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VLADIMIR TOMBERG

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LEARNING-FLOW MANAGEMENT AND TEACHER CONTROL IN ONLINE PERSONAL LEARNING ENVIRONMENTS

Institute of Educational Sciences, Tallinn University, Tallinn, Estonia

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VI. Tomberg, V., Laanpere, M., Ley, T. & Normak, P. (2013), Sustaining Teacher Control in a Blog-Based Personal Learning Environment. In International Review of Research in Open and Distance Learning, 14, (3), 109-133, Athabasca University Press

Author's contribution:

- Finalizing the research questions, preparing the theoretical framework, managing the research and design and coordinating the process of collaborative writing for the five (5) papers in which I am the first author. For these, I also presented the results from corresponding scientific conferences.
- During the preparation of the paper *Interrelation between Trust and Sharing Attitudes in Distributed Personal Learning Environments: The Case Study of LePress PLE* (Sousa et al 2011), I conducted a survey of the students who had used *LePress* and composed the corresponding part of the paper.

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INTRODUCTION

I would like to begin this introduction with a description of my personal development as a teacher. I was 26 years old and working in the media industry. One day, the headmaster of a high school asked me to work as a temporary replacement for a teacher who was absent due to illness. I considered this opportunity as a chance to gain some new experience and I agreed. Interestingly, from such a casual beginning, teaching gradually became my chosen profession.

My first teaching experience was as a diving instructor in the army. I taught young soldiers the skills that were critical for their survival - any wrong move under water could be fatal. The teaching methods used in the army were based on the highest levels of discipline and subordination. The recipe for ensuring discipline was quite simple – a menacing look, a loud intimidating voice and regular control over the soldiers' activities. Later, when I taught in high school, I used mostly the same methods. My belief in the validity of these methods was confirmed by the fact that the majority of my colleagues at that time behaved in a similar way.

After several years of teaching, I entered the Master program of Multimedia and Learning Systems at Tallinn University. Studying and subsequent work experience in the university completely changed my views regarding teaching. My university colleagues promoted initiative and self-directedness in the students; they spent a lot of time in discussions, group work and other types of activities aimed at the development of critical thinking among learners. By adopting new teaching methods, I found that the motivation of students to learn was considerably increased and learning outcomes were improved.

During the time of my Master studies, I defended master thesis "Realization of IMS Question & Test Interoperability Specifications. The case of the testing system of IVA". The following year I commenced my doctoral studies at Tallinn University and at the same time, was employed as a researcher in the Centre for Educational Technology in the Institute of Informatics. Being involved in research and development of various Web 2.0 tools, I also started to use different social media tools, such as blogs, forums, and wikis, in teaching. Although these tools were not designed specifically for learning and teaching purposes, they offer additional opportunities for supporting learning activities of students. More importantly, the use of Web 2.0 tools to build and use personal learning environments promotes self-directed learning. On the other hand, the use of dispersed social media tools by learners decreases the possibilities for teachers to observe and therefore adequately supervise the learners; the more the learner assumes control over the learning process, the more the teacher loses control. This raises the question about the necessity of returning some degree of control back to the teacher.

In the current doctoral thesis, I studied the question of control in the context of blog-based personal learning environments. For collecting and analysing empirical data, we have developed a special software tool called *LePress (learning*

WordPress), which allows a teacher to connect dispersed personal blogs of students around a course organized in the teacher's own blog.

The thesis comprises an introduction and five sections. In the *first* section we present the motivation for the current thesis as well as the main research questions; the *second* section is devoted to the methodology used in the research; the theoretical foundation is discussed in the *third* section; the findings published in the related publications are presented in the *fourth* section and the *fifth* section contains the concluding remarks.

1. RESEARCH QUESTIONS

The last decade was characterized by a massive introduction of *Virtual Learning Environments* (VLE) in education. Although some authors consider the concepts of VLE and *Learning Management Systems* (LMS) as synonymous, a clear distinction between them exists. VLE is a much more general notion and besides LMS, it embraces other types of e-learning environments including *Personal Learning Environments* (PLE) (Henri, Charlier, Limpens, & Edelweiss, 2008; Wilson, Liber, Johnson, Beauvoir, & Sharples, 2009) and *Learning Object Repositories*. In this work we adopt the definitions given in the work of Laanpere et al (Laanpere, Põldoja, & Normak, 2012), in which for example, the LMS are considered as a specific type of institutional VLE.

Initially, PLE was introduced as a technological concept denoting the application of Web 2.0 technologies and service oriented architecture (SOA) in education (M. Johnson & Liber, 2008). On the other hand, Attwell (2007) considered the PLE as a general, personally managed space for learning, which is not limited by any technological borders: "The only thing most people seemed to agree on was that it was not a software application." (Attwell, 2007) Attwell claimed that the PLE should bring together informal learning, workplace learning, learning at home, learning motivated by personal interest, as well as learning through engagement in formal educational programmes (Attwell, 2007). Schaffert and Hilzensauer (2008) considered the PLE as certain Web sites or services where learners can produce learning content or reflections and store documentation about their learning processes (Schaffert & Hilzensauer, 2008).

In this work we consider the PLE as an integrated, user-defined set of modern Web 2.0 tools, such as blogs, wiki, etc., which encourage learners' self-directedness and provide more support for socialization and networking in comparison to the traditional LMS. The PLE is considered to be an environment that is suitable for scaffolding self-directed learning. However, application of the PLE in formal higher education is limited in comparison to the LMS; the latter is specially designed for use in the context of formal learning. Salinas et al (2011) defined the basic features of the PLE (which also contains many features inherent in the LMS): they should support learners in (a) deciding on their own learning goals, (b) managing their own learning process, (c) communicating with others during the learning process, and they should support achievement of the learning goals (Salinas, Marín, & Escandell, 2011). Wilson et al (2009) advocated parallel use of the PLE and the LMS (they used the term VLE for the latter). They recommended that the PLE should be used predominantly in informal learning and possibly for some types of competence-based learning, while the LMS should be used in formal education systems (Wilson et al., 2009). However, they conceded there was a certain merging of these concepts: LMS allows usage of its services by the PLE, and some features of the PLE are incorporated in the LMS.

Although the modern constructivist approach to education implies the necessity of merging features of the LMS with the PLE, there exists no common understanding about its practical implementation. For example, tasks such as the management of learning goals and simple textual communication between learners can be implemented using many different Web 2.0 tools. On the other hand, in the context of formal learning, *learning flow* management requires availability of specific functionalities that are not naturally presented in modern Web 2.0 tools. Moreover, implementing these functionalities in the PLE should not cause any significant interference to the usage of existing features of these tools. In addition, the new functions should remain easy to learn and easy to use.

With specific reference to the blog-based PLE, the *first* research question of this thesis is:

> *How to design and implement a non-destructive adaptation of blog-based PLE, which provides pedagogical semantics and functionalities that support the main types of online learning flows in the context of formal education?*

The *second* research question of this thesis is:

> *In what way and to what extent can a dedicated course coordination tool sustain the teacher's control over learning flows in blog-based personal learning environments, without inhibiting the self-direction of learners?*

To answer these questions we conducted a series of studies using design-based research methods and consequently developed a course coordination tool – *LePress* – that in turn was used for conducting empirical study in a real learning and teaching environment. The essential results of the thesis are published in six papers listed under "Related Publications" above.

Four design-based research iterations were conducted, and the LePress software was used to prove the adaptability of Web 2.0 tools to the formal learning process in a non-destructive way. New technological solutions were proposed for tracking learning flow in the blog-based personal learning environment and solutions were designed for the assessment of and feedback from students' work using the native logic of the WordPress blog engine. Validation studies were also conducted into how LePress supports the pedagogically meaningful asynchronous interaction between teachers and learners. Finally, evidence was found that by using blog-based teaching, the teacher could maintain the necessary control over learning activities.

The learning workflow functionality, software architecture and user interface of LePress were designed by the author of this thesis. The author was also an initiator and the main contributor of all the studies that were conducted and the corresponding papers.

In the following sections we present the research methodology used, the theoretical foundation of the research and the findings.

2. METHODOLOGY

This section explores the research methodology chosen for the current study. The section commences with a review of the dependence of research methodology (including the actual research methods) on the general style of research and also the research domain. The methods used in the general domain of the current study, educational technology, are then discussed. The section concludes with an in-depth discussion of the methodology chosen for this study – design-based research.

2.1. GENERAL CONSIDERATIONS FOR CHOOSING RESEARCH METHODOLOGY

Research methodologies and methods that prevail in different research domains differ more or less from each other. In the case where research is carried out in only one domain, previous experience and the suggestions of domain experts can be used to determine a suitable methodology. However, the problem of choosing research methodology and suitable research methods becomes more complicated, when the study involves different research domains.

The current research takes place at the interface of the *information technology* and *education* domains. It is therefore reasonable to choose research methods from both these domains, depending on the questions under consideration.

In their fundamental work, Cohen, Manion, and Morrison (2007) inventoried the most established, up to date educational research styles, appropriate methods, guidelines and best practices (Cohen, Manion, & Morrison, 2007). However, the authors have limited their work to only traditional education research. By providing a solid philosophical and methodological basis for researchers and by covering a majority of the needs for 'pure' educational studies, Cohen et al did not consider all the possible adjacent fields. In particular, they did not address the methods that are used in educational technology.

2.2. EDUCATIONAL TECHNOLOGY RESEARCH

As a field of study, educational technology emerged during the 1920s and was significantly disseminated after World War II with the introduction of new technologies and media, such as cinema, radio, television, and subsequently, teleconferencing tools (Van den Akker, Gravemeijer, McKenney, & Nieveen, 2006).

Many researchers (Hoepfl, 1997; S. D. Johnson, 1995; Zuga, 1994) claimed that when research becomes interdisciplinary and the focus shifts to technologies, traditional educational research methods are insufficient. Reeves (1995) found that the majority of studies published during the last five years had predictive goals of testing hypotheses derived from theory or comparing one medium for instructional

delivery with another, such as quasi-experimental studies of distance education *versus* traditional methods (Reeves, 1995). During the 1990s, when the use of computers in education became widespread, early adopters started to use new media tools in education as well as new forms of learning and teaching. As a result the overall education framework became more complex. Saba (2002) explained this complexity by considering relationships that emerge in the process of distance education as *"a set of nested and hierarchical sub-systems, which have their own internal behavior, but each is affected by the behavior of all the other "levels", and affects the behavior of all the other levels"* (Saba, 2002). This hierarchy is illustrated in *Figure 1***Tõrge! Ei leia viiteallikat.**.

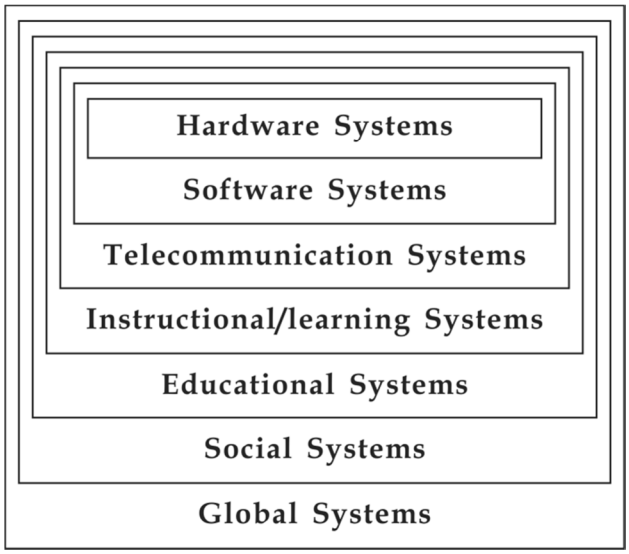

Figure 1. Hierarchical Subsystems of Distance Education (Saba, 2002)

Saba showed a variety of relationships between different components in this hierarchical system. It does not make sense to study one separate component without being cognizant of its relationship with the others. The primary function is affected by all the other components that have technological systems – hardware, software, and telecommunication systems. Reeves (2006) also claimed later that the role of technology is to fundamentally enhance teaching and learning. However, he noted a very weak impact of reviewed studies on actual practice and concluded: "educational technology research has been plagued by a history of "no significant differences" and even the most thorough meta-analyses of the quasi-experimental research studies conducted by educational technologists yield effect sizes that are extremely modest at best" (Reeves, 2006). As a possible alternative, Reeves proposed to investigate the direction of design research methods, arguing that the

practical results of such studies (even in very small-scale cases) will have a more significant impact on educational science.

To emphasize the needs for new research methods in educational technologies, Reeves (2006) announced his "call for action", in which he challenged researchers to use *design-based research* (DBR) in their research:

> *"Inspired by the design-based research initiatives outlined above and guided by methodologists such as van den Akker (Van den Akker, 1999), it is time for educational technologists to adopt a more socially responsible approach to inquiry. The design knowledge required in our field is not something that can be derived from the kinds of simplistic, often "one-off," quasi-experiments that have characterized our shameful legacy of pseudoscience. Without better research, teachers, administrators, instructional designers, policy makers, and others will continue to struggle to use educational technology to reform teaching and learning at all levels"* (Reeves, 2006).

Note that in his *'Call for Good Research in Technology Education'*, Waetjen had already stated in 1992 that the current recommendation was to use experimental type research as much as possible (Waetjen, 1992).

It is important to note here that design-based research is a 'method', in which interventions are conceptualized with follow-up experiments in natural settings, aiming to create new frameworks for learning and teaching. Design-based research is discussed in greater depth in the following section.

2.3. DESIGN-BASED RESEARCH

Design-based Research Overview

As a research methodology for this work we have selected *design-based research* (Barab & Squire, 2004; Sandoval & Bell, 2004; Van den Akker et al., 2006; Wang & Hannafin, 2005). Note that although this methodology is well established, different authors have used different names for it: *'development (sometimes developmental) research'* (Richey, Klein, & Nelson, 2004; Van den Akker, 1999), *'design research'* (Kelly, 2004; Reeves, 2006; Van den Akker et al., 2006), *'design experiments'* (Brown, 1992), (Cobb, Confrey, diSessa, Lehrer, & Schauble, 2003; Collins, Joseph, & Bielaczyc, 2009; Kali, 2009), and *'formative experiment'* (Newman, 1990). Barab & Squire (2004) claimed that design-based research is not a specific approach, but "a series of approaches, with the intent of producing *new theories*, *artefacts*, and *practices* that account for and potentially impact learning and teaching in naturalistic settings" (Barab & Squire, 2004). Mor (2010) proposed an alternative DBR definition: "Design based research is a methodology for the study of function. Often referred to as design research or design experiments, it is

concerned with the design of learning processes, taking account of the involved complexities, multiple levels and contexts of educational settings" (Mor, 2010).

By publishing his "*Call for a Science of Design"*, Simon (1969) defined for the first time, the process of design as a core for professional practice (Simon, 1969). Mor (2010) found important correlations of Simon's basic design concepts with educational science. Being based on Simon's conceptual difference between *natural and design sciences*, where natural science is concerned with *'what is'*, and design science asks *'what ought to be'*, Mor claimed that "the main concern of educational research is *how they ought to learn* and how they *can be helped to learn*". This claim allows the assumption that educational research is a design discipline in its nature. By continuing to develop this idea, Mor identified the importance of the human agent who interacts with the objects of study: "Whereas natural science strives for representational invariants, design science is deeply concerned with the way problems under investigation are represented in order to illuminate our capacity to solve problems." The teacher and the learners can be considered as the main actors, who can and should be involved in DBR (Mor, 2010). Van den Akker also supported the idea of the involvement of participants in the research: "interaction with practitioners is needed to gradually clarify both the problem at stake and the characteristics of its potential solution." (Van den Akker et al., 2006).

Design-based research seems to be especially useful when the teacher is involved in the research as the conductor and actually taking part in the experiment. Edelson (2002) wrote: "…we have found the voice of teachers in this design process to be particularly valuable" (Edelson, 2002). Walker (2006) stated: "…teachers and students are central to the functioning of educational practices and so design research in education needs methods drawn from the human sciences, arts, and humanities" (Walker, 2006). By emphasizing the importance of the teacher as a creative participant in the design-based research, Schön pointed out that "…an epistemology of practice must be an epistemology of designing" (Schön, 1992). He also emphasizes the importance of dialog in learning. Schön considered dialog between a teacher and students as "a collaborative, communicative process of design and discovery" (Schön, 1992). He introduced the term *'community of design inquiry'*, which blends together *'community of inquiry'* (Garrison, Anderson, & Archer, 1999) and DBR concepts. Learning happens in a community of inquiry by means of active research that has the following three main components: *cognitive presence*, *social presence*, and *teaching presence*. Schön argued, that the teacher and the learner "…would face a problem of communicating across divergent design or problem-solving worlds; their task here would be to create and sustain a *community of design inquiry*" (Schön, 1992). According to Schön, the teaching that takes place in communities of design inquiry could be referred to as *'reflective teaching'*. In reflective teaching "teacher and student engage in a reflective conversation with the situation, which takes the form of communicative *design inquiry*" (Schön, 1992).

Main Features of Design-based Research

The range of research areas that relates to DBR includes cognitive psychology, observational research methods, human–computer interaction, software development, curriculum development, and teaching practices (Edelson, 2002). Similarly, DBR has some features in common with a number of other research methodologies. The principal investigator of the Design-Based Research Collective, Christopher Hoadley (2011), identified the main similarities between DBR and some of these methodologies. These are:

- *Participatory Action Research*, DBR treats intervention as both an outcome and a way to interpret results;
- *Formative Evaluation Research*, DBR aims to improve interventions;
- *Ethnography*, DBR involves a dual role as participant-observer;
- *Positivist experiments*, DBR believes in making predictions and falsifying them (Hoadley, 2011).

In spite of these similarities, DBR is an independent methodology and does not correspond to any of the methodologies listed above. According to Van den Akker "DBR aims at making both practical and scientific contributions. In the search for innovative "solutions" for educational problems, interaction with practitioners ... is essential" (Van den Akker, 1999). He aimed at creating a practical and effective intervention for an existing problem or intended change in the real world instead testing whether theory, when applied to practice, is a good predictor of events. Later, Van den Akker et al (2006) asserted three main motives for using a design-based research in the field of educational studies:

- *Increase the relevance of research* for educational policy and practice;
- *Develop empirically grounded theories* through combined study of both the process of learning and the means that support that process;
- *Increase the robustness* of design practice (Van den Akker et al., 2006).

Edelson (2002) specified three types of theories that can be developed through DBR:

1) A *domain theory,* as the generalization of some portion of a problem analysis about learners and how they learn, and teachers and how they teach;
2) A *design framework,* as a generalized design solution. Design framework is for prescribing the characteristics that a designed artefact must have to achieve a particular set of goals in a particular context.
3) A design *methodology* that provides guidelines for the *process rather than the product*. It describes a design process, forms of expertise required, and roles to be played by the individuals representing those forms of expertise (Edelson, 2002).

It is important to note that *design methodology* can be applied to regular design, e.g., in a process of software development as well as to research, where the design methods are applied.

Reeves (Reeves, 2006) summarized approaches used in DBR and in traditional predictive research (*Figure 2*). Workflows used in these approaches are different in the definition of the problem, in the process of inquiry, and in the expected results.

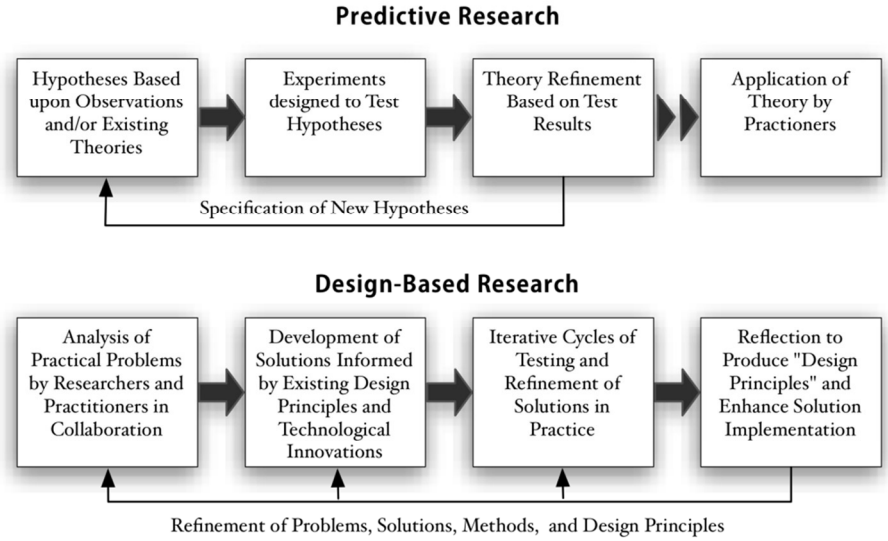

Figure 2. Predictive and design-based research approaches in educational technology research (Reeves, 2006)

Design-based research starts with rigorous analysis of a learning problem by a theorist or researcher and this leads to quite specific ideas for interventions. In turn, designers "build systems that use information technology to build specific teaching and learning materials and methods designed to realize learning gains predicted by theory and research. If the theoretical analysis is right then these interventions ought to give markedly more effective results" (Walker, 2006).

