the core part of self-directed and self-organizing learning behaviors are gaining more attention. Web 2.0 can support the decision making role of students in three dimensions. Firstly, the abundance of Web 2.0 tools along with the intensive contact of today's students with technology provide an unprecedented opportunity for supporting self-organizing and self-directing students to explore the web to satisfy their heterogeneous learning needs (Veen & Vrakking, 2006; Brown, 2000). According to Brown (2000), the permanent contact of today's students with web technologies and the open nature of web, provide them with opportunity to be the discoverers and thinkers of relevant technologies and learning resources and then to be the conveyors of them to their educational settings. As a result, students are intensively showing a new behavior called bricolage, i.e. "the ability to find something - an object, tool, document, a piece of code - and to use it to build something you deem important", which is compatible with their natural spirit of exploration (Brown, 2000). This technology-induced behavior can provide an exploratory-based learning situation which educators can use to corroborate the role of students as decision makers by prompting them to manage their learning process through designing and developing personal knowledge and technology management strategies (Rahimi, Van den Berg, & Veen, 2013a, 2013b).

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Secondly, selecting the most appropriate technologies to support teaching and learning activities is becoming more and more complicated due to the growing heterogeneity of available web tools and resources (Couros, 2010). This growing heterogeneity can trigger several learning processes and corroborate the role of students as decision makers in educational process. As illustrated by Couros (2010), the heterogeneity of Web 2.0 tools and services is enforcing teachers and students to acquire new skills in order to discover learning affordances of these tools and integrate them in their educational processes. As a result, choosing what to learn, what tools to use, how to find the right tool or content, and what community to join are becoming prevalent processes in today's learning and position decision making as an important learning skill for educators and students (Siemens, 2004). Moreover, according to O'Reilly (2005), the features and functionalities of Web 2.0 tools are considered to be in a "perpetual beta" state. On this basis, the permanent and extensive contact of students with Web 2.0 tools beside "unceasing development" of these tools can posit students as pioneer explorers of new functionalities of Web 2.0. As a result, it can change the expectations from the students and open a great opportunity for them to act as decision makers, co-designers, and partners in educational processes.

Thirdly, the sophisticated interfaces of Web 2.0 support easy development of the drag and drop, semantic, widget-based websites by using AJAX, XML, RSS, CSS, and mash-up services. As a result, students can use these technologies to manage their learning activities not only by remixing of content but also by mashing up of tools and services. This feature of Web2.0 along with the provision of opportunity for students to make decision regarding their learning trajectory, can provide possibility for them to develop their PLEs by adding their personal choices including learning content, tools, and peers into them. Figure 3 summarizes

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the learning potential of Web 2.0 and depicts a map between these potential and the elements of the student's control model.

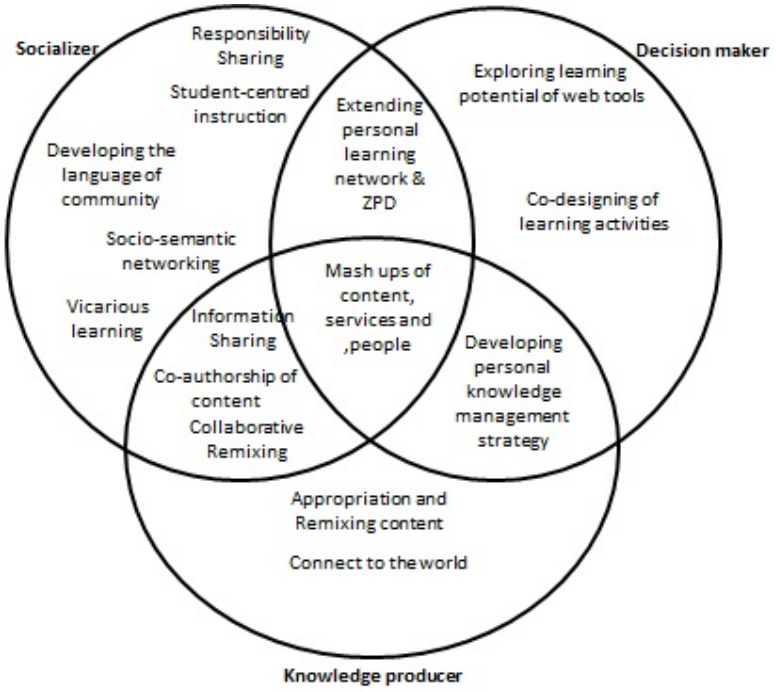

Figure 3: Mapping the learning potential of Web 2.0 into student control model

Technology-enhanced learning activities

To design technology-enhanced learning activities, we adopted and appropriated the Bloom's digital taxonomy map proposed by Churches (2008). Bloom's taxonomy (Bloom, 1956) represents the cognitive process dimensions as a continuum from lower order thinking skills to higher thinking skills being: knowledge, comprehension, application, analysis, synthesis, and evaluation. Anderson and Krathwohl (2001) revised Bloom's taxonomy by assigning a number of sup-process to each dimension and defining *creating* as a new higher order thinking skill. Thus, the revised Bloom's taxonomy has proposed a new continuum of