The approaches for DBR validation have some peculiarities: "design studies, particularly to the extent that they are hypothesis and framework generating, may be viewed as contributing to model formulation rather than for model estimation or model validation" (Kelly, 2004). Van der Akker (1999) proposed evaluating validity through expert appraisal, practicality via micro-evaluations and try-outs, and effectiveness in field tests (Van den Akker, 1999).

Van der Akker (1999) defined a formative evaluation as a key activity for DBR, because it provides the information that continuously feeds the cyclic learning process of development during the subsequent loops of a design and development trajectory (Van den Akker, 1999). He identified two of the most important

characteristics of formative evaluation. The first was a *priority on information richness*. Van der Akker states that "richness of information, notably salience and meaningfulness of suggestions in how to make an intervention stronger, is therefore more productive than standardization of methods to collect and analyse data" (Van den Akker, 1999). The information richness is considered to be especially important for early stages of formative evaluation, when the intervention is still poorly crystallized.

The second characteristic, van der Akker named *efficiency and shifting emphasis in quality criteria*. "During development processes, the emphasis in criteria for quality usually shifts from *validity,* to *practicality,* to *effectiveness*" (Van den Akker, 1999). Though such a characteristic of formative evaluation is obvious for the DBR, it differs from that used in traditional educational research.

Research Methods Used in Design-based Research

Design-based research is a synthetic methodology of inquiry that involves research methods from different domains. For example, Richey et al. (2004) performed a comprehensive analysis of 154 DBR studies (they used the term "developmental research") and proposed to divide this research into two types (Table 1).

Table 1. *Summary of the Two Types of Developmental Research (Richey et al., 2004)*

	Type 1	Type 2
Emphasis	Study of specific product or program design, development, &/or evaluation projects	Study of design, development, or evaluation processes, tools, or models
Product	Lessons learned from developing specific products and analysing the conditions that facilitate their use	New design, development, and evaluation procedures &/or models, and conditions that facilitate their use
	Context-specific Conclusions	Generalized Conclusions

Type 1 typically involves situations in which the product development process used in a particular situation is described and analysed and the final product is evaluated. This research type addresses issues such as the following:

- Suggested improvements in the product or program;
- The conditions that promote successful use of the product or program;
- The impact of the particular product or program;
- Conditions that will be conducive to efficient design, development, and/or evaluation of the instructional product or program.

Type 2 typically addresses the design, development, and evaluation processes themselves rather than a demonstration of such processes. The ultimate objective of this research is the production of knowledge, often in the form of a new (or an

enhanced) design or development model. This research type addresses issues such as the following:

- Evidence of the validity and/or effectiveness of a particular technique or model;
- Conditions and procedures that facilitate the successful use of a particular technique or model;
- Explanations of the successes or failures encountered in using a particular technique or model;
- A synthesis of events and/or opinions related to the use of a particular technique or model;
- A new or enhanced design, development, and/or evaluation model.

Based on the analysis of 56 type 1 studies and 58 type 2 studies, Richey et al proposed a summary table of the research methods used (Table 2). Note that Table 2 is based on the analysis of a certain set of research papers and therefore does not necessarily cover all possible research methods suitable for use in DBR.

Table 2. *Common Research Methods Employed in Developmental Research Studies*

Research Type	Function/Phase	Research Methods Employed
Type 1	Product design & development	Case study, In-depth interview, Field observation, Document analysis
Type 1	Product evaluation	Evaluation, Case study, Survey, In-depth interview, Document analysis
Type 1	Validation of tool or technique	Evaluation, Experimental, Expert review, In-depth interview, Survey
Type 2	Model development	Literature review, Case study, Survey, Delphi, Think-aloud protocols
Type 2	Model use	Survey, In-depth interview, Case study, Field observation, Document analysis
Type 2	Model validation	Experimental, In-depth interview, Expert review, Replication

The main component of DBR that differs from traditional research methods is the design. Wang & Hannafin (2005) proposed a reason for the diversity of DBR methods: "design-based research posits synergistic relationships among researching, designing, and engineering" (Wang & Hannafin, 2005). They also asserted, that "researchers manage research processes in collaboration with participants, design and interventions to refine implement systematically and

improve initial designs, and ultimately seek to advance both pragmatic and theoretical aims affecting practice" (Wang & Hannafin, 2005).

According to Banathy, in design science "methods are tools for creating and changing human artefacts. Methods are thus selected to fit the specifics of the problem and situation, and may consist of any one or a combination of explanatory, interpretive, experimental, computational, mathematical or exploratory methods" (Banathy, 1996). The artefact can be, for instance, learning software or even a pedagogical achievement. With reference to the Design-Based Research Collective (The Design-Based Research Collective, 2003), Kelly (2006) specified that the concept of an "artefact" need not be "concrete" such as a computer program. It might describe aspects of activity structures, institutions, scaffolds and curricula, but it is something that can be eventually adopted, adapted and used by others (Kelly, 2006). Kelly defined two types of artefacts that can be objects of design-based research: *process as an artefact,* as a result of teaching experiments, where the researcher and the teacher are the same person, and *software as an artefact,* which is usually concerned with learning environments. The main goal of research that focuses on *software as an artefact* is not the production of software *per se*, but rather the exploration of research questions about learning or teaching. These questions are reified, explored, and tested by the design and use of the software/learning environment. (Kelly, 2006)

The generic nature of the concept "artefact" made DBR especially suitable for studying *technology enhanced learning* (TEL). The artefacts used in TEL belong to a wide variety of different categories – learning environments, educational software, learning content, learning tools, etc. Moreover, in DBR, these artefacts are not something static, but they are always under constant development. As mentioned by Richey et al (2004) "development, in its most generic sense, implies gradual growth, evolution, and change" (Richey et al., 2004). It applies particularly to software development – starting from a prototype, a software solution is *iteratively* tested, assessed, and gradually improved. An example of a typical iterative design cycle is illustrated in *Figure 3*.

Each iteration cycle consists of five steps:

1. Examination of current practices and activities. Needs are identified through scenario-based design techniques, interviews, and observations;
2. Tensions, controversies, and conflicts within and between activity systems are identified;
3. A period of search and questioning begins as new models and metaphors are considered and new solutions and designs are developed;
4. Initial series of trials and testing of designs in actual settings, new priorities and approaches emerge;
5. Periods of reconceptualization, revision, and redesign;

The entire cycle will be repeated until some resolution, new stability, or closure is achieved. (Gay & Hembrooke, 2004)

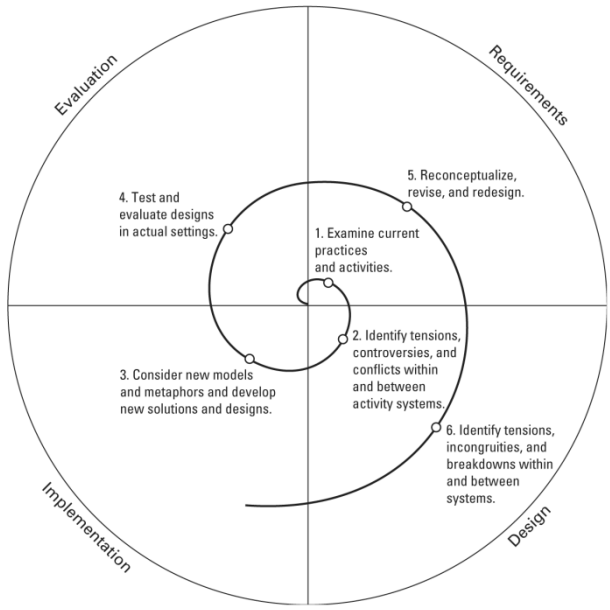

Figure 3. An iterative design cycle (Gay & Hembrooke, 2004)

Note that DBR methodology allows a flexible approach in the course of development – initial ideas that are planned for implementation can be radically changed and even cancelled. Methods applied in different iterations can be different as well. Wang and Hannafin (2005) noted that "methods vary during different phases as new needs and issues emerge and the focus of the research evolves" (Wang & Hannafin, 2005).

2.4. APPLICATION IN THE CURRENT STUDY

In our approach to DBR, we adhered to the proposals of Barab and Squire (2004) for the creation of new software artefacts supporting the interaction of teachers and students in an online course environment (Barab & Squire, 2004). The main research questions were inspired by fundamental questions of education that can be presented using Mor's (2010) formulation – how *learners ought to learn* and how they *can be helped to learn* (Mor, 2010). These specific questions were used in the online personal learning environments and focused on the role of teachers.

According to the typology employed by Richey et al (Richey et al., 2004), the current study belongs to Type 1, consisting of design, development, and evaluation of tools that support teaching and learning in online learning environments.

This research has an iterative structure and consists of four iterations. Based on Gay & Hembrooke's (Gay & Hembrooke, 2004) suggestion for iterative studies (*Figure 3*), the research was divided into four iteration cycles (*Figure 4*). The activities that were conducted in each cycle were different, depending on the objective of the cycle. The structure of the cycles followed the structure described in *Figure 3*.

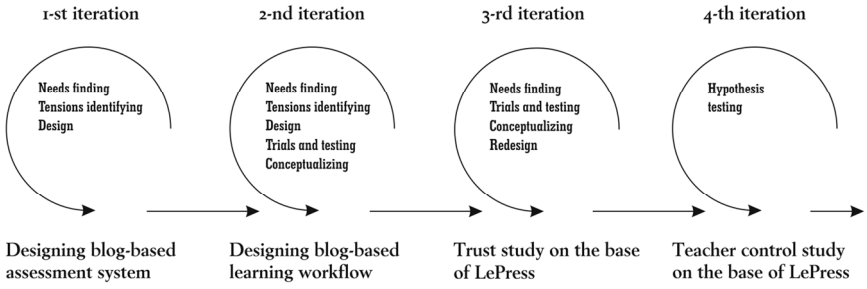

Figure 4. Iteration cycles made within DBR

The thesis as a whole is based on DBR; however, the fourth iteration contains a traditional predictive sub-study with statistical hypothesis testing. This was done for two reasons: firstly, there was a need for a different kind of approach for the evaluation of the design, because it was impossible to perform an evaluation using typical DBR methods; secondly, based on previous iterations, there were now several new hypotheses related to teacher control, which needed to be tested. It should be noted that other authors have previously proposed mixing DBR iterations with other methods (Andriessen, 2006; Kelly, 2012).

The research performed in each of the iterations was reflected in one or two papers that are included in the appendices of the thesis and described in Section 4.

3. THEORETICAL FOUNDATION

This section presents an overview and discusses the main results obtained so far by other researchers in the subject area of the thesis. The chapter discusses certain aspects of the foundations in greater depth than is evident in the research papers of the author. This is due to the fact that the length of the research papers was limited, which in turn, required the theoretical parts of the papers to be abbreviated.

The *first* subsection is devoted to the major changes and opportunities that technology offers for enhancing learning and teaching. The *second* subsection discusses support mechanisms of learning (or more specifically, *learning flows*) – in personal learning environments and the *third* subsection discusses teacher control in situations where learners are using personal learning environments.

3.1. USING TECHNOLOGIES IN LEARNING AND TEACHING

The fact that technology has already had a huge impact on learning and teaching processes is indisputable. McLuhan predicted as early as 1964 that the appearance of the movie, radio, and television will bring us to a “classroom without walls”, arguing that technologies influence and define the usage (McLuhan, 1964). The invention and introduction of such kind of devices as the *iPad* can be presented here as a good example – tablet computers are already a typical device used in many schools. Today Apple App Store provides a full range of educational software applications and learning media resources. Web users share thousands of tutorials and reflections about their experience by using tablet computers in the learning process. The One Laptop per Child Association has changed their laptop priority to tablet computers by designing an inexpensive XO-3 tablet computer with a Linux-based operating system and an embedded educational software suite. However, different styles of learning are supported with the use of a tablet computer as compared to the use of a desktop or laptop computer. For example, in contrast to personal computers, a typical tablet computer does not support multiuser accounts; it provides a user-combined access to all calendars, emails and other personal material and therefore it probably cannot be shared in a class like desktop computers. Dron (2007) corroborated the prediction of McLuhan: “...the affordances of any medium must determine what can be achieved through its use and, therefore, the choice of medium will materially affect the learning that it may help to engender" (Dron, 2007). Anderson and Dron (2011) described the influence of technology by comparing educational process with a dance: “the technology sets the beat and creates the music, while the pedagogy defines the moves” (Anderson & Dron, 2011). Music gives birth to the movement – by listening to music one starts to dance, being guided by a tempo. Just as dance movements are difficult without the music, similarly pedagogy without technologies limits the development of the processes that occur in learning.

This study is focused on a technological invention that has had a huge – and still growing –impact on the ways of learning – Web 2.0. It was initially proposed as "The web as a platform" (O'Reilly, 2007) and today is being widely adopted for use in diverse learning applications.

Using Web 2.0 Tools for Learning and Teaching

The term Web 2.0 was proposed for the first time by DiNucci (DiNucci, 1999) and became popular after the first Web 2.0 conference that was hosted by O'Reilly Media and Media Live in 2004[1]. Compared to the previous *static* Web, the new Web 2.0 is *dynamic*; it allows users to actively participate in the creation of the content and in communication. Adoption of this concept caused the development of a huge number of different social media tools, which allowed the users to co-create content with wiki, communicate in blogs and forums, share photos, audio, and video files etc. The users actively participate in social interactions that are simple with technologies such as instant messengers, email, IP telephony, wikis, blog comments/trackbacks and forums (Dron & Bhattacharya, 2007).

The popularity of Web 2.0 tools is explained by the fact that they offer a better level of user participation, openness, network effects (Zourou, 2012), and also, they often offer a high quality of learning resources (Ullrich et al., 2008). Web 2.0 applications and social software are increasingly used for knowledge development and sharing, and for cultural interchange and networking (Attwell, 2008). In the context of learning this allows the learner to take more control over their learning activities (Dron & Anderson, 2009). The learner can build a personal learning environment, consume and share resources, participate in discussions, etc.

However, there are some serious risks if Web 2.0 tools are not used properly in education. Dron and Bhattacharya (2007) emphasized a risky element in the use of Web 2.0 by comparing the free choice digital world to a walled garden of the LMS. Like real gardens, the walled gardens have predefined tracks, artefacts, and rules. In the walled garden people feel comfortable and safe. However, even a gardener does not often change the garden, once it is built. Only limited additions and corrections are available for development, especially if the garden (the LMS) is actively used. Because of these restrictions, Dron and Bhattacharya labelled the LMS as an example of the "Stalinist regime" (Dron & Bhattacharya, 2007). In contrast to the walled gardens, Web 2.0 is the jungle of social media that grows on its own, offering new functions and activities.

Dron (2007) asserted that using WEB 2.0 tools for teaching can never be ideal because "... it would generally be difficult to base an entire sequence of learning transactions on such tools as they are unable, on their own, to perform or to support the full range of functions that might be expected of a teacher" (Dron, 2007). Together with Bhattacharya (2007) Dron created a list of issues that may present

[1] The Web 2.0 conference: http://www.web2con.com/web2con/

themselves in the practical use of Web 2.0 tools in the teaching process. In the current study, we address the following:

- *Clashing cultures*. Dron and Bhattacharya considered specific types of education cultures associated with LMSs and the distributed Web 2.0 environments. The main problems that the authors envisaged were the collisions between conventional 'top down' approaches in universities and 'bottom-up' approaches characteristic of personal learning.
- *Loss of monitoring*. This issue is associated with the ability of a teacher to monitor the interactions of students. While LMSs have a designated tool for initiating, directing, and monitoring the actions of the students, the Web 2.0 based environments are built 'bottom-up'. The students in Web 2.0 environments not only decide when, and with whom they interact, but can also make their actions invisible for the teacher. By losing the ability to monitor, the teacher also *loses control* over the learning process of the students.
- *Assessment woes*. In Web 2.0 environments, the teacher has difficulty keeping records of the students. It is technically difficult to automate gathering results of assessments from distributed learning environments of learners. At the same time, manual assessments of students' work in distributed learning environments can be very time-consuming for the teacher.
- *Overwhelming choice.* This means it is an impossibility to offer consistent guidance for students in the Web 2.0 environment in contrast to LMS. The inability to monitor this issue is specifically related to losing control by the teacher.

These issues can be serious obstacles in the way of teachers and learners who want to adapt Web 2.0 technologies for learning. The major problem is how to integrate the positive features of the LMSs and Web 2.0 based personal learning environments into a coherent learning environment (Henri et al., 2008).

In this thesis, we address this problem in the specific context of blog-based personal learning environments.

Blog-Based Learning Environments

Blogs (sometimes called *weblogs*) are Web 2.0 tools that are widely recognized as being well suited for supporting learning (Halic, Lee, Paulus, & Spence, 2010). Blogs are the Web informational sites that allow authoring, editing, and publishing of discrete entries – blog posts and comments. A blogger arranges content in the blog by topics, and then it appears sorted in reverse chronological order (most recent first). Usually blog software is installed on a Web server and provided to users free of charge. For example, a major blog provider is *Wordpress.com* that uses *freemium*, ad-supported, and subscription revenue models. Many open source blog platforms that are available free of charge (WordPress, b2evolution, etc.) can be installed on a personal server by an advanced user.

The blog platforms enable asynchronous dialogue between the bloggers. This is probably one of the main reasons why using blogs gained popularity in formal education in the last few years. Among the reasons for using blogs in learning, educators have identified the ability of blogs to engage people in collaborative activity, knowledge sharing and a sense of community that can be enhanced through both student and instructor interaction via the blog (Halic et al., 2010). Dron also noted the simplicity with which blogs can combine elements of publication and communication. They can support multiple forms of communication (for example, using RSS feeds), straddling boundaries between publication and dialogue (Dron, 2007). Several types of *linkbacks* (method to obtain notification by linking to documents in another blog) allow automatic tracking of specific blog posts of other bloggers, thereby realizing dynamic connections between the blogs (O'Reilly, 2007).

Halic et al (2010) found that blogs better suit learning needs when they are coupled with compatible pedagogical conceptions (Halic et al., 2010). Apparently the teacher-centric instructivist models of learning are not the best options to follow in blog-based learning environments. On the contrary, Web 2.0 technologies support learner-centric constructivist learning (Dron & Anderson, 2009) implying active knowledge building by learners rather than knowledge-acquisition. Ability of the learner to choose when and where to participate drives the use of blogs far more than the expected pedagogical benefits (Dron, 2007).

From a teaching point of view, blogs can make the learning process of students more transparent (Halic et al., 2010). By reading blog posts of students, teachers can get a better overview of the students' understanding of the course material, to identify what students refer to as expert knowledge and questions that were not answered in the class or in course materials. Such information about a students' learning process provides valuable feedback to the teachers for improving their teaching activities (Paulus, Payne, & Jahns, 2009). Blog-based learning environments have strong potential to encourage mirroring activities (Järvelä & Hadwin, 2013), when learners collect, aggregate, and reflect data back to the users about individual and collective interactions and engagements. Communication in blogs takes place in the form of blog posts, comments, trackbacks and feedbacks usually in an open environment. These forms of group-based learning can raise the awareness of collaborators of individual or collective actions. Because of the social nature of blogs, this is especially true for social awareness, such as knowing team members perceptions, ratings, or knowledge (Buder & Bodemer, 2008).

In spite of these useful features, blogs have certain limitations in their usefulness for learning and teaching because they normally are not developed specifically for educational purposes (Kim, 2008). The limitations become especially apparent in the context of formal institutional learning: formal learning should comply with certain quality criteria and is therefore normally quite regulated. In addition, blogs do not support the performance of some functions that inevitably should be present

in formal learning. The assessment of learners in blog-based learning environments is an example of these functions and one of the focuses of the current thesis.

Assessments in Blog-Based Learning Environments

Assessment is an important factor motivating the students to engage in the blogging component of the course (Churchill, 2009). However, because of the publication-oriented design of blogs, several issues arise when conducting assessments in blog-based learning environments. These issues can be divided into two main groups: (1) issues caused by the lack of the blogs' functionalities that restrict the usage of various tasks and (2) issues associated with the technical conduct of assessments.