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thinking process consisting of *remembering*, *understanding*, *applying*, *analyzing*, *evaluating* and *creating* sub-processes. Churches (2008) extended the revised Bloom's taxonomy and proposed Bloom's digital taxonomy map by assigning digital learning activities to these cognitive processes as below:

- ***Remembering***: recognizing, listing, describing, identifying, retrieving, naming, locating, finding, bullet pointing, highlighting, bookmarking, social networking, social bookmarking, favorite-ing/local bookmarking, searching, googling.

- ***Understanding***: interpreting, summarizing, inferring, paraphrasing, classifying, comparing, explaining, exemplifying, advanced searching, Boolean searching, blog journaling, twittering, categorizing and tagging, commenting, annotating, subscribing.

- ***Applying***: implementing, carrying out, using, executing, running, loading, playing, operating, hacking, uploading, sharing, editing.

- Analyzing: comparing, organizing, deconstructing, attributing, outlining, finding, structuring, integrating, mashing, linking, reverse-engineering, cracking, mind-mapping, validating, tagging.

- ***Evaluating***: checking, hypothesizing, critiquing, experimenting, judging, testing, detecting, monitoring, blog/vlog commenting, reviewing, posting, moderating, collaborating, networking, reflecting, (alpha & beta) testing.

- ***Creating***: designing, constructing, planning, producing, inventing, devising, making, programming, filming, animating, blogging, video blogging, mixing, remixing, wiki-ing, publishing, vodcasting, podcasting, directing/producing, creating or building mash ups.

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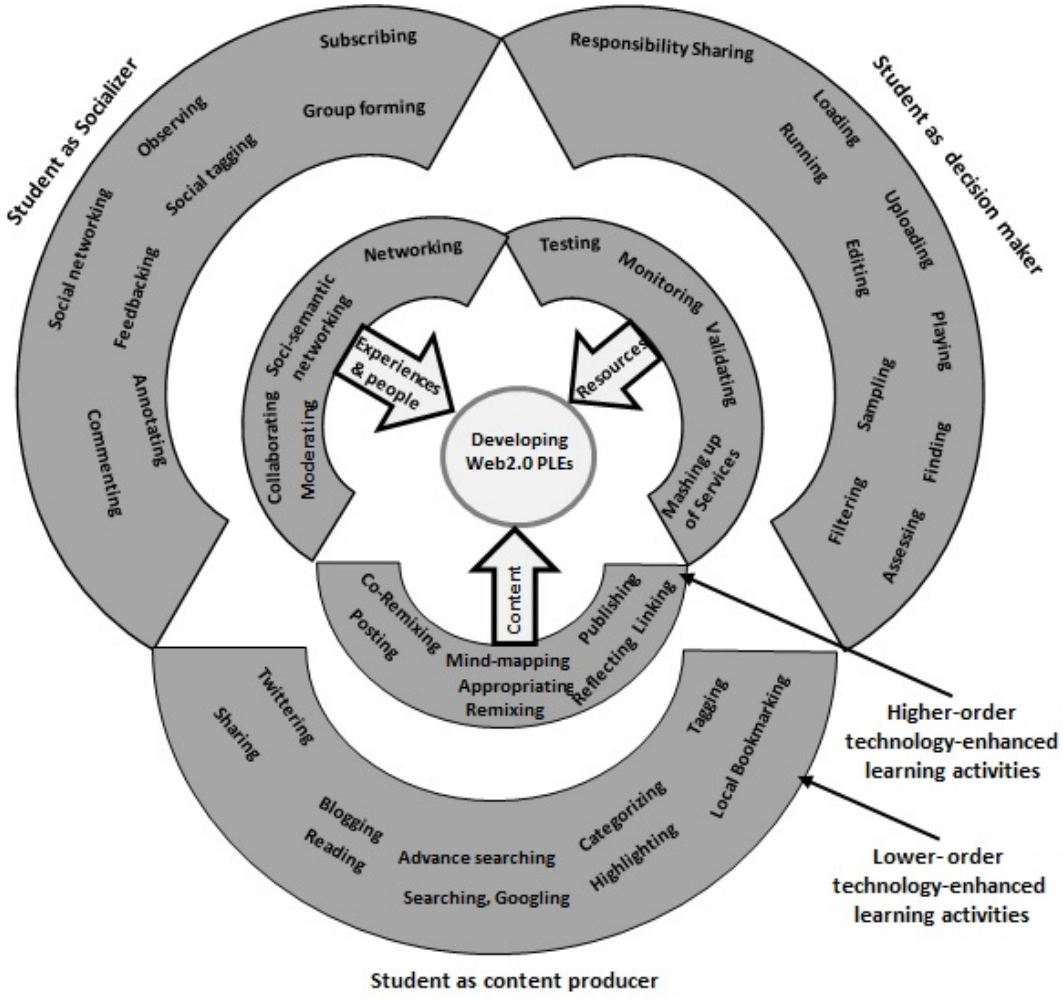