With respect to issues noted in the group (1) above, blogs are more suitable for formative rather than summative assessments. While formative assessment can be based on the blog posts of the learners, summative assessment with grading is more difficult because of the confidentiality requirements concerning grades and the absence of data handling features of blogs. Although blogs are well suited to some types of assessment tasks (for example essays, reflections, or literature reviews), it is hard or sometimes even impossible to use some other types of assessment tasks without using some additional tools (for example forum-based or group-based assessment, or conducting tests). Because of strict publishing policy, blogs do not allow the users to write posts on the personal blogs of somebody else. This certainly does not support collaborative learning. It should be noted here that according to some studies, students with a shared blog were less active in blogging as compared to students having personal blogs (Kim, 2008). In addition, blogs do not have group-forming mechanisms, tools for private communication, both internally and between the groups etc. Consequently, it is hard to assign and implement group tasks using a blog.

Bhattacharya and Dron considered an *electronic portfolio* as a tool that can solve many issues related to monitoring, control, and trust in the learning process. By noticing a lack of monitoring in Web 2.0, they proposed to implement the monitoring through the process of self-evaluation, peer review and developing electronic learning portfolios by the students (Bhattacharya & Dron, 2007).

With respect to issues noted in group (2) above, Dron and Bhattacharya (2007), state that the most important issues in blog-based learning are monitoring and history. To improve the process of learning, teachers should continuously analyse existing data, and when necessary, modify their actions accordingly (Dron & Bhattacharya, 2007). Without a central point of data convergence, these tasks are extremely complicated: accessing blog posts distributed among a large number of blogs of different students without a dedicated personal navigation tool can be extremely time-consuming. An institutional auditor who tries to verify and validate the consistency and fairness of assessments will find it even more difficult.

To solve issues related to gathering information from blogs of learners, teachers usually use RSS feeds. However, where there are courses with a large number of

learners, the starting and ending feeds subscription requires time-consuming manual operations. In addition, there are no easy ways to automate filtering the posts. Põldoja and Laanpere (2009, 2010) proposed to use specific tags for this purpose (Põldoja & Laanpere, 2009; Põldoja, 2010). Although this approach would solve the monitoring issue, it is still semi-automatic, because the users need to manually tag each course post.

The research papers referred in Sections 0 and 0 provide further elaboration of this topic.

3.2. SUPPORTING LEARNING FLOW IN PLE

Learning in a personal learning environment is mostly self-directed, where the learner decides on the learning activities. It works well for proactive and motivated learners having the necessary learning skills. On the other hand learners, who are either not sufficiently motivated or lack the required learning skills, can easily get into difficulties and therefore need adequate support. In order to offer support it is important – as it is in any other area of human activity– to understand the processes that should be supported. For understanding and analysing the processes, the modelling of these processes has to be proven and effective. This subsection discusses the modelling of learning processes, referred to below as *learning flows,* as well an instrument for supporting learning in a PLE – a *Course Coordination Space* (CCS).

Learning Flow and Course Coordination Space

The term 'learning flow' can be defined as an interrelated system of learning activities aimed at achieving a learning objective. Learning activities refer to a collection of specific objects and services needed to perform the activity and can be described using IMS Learning Design (IMS LD) specifications (IMS Global Learning Consortium, 2003). Although these specifications are well developed for describing learning flows, their implementation is unsatisfactory: for example, the automation of data flows between different learning tools is still an open issue (Palomino-Ramírez, L. Bote-Lorenzo, Asensio-Pérez, & A. Dimitriadis, 2008). It should be noted that learning flow is a specific example of the business workflow (Cesarini, Monga, & Tedesco, 2004).

As it was mentioned above, learning flows can be considered as a specific example of business workflows, and these can be described for example by UML or BPMN notation languages. Each *learning flow* consists of a consequence of learning activities that is implemented with the aim of achieving a specific learning objective. Learning activities are performed by actors who have a role, such as teacher, student or administrator etc. *Figure 5* presents the conceptual model of learning flow that was used in the studies of the current thesis.

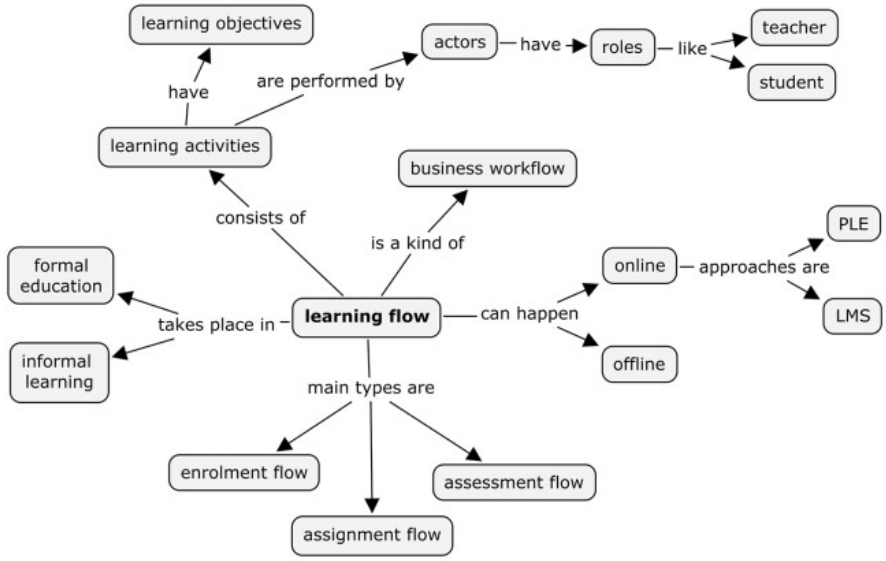

Figure 5. Conceptual model of learning flow

Note that there are other possibilities for the formal presentation of learning flows (Britain, 2004; Conole, Oliver, Falconer, Littlejohn, & Harvey, 2007). We considered learning flow as a specific case of business workflow, and therefore in our papers used BPMN and UML notations, because these notations are pedagogically neutral. Note also, that in contrast to LMS, where a pre-designed flow of activities is proposed for a learner, the PLE system only proposes certain specific affordances for the learner. The activities in PLE develop in a bottom-up manner, which is hard to pre-describe using Learning Design notations.

Implementation of a learning flow in an LMS is usually a straightforward task, because learning tasks are often designed by a single person, either a teacher or a tutor, and on the assumption that students have performed certain predetermined learning activities. It is quite different if learners are using a web-based PLE; usually services that the PLE is composed of are not developed for learning purposes. This may cause problems especially in formal education with rigid teaching and learning procedures.

To implement learning flows in the PLE, different researchers have proposed the design of tools that are capable of coordinating the activities between PLE and LMS. Bhattacharya and Dron (2007) recommended the use of "Web 2.0 tools by integrating them with LMS where it is possible" (Dron & Bhattacharya, 2007). Casquero et al (2010) proposed the creation of a separate PLE interface where

widgets form the LMS and the PLE can be integrated together (Casquero, Portillo, Ovelar, Benito, & Romo, 2010). Wilson (2007) proposed a concept of 'Course Coordination Space' (CCS) – software that could intermediate between institutional LMS and a PLE. According to Wilson, the CCS should pass the LMS data, concerning course content and scheduling, assessments, and monitoring into the personal learning space of learners in the form of feeds. The learners in turn would utilize the data using dedicated widgets embedded into their learning tools. The CCS should be a lightweight software solution that is optimized to support peer matching and enable peer, as well group conversations. The CCS could also store information about the teacher and learners' activities, to be used for learning analytics (Wilson, 2007). The CCS would give teachers a tool for observing the learning activities of learners who use personal learning environments.

Wilson introduced the CCS concept on a very general level, without specification of the actors involved. Garrison and Baynton (1987) considered a student and a teacher as the main actors, interacting through a dialogue that occurs around learning content (Garrison & Baynton, 1987). Altogether there are six types of pairs that may require mediation in an online learning environment: *student – student*, *student – teacher*, *student – content*, *content – content*, *teacher – content,* and *teacher-teacher*. The resulting interactions form a learning flow. Dron (2007) proposed considering an additional actor – a *group of learners* – which added four new types of interactions: *student – group, group – group, teacher – group, content – group* (Dron, 2007). Munro (1991) proposed considering the teacher as an actor who represents the role of the *institution* (Munro, 1991). However, teaching and administrative functions are normally clearly separated. Therefore, according to the activity theory (Engeström, Miettinen, & Punamäki, 1999), the *institution* as a regulating instrument should be a separate actor. Adding the *institution* as an actor gives four new interacting pairs: *institution – teacher, institution – student, institution – content, and institution – group*. Wilson argued that the biggest need for coordination is between the *institution* and the PLE. Thus, the *learning system* as an additional actor in the learning process can be considered. This would add new types of interactions: *system – student, system - teacher, system – content, system – institution,* and *system - group*.

Paavola and Hakkarainen (2005) proposed a *Trialogic Learning Model,* which can be used as a framework for research, where mediating tools are considered according to Engeström's Activity Theory. They combined three metaphors of learning – the acquisition metaphor, the participation metaphor and knowledge-creation metaphor into a knowledge-creation approach, which people use to collaboratively develop mediating artefacts (Paavola & Hakkarainen, 2005). The knowledge or artefact creation metaphor supports innovation and advancement of knowledge by aiming to build new knowledge on the base of existing knowledge. This approach implies three models of innovative knowledge communities based on three different theories. The first is the *theory of knowledge building* (Bereiter, 2004); it is based on dynamic expertise and a progressive problem-solving approach

or progressive inquiry. The progressive inquiry is based on three basic realms: *material realities*, *mental states of the learner*, and *conceptual entities*, such as theories and ideas. The conceptual entities in turn include objects presented in the form of conceptual artefacts. The second theory is the *knowledge community model.* It is proposed in the theory of expansive learning (Engeström, 1987), which aims at producing new forms of activities based on cycles of development of expansive learning. The third theory uses a *model of knowledge creation* (Nonaka & Takeuchi, 1995) where tacit knowledge can be used to facilitate new knowledge through a spiral of knowledge creation by involving four types of knowledge conversion.

Paavola and Hakkarainen called upon the scientific community to develop new kinds of learning environments that introduce a ''trialogical'' element into education with respect to organizing the learning community's activity around shared objects of inquiry (Paavola & Hakkarainen, 2005). We consider Course Coordination Space and LePress in particular, as a tool that should be used to build such kind of new learning environments by connecting LMS and PLE into one innovative knowledge-construction tool.

According to Paavola and Hakkarainen, in the process of knowledge-creation, people ''put'' (or embody, objectify) knowledge on these artefacts: scientific theories, plans, models, instruments, and so on. From this point of view, we can consider CCS as a mediating artefact, in which knowledge is embedded and skills and practices are emphasized. CCS can implement this theory exactly as proposed by (Paavola & Hakkarainen, 2005): to embed learning activities in authentic cultural contexts and tasks by breaking the boundaries between schools and the surrounding society. It appears to be especially relevant in the case of the PLE, which is an environment that is usually developed in a bottom-up fashion, constructed by learners on their own initiative. The surrounding society has a significant influence in shaping and structuring the PLE. Therefore, we can consider "breaking the boundaries between schools and the surrounding society" and connecting LMS and PLE by Course Coordination Space as similar processes that have the same roots and share similar goals.

Considering different subsets of actors and types of interactions in the learning process, different types of the CCS can be designed. For example, *Dippler*[2] represents a large-scale solution – a digital learning ecosystem platform developed in Tallinn University (Laanpere et al., 2012). Dippler is a scalable, server-based technical solution that can serve a complete university or a consortium of educational institutions. In turn, *EduFeedr*[3] which supports *teacher – student*, and *student – student* interactions represents an example of a smaller scale CCS (Põldoja & Laanpere, 2009; Põldoja, 2010).

Developed in the framework of this study *LePress* represents a lightweight solution based on *WordPress* plug-in. LePress supports *teacher – learner* interactions

[2] VLE Dippler: http://trac.htk.tlu.ee/iva2/wiki
[3] EduFeedr development site: http://www.edufeedr.org/

(Tomberg et al., 2012) in a blog-based learning environment. LePress can be rapidly deployed: a user needs only a personal account in the WordPress blog with administrative rights to install plug-ins. LePress users can start a new course or connect to an existing course immediately after activation of the plug-in. LePress is non-destructive to the user data: even after uninstalling LePress all blog posts and comments will remain in the blog. This feature allows learners who use their WordPress blogs as an e-portfolio to install LePress *ad liberum*, providing temporary connection with the courses and ensuring consistency of their personal e-portfolio.

For describing learning flow and preserving the history of learning activities, the data that are collected from activities of students in a personal learning environment should be mapped into pedagogical concepts. Certain sets of data should be assigned specific meaning that describes the activities of learners in pedagogical terms. This would allow using a specific predefined set of metadata, referred to in our papers as *learning semantics*. This term refers to specific vocabulary that can be used for metadata that supports describing and analysing learning activities. We discussed ways of implementing such semantics into an online course in the article that is not included in the current thesis (Tomberg & Laanpere, 2009).

Enforcing Learning Semantics

There are various options available for implementing courses and collecting data from blog-based learning environments. One possible option (and probably the most popular) is to use a supplementary learning management system that runs concurrently with the learner's blog. For example, *teachPress*[4] maintains the course data and publications separately from blog publications. Other tools, like *Learninglog*[5] and *BuddyPress ScholarPress Courseware*[6] allow privacy settings, have the ability to form groups and manage assignments etc., by binding course users to one specific installation of WordPress.

In contrast, LePress allows seamless embedding of functionalities of the learning management system into the publishing process. By using LePress, a blogger has the same level of independence as with WordPress without any plug-ins. A blog can be installed in any location and have no relationship with the blogs of other participants. It allows connecting distributed blogs on a temporary basis, thus allowing the users simultaneous participation in many courses that run on WordPress installations all around the world. LePress also provides users with a quick 'on-demand' connection and disconnection to the courses, by supporting the easy organization of vocational training courses, summer schools, and other forms of short-term learning.

[4] TeachPress WordPress plug-in: http://wordpress.org/extend/plugins/teachpress/
[5] Learninglog WordPress plug-in: http://wordpress.org/extend/plugins/learninglog/
[6] BuddyPress ScholarPress Courseware WordPress plug-in: http://wordpress.org/extend/plugins/buddypress-courseware/

An important design distinction of LePress is the smooth embedding of learning activities into existing blog publishing workflow. For that, an additional learning semantics had to be introduced which allowed mapping of learning concepts to publishing concepts. LePress provides the publishing of blog data with additional learning metadata and provides required learning flow automation. In the event of a user uninstalling LePress, all published content will remain in the blog – only additional semantic annotation of the specific course will be lost.

For further information on the methods of implementing learning workflow into publishing workflow and its possible benefits in learning analytics, please consult the references to the published papers in Sections 0 and 0.

3.3. TRUST AND PRIVACY

The more learning shifts away from walled LMS to Web 2.0, the more learners lose trust, both in the learning content as well as in their peers (Carchiolo, Correnti, Longheu, Malgeri, & Mangioni, 2008).

During recent years, researchers have more frequently linked issues of trust with issues of privacy and security. Such factors as the possibility of misusing the users' personal data, malicious crackers and hackers, unauthorized access to sensitive data – all decrease the level of the user's trust in a system and in the learning process. (Dron & Bhattacharya, 2007) The issues of data security and the personal safety of students are especially real when using PLE (Attwell, 2007) because the freedom to use external services exceeds the risk of using them. Therefore, the safety of students' personal data may depend more on the safety of different external service providers instead of the *alma mater* (Dron & Bhattacharya, 2007). This is why safety issues deserve special attention when developing software that is intended to support learning in personal learning environments.

For further information regarding the study on trust and sharing attitudes in PLE, please consult the references in the paper in Section 0.

Teacher Control in Online Personal Learning Environments

As indicated above, teachers may lose a great deal of control over the learning process in situations where students are using Personal Learning Environments. This is a major challenge especially for educational institutions that offer formal education, and are therefore obliged to follow certain quality requirements. Consequently, certain instruments are needed for ensuring the quality of students' (self-directed) learning. This section discusses the concept of self-directed learning as well as studies on education processes where self-directed learning plays an important role, namely distance education. The final subsection specifically discusses the matter of teachers' control where learning takes place in an online personal learning environment.

Self-Directed Learning

The concept of *self-directed learning* was even known in ancient Greece, where it was referred to as *auto-didacticism*. It means learning by one's self, or learning without a teacher or a facilitator.

In educational theory, this concept appeared in the 1970s as the opposing concept of *teacher-directed learning*. Knowles (1975) defined self-directed learning as a process: "... in which individuals take the initiative, with or without the help of others, in diagnosing their learning needs, formulating learning goals, identifying human and material resources for learning, choosing and implementing appropriate learning strategies, and evaluating learning outcomes" (Knowles, 1975). Later Knowles et al. (2005) defined self-directed learning as one of the six principles for andragogy (Knowles, Holton, & Swanson, 2005). Some authors proposed different types of self-direction, for example: self-direction as a philosophical ideal, self-direction as a psychological attribute or educational orientation, self-direction as a set of activities outside formal education, self-direction as a set of activities within formal education (Candy, 1991). Garcia and Pintrich (1994) claimed that distinction between *self-directed* and *self-regulated* learning can be made based on the level of control (Garcia & R Pintrich, 1994). Garrison (2003) proposed to subdivide self-directed learning into *self-control* and *self-monitoring*, where self-regulation of students' is *monitoring*, *controlling*, and *regulating* their own cognitive activities and actual behaviour, that means *responsibility* and *control in the learning process* (Garrison, 2003). We have adopted the initial definition by Knowles (see above).

Distance Education Theories

Distance education has always involved using certain technology: from audio- and videotapes to computers and other equipment. Evolution of distance education had three generations of paradigms: *cognitive-behaviourist*, *social constructivist*, and *connectivist pedagogy* (Anderson & Dron, 2011). Each generation is well grounded by pedagogical theories, and has different types and levels of dialog between a learner and a teacher.

Cognitive behaviourism considers the teacher as the creator of content and the learner as the *studying individual* who should memorize this content (Anderson & Dron, 2011). From a technology point of view, mainly printed media, TV, radio, and one-to-one communications were used.

Social constructivism originates from the work of Jean Piaget and Lev Vygotsky. Anderson and Kanuka (1999) defined four epistemological constructivism *positions* each corresponding to one learning theory: Cognitive Constructivism, Radical Constructivism, Situated Constructivism, and Co-Constructivism (Anderson & Kanuka, 1999). They described those positions, provided implications for practice, and formulated four common constructivism beliefs. Anderson and Dron (2011) extended these beliefs to seven: (1) new knowledge as building upon the foundation of previous learning, (2) context in shaping learners' knowledge development, (3)

learning as an active rather than passive process, (4) language and other social tools in constructing knowledge, (5) metacognition and evaluation as a means to develop learners' capacity to assess their own learning, (6) learning environment as learner-centred and stressing the importance of multiple perspectives, (7) knowledge needing to be subject to social discussion, validation, and application in real world contexts (Anderson & Dron, 2011). Constructivism theory considers the teacher as a *scaffolder* – one who stimulates knowledge creation by learners.

Connectivism originates from the works of George Siemens and Stephen Downes. It argues that learner explores knowledge in the *network*, where the teacher has the role of a *critical friend* or a *traveller*. The typical result of networked learning is a created artefact (Anderson & Dron, 2011).

In the current thesis, we were guided by the concepts of constructivism and connectivism. Both of these learning theories are heavily based on different types of transactions.

Transactional distance

With the aim of exploring teacher-learner relationships, Michael Moore developed the theory of *transactional distance*. Transactional distance measures the psychological and communication spaces in a distance-learning context between a learner and a teacher (Moore, 1993). The communication gap is determined by the technology used (Dron, 2007) and the psychological gap is "how close the student feels to the tutor" (Chen & Chung, 2001). Moore proposes two measurable variables that affect the transactional distance: *structure* and *dialogue*. The more structured the communication between the learner and the teacher, the longer the transactional distance. And vice versa: the greater the level of dialogue, the shorter the transactional distance. Saba and Shearer (1994) found a reciprocal relationship between these variables: the greater the structure, the lesser the dialogue and vice versa (Saba & Shearer, 1994). By examining the structure and dialogue, Saba proposed the Causal Loop Diagram (*Figure 6*).

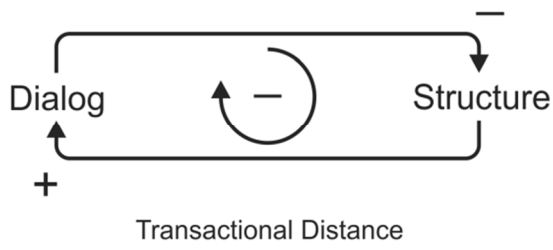

Figure 6. Saba's Causal Loop Diagram of Transactional Distance (Saba, 2002)

This diagram illustrates an inverse relationship between dialogue and structure as mentioned above. This relationship keeps the system stable: if the learner needs additional direct instructions, structure as well as transactional distance increases and vice versa, if the learner requires more autonomy, the transactional distance and structure decrease, and the level of dialog increases.

The relationship between transactional distance and control is discussed in the following sub-section.

Transactional Control

The concept of *transactional control* was proposed by Dron (2007) as an extension of Moore's theory of transactional distance. The need to extend the theory arose from the fact that Moore developed it at a time when "e-learning" was in its infancy and technical possibilities to interact with teachers, content, and peers were limited.

Dron proposed to aggregate the *choice* and *time* components of transactional distance into '*transactional control'*. He describes transactional control as a "part of transactional distance that defined its dynamics, the result of the gulf in communication rather than the psychological gulf" (Dron, 2007). However, transactional control has some relationship to structure and dialogue, as well as to the autonomy of learners. Choice can be different in terms of *scale* and *actors* or *agents* that make the choice. Dron specified *learners*, *teachers*, and the *process of negotiation* as the main choice-making agents. Among many potential agents that can be involved in choice-making Dron also referred to computer software, books, Web sites, and other learners. Dron envisaged transactional control as the measurement of: (1) *who makes the choices* to engage in specific learning activities; (2)the *frequency of change* between who makes the choices over a period of time; (3) the *degree of constraint* that is imposed when making those choices (Dron, 2007).

Dron noticed that *highly structured transactional control is the result of the teacher having control over the learning activities.* In such cases, dialogue between the teacher and the learner has almost no chance of happening. When dialogue between the teacher and the learner intensifies, the participants begin to share common conceptions of the learning goals and learning process. This allows the teacher to increase the confidence of the student in their ability to manage their learning activities without assistance. As a result some degree of control is transferred to the student. Therefore Dron considers *dialogue* not only as a *dimension* of the transactional distance, but also as a *catalyst for an exchange of control* between the teacher and the learner and a "significant means of negotiating control" (Dron, 2007).

This position allows conceptualization of control as a common feature of learner and teacher. Such conceptualization agrees with an earlier work of Garrison and Baynton (1987) who considered control as the opportunity and ability to influence, direct, and determine decisions related to the educational process (Garrison &

Baynton, 1987). They also considered *independence* as a dimension of control, and the role of communication between the teacher and learner in implementing control.

Although this thesis focuses on teacher control, a strong relationship between them is essential. Therefore we consider both learner and teacher control in two subsequent subsections.

Learner Control

The amount of support that the learner receives from the teacher can vary widely, depending on the degree of the learner's autonomy. For example, children are less able to direct themselves in learning. The autonomy of a learner grows with their age, personal experience, and level of education. Dron (2007) relates the autonomy and educational level of a learner to their ability to make conscious choices (Dron, 2007) (see *Figure 7*).

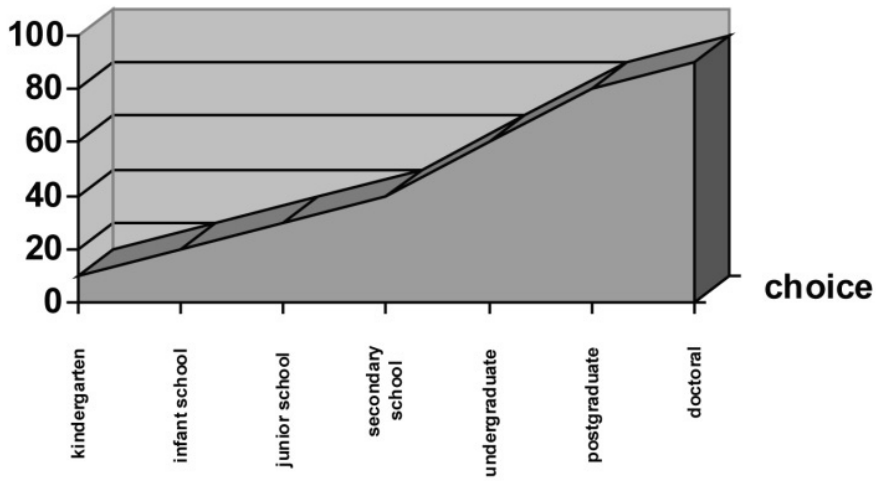

Figure 7. Hypothetical relationship between educational level and conscious choice (Dron, 2007)

There certainly can be significant deviations from the average. For example, autodidacts possess a higher level of personal autonomy and tend to manage their learning goals, methods and learning trajectories themselves, without the support of facilitators.

Learner control is related to a learner's ability in self-direction – the more able a learner is in self-direction, the more control he or she can exert. Candy differentiated two types of control, depending on the type of self-direction: self-direction as a goal, and self-direction as a process (Candy, 1991). In the case of self-

direction as a goal, the learner is capable of controlling the management of goals, methods, and learning resources. Candy associates this capability with personal autonomy, willingness and capacity to conduct one's own education (self-management). In the case of self-direction as a process, the learner is capable of controlling a learning trajectory individually. Candy associates this ability with two subtypes of self-direction: a mode of organizing instruction in formal settings (learner control), and the individual, non-institutional pursuit of learning opportunities in the 'natural social setting' (autodidaxy) (Candy, 1991). In both of these subtypes, a balance of control between the learner and teacher can iteratively vary, depending on the context, personal capabilities of the learner and readiness of the teacher to provide support. Following Candy's study, Dron (2007) refined the definition of control as "a constant and dynamically changing variable, not just because it is a negotiable quantity, but because of the nature of people and their diverse needs as learners" (Dron, 2007).

Many authors agree that the capability of a learner to manage their learning trajectory is critical for successful self-directed learning (Crook & Lewthwaite, 2010; Dron, 2007; Merriënboer & Sluijsmans, 2008; Mor, 2010; Pata & Merisalo, 2009). The theory of transactional control suggests that a key systemic feature of a learning trajectory is the level and pacing of choice, who makes the choices in the first place, and how those choices constrain further choices and the choices of others (Dron, 2007). Dron defined a learning trajectory as a sequence of learning activities. The 'trajectory' term refers to planning-related concepts. The learning *trajectory* can be considered as something that is *planned for the future*. The actual learning path can differ considerably from this initially planned learning trajectory.

It is important for a self-directed learner to have sufficient level of transactional control. However, according to the transactional control theory, the learner can get more control only at the expense of the teacher's control. On the other hand, the proportion of a teacher's control in the case of students who are using personal learning environments is often relatively small, and as a result the potential of a teacher to support students will possibly not be fully realized. This raises the issue of teacher control.

Teacher control

As already explained above, nowadays the role of the teacher in controlling the learning process is changing. Anderson and Dron (2011) explained these changes by the social-constructivist pedagogy: "... the locus of control in a social-constructivist system shifts somewhat away from the teacher, who becomes more of a guide than an instructor …" (Anderson & Dron, 2011). Using Atwell's (2007) words, in this context we could well ask "what role teachers and institutions would play if learners themselves developed and controlled their own on-line learning environment." (Attwell, 2007) Anderson and Dron believe that the teachers of today still assume that they have "the critical role of shaping the learning activities and designing the structure in which those activities occur" (Anderson & Dron, 2011).

According to Buchem et al (2009), using PLE the teacher and learners share control over different *objects, tools, rules, community, and division of labour* (Buchem, Attwell, & Torres, 2009). Note here that they considered *learning goals and outcomes, information sources, data, services, resources, and content* as objects of control as well. However, neither teachers nor students have control over Web-services used as components in PLEs. It can easily happen that a service will be terminated (example: Google Wave[7]), or functionality or terms of use will be changed.

Concerning the different aspects of control, according to Saba (2002) teachers tend to put more emphasis on controlling the structure of learning and learners on dialogue and autonomy (Saba, 2002). This difference in emphases serves the learners well because they normally appreciate suggestions concerning learning content, tools or methods (some students even feel uncomfortable themselves when they have too much autonomy). Consequently, a certain amount of *teaching presence* should always be available for the learners.

Teaching presence is a well-established concept (Anderson, Rourke, & Garrison, 2001). Anderson et al (2001) claimed that if a learner has no direct contact with the teacher (which is the case when learning takes place in a web-based environment), strong *teaching presence* is required. They divided teaching presence into three components, each associated with a specific type of activity: (1) *design and administration* (building curriculum materials including the creation of one's own, and the integration external learning objects), (2) *facilitating discourse* (modelling appropriate behaviours, commenting upon and encouraging student responses, including the less active participants, and curtailing the effusive comments), and (3) *direct instruction* (providing intellectual and scholarly leadership, sharing their subject matter knowledge with students). (Anderson et al., 2001) Teaching presence is especially important during online discussions, because learners normally are not willing to moderate discussions. Dron (2007) noted that "free-form discussion is seldom as effective in a learning context as one which is at least moderated to ensure that it remains on track" (Dron, 2007).

One aspect of the structure of learning - one in which the role of a teacher is significant – concerns the question, "... who is making the choices about where to go next at any given point in a sequence of learning activities" (Dron, 2007). The decision-maker retains control of the learning process. One possibility of returning some degree of control to the teacher is to delegate the opportunity of triggering or initiating the activities. Even if a learner is the final decision-maker, the teacher can still be the one proposing the options. An ability to trigger activities retains the feeling of control for the teacher (Dron, 2007) All these aspects should be taken into account when developing course coordination spaces or other software that is designed to be used for learning and teaching purposes.

[7] Update on Google Wave: http://googleblog.blogspot.com/2010/08/update-on-google-wave.html

3.4. APPLICATION IN THE CURRENT STUDY

The issues discussed in Section 3 directly reflect how the current research evolved. We commenced by studying *assessment* in blog-based learning. It became evident that some types of assessments are difficult to implement in blogs, mainly because of certain technological and architectural reasons relating to the blogging software. Examining the problems concerning assessment in greater depth, it became evident that the core of the problems lay in the difficulty of establishing an information flow between individual weblogs. Moreover, having solved the problems related to information flow would allow implementing a number of additional functions in a blog-based learning environment.

Consequently the scope of research was expanded and focused on information needs and information exchange necessary for describing learning flows in blog-based learning environment. As a testbed, a course coordination space called *LePress* was developed. When conducting empirical research, we used the *WordPress* blogging platform, for which *LePress* was a plug-in.

Testing *LePress* revealed pedagogical issue that was based on the following fundamental question: what the role is and how control should be assigned to the various actors in self-directed, blog-based learning in formal education.

Thereafter we conducted an empirical research for validating the hypothesis that *LePress*, at a course coordination space, returns to a teacher the necessary control over the learning process. Based on extensive literature and on our own research results, *LePress* was correspondingly upgraded.

4. FINDINGS

This section gives a short overview of the main results published in articles that are included in the current thesis. The following subsections are identified by the titles of corresponding articles.

4.1. TOWARDS LIGHTWEIGHT LMS 2.0: A BLOG-BASED APPROACH TO ONLINE ASSESSMENT

In this paper we reflected on the first iteration of our research. The objective and the major tasks of the iteration are depicted in *Figure 8* which is an instance of *Figure 4* with the emphasized current iteration. The objective of the paper was to find ways of helping a teacher to organize simple writing assessments in the context of blog-based courses. To reach this goal we needed to organize intercommunication between the blogs of students and a teacher into specific assessment workflow.

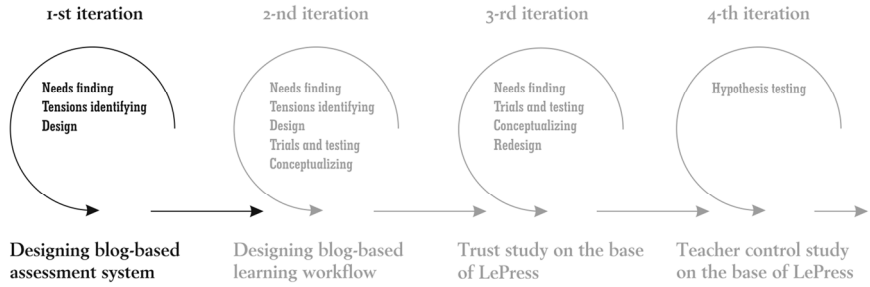

Figure 8. First iteration in design-based research study

For the design and development, we used the WordPress blogging platform. We mapped the most frequently used activities of the teachers and learners in the context of in-class assessment and determined the requirements for learning transactions between the blogs. Subsequently, we designed an assessment of workflow that could be implemented between the blogs of the student and the teacher. In order to keep the process of blogging straightforward we reused the native elements of the blogs: trackback and category. We also proposed specific technologies for implementation of inter-blog conversation using XML-RPC language. Finally, we made mock-ups of a user interface. Based on the result of this work, we developed an initial prototype of LePress software. By using this prototype, the blog of the teacher could be turned into a hub, which connects course participants from other blogs. This possibility could solve issues of scalability and course monitoring and allow the learners and the teacher to continue using their personal blogs independently. This approach would also solve a problem indicated

by Kim (2008). He argued that there are two main models for organization of blog-based learning: (1) a centralized e-education system where all involved students use one hub blog for communication, and (2) a decentralized system, where each student has a personal blog connected to other blogs by means of RSS (Kim, 2008). While Kim criticizes the centralized approach because of an absence of personal space and the students' feeling of ownership, he also indicated insufficient scalability and monitoring possibilities of the decentralized approach – the bigger a group of learners and the length of a course the more difficult to coordinate the course activities. Implementation of the prototype would be a decentralized system being at the same time scalable and allowing monitoring learning activities on the course.

4.2. DELIVERING QTI SELF-TESTS TO PERSONAL LEARNING ENVIRONMENTS USING WOOKIE WIDGETS

This study focused on the possibility of implementing standardized QTI[8] 2.0 compliant tests in blog-based learning. We designed a scenario, which describes how the teacher and the student can use QTI 2.0 compliant questions from open, online repositories in their blogs. Based on the results, we designed and developed a prototype of QAPS (QTI Assessment Proxy Service) that mediates between QTI 2.0 repositories and Apache Wookie[9] W3C engine. The Wookie engine is used for implementing standard W3C widgets into the blogs. This development allowed us to integrate W3C compliant widgets containing QTI compliant tests virtually into any modern Web 2.0 platform, including blogs. On the basis of this study, we designed and developed a software prototype of the widget, which allows teachers to assign tests for students directly in the teacher's blog posts.

With this article we completed the first iteration of our research. The study also illustrates how media limitations can be avoided when using different types of assessment in Web 2.0 environment. Subsequently, we applied this knowledge concerning the use of widgets in Personal Learning Environments when designing *LePress*.

In this iteration, we intended to demonstrate opportunities for the implementation of assessment tools into blogs that support different learning scenarios in PLE. This implementation was considered as proof of a concept or an example of a recipe, rather than a description of the specific approach; therefore, we have not returned to this topic in our later research.

[8] QTI — IMS Question and Test Interoperability specification. The XML-based open standard for question and tests exchange.
[9] Apache Wookie is a Java server application that allows deployment of learning widgets. http://incubator.apache.org/wookie/

4.3. LEARNING FLOW MANAGEMENT AND SEMANTIC DATA EXCHANGE

This paper described the second research iteration (*Figure 9*).

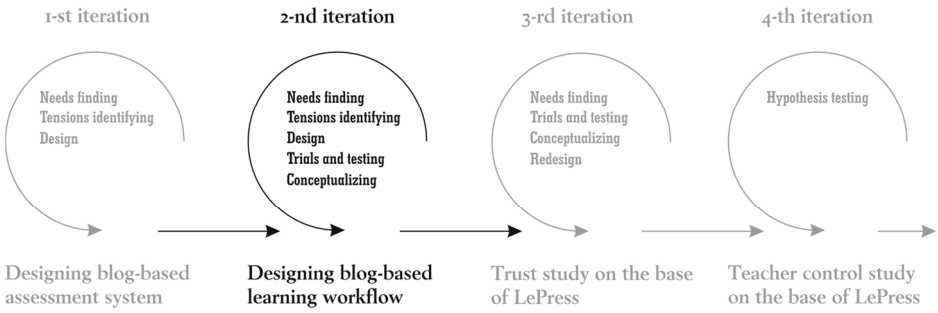

Figure 9. Second iteration in design-based research study

Based on the results of the first iteration, we proposed a formal description of learning-related workflows in a blog-based environment. We determined a wider spectrum of learning activities that is necessary to be included into learning flows in a blog-based environment, such as *registration for the course*, *course enrolment*, *homework assignments*, *submissions*, *grading*, and *teacher feedback*. To implement these learning activities we mapped such learning concepts as *assessment*, *learner*, *teacher*, *assignment*, *submission*, *deadline*, *grades*, and *feedback* into existing concepts that are used in the blog publishing process. Automatic grouping and linking a series of specifically tagged blog-posts and comments gives the teacher an opportunity to get a complete picture of the learning-related flows in the blog.

For solving problems of mapping between learning and publishing concepts and exchanging semantically enriched, course-related metadata between blogs, we made a parallel study on microformats, which was reflected in an additional paper that was not included into this thesis (Tomberg & Laanpere, 2009).

Based on the results of this study, we designed and developed the first release of *LePress* software and introduced it into several university courses with an aim of collecting empirical data for further research. With this event, *LePress* acted as a *course coordination space* and a central point of course-related data convergence.

4.4. ENHANCING LEARNING ANALYTICS IN DISTRIBUTED PERSONAL LEARNING ENVIRONMENTS

This is a follow-up of a previous article and it was targeted to enhance mapping (and preservation) of the history of learning activities by means of gathering learning data from a blog-based PLE for learning analytics purposes. The main

issue here is dispersion of the data between different PLE tools and repositories. The fact that the data are semantically enriched (see the description of the previous article "Learning Flow Management and Semantic Data Exchange") allowed use of the methods employed in learning analytics. As an example of using semantically enriched blog data for the development of learning services, we proposed using the *Knowledge Building*[10] plug-in for *WordPress*. This plug-in introduces the collaborative learning method called *Six Thinking Hats* (De Bono, 1985) for blogs. By using *Knowledge Building*, users can label each discussion comment with specific learning meaning and thus enhance the vocabulary of terms ready for learning analytics. This gives additional possibilities to teachers for tracking learning activities and interactions between the learners in a more meaningful way by assessing pedagogically different exposures of the learning activities of students.

Based on the results of this research, *LePress* is planned to be correspondingly upgraded, allowing the storage of data about learners' activities in a blog-based learning environment and using it for performing learning analytics.

4.5. INTERRELATION BETWEEN TRUST AND SHARING ATTITUDES IN DISTRIBUTED PERSONAL LEARNING ENVIRONMENTS

Existence of a common course coordination space – in our case *LePress* – raised the question of its effective use. This article reflected the third research iteration (*Figure 10*) and focused on trust and sharing attitudes of the students in PLE.

We examined student's attitudes and expectations towards sharing learning resources via the public Web, sharing the assignment submissions and teacher's feedback with fellow students, and participating in the negotiation of shared meaning. The study showed that students usually share their personal information, comments and status only with the people they trust. The students made their decision to allow a new person to enter their "ring of trust" on the basis of trust delegation, similar interests and preferences, and perceived honesty. The students did not mind sharing their learning process and products via blog-based PLE and the majority agreed that blogs make the learning process transparent and shareable. A third of the participants preferred to have their own learning resources on the public Web. The majority preferred the affordances of a blog-based PLE (commenting, tagging, feeds, and openness) to those of a traditional LMS, but *they expected a higher level of personal control* over their PLE in specifying the sharing settings. More importantly, openness of PLE and sharing with others would help to evaluate the trustworthiness.