Figure 4: Mapping Bloom's digital taxonomy into student control model

Figure. 4 shows an example of mapping Bloom's digital taxonomy into the defined roles for students in the student's control model. Teachers can use this map to design appropriate technology-enhanced learning activities to assist and scaffold students to develop and deploy Web 2.0 based PLEs and accomplish their learning projects. According to this map, the PLE development process includes two sub-processes consisting of lower-order technology-enhanced learning activities, and higher-order technology-enhanced learning activities. To develop their PLEs students can start with accomplishing the lower-order technology-

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enhanced learning activities and then continue by running the higher-order technology-enhanced learning activities.

The map can support the key elements of the student's control model. Indeed, accomplishing learning activities such as advanced searching, tagging, blogging, twitting, mind mapping, and evaluating, remixing and appropriating of content can arguably provide students with the opportunity to acquire appropriate domain-specific knowledge, cognitive skills and competencies. During this process which can be characterized as learning by doing and content building process, it is likely that students acquire technical skills about the web tools and their learning potential which, as argued by Drexler (2010), can improve their autonomy during their learning processes. It should be noted that, to support the inherent personal development approach embedded in the PLE concept, appropriation of content should promote and facilitate a personal developmental trajectory for students. Indeed, without careful consideration of this developmental trajectory, according to Scardamalia and Bereiter (2006), any activity-based learning experiences can easily decline to a form of "shallow constructivism" or "doing for the sake of doing." Accordingly, to avoid this drawback and to emphasize the importance of the process of content building, appropriate learning activities such as reflecting, self-evaluating, creating personal meaning from learning experiences, and evaluating the quality of online content are required. This type of learning activities can foster internal learning abilities such as self-reflecting and develop critical thinking regarding the options and range of possibilities to select and evaluate content.

The social context of learning environment can assist students to keep control by providing them learning resources and relevant support they need to overcome the difficulties faced during the learning process and assisting them to make appropriate decisions (Garrison & Baynton, 1987). In technology-based learning environments such as PLEs, there are five

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sorts of interaction between the student and their social context, namely teacher-student, student-students, student-people outside of classroom, student-content, and student-interface (Moore, 1989; Hillman, Willis, & Gunawardena, 1994). The first three interactions outline the socializer role, while the last two interactions are related to the knowledge producer and decision maker roles of student, respectively. By defining the social learning activities such as social tagging, annotating, and group forming the map can assist students to learn and practice the principles of being a socializer to seek and achieve needed support to keep their control.

The map can augment the decision making role of students by allowing them to find, use, assess, and introduce relevant web tools and services. It also can corroborate the role of students in planning and designing educational practices by allowing them to explore and introduce the learning potential of web tools. It also encourages them to develop personal knowledge management strategy through tagging, categorizing, filtering and mashing up of content and services.

Requirements for implementing the model

There is a set of prerequisite conditions needed to be considered in order to implement this approach in a classroom setting. These requirements include:

- *Defining a learning project:* The learning project gives a meaning and direction to the students' learning activities. It also defines the tangible and measureable learning objectives and expected outcomes needed by the assessment and evaluation rubric.
- *Meeting technological requirements:* i.e. providing reasonable access to Internet and required web tools, providing an initial technical platform to keep students' PLEs together and allow them to observe each other learning experiences.
- *Providing initial support*: i.e. appropriate learning content, a list of relevant experts outside of the classroom setting to contact, guidelines to evaluate the quality and validity of online content, training students the basic functionalities of the selected web tools, defining an appropriate group working mechanism, and defining appropriate assessment and evaluation rubric.

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Conclusion

This paper proposes a pedagogy-driven framework for developing Web 2.0 based PLEs in educational settings. Supporting students' control through defining and adopting active roles in order to equip them with necessary competencies and skills needed to deal with the challenges of current knowledge intensive era is the main objective of this framework. Teachers can use this framework as a guideline to design appropriate enhanced technology-based learning activities to scaffold and assist students to develop and deploy Web 2.0 based PLEs to accomplish their learning projects. Further research is supposed to be needed to test, evaluate and improve the roadmap introduced.

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