[10] http://wordpress.org/extend/plugins/knowledge-building/

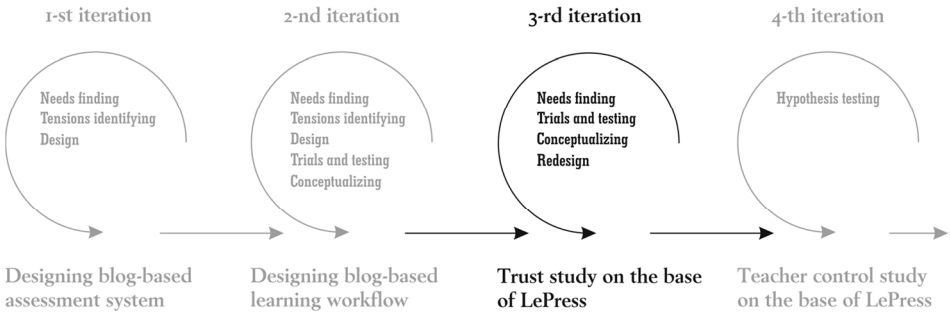

Figure 10. Third iteration in design-based research study

This research revealed a need to support ad-hoc groups within formal study groups, with varying level of openness (public, for authenticated users, for course colleagues, for sub-group members, for friends). There should also be tools for evaluating/ranking the quality of relationships and setting the level of sharing on the group level. When designing LePress, an endeavour was made to introduce learning activities into a blog in the least destructive way possible for the original blogging process. The goal was achievable when a teacher had to communicate with the students in person. However, it is hard to implement when one needs to support a group-based activity in blogs. In contrast to the forums, the blogs do not support grouping of users. Some educators avoid this limitation by creating a separate blog instance for each group of students and by providing members privileges to edit posts in the group-blog (Warlick, 2013). However, the replication of students' knowledge among different blogs is not good practice for consistency of data. It is hard to synchronize data in group-blogs with data in personal blogs; therefore, this approach does not support the collection of materials for personal learning portfolios. Instead of consolidating data in the group-blog, we designed the replication of the data on the base of personal blogs. When students need to write a group-post, they do that in their own blog and mark this post as being group-based. This post is then automatically replicated between all the blogs of group members. Each member can edit the content of this post in their own blog by following automatic synchronization between other blogs. At the time of writing this thesis, the replication feature was designed and in the development stage. However, we had already partially implemented a similar feature for teachers in which the teacher can select any blog user and assign a status of co-teacher to him/her. Subsequent to this, the new co-teacher is allowed to make an entry into the course blog and implement all the possible teaching-related tasks.

Based on the results of this study, when designing *LePress*, we implemented a limited visibility of personal grades (visible only to the student concerned), as well the possibility of creating on-demand groups within a course having different access levels to personal blogs of learners.

4.6. SUSTAINING TEACHER CONTROL IN A BLOG-BASED PERSONAL LEARNING ENVIRONMENT

This study was the closing study, and the paper reflects the forth iteration (*Figure 11*) in the series of activities conducted in the framework of this thesis.

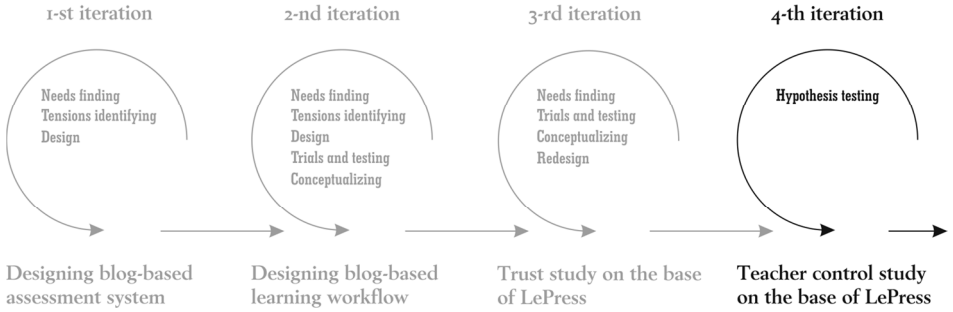

Figure 11. Fourth iteration in design-based research study

As already noted above, the role of the teacher in a distributed and personalized learning environment is changing and becoming more like a facilitator. Inevitably, this results in a decrease of control on the teacher's side and also the possibility of determining when and what kind of support a learner needs. The main aim of this research phase was the validation of the assumption that a course coordination space, such as LePress, could support a perceived feeling of teacher control over the learning processes in a blog-based, personal learning environment.

In the previous iterations, we addressed the challenge of adding regulations into an environment that has never been regulated in such a way. Järvelä and Hadwin (2013) noted that the potential role of CSCL tools in supporting the planning, monitoring, and regulation of collaborative learning processes has been virtually ignored by researchers in previous years. By introducing regulations intended for the self-regulation of learners, deliberately negotiating task goals and standards had to be considered in order to guide work, strategically adopt and adapt tools and strategies to optimize task performance and learning, monitor progress and intervene if results deviated from the plan (Schunk & Zimmerman, 1994; Winne & Hadwin, 1998; Zimmerman, 1989). In designing LePress the aim, as mentioned by Järvelä and Hadwin, was to monitor and control such processes as activating self/group tasks, and strategy knowledge, planning, monitoring, evaluating, or strategically adapting engagement. We share the views of Järvelä and Hadwin on self-regulation as one aspect of a broader concept of regulatory processes, including also co-regulation and socially shared regulation. We followed these ideas by designing LePress for supporting mirroring, aggregating, and synthesizing information to invite monitoring and regulation (Järvelä & Hadwin, 2013).

We conducted an empirical study by surveying a group of 37 teachers who have used *LePress* for at least six months in teaching blog-based courses. We found that teachers perceive *LePress* as a tool that enables a higher degree of teacher control. In addition, we found that a perceived teacher control would contribute to a perceived *ease of use* of the tool. This study demonstrates that teachers using blog-based teaching methods can maintain the necessary control over learning activities.

5. CONCLUSION

This thesis focused on the problems of identifying learning workflows of students and offering teachers the necessary control in distributed, blog-based learning where students use their personal learning environments (PLE). We believe that both these problems deserve much more attention by the community of researchers than has been the case so far.

For solving the problems we formulated the following two research questions:

1. *How to design and implement a non-destructive adaptation of blog-based PLE, which provides pedagogical semantics and functionalities that support the main types of online learning flows in the context of formal education?*
2. *In what way and to what extent can a dedicated course coordination tool sustain the teacher's control over learning flows in blog-based personal learning environments, without inhibiting the self-direction of learners?*

The research was accompanied with the parallel development of a WordPress plug-in called LePress for performing related empirical studies. We demonstrated that the WordPress-based PLE could be used for conducting formal learning through non-destructive design. We turned blog publishing workflows into learning workflows, and integrated them with other elements of the course – course enrolment, assignments, homework submissions, assessment and feedback – allowing us to consider LePress as a course coordination space for blog-based courses. In particular, LePress allowed the learners to use blogging services offered by different providers. Our validation studies confirmed that LePress was positively perceived by students as well as by teachers; it was considered user-friendly and intuitive - that is, easy to use and easy to learn.

Empirical studies showed that adaptation and purposeful usage of new Web 2.0 tools depends heavily on the readiness of students to disclose their activities to a wider community. We found that the learners with a higher level of trust in learning content and in their peers are more willing to engage in sharing online activities. We also found evidence that teacher control is an important factor in how favourably learning software is judged by teachers. It has become evident that teacher control is an important factor to be considered by designers in the future development of PLEs.

While the topic of students' control has been popular among scientists for many years, the issues related to teacher control have not received enough attention from the community of pedagogical researchers. Based on the existing theories of control of Moor, Candy, Dron and others, this study provides a framework for future research on teacher-control issues. Moreover, the developed tool and results of its applications can be reused in designing and implementing blog-based courses.

Another important aspect for supporting self-regulating learning that still needs to be elaborated is awareness. According to Järvelä and Hadwin, it can be observed in

forms of social awareness, action awareness, and activity awareness (Järvelä & Hadwin, 2013). New types of mirroring and metacognitive tools should make collaborators aware of individual or collective actions, thereby making affordances for monitoring, evaluating, interpreting, and acting on that information themselves. We see interesting challenges for further research here.

There is unexplored potential for studies on regulating learning-related workflows, considering different actors and founded on activity and socio-constructivism theories. The current research is focused on blog-based learning, which implies a high level of participation. According to Paavola and Hakkarainen, the participation metaphor emphasizes the social character of knowledge; knowledge is constructed in social interaction and within cultural settings (Paavola & Hakkarainen, 2005). In connection with this, there is an interesting possibility for further research on social knowledge building with surveys based on existing validated research instruments that allow cross-cultural comparison.

When designing LePress we focused mainly on teacher-student interactions, and research questions were more concentrated on the teacher's perspective. However, feedback received on the study shows that there is a significant demand for research and development of tools for PLE that are capable of supporting the meta-cognitive skills of learners. Possible ways of supporting group-based knowledge building using course coordination space also requires further investigation. This raises questions about the practical application of these tools in both formal and informal learning content.

Although LePress was designed and developed exclusively for the purposes of the current thesis, it gave significant input to the development of Dippler – a next generation e-learning platform which was developed in Tallinn University and is currently in the piloting phase In contrast to LePress, Dippler can be implemented by an institution only, and cannot be used in a fully informal environment. The advantage of LePress is the possibility of using it in the content of informal learning. The LePress course can be deployed between dispersed WordPress blogs in a matter of minutes and it does not need any central server to work successfully. Although available functionalities for the teacher are different between LePress and Dippler, the learners interact and implement learning tasks using the same WordPress blogs.

Therefore, the research problems described above that are related to blog-based learning and deserve further study now or possibly in the future, can now be investigated in the Dippler environment as well. At the same time LePress is still used by many teachers and provides a unique possibility for fast deployment of the formal courses on the base of WordPress blogs for vocational education, summer schools and other learning events, which occurs outside of university walls.

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PUBLICATIONS

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Tomberg,V., & Laanpere, M. (2008). Towards Lightweight LMS 2.0: A Blog-Based Approach to Online Assessment. In P. Dillenbourg & M. Specht (Eds.), Times of Convergence, Technologies Across Learning Contexts, Lecture Notes in Computer Science (Vol. 5192, pp. 431–436). Springer Berlin Heidelberg. doi: 10.1007/978-3-540-87605-2_48

Towards Lightweight LMS 2.0: A Blog-Based Approach to Online Assessment

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Abstract. Blogs have not been designed for online teaching and learning, yet they have recently become a "must try" component of learning environment in academic circles. This paper focuses on one of the challenges of blog-based e-learning: implementation of feedback and assessment workflows in distributed e-learning landscape. Some most typical assessment-related workflows are described and a prototype of an add-on module for an open-source blogging tool Wordpress is demonstrated.

Keywords: Web 2.0, blog, interoperability, learning management system, assessment.

1 Web 2.0 in Education

Although the use of Learning Management Systems has become the synonym of e-learning in universities around the world during the last decade, recently their dominance have been threatened by open, flexible and easy-to-use Web 2.0 tools. Web 2.0 is a metaphor contrasting the social and participative way [1] of using the new tools like blogs, wikis and recommendation systems to the first generation of Web applications. Web 2.0 applications are not revolutionary in the technical sense, but they have changed the patterns of users' behavior on the WWW. Web 2.0 is often referred as read-write Web, as opposed to read-only Web 1.0. As Cristóbal and Romaní have put it: ‚the Internet isn't just a reading source anymore: it extends itself into a constructivist space of writing and participation's interchange' [2]. From the perspective of educational science, Web 2.0 draws attention as an environment that has explicit social orientation, and its uses in the context of teaching and learning are supported by the mainstream educational theory called social constructivism. [3]

Most often, the Web 2.0 tools are used in the education as a suitable platform for a knowledge building and reflecting, but also for collaborative production and exchange of learning resources. Blogs have became increasingly popular among educators as an easy-to-use Web publishing platform that can be used both on the individual and group level. Yet, the blog is not just a publishing tool, but also a platform for discussions. If combined with RSS feed readers or aggregators, blogs can easily replace the traditional Web forums in the context of online teaching and learning. As Huffaker [4] has argued: ‚blogs can be an important addition to educational technology initiatives because they

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promote literacy through storytelling, allow collaborative learning, provide anytime-anywhere access, and remain fungible across academic disciplines‘.

The main challenge that raises from using blogs in the context of online teaching and learning is related with difficulties of conducting an iterative process of assessment and feedback given by a teacher to written assignments that are published by the students in the distributed learning environment. The usability of blogs in this setting is reduced because blogs have not been designed specifically for teaching and learning, which causes the following problems: (a) it is not so easy to separate student contributions from different courses that are running in parallel with each other, (b) there is no easy way to have a quick overview of all grades or feedback comments given by the teacher during one course, (c) there is no easy way to limit the access to the teacher‘s comments to a student’s blog post.

In this paper, we are going to propose a solution to these problems by adapting the Wordpess blog software so that it will support assessment-related workflow management between several blogs. We have started our search for solution with the following requirements: (1) the additional functionalities should be implemented with minimal intervention to the existing software architecture and the typical way of using the blogs, (2) we should take advantage of existing protocols, interfaces and techniques built into the Wordpress blog software, (3) we should increase the interoperability of our implementation by following the standards and specifications as much as possible, and (4) the typical character of assessment-related workflow should be maintained also in the distributed environment consisting of multiple blogs.

A successful implementation of blog-based assessment workflows will hopefully increase the pedagogical usability and effectiveness of blogs in the context of online teaching and learning.

2 The Assessment Workflow in the Classroom and in the Blog-Based Learning Environment

We argue that workflow management provides a suitable framework for describing and organising the iterative process of assessment in a blog-based distributed virtual learning environment. Van Aalst [5] is making a distinction between the terms ‚workflow‘ and ‚collaborative process‘. The latter is emphasizing only collaboration and information sharing, without explicitly describing or defining the processes. The workflows can be divided into three types according to their level of formalisation and automatisation [5]: (a) **ad-hoc workflows** that relate to processes where the procedure is not defined in advance, (b) **administrative workflows** that correspond to case-driven processes which follow a well-defined procedure, and (c) **production workflows** that are concerned with highly structured processes with almost no variations. The assessment process in an ordinary blog-based learning environment can be interpreted as a collaborative process, but our aim is to modify the blog software in order to achieve the level of semi-automated administrative workflow.

Assessment of learning outcomes in an online environment can be seen as a workflow involving two or more subjects: a teacher (or facilitator) and one or more students. The assessment workflow has three dimensions:

- **The case dimension**: an assignment,
- **The resource dimension**: a learning resource, a blog post, a comment or a grade, and
- **The process dimension**: a series of tasks accomplished by a teacher and students.

In the classroom setting, a teacher usually presents the goal and content of each assignment, as well as related tasks (with deadlines and other conditions) and resources. The students are usually present in the classroom while receiving the assignment and also when they submit their results. Teacher gives feedback to submitted works, possibly requesting for improving the ones that do not meet the criteria. The final step in this workflow is grading the student's work by the teacher. In order to make the workflow more flexible, many educational institutions have implemented an alternative communication channels for collecting assignments and distributing grades (e.g. dropboxes).

In case of implementing a similar assessment workflow in a blog-based learning environment, various approaches can be used. For example, authors of a *Class Blogmeister* [6] system suggest that a teacher should register all students as users of a single blog. In this setting, the assessment workflow is implemented on a simplest way: each student publishes his/her work as a blog post directly to the joint blog administered by the teacher. The teacher then gives feedback by submitting comments to the blog posts of students. In spite of simplicity of this approach, it has also weaknesses. In particular, the main advantage of blog as personal publishing tool is lost as there is no personal storage place for individual contributions. In case of participating in several blog-based courses, the student will lose the connection to his own works distributed between multiple blogs that belong to different teachers. Quite likely, this approach cannot be scalable beyond small single pilot courses.

According to Hirvela [7], today's students prefer to be assessed by presenting their works using a personal digital portfolios. Portfolio approach gives the student an additional motivation to personalise her learning environment and to document her learning history [8]. The easiest way to build one's own personal e-portfolio is to use blog, most of the special e-portfolio systems (e.g. ELGG) contain a blog tool.

Wordpress and Movable Type, the most popular blog engines, have two basic built-in methods called *trackback* and *pingback*, which allow automated data exchange between different blogs (or between a blog and another Web application like Technorati). The common feature of these two methods is that a publication of a new post in one blog is automatically announced within another blog.

Assessment-related workflow needs intercommunication between the blogs of the teacher and the student that can be organised by means of the above mentioned methods in case they can be enhanced by adding some specific functionalities. Such functionalities can be implemented to Wordpress software using plug-in architecture. The plug-in should work in a standard way: the data exchange between the blogs occurs by means of extended XML-RPC calls.

3 Implementing Assessment Workflow in Wordpress

In the following, we are going to describe a blog-based implementation of a simple assessment workflow that involves only one teacher and one student.

In order to specify a course as a container for a set of assignments (workflow cases), we suggest to use the *category* feature of Wordpress blog engine. This gives the teacher an opportunity to separate his lecture's materials and assignments for the different groups of the students in a different, logically separated virtual ‚classrooms'. Students can subscribe to RSS feed that filters out from the teacher's blog only those messages and assignments that are relevant to the course they have registered to.

All of additional functionalities can be used by the teacher through a special menu that was added by us to the Wordpress software. This menu will appear to the Dashboard after installation of our assessment workflow plug-in called LeFlow.

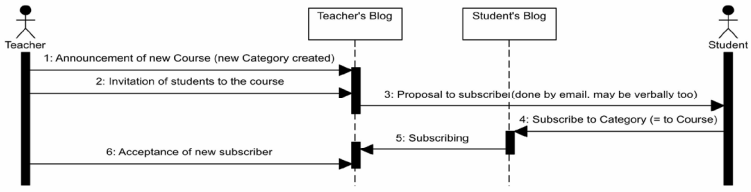


Fig. 1. Announcement of subscribing to the course

We propose the following workflow for subscribing the students to the course (Figure 1). The teacher creates a new course by opening a new category in his personal blog (1) and invites the students to subscribe their blogs to the RSS feed for this category (2). An e-mail invitation is sent by Wordpress after the teacher has filled in the special Web form (3). If the LeFlow plug-in has been installed to the blog of each student, they can subscribe to the course using the special LeFlow menu (4, 5). Then, the teacher accepts the course registration requests using a Web form (6). Since this moment, any post in the teacher's blog is forwarded to the blogs of students using the pingback method (Figure 2).

Now the teacher can publish a new assignment. The teacher submits a new post in his blog (task 1, Figure 2). If this post is marked as being an assignment, the teacher should provide some additional information such as a deadline or special conditions for this task. Publishing a new assignment creates an automatic announcement (2) that is instantly passed via pingback to each student registered to this course (3).

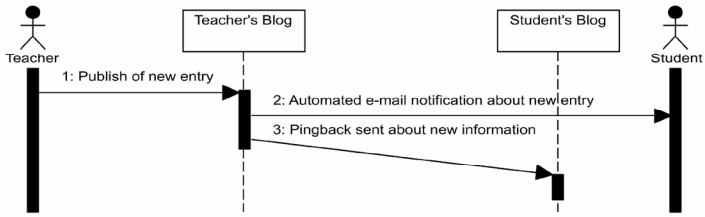


Fig. 2. Publishing of a new entry in the teacher's blog

If published entry is assignment (Figure 3), a student is invited to publish her response in her blog. It should be done through a special *Results* page that is created by LeFlow plugin. Student submits her response to assignment as a new blog post and marks it with the relevant category tag.

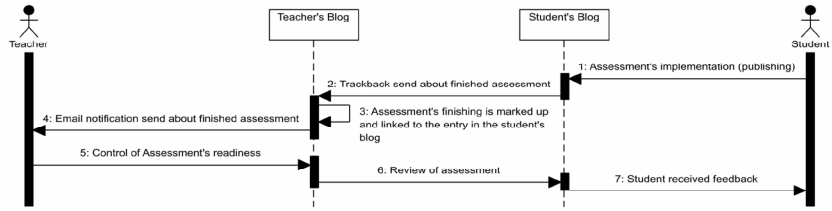
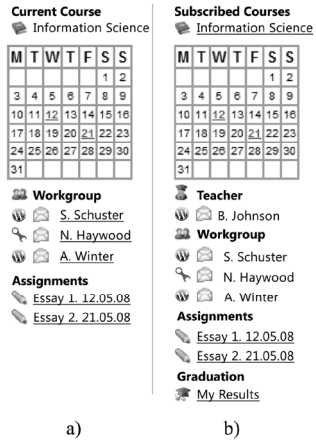


Fig. 3. Assessment's implementation and feedback

All assignments that are submitted by students are collected via trackback to the special *Results* page on the Dashboard of teacher's Wordpress as a list of links.



a) b)

Fig. 4. A prototype of the blog's control panel; a) for teacher, b) for student

Technically, our scenario enables that each blog user can act both as a teacher and as a student because we assume that all users of blogs have opportunity to open their own personal courses. This feature can be used e.g. for organising groupwork and peer-assessment between students. Yet, there are minor differences between the student's and teacher's Control Panel and Results page (see Figure 4 above).

4 Conclusions

This paper focused on the use of blogs in teaching and learning, as an alternative to large, monolithic and multi-functional Learning Management Systems like Moodle or

WebCT. Our approach is based on self-developed prototype of LeFlow plug-in to Wordpress blog system that enables to manage simple assessment-related workflows three native components of blog systems: Trackback, Pingback and Category. The plug-in will enhance functionalities of Wordpress: users will be able to create groups, invite other user to join their group and send them assignments. The group members can submit the completed assignments using their blog; teacher gives feedback in the same manner. The work is still in progress, our prototype is about to be tested in real-life situation with an international group of Masters students in winter term 2008.

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II

Tomberg, V., Kuli, R., Laanpere, M., & Normak, P. (2010). Delivering QTI Self-tests to Personal Learning Environments Using Wookie Widgets. In X. Luo, M. Spaniol, L. Wang, Q. Li, W. Nejdl, & W. Zhang (Eds.), Advances in Web-Based Learning – ICWL 2010, Lecture Notes in Computer Science (Vol. 6483, pp. 250–258). Springer Berlin Heidelberg. doi: 10.1007/978-3-642-17407-0_26

Delivering QTI Self-tests to Personal Learning Environments Using Wookie Widgets

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Abstract. Although online tests are a quite popular form of assessing learning outcomes in traditional Learning Management Systems, it is quite difficult to deliver the wealth of existing re-usable QTI-compliant tests into Web 2.0 style Personal Learning Environments. This paper addresses both pedagogical scenarios and technical solution for using QTI self-tests in blogs, personal e-portfolios and social media platforms. The empirical part describes the development of the original QTI Assessment Proxy Service and QTI self-test player based on the Wookie widget engine.

Keywords: widget, personal learning environment, computer-assisted assessment, QTI, self-test, Wookie.

1 Introduction

One of the recent trends in technology-enhanced learning is related with the growing popularity of Personal Learning Environments (PLE) based on Web 2.0 principles and technologies. The change of tools has been accompanied with the pedagogical paradigm shift: from teacher-driven to self-directed learning process, from passive consuming of pre-packaged learning content to active knowledge building by learners themselves. Both this paradigm shift and the simplistic nature of Web 2.0 technology are causing a decrease in the use of existing digital content, which is still valuable and re-usable. One type of digital learning objects, which currently can be hardly delivered to PLE are questions and tests. Test is still one of the most popular content types in traditional Learning Management Systems; there is a wealth of valuable, re-usable questions and tests stored in Learning Object Repositories.

This paper focuses on the following research problem: how to make use of existing standard-compliant test contents in PLEs and other Web 2.0 based systems?

Our goal is to offer both pedagogical scenarios, and a technological solution for delivering online tests to learners using Personal Learning Environments. At this phase, we are limiting ourselves only to the simplest case – delivering self-tests, which do not require authentication from the students and do not store their responses. If the first phase will result in success, we are planning to continue with more challenging tasks: delivering personalized tests requiring authentication, storing the results and also authoring the tests within PLEs.

X. Luo et al. (Eds.): ICWL 2010, LNCS 6483, pp. 250–258, 2010.

2 Using Self-tests in PLE

Wilson et al [1] have described how the dominant design of virtual learning environments (institutional, monolithic Learning Management Systems) is being challenged by an alternative design which they call Personal Learning Environments (PLE). PLE is a user-defined compilation of different Web 2.0 tools and services which support self-directed learning in various forms: individual and collaborative knowledge building, authoring, and sharing the digital artifacts, aggregating the dynamic Web content from various providers, reflecting, and presence. PLE is representing a new paradigm of learning with technology, where the learning environment is seen as a result of learning process, not as an input defined by the teacher. In that sense, PLE promotes radical social constructivist views on learning and teaching.

PLEs can be (and are) used for massive open online courses [2], joint study programs involving several universities [3], peer tutoring, informal learning in virtual communities of practice, independent competence development with personal e-portfolio etc.

Existing technical solutions for PLE range from simple blogs to aggregator, browser-based solutions like MUPPLE [4], Widget-based LMS (e.g. HaikuLearning), Elgg, Facebook.

We propose the following scenarios for using self-tests in PLE:

1. Teacher embeds selected self-tests into her/his blog and invites learners to practice with it;
2. Learners are provided an embedded search tool for finding suitable self-tests from repository;
3. Students generate self-test by themselves (test is a learning outcome), these tests can be then embedded in learner's blog and also used for peer assessment.

3 IMS QTI: De Facto Standard for Assessment-Related Content

The first software systems used for computer-assisted assessment were closed desktop solutions with almost no interoperability [5]. Such systems did not use any standardized file formats for saving the questions and tests, all the assessment-related data was stored in a local database. Appearance of Web-based assessment systems and increasing need to re-use the test contents across different platforms was driving the movement towards assessment-related standards. In the end of the 20th century, IMS Global Learning Consortium initiated the development of common data format for online tests and questions. The first release of Question and Test Interoperability (QTI) specification was published in 1999 and soon it became de facto standard among software developers and content providers. The specification offered common XML based format for storing and exchanging the metadata about separate questions and compound tests. QTI XML format is free for use and not attached to the any specific architecture or software vendor.

QTI XML format can be used in several typical cases of online assessment. At first, the questions and tests can be presented as a special compressed package file that can be used for importing and exporting needs between different learning systems. Unfortunately, the logic of describing questions in QTI version 1 was not

perfect [6]; sometimes questions imported from one system was impossible to import because of different types of questions and visualizations used [7]. This limitation was bypassed when the second QTI version appeared in 2005 (QTIv2). Although the current QTI specification version 2.1 still has beta status, its simplicity and flexibility allows to use the QTI XML format almost for all today's testing use cases.

The second version of QTI specifications was thoroughly redesigned and the use cases were significantly extended. Besides simple importing and exporting scenarios IMS developers proposed to use the QTI XML as format for interchanging test data between testing related services. The specification proposes to consider a testing system as a set of tools or services, e.g. an authoring tool, repository, test construction tool, and assessment delivery system. Now new questions can be sent from the online authoring tools directly to the online repository; the online test construction tools can load these questions and build tests from them, these tests in turn can be saved to the repositories, all this can be implemented by using QTI XML. Finally the ready tests can be loaded into the online assessment delivery systems for conducting tests with learners.

The current PLE environments are weakly structured and in most cases, not designed specially for learning and teaching purposes. The PLE does not include tools like the assessment delivery system, which is offered by QTI use cases. We suppose that in PLE environment the need for using tests for learners' assessment can be found almost in any used tool, like blog, wiki or discussion board. We are examining Web browser widgets as tools that can be used for this purpose.

4 Widget Technology

Widgets are lightweight Web applications, which are designed for a single specific function (e.g. calendar, clock), with quick instant access to Web 2.0 services or internet content [8]. W3C defines a widget as an 'interactive single purpose application for displaying and/or updating local data or data on the Web, packaged in a way to allow a single download and installation on a user's machine or mobile device' [9].

The first desktop widgets were introduced in Mac OS in 1980's. Mac OS included small applications called "Desk Accessories" — calculator, calendar, clock, sticky notes and games. Web browser widgets started to spread more widely in 1996, when several widgets providers appeared (e.g. My Yahoo and Netscape PowerStart).

Today a great choice of different widget platforms and related specifications exists; therefore it's really difficult to decide which one to use. Using several widgets from different providers simultaneously seems as not a preferable way because of necessity of the ample quantity of the system resources; each widget usually uses the parental runtime component, so-called widget's engine which provides resources and environment required for widget's work. Using one widget on another platform looks now as an impossible case: the main issue with different platforms is the lack of interoperability. At the current moment it is impossible to import nor export widgets for exchange between different systems. For example, an Opera widget cannot be used on Apache Wookie server and vice-versa, as well as w3c-compatible widgets

cannot be executed in the Opera browser. The specifications of several widget platforms are quite similar to each other, but in many cases they have some elements and a special behavior, which are hard to port to other platforms. This absence of interoperability brought to a situation when the appearance of common approaches to widgets' standardization becomes a high level necessity.

In 2006, the first draft of W3C Widget Packaging and Configuration specification[1] was released, which describes how a modern widget has to be built, what are the configuration options, which JavaScript methods a W3C Widget object has, and in which archive format a widget must be compressed.

In 2009, W3C Widget Packaging and Configuration received a status 'Candidate Recommendation'. It means that now the specification is quite well described and can be taken seriously when developing widget engines or related software solutions.

Simple W3C widget structure consists of HTML page, CSS style sheets, images and some JavaScript coding, which gives functionality for the widget, e.g. querying a server and retrieving weather information.

5 Requirements for Widget-Based Player for QTI Self-tests

The development of our solution was aimed to enable the assessment tests in an informal WEB 2.0 environment (e.g. blogs). In this first prototype based on our original QAPS API, we are trying to implement the easiest solutions that can enable self testing only. This enables us to concentrate on protocols and data format needed for passing standardized data from open repositories to different PLE software using widgets. This solution will be the first step in the implementation of other testing scenarios in PLE environment. In future it must be complicated with adding full assessment functionality which includes authentication and saving tests' results.

For the current solution we have now only one use case. For implementation of this case we defined the following list of requirements.

5.1 Users

The users involved in this service are all persons who use PLE environment for self-directed learning. For first implementation we consider the users who need to consolidate or estimate their previously learned knowledge by using self-tests. These users can be Learners of educational institution who reads educational blogs with learning materials or Employees who uses corporate Moodle to improve skills or to get new competencies. Our first use case implies anonymous self-testing; therefore, no personal data about users will be logged.

5.2 Data

The software should visualize and process assessment data compliant with IMS QTIv2.1, the most stable and versatile format for describing the tests and questions.

[1] http://www.w3.org/TR/widgets/

5.3 Functional Requirements

The following functions define a four-step process of user interaction with software: searching the most suitable test from a repository, visualization of testing questions, submitting the test, and receiving results of test's completion with the feedback if any. Several of these steps are compound, and sometimes can be implemented with simultaneous processing by different modules. Short description of each functional requirement is shown in Table 1.

Table 1. Short descriptions of the functional requirements

Searching a suitable test from a repository	The search will be accomplished on the server side using keywords. The server software must support QTIv2 XML format for storing tests and questions. For successful precision of searching QTI metadata must be supported by repository.
Visualization of testing questions and submitting the test	The testing questions must be shown in the widget's user interface integrated into a blog, wiki or any HTML page. The widgets must meet the case of W3C widget specifications. Received from repository QTI XML data must be rendered into HTML with JavaScript to provide interactions with the tests. Each question must be shown and answered separately, one by one.
Receiving results of test's completion with feedback	After the test accomplishment, user must receive a grade in the form of a final score. In case if the questions are accompanied with feedback, they all must be shown to the user in connection with question answered.

In future development we have plans to extend these functionalities with authentication of users, personalized tests and logging personal data about user activities and testing results.

6 Development of QAPS Prototype

6.1 Overall Architecture of Software Solution

In this chapter we describe the architecture of a distributed system, where in the centre is our original piece of middleware: QAPS (QTI Assessment Proxy Service). QAPS is an Application Programming Interface (API), which deals with self-test related data exchange between a Learning Object Repository and the Widget engine. The main goal of our widget-based QTI player is to enable an assessment delivery to the PLE (e.g. blog). To implement the embedding widgets into blogs we used Java servlet server Apache Tomcat, which serves several web services and software: Wookie application, QAPS API and question rendering engine R2Q2[2]. The overall architecture of our solution is shown in the Fig. 1.

On the left side of the figure different instances of PLE platforms are shown, they are intended as the targets for a conducting of tests.

[2] R2Q2 tools: http://www.r2q2.ecs.soton.ac.uk/

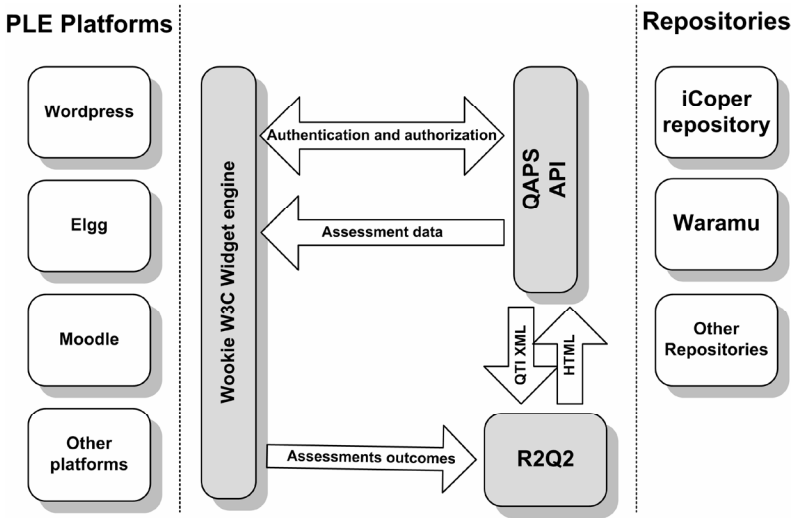

Fig. 1. The architecture of using QAPS API for Self Testing Solution

To enable uploading and a deployment of widgets on different platforms, we used a Java server application Apache Wookie[3] that is shown next to PLE instances. Provided by Wookie widgets are based on the W3C Widgets specification. Wookie widgets can include all usual kinds of mini-applications, badges, and gadgets, and also applications like chats, quizzes, and games. Also they can use extended APIs such as Google Wave Gadgets[4] and OpenSocial[5].

Wookie widgets must be integrated in a blog or a simple Web page via a special, platform-related plug-in or embedded via iframe HTML code. Current Apache Wookie plug-ins are available for such blog platforms as Wordpess, social networking engine Elgg, learning activity management system LAMS, and course management system Moodle. A typical plug-in allows to configure the Wookie host, and then to select a widget to be displayed on the page. For easier development and integration plug-ins for W3C widgets into existing solutions the PHP, Java, Python, C#, and Ruby frameworks are available.

R2Q2 is a set of Web services for rendering QTIv2 questions and processing the responses. R2Q2 was developed in University of Southampton in 2006, and since that time it is widely used by integrators of testing solutions in business and educational institutions. In our implementation, QTIv2 engine is used for:

- Rendering QTIv2 questions using R2Q2 visualization engine;
- Checking answers using R2Q2 service;
- Returning feedback (if any) from R2Q2 service.

[3] Apache Wookie server application: http://incubator.apache.org/wookie
[4] Google Wave API: http://code.google.com/apis/wave/extensions/gadgets/guide.html
[5] OpenSocial API: http://code.google.com/apis/opensocial/

Widgets for the web environment are usually JavaScript applications; our case is not an exception to this rule. The generation of many requests to different web services using JavaScript is a complex task. Because of that, we used Java to develop a standalone API called QAPS — QTI Assessment Proxy Service. QAPS API is shown on the top of Fig. 1 and it is used to act like a proxy for R2Q2 and Waramu services.

The server-side QAPS API is one part of our solution, the second part is the client-side widget that can be embedded into different PLE software. The widget and QAPS communicate with each other via HTTP GET and POST requests using XML markup. QAPS forwards the requests received from widgets to different web services. Currently implemented services are R2Q2 for QTI XML data processing and Waramu repository for storage QTI testing data. If required, the current service-oriented architecture allows addition of other services too.

For simplification of the picture, the Assessment outcomes arrow in Fig. 1 directed straight to R2Q2 service. In reality, this data also traverses through QAPS because Wookie itself has no ability to communicate with R2Q2.

On the right of Fig. 1, different examples of repositories are shown. In current implementation we use Waramu[6]: a Learning Object Repository developed in Tallinn University. Waramu is licensed under BSD license, developed using Java, and runs on Glassfish using Mysql database. Waramu supports IEEE LOM and Dublin Core metadata standards, but these schemas can be expanded/adapted, or alternative metadata schemas can be added. Waramu does not have any user interface; it interacts as SOAP Web service with other applications. Yet, the QAPS API is not bound just to Waramu repository – it can retrieve questions and tests also from other standard-compliant repositories like OICS (Open iCoper Content Space, developed within the iCoper project).

6.2 Workflow

By default the widget's user interface shows an assessment search form immediately after the loading. When user inputs a search text, for example searching for tests titled "QTI tests", then HTTP GET with input is sent to API (see Fig. 2 #1). API then forwards the request to the Waramu repository. On successful request, a list of assessments is displayed; otherwise, the message returned by API is shown.

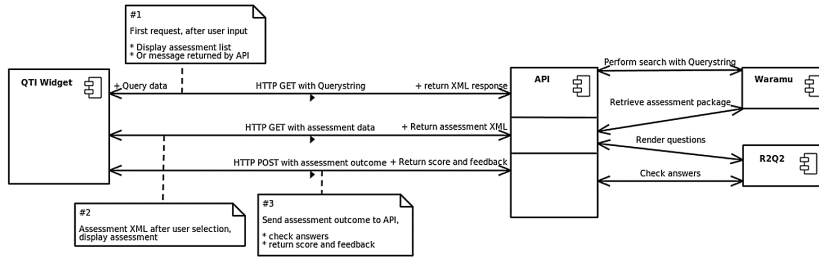

Fig. 2. QTI player prototype components and requests

[6] Waramu repository: http://trac.htk.tlu.ee/waramu

After user selects the desired assessment, another HTTP GET request is made with assessment data keys included (repository attachmentId and resourceId) (see Fig. 2 #2). Then API downloads test from repository and sends each question to R2Q2 for XHTML markup. The returned XML response contains an XHTML code for each question and some additional data for later use. This data contains of instructions for services, several identifiers to keep the track about questions that will be needed for checking of answers. Then the widget will display an assessment to the user of PLE tool.

On the time of assessment completion HTTP POST is sent to API with additional data from previous response (see Fig. 2 #3). This additional data is used to check answers and return XML response containing a score and feedback (if any) for each question to the widget. The widget then displays an overall score and an additional feedback data for each question.

Currently the working prototype of QAPS is ready to be tested in the real-life situation with master students in Tallinn University.

7 Conclusions

With the implementation of QAPS, we have demonstrated the feasibility of re-using the existing QTI content stored in Learning Object Repositories. It can be expected that adding authentication and storage of responses will decrease the flexibility of the current solution. There is a need for developing another service, which is going to aggregate the learner profiles, and store their test results. The initial prototype of QAPS demonstrates that it is possible to create a service and a widget for delivering assessments in Personal Learning Environment. Even without saving the assessment outcome data, such solution will probably find thankful users in the community of PLE pioneers.

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III

Tomberg, V., Laanpere, M., & Lamas, D. (2010). Learning Flow Management and Semantic Data Exchange between Blog-Based Personal Learning Environments. In G. Leitner, M. Martin Hitz, & A. Holzinger (Eds.), HCI in Work and Learning, Life and Leisure, Lecture Notes in Computer Science (Vol. 6389, pp. 340–352). Springer Berlin Heidelberg. doi: 10.1007/978-3-642-16607-5_23

Learning Flow Management and Semantic Data Exchange between Blog-Based Personal Learning Environments

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Abstract. The use of blogs as Personal Learning Environment is an emerging trend in higher education. While many teaching and learning tasks are easy to implement in a blog-based PLE, this type of tools still lacks some of the important features that made traditional Learning Management Systems efficient for both teachers and learners.

This paper addresses the challenges of enhancing blog-based learning environments with two new functionalities: learning workflow management and semantic data exchange.

Keywords: Blogs, assessments, learning flow, WordPress, plug-ins, development, LePress, semantic metadata, microformats.

1 Introduction

The use of personal blogs in teaching and learning has increased significantly during the last five years, becoming one of the major trends in the domain of technology-enhanced learning. Whereas this trend is clearly related with the simplicity of publishing, reading and discussing through blogs, these still miss relevant functionality, which hinders their systematic adoption in educational settings. For instance, it is quite difficult to manage assignment related workflows and to promote semantic data exchange between multiple blog instances.

This paper reports on an approach to bring assignment related workflow management and context specific semantic data exchange to WordPress.

We start with a review of the background on blog-based Personal Learning Environments, followed by a conceptualization of learning flow management between multiple blog instances. Finally, we describe a usage scenario and the prototype of LePress – a learning flow management extension for WordPress blog engine – and discuss its implementation and potential applications.

2 Personal Learning Environments

Nowadays universities generally use some kind of Learning Management Systems (LMS). Such popularity is the result of the maturity of the inherent concepts as well

G. Leitner, M. Hitz, and A. Holzinger (Eds.): USAB 2010, LNCS 6389, pp. 340–352, 2010.

as of the fact that LMS are now stable environments featuring high availability, scalability, usability, interoperability, stability, security performance [1].

However, technology enhanced learning researchers argue that the adoption of Personal Learning Environments might result in a quantum leap over LMS based approaches. As envisioned, PLE facilitate learner-based constructivist learning processes and promote the usage of open resources, and Web 2.0 tools by opposition to the teacher-centric tactics enabled by typical, Web 1.0 associated LMS [2].

Nevertheless, even in the most progressive universities, the adoption of PLE is still incipient both due to its novelty [3] and to the fact that the concept is unknown still to most faculty. Integrating PLE in the learning process is further deterred by the lack of knowledge on how to used the emerging tools to facilitate the achievement of learning goals – on one hand, people wait with great enthusiasm the announcement of new communication tools quickly declaring them as very suitable add-ons for the PLE concept, on the other hand, there is no common understanding of how to integrate such new tools into the learning processes as there is also insufficient understanding of how to methodologically benefit from such an integration.

Additionally and although the number of tools potentially useful in a PLE is growing everyday, there still is no common understanding on how to sustainably articulate them in order to scaffold learning workflows. In part, these results from the implicit untidy nature of PLE, as there are no strict rules and ordered sequences of actions such as found on LMS – from this point of view, the usage of PLEs is harder to analyse, describe and manage when compared to that of a typical LMS. This downside also results from the lack of shared knowledge those using these artefacts – the educators – and those developing them.

Finally it should also be mentioned that there is a probability that the acceptance PLE will not overcome that of LMS in the near future. As Anderson argues, the impact of using Web 2.0 tools on results and cost of learning is not enough studied yet: "It is also unclear how energetically formal education institutions should build in social spaces that were originally designed for informal socialization and networking" [4]. We believe that this process will likely take place little by little, simultaneously with the growing understanding role of PLE in education and with the understanding of ways for supporting traditional learning activities with PLE. For a start it is necessary to learn how to implement such functionalities in PLE and only after that take it away from LMS.

In the research work herein reported we explore the idea of implementing typical learning workflow activities on PLE based on a popular open-source blog tool.

3 Blogs as Learning Tools

Blogs and other so-called Web 2.0 tools are proving to be suitable building blocks of more learner-centred learning environments. Initially blogs were just personal diaries that were being used mainly for publishing author's texts over the Internet together with the possibility of eliciting comments from their readers for readers. The nature of these digital diaries has been changing progressively as bloggers discovered and understood the newly enabled possibilities. Eventually blogs became much more than digital diaries and we can now find entire websites and services built on top of the

initial weblog concept. Further, blogging functionality is nowadays supported by most social network – micro blogging is a core service for the majority of mainstream social services such as Facebook and Twitter [5].

Using blogs in education and especially in learning processes has active supporters as not less active opponents. There is significant body of research confirming the advantages of blogs as replacements of other computer-mediated communication tools in learning processes. For example, the usage of Really Simple Syndication (RSS) motivates students to participate in discussions [6] by continually supporting "pull" synchronization rather than requiring "push" actions on the teacher's or students' side, which makes users feel less intrusive [7]. Another foremost feature of almost any blog engine is the simplicity of the publication process, which easily relates better to any young student profile than centrally administrated LMS [8]. The same feature contributes towards the students' feeling of confidence that he/she has some level of control over the learning process.

The first attempts of using blogs in education started in the early 2000-s. For example Betts and Glogoff proposed such variants of using blog in class, as assignments, reflections, and journal entries. Analysis of several courses conducted using blogs demonstrated that students showed high level of interest towards this new tool. Indeed students began to propose additional variants for the course activities, such as literacy inventories, purposive reading, observation notes and linguistic analysis [9].

Later, Du and Wagner examined the use of blogs in constructivist education approaches and classified the basic advantages of blog use highlighting three of them: support for active learning, support for collaborative learning and reinforced individual accountability [10].

Collaborative learning, according to Du and Wagner 'results in better learning outcomes, compared with individual-oriented learning'. Because of the web nature of blogs, they promote the facilitation of the power of linking, of providing feedback, and of enabling different forms of connections between participants in the learning process.

An important advantage of using blogs in education, still according to Du and Wagner, is the ability fostered by blogs to reinforce individual accountability. This is accomplished in three ways: non-anonymity — personal responsibility of students to progress; individualized feedback — embedded in blog capabilities for receiving feedback from teacher and students; benchmarking and self-assessment — possibility for student to compare own work with works of other students.

The blogosphere is a collection of interconnected blogs. As any open and decentralized environment and any free community, it is difficult to be controlled. Therefore the use of blogs is usually not as widespread in universities and schools as institutional LMS. On the contrary, shifted locus of control in blogs presupposes their smooth integration into the PLE concept space as it builds on minimizing top-down administration and maximizing the self-directedness of the students.

By analysing typical uses of blogs in learning, Laine had classified many different uses for blogs, such as: problem solving tool, discussion tool, reporting tool, learning diary, preparation tool, link dump, collaboration tool, bonding tool, fun factory, and shield against shyness [11]. It should be noted that highlighted uses contain many activities that can be found in traditional learning courses. This allows us to establish the theoretical possibility of implementation online, blog based, courses.

4 Beyond Blogging

In order to accomplish our goals, we started by identifying which blogging workflows were already used in learning processes. Specifically, our interest lied on studying how assignments could be posted and assessed using blogs. We assumed that teachers had previous experience in using blogs, for instance in the delivering of learning materials. We also assumed that the posting of assignments and their assessment would be desirable.

Further, we also assume that each student would use its own blog as an e-portfolio publishing accomplished assignments and getting feedback from teachers and fellow students in the form of comments or grades. Using their blogs in any other ways should never be a problem for either teachers or students.

Current blog platforms usually provide both categories and tags as semantic annotation tools, which are suitable aggregation mechanism within each blog but not across blogs. Tramullas and Garrido [12] stated that the semantic Web been integrated into blogs is yet to happen, although this can be done through the development of new functionalities.

Again, current blog platforms provide the ability to comment, which on top of its basic purpose, can also be used to link different messages on distinct blogs. Other possibilities for linking messages are mechanisms such as pingback and trackback. Unfortunately, all fail to provide suitable semantic annotation.

As we believe that a blog platform should remain a blog platform, we attempted to address our problem extending the basic blog feature set with a blog extension prototype, which adds an extended feature set without disabling any of a blog system's central characteristics.

For implementing described above task we developed a blog extension prototype LePress. LePress is a WordPress plug-in; this name is a combination of the words Learning and WordPress.

5 Usage Scenario

Let's consider the following usage scenario: A teacher is about to begin a new course. She has most of her learning materials already hosted in her teaching blog but she would like to reorganize them for this new course. With the LePress plug-in installed, the teacher gets to create courses and easily aggregate the available learning materials in logical units. Further, she can even use some of the learning materials as assignments upon which student assessment is planned.

The teacher's next step is the registration of the students. If a multiuser version of WordPress is being used then, setting LePress powered blogs for the students is straightforward. Otherwise, students have the option of either using their own existing blogs or creating new blogs and install the LePress Student plug-in by themselves. The teacher may then ask students to register by automatically sending them email invitations.

Once the registration of the students is completed, a special relationship between the blogs of the teacher and the students is established and the learning process may start. From this moment the teacher now has access to the roll of students, their blogs and e-mail addresses and vice-versa, all from their blog's extended interface. This

virtual integration allows participants to coexist in a common information space and to follow the process of the course concurrently. This also fosters the creation of some classroom awareness and the communication among classmates.

Further, the teacher can now assign tasks for students to carry out using her blog. Students are automatically notified about the assigned tasks in their blogs and may publish the assignment's outcomes directly in their own blogs. Later, the teacher is also automatically notified about students' completion of tasks and may assess, comment and grade the students' work in their blogs.

Of course, one can argue that some of what was described in the previous paragraphs could also be accomplished with a blog's basic feature set. Whereas this might be true for some tasks such as the publication of task assignments, the posting of assignments outcomes, and the sharing of comments, it surely doesn't hold for the case of logical aggregation of course materials, course enrolment, assignment setting, tracking and assessing.

Hence, we can now identify two types of activities when delivering a course using a blog: Activities that can be achieved using the blog's basic functionalities and activities that require additional functionalities and it is the latter type of activities that is addressed by the LePress blog extension prototype.

6 Blogs and Courses

The conceptual design of LePress was based on three main guidelines: ensuring that both teacher's and learners' usual learning flows are supported in an usable, natural and simple way; aiming for minimal or absent blog architecture interference ensuring all basic feature set while leaving extended functionality transparent and ready to be used when needed; and achieving maximum or total blog architecture reuse ensuring that no feature is implement it doesn't carry substantial s added value.

With these guidelines in mind, the first challenge was to help the teacher deploy she’s course. This was addressed interpreting a course as a collection of learning activities, which happened on and during predetermined moments in time (figure 1). Activities are themselves blog postings, which may relate to such elements as learning materials, discussions, assignments, and assessments. A course would also count with one teacher and a number of students.

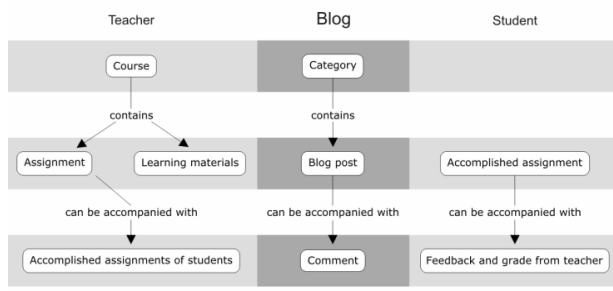

Fig. 1. Mapping the entities of blogs to concepts of LePress courses

Blog postings are organized in categories and the same happens with postings of learning activities. The difference is that the latter are assigned to special LePress course categories. These LePress categories enable additional functionalities such as binding of users and specific category to tie enrolled students to a specific course. Course categories are standard WordPress categories labelled by a 'new course' attribute.

Both teacher and students are also parts of a given course in LePress. The teacher is the author and owner of course, which she deploys on her blog using a course category. Course categories store metadata on course designation, teacher details and institution. The form with mentioned above filled data is shown on figure 2.

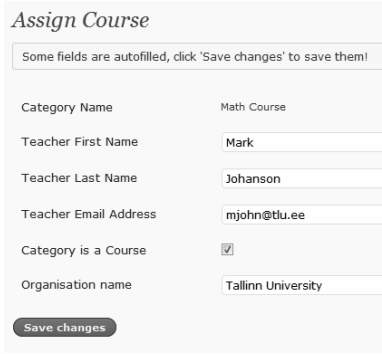

Fig. 2. Course category description in LePress' user interface

Another one advantage of this approach is the possibility of using RSS feeds to track the course's evolution with tools other than the teacher or students' blogs. This broadens the boundary of the course to all RSS enabled devices.

The second challenge was to bind the teacher and her students to a course. As the owner of the blog within which the course is deployed, the teacher is naturally bound to her course.

As for binding the students to a course, this was addressed by allowing the definition of communities of users based on specific blog categories. With this feature, the teacher can track all of her courses' students and related performance indicators; the students can get to know who their classmates are thus fostering the creation of the classroom awareness and facilitating communication among classmates.

The third challenge was an implementing of a mechanism of assignment and assessment. As noted before, all the course activities are published as regular blog posts. Assignments, however, are published using a special assignment post, which stores some additional metadata – for the time being only start and end dates are stored – and which is automatically announced to all students' blogs in their LePress interfaces (figure 3).

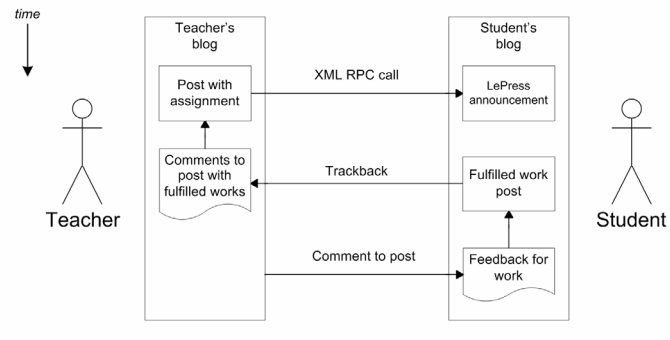

Fig. 3. Interaction of teacher and student during a course

Students should accomplish the assigned task in theirs blog and may refer to their own LePress interfaces for the assignment's content and deadline.

Finally, the teacher may use standard comments to provide the user with the feedback that she sees fit or she may use her blog's LePress interface to write her comments, grade the assignments and keep track of students' activities and accomplished assignments.

Comments written on the teacher's LePress interface appear in the students' blogs as standard comments together with an eventual grade given by the teacher. Grades are free form.

7 Supported Learning Workflow

The general architecture of a blog-based PLE involving the LePress module is depicted in Figure 4. We propose to conceptualise the use of PLE into three layers: the User, the Learning Flow, and the Learning Content layers.

The Learning Flow layer is in the middle, consisting of multiple blog instances, each of them with either the LePress Teacher or LePress Student plug-in installed. It is the LePress plug-in that supports the envisioned learning workflow.

In following we are describing the main parts of LePress learning workflow.

Course creation: the courses are deployed by creating a new course category in the teacher's blog and by assigning it all the relevant metadata (see figure 3).

Announcement and enrolment: the teacher can announce each course by filling in an invitation form with the students e-mail addresses from within LePress' interface or she can use LePress to import a text file containing the students' email address to automatically generate the invitations. In context of LePress environment the enrolment is the subscription to the 'course' blog category. It may only results in true enrolment if achieved within a student's blog LePress interface. Subscribing to the course using a standard RSS reader will not enable any of LePress' features; it can be used by students as additional way for receiving information.

To complete the enrolment process the teacher must accept the subscription requests.

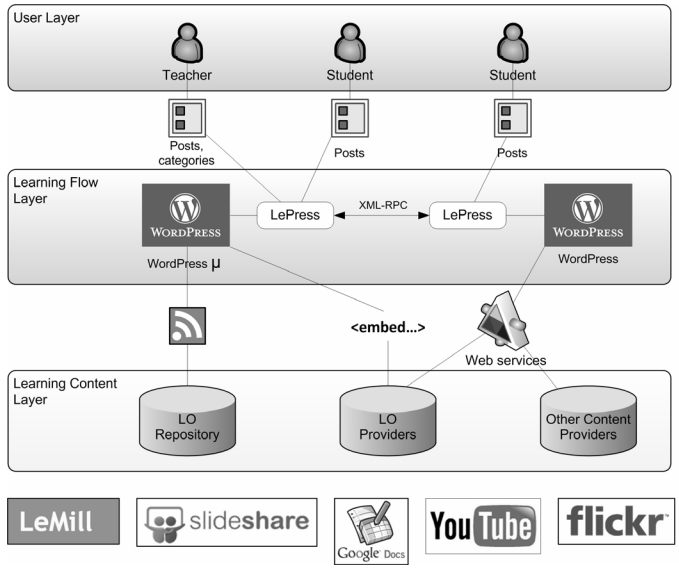

Fig. 4. LePress provides assessment workflow in layered architecture of modern PLE

Publishing course materials: the teacher publishes course materials as standard blog posts assigned to the course category.

Announcing assignments: assignments are announced within the teacher's blog using the LePress interface. As said before, assignments are special metadata-enabled posts, which have a start and finish date. These posts are automatically tracked by LePress using an XML-RPC call (see figure 3) and listed in all blogs belonging to enrolled students. The assignment is also announced to each enrolled student via an e-mail message.

Submitting assignments by the students: a submitted post will only be identified as an assignment submission if published from LePress Results page. Such the posts will appear as standard posts in the student's blog and as trackbacked comments associated with the original assignment post in the teacher's blog. This way, a permanent link is maintained between the assignment and the assignment's results.

Assessment: all assignment-related posts submitted by students appeared as comments in the blog of teacher and also tracked at the LePress results page of teacher as a list of links to originals. The teacher can view works of students in their blogs by following the link from LePress results page. When the teacher wants to evaluate a work of the student, he/she can do it from the same LePress Results page also. By clicking to link he gets a special form where it is possible to write text notes and to grade the work. LePress maintains a record by automatically placing its content into the blog of student as comment under accomplished work (figure 3).

This way LePress supports efficiently three most typical learning flow scenarios for the blogs of the teacher and students: assignment announcement, assignment submission, and assessment.

The published posts with accomplished works of the student are duplicated as comments for teacher's assignment-post and in turn the feedbacks of the teacher are appeared as comments for the work-post in the blog of students.

All these comments look very natural for blogs, but they can be implemented as described above only with the support of LePress. Any other standard functionality directly provided by WordPress can be used, for example if teacher or student gets a comment for blog post, he can automatically receive an email announcement about this.

8 LePress' Backend and Frontend

To enable course management an additional LePress menu was added to the teacher's WordPress administrative interface. This menu has four options: Courses, Subscriptions, Write assignments and Manage assignments. Each of these options enables some of the teacher's course related everyday tasks:

- In the Courses screen the teacher can manage his/her blog's categories assigning them course status as well as other metadata elements;
- The Subscriptions screen facilitates the management of the students. It provides tools to invite, track and delete students from any of the teacher's courses;
- The Write assignment screen allows for the publication of assignments within each of the teacher's courses;
- The Manage assignments screen offers the teacher a class-book like interface which lists students name, blog links and assignment status. Assignments can be accomplished or not accomplished. Accomplished assignments are graded and commented upon by the teacher and are automatically linked to the relevant post in the student's blog.

Students have a similar backend menu in their blog's administrative interface, but this has only two options, Subscriptions and Assignments:

- The Subscriptions option allows students to manage their enrolments to courses;
- The Assignments screen lists all published assignments together with the links to forms that enable the fulfillment of each assigned task.

To enable higher levels of usability and productivity, teachers and students have also access to 'frontend' LePress interface. We developed a separate user interface that caters for the control and management of almost all course-related tasks. In contrast to the form of implementation of the LePress 'backend' this 'frontend' is implemented as a WordPress widget. Widget is a small portion of an HTML code that can be embedded into a web page. LePress widget contains of data related to course management, e.g. course calendar, deadlines of assessments, names and emails of participants and so on (Figure 5).

This data can be accessed at any time straight from the blog's user interface, without the necessity to move into WordPress dashboard. These widgets can be switched on/off in the teacher's or students' blog using standard WordPress widgets management interface.

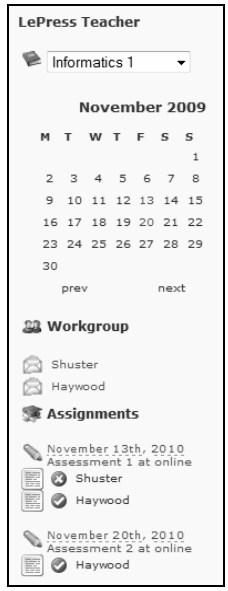

Fig. 5. LePress widget

Figure 5 depicts the teacher's widget; the student's widget has the same functionality but without possibility to manage the assignments. On the top, there is a dropdown box for choosing a course, which causes all related content to be displayed.

Assignments related to the selected course can be accessed either using the calendar or the list of assignments displayed at the bottom of the widget.

Within the calendar, assignments are available as links established over their respective end dates.

Within the list of assignments, for each assignment the widget lists the students who already completed the assignment and providing direct access to each student's work and facilitates the grading and feedback functionality. Icons differentiate the assessment status as accessed and not accessed.

LePress widget also fosters within course communication by listing all course members together with their e-mail addresses and blog links.

One of interesting opportunities that can be integrated into existing software by help of widgets is a semantic data exchange. This will be explained in next chapter.

9 Semantic Data Exchange

As with most social services, data exchanged within LePress might not be easily reusable unless some meaning is attached to it. LePress uses data that can be reused by instructors and students, typical examples of such data is the deadline of an assessment or names and e-mail addresses of the course participants. The question is: how to allow the users to reuse such data outside of a blog in other various tools? For

example, the date for an assessment's deadline can be exported from the browser and imported into a personal calendar application in a local computer, Internet services like Google Calendar or a personal mobile device like phone or iPod. The same procedure can be implemented with the personal data of the students and teachers, for example names and e-mail addresses can be imported to the personal address book.

In order to facilitate the flow of the course related data between course participants and improve usability of using LePress software, we developed the semantic data exchange in LePress.

There are not many ways to pass semantic data to the end user in the web environment. The most known and popular technologies that allow the embedding of semantic markup into web documents are microformats for HTML, RDFa for XHTML 2, and microdata for HTML 5. In current research we do not consider microdata because of its novelty and the lack of tools that can work with it. RDFa and microformats seem like more suitable candidates for supporting semantic data exchange in LePress. However, although RDFa is potentially powerful, it lacks the browser side support microformats currently have [13]. The biggest disadvantage of microformats is a limited vocabulary that does not have enough means for describing course related data. This limitation can be settled by the creation of new microformats that must be proposed and accepted by the microformat community. Also, the existing elemental microformats can be easily combined into the new compound microformats if such a combination will give new meaning to the data. Microformats are very wide-spread and supported by global services like search engines, such as Google and Bing. Because of this, and in spite of its semantic shortcomings, microformats were chosen to provide the context for the LePress data.

The course-related microformat data is embedded into the code of the LePress widget. When a page with the LePress widget is loaded into the browser, the microformat data can be read and interpreted. Popular browsers enable the interpretation of microformats either natively or by means of third-party extension. Figure 6 depicts an example of accessing the microformat data using the Tails Export extension for Firefox.

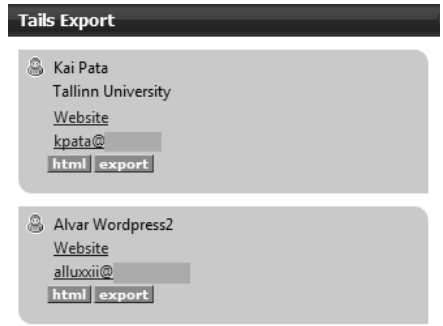

Fig. 6. Tails Export add-on for Firefox with ready to export microformat data from LePress widget

At the present time, LePress supports two of the most popular microformats: hCard and hCalendar. The hCard format is perfectly suited to convey a course participant's personal data. When using the microformat-enabled browsers or browser plug-ins, the LePress hCard data can be exported to a vCard file or directly to a contact manager application such as Microsoft Outlook.

With the hCalendar format, LePress enables a similar functionality for the course related events such as the assignments. They can be exported into the iCalendar file or directly into the calendar application or service, providing a seamless integration of LePress with the day-to-day tools of the course participants.

As illustrated by these two simple examples, the use of microformats can provide countless potential cases of using data mash-ups from different sources, which can be especially interesting in the context of educational settings. With the two above presented microformat data exchange implementations, we only demonstrated a small part of the foreseen possibilities for the use of semantic data. Today, microformats can represent many commonly published things like people, events, blog posts, reviews and tags, and these possibilities can be implemented in LePress in the future. We believe that this facet of LePress can and should be further investigated in order to enable richer LePress interactions among users and integration within its own components and with the surrounding functionalities and applications.

10 Current Implementation and Future Developments

WordPress was the blog platform chosen to test our ideas and to implement the current blog extension prototype. One of the reasons was the size of its userbase, but the main motive for choosing WordPress was its easy plug-in extensibility. WordPress is, however, not a final solution for implementing and testing the concepts outlined in this paper, but rather as a first draft that might be ported to other blog platforms should our approach prove successful. In fact, interoperability among distinct blog platforms would be an inherent goal from a PLE perspective.

The latest release of LePress is a stable version 1.02; the user manual is being developed so that the plug-in can be made available to the entire WordPress community. The plug-in is distributed in two editions – LePress Teacher and LePress Student. Both are required for enabling the simple learning flow management in LePress.

We see some interesting perspectives that open the current research. At first, it is possible to mash up assignment-related data. On the given example we have shown how a blog category that is interpreted as a course can be subscribed to with a standard RSS reader. This way is already widely used by educators. In our case we propose not only RSS data, but data that is semantically rich by means of microformats. This opens up new ways to make mash-ups of courses.

Widgets can further foster the PLE concept. The example illustrated in this paper is but a small step compared to what else can possibly be achieved. The mainstream blog platforms are becoming more open towards accommodation of diverse widgets.

The weakest point of LePress is that it works only on these WordPress instances where user is able to install our plug-in. However, many bloggers use different blogging platforms (Blogspot, Movable Type etc). This is why we plan to explore the possibilities for implementing learning flow management across different blog engines.

11 Conclusion

The simplest learning flow taking place in a Web-based environment contains announcement of assignment by the teacher, assignment submission by students, review and assessment of submitted assignments by the teacher and receipt of feedback/grade by students. By developing the LePress plug-in for WordPress we demonstrated how this learning flow can be automated using the typical features of blog engines: trackback, categories and sidebar widgets. We also explored how course- and assignment-related semantic data could be distributed using Microformats. Within our laboratory tests, potential users (teachers and students) were satisfied with the user experience. However, in order to prove the applicability of LePress on the wider scale, pilot tests should be conducted in a real-life context with large groups of users.

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IV

Sousa, S. C., **Tomberg, V.**, Lamas, D. R., & Laanpere, M. (2011). Interrelation between Trust and Sharing Attitudes in Distributed Personal Learning Environments: The Case Study of LePress PLE. In H. Leung, E. Popescu, Y. Cao, R. Lau, & W. Nejdl (Eds.), Advances in Web-Based Learning – ICWL 2011, Lecture Notes in Computer Science (Vol 7048, pp. 72–81). Springer Berlin Heidelberg. doi: 10.1007/978-3-642-25813-8_8

Interrelation between Trust and Sharing Attitudes in Distributed Personal Learning Environments: The Case Study of LePress PLE

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Abstract. This paper focuses on relations between learners' generic level of trust in online environments and their attitudes towards openness and sharing in a blog-based personal learning environment LePress. The main rationale of this study was inspired by the changes present in today's education, where the use of blogs as Personal Learning Environments is becoming an emerging trend in higher education. We claim that by understanding interrelation of trust and attitudes towards sharing within this open and flexible environments, we will be able to contribute to the design decisions regarding the LePress, which lead to increasing the participation of individuals and communities in inherent formal and informal learning processes in a number of contexts. Major contributions of this paper are towards understanding (1) the relationship between trust and teacher/learners attitudes towards sharing in a blog-based personal learning environment and (2) the correlation between users trust level and expectations towards affordances of online learning tools.

Keywords: trust, blogs, learning flow, Wordpress, LePress, Personal Learning Environments.

1 Introduction

This study explores the influence of generic level of trust to attitudes of learners towards openness and sharing in distributed Personal Learning Environments (PLE). Our aim is to provide a broader understanding of the nature of the relationship between learners' attitudes and expectations towards sharing and trust when in open learning context. This is due to the belief that the trust elements within distributed PLEs can somehow beneficiate each individual, a structured group or a community' sharing attitudes and behaviors.

This paper starts by providing a brief literature review on recent changes in online learning environments and trust-related issues in online communities. Our focus is narrowed down to the use of blogs as PLEs in formal higher education context. The next part of the paper introduces a blog-based PLE called LePress, which is an enhancement of the most popular blog engine WordPress. The final part of the paper summarizes the results from survey, which was carried out among 32 LePress users in two different higher education institutions.

H. Leung et al. (Eds.): ICWL 2011, LNCS 7048, pp. 72–81, 2011.

2 Online Learning Environments and Trust Issues

Learning, nowadays, can no longer be seen as a passive activity, it becomes an autonomous activity, where learners are openly responsible for the learning processes as well as for actively participating towards it.

A tendency towards a more individual-centered approaches whereas group-centered activities, creates context and where each individual contributes to the intellectual climate and the technological infrastructure of society, rather than the effects of media itself [5].

The view of the Internet as we seen a decade ago, as a mere repository of information and data has no longer exists. Especially, within this increasingly availability of user-generated content mechanisms in the World Wide Web and the increasing growth of social networking services, like the Web 2.0, or read-write Web.

The tools had transformed the Internet into a hub of socialization and are more then ever before representing the logical extension of our human tendencies toward togetherness. These tools are somehow tailoring our society and culture in general. These technologically enhanced social contexts represent new identities that are being formed and evolving individually or collectively and each one is tailored by each individual's diversity [6].

One consequence of that is that nowadays we can find very difficult to solely rely on face-to-face communications. And as the penetration of these social computing tools (like blogs, wikis, social bookmarking, virtual worlds, podcasts, RSS feeds, media sharing, and social networking sites) are becoming increasingly high we find new opportunities for individuals or groups to launch new collaborative approaches and form new social engagement contexts through the World Wide Web [4].

The change communication tools in has been shaping our society and changing the way we relate, organize our work and learn in general. In sum, this new social media approaches have been enabling the creation of a new social and cultural diversity, in other words have been shaping a new social and cultural space where is possible to communicate, work, interact or form new relationships without physical or temporal frontiers [12].

These emerging, increasingly digitalized lifestyles are suitable for individuals who are competent users of technology and capable of self-actualization. This kind of individuals need to feel safe and accepted in their relationship space in order for them to be willing to participate and engage in a mutual dialogue [14,11].

As any relationship (formed virtually or in face to face contexts) needs for environments with a particular history of trust, varied motives, mistakes and forgiveness that need to be created and maintained. In those contexts a careless communication potentially leads to lack of character, personality, familiarity which curbs the sharing values, gender, age, people's roles, social status – dimensions which are normally relied upon to determine people's trust based attitudes or decisions [7].

Another raising trend in today's higher education is the tendency to use Personal Learning Environments instead of, or in parrallel with traditional Learning Management Systems. In spite of we still see a tendency for universities to use different types of Learning Management Systems (LMS), mostly due to the already

existing maturity of the inherent concepts. As well as because of the fact that LMS are now stable environments featuring high availability, scalability, usability, interoperability, stability, security performance [8].

There is an increasing tendency to agree that the adoption of Personal Learning Environments might result in a quantum leap over LMS based approaches, especially within the technology enhanced learning community of researchers. As envisioned, PLE facilitate learner-based constructivist learning processes and promote the usage of open resources, and Web 2.0 tools by opposition to the teacher-centric tactics enabled by typical, Web 1.0 associated LMS [9].

We argue that trust can represent an important key role in facilitating or hindering the adoption of blog-based Personal Learning Environments and open educational resources. We beilieve that trust affects individuals' predisposition to interact, by shaping their willingness to rely on others, or by influencing their ability to believe that other's actions will eventually lead to expected results [10]. As well trust can influence individuals' beliefs, attitudes and behaviors towards learning and sharing process, as it is a key element for provide cooperation and collaboration practices [14, 13, 11] Therefore, we propose that developers of blog-based learning environments should take into account the potential impact of trust-related factors to the attitudes and expectations of users.

3 LePress

Blogs are considered as a popular platform for using as PLE; they allow learners to build their learning portfolios by sharing, reading and reflecting on the learning experiences. Modern blogging platforms allow mixing multimedia information from different sources directly in blog posts.

LePress is an open-source software plug-in for popular WordPress blogging platform, it was developed in the Institute of Informatics, Tallinn University. As its name implies (LePress is a short version of Learning WordPress), LePress is intended for adding specific learning-related functionalities into WordPress. There exist a plenty of different Wordpress plug-ins which support different aspects of online learning. A specific feature of LePress is built-in support for managing learning related workflows (or learning flows) for course enrollment and assessment of learning outcomes.

Wilson [1] sees personal blogs as the key component of PLE that can be connected with institutions through using specially designed *'Course Coordination Space'*. There is no strict definition of such space, it can be implemented in many forms, but this should be a lightweight software solution capable for providing courses' provisioning, scheduling, and monitoring. The possibility to ensure user support is another critical functionality of course coordination space. Following this design we developed LePress for providing a connection between the formal universities' learning courses and informal PLEs distributed among blogs of teachers and students. The native functionalities of LePress cover almost all tasks intended for Course coordination space.

LePress allows teachers to create courses on the base of their WordPress blogs and register students in them. In addition to various ways of using blogs in course works [2, 3] in LePress teacher can also produce special posts that are considered by the system as assignments or learning tasks. Being automatically notified about new assignments and deadlines the students can publish their homeworks in their own blogs. These posts automatically gathered by LePress and delivered to dedicated gradebook, accessbile only by the teacher. Teacher in turn can assess these submissions, grade them and send personal feedback.

LePress uses non-destructive approach to existing workflows in WordPress. Actually the users continue to work with their blogs in usual way by posting the own and commenting other's posts. The only additional task is to use dedicated categories for course-related posts and selected posts in teacher's blog as assignments [15].

LePress is not a unique WordPress plug-in for organizing courses, but it is very different in its design. Currently there are two other popular plug-ins that declare the functionality of course management on the base of WordPress, namely BuddyPress Courseware and Learninglog.

BuddyPress Courseware proposes a big scale approach. It offers for teachers a lot of versatile functionalities trying to find a possible substitution almost for any functionality of traditional LMS. Filling of variety different types of formal documentations like a course description, books register, or course bibliography is typically a strong requirement for the university course preparation process. However these and many other formal activities hardly can be considered as mandatory part of teaching process in PLE. Such kind of information is more expected to be presented at the institutional side, for example university can publish the course related data using XCRI (eXchanging Course-Related Information) standard syntax.

Attractiveness of blogs for end-users (in our case for teachers and students) often originates from simplicity and usability of blogs, therefore constructing complex data structures with large amount of functionalities on the top of the personal blog seems as disputable approach. The first question is why we need to build the fully functional traditional LMS on the top of the blogs, while many excellent 'pure' LMS are already produced and used in universities? What are advantages of such approach in terms of pedagogy and implementation of course workflow?

BuddyPress Courseware and Learninglog plug-ins have a mandatory requirement of prerequisite installation of additional BuddyPress plug-in which can be considered as another limitation. The popular plug-in BuddyPress provides for WordPress several features of social network. Use of BuddyPress is a pointless activity in single-user WordPress blog; it is designed to be installed on the top of special multiuser WordPress (WPMU) or WordPress version 3 with networking activated. After installation of BuddyPress local users can be organized into groups, add each other to friends, send messages and use forums for intercommunications. The mentioned above plug-ins for coursework implementation must be installed on the top of BuddyPress to use its group-management functionality. However this solution has some disadvantages. The main problem is an impossibility to add into the course any students from the blogs that belong outside of WPMU or WordPress network; only registered in specific WPMU or in the WordPress network local users can be added

into groups. Currently there is only one possibility to link external blog into BuddyPress group, it is subscribing to RSS feed by installing a special additional plug-in. Though this runaround do not allows an external user to be a true group participant.

This limitation makes it difficult to organize courses with participants who use personal blogs dispersed on different hosting servers. As there is no way to add participants from outside of specific software instance, it transforms an open blog-based PLE into a traditional closed learning management system.

The need for using an additional software instance (BuddyPress) is the second shortcoming of mentioned above solutions, because installation and managing of current version of BuddyPress is not an easy task. Also this software has several known compatibility issues. A necessary of administration of additional software requires from teachers extra workload and technical skills.

In contrast to the other existing educational extensions for Wordpress for, LePress is designed as a Course Coordination Space and thereby it provides a connection between formal university courses and PLE. Students can run their own LePress-enhanced blog on a separate server or choose a central WPMU server hosted by the university. This allows an owner of external WordPress blog who already uses it as e-Portfolio to instantly join into the courses announced in another blog.

4 Research Approach

The aim of this study was to identify interrelation between general trust level and attitudes towards sharing within open, blog-based learning environments. To achieve this aim, two research questions were formulated:

1. What are the student's attitudes and expectations towards (a) sharing learning resources via the public Web, (b) sharing the assignment submissions and teacher's feedback with fellow students; and (c) participating in the negotiation of shared meaning?
2. How is the generic trust level of LePress users related with their attitudes towards affordances they expect from an online learning environment?

The questionnaire contained 18 questions and was divided in four parts: demographic and background information questions; attitudes towards sharing; trust related issues online; the affordances of online learning environments. The survey was written in English, Russian and Estonian. Responses from thirty-two students (from two higher education institutions) were collected from which we used twenty-nine completed ones for data analysis purpose, eleven in Russian, eighteen in Estonian. Thirteen respondents were female and sixteen male, age range varied between 18 and 52 years. All students have been taking at least one course, which was taught in blended mode using a blog-based Personal Learning Environment LePress.

5 Results

The following paragraphs summarizes the survey results in relation to: general learners Internet activity patterns; their sharing patterns; predisposition to relate or interact online; the learning environment; the feedback given; and learning activities.

General Internet Activity Patterns – results analysis shows that most uses the Internet to interact with others online in a daily base (82.76%). Also, reveled that people find activities like "reading and sending e-mail" (65.52%) as the most useful activity in the Internet, see f. This activity is followed by "Search for information [search engines, etc] " (31.03%), "Learning, sharing ideas in formal education contexts [school, institutions, etc]" (24.14%) and "Organizing or initiate activities, meetings, events". Finally comes "Sharing documents [doc, pictures, videos, music] " and "Chatting and Socializing".

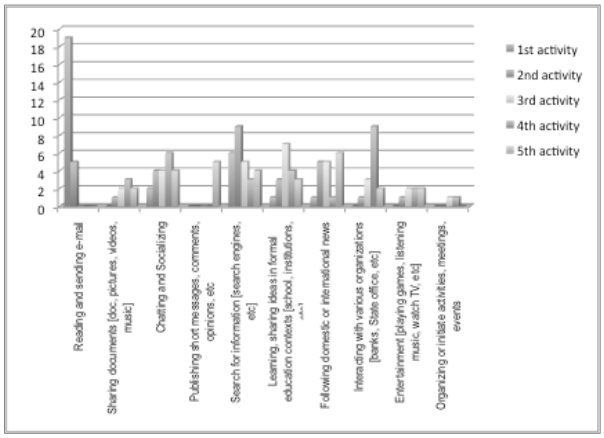

Fig. 1. Rank of activities consider more useful in online contexts

Students' Attitudes towards Sharing Learning Resources and Information – in here we observe people's predisposition to share in distinct online relationships contexts. More specifically, observe people's predisposition to share within a more close relationship context (e.g. friends, family and co-workers) and when in a more open one (e.g. acquaintances, student/teacher and strangers). Those sharing context where raised on issues like (1) sharing learning resources; (2) sharing personal information; (3) exchange comments and messages; and (4) on sharing Facebook status message. Results indicate a clear preference towards participating and sharing in groups with more close relationship than those with loose and open relationship.

Students' Attitudes towards Trusting in a Specific Online Person – when asked student's the question "what make you trust in a particular person online" the answers showed a tendency to consider vey important issues like: if the person is honorable (34,48%) and capable to respect them (31,03%). Where also consider important to know that person with whom they are going to communicate with (37.93%) and to share similar interest and preferences (34.48%).

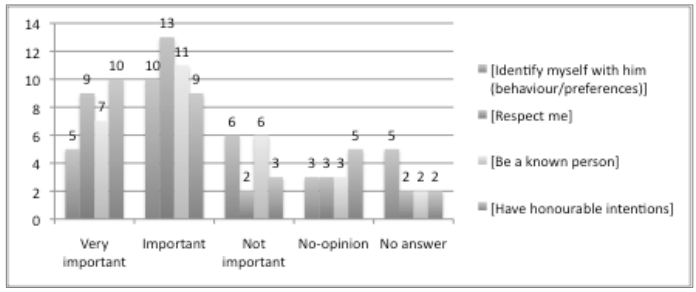

Fig. 2. What make you trust in a particular online person?

Students' Attitudes towards Willingness to Engage in a Give and Take Action – the most considered features that make them be willing engage in a more give and take action are the sense of honesty in the people with whom they will share (48,28%) and receive the information (37,93%). In other words believing that he or she will be a reliable source of information. Also, a sense of mutual respect and affinity is considered a very important feature (31,03%). Willingness to share (85,52%) and feeling of empathy and sympathy (41,38%) are considering important features as well, see figure below.

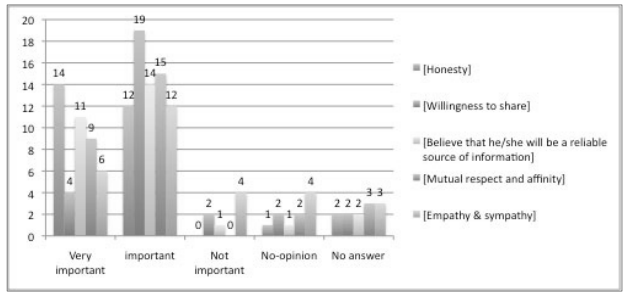

Fig. 3. What is the most important feature that makes you willing to engage in a give and take action online?

Most Important Condition to Be Willing to Interact with Another Person Online – is to know how they behave, especially if they behave in a friendly and transparent manner (44,83%) and again honest (44,83%) is also an important factor. Another important issue to make them willing to interact online with someone else is the feeling of relative security in the relation (34,48%) but in the other hand they did not consider predictability and important factor (51,72%). Important features also consider here are the sense of belonging (27,59%) and mutual respect (37,93%). See figure below.

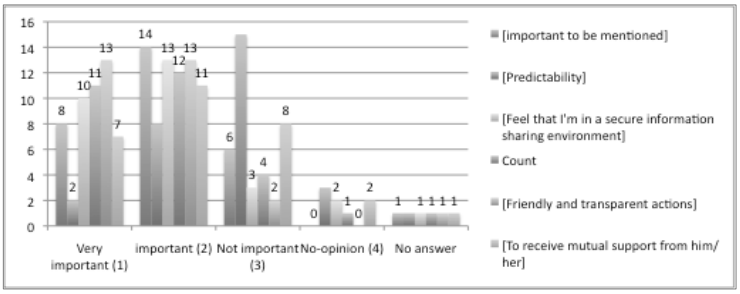

Fig. 4. What is the most important feature that makes you willing to engage in a give and take action online?

The finally and fourth part of the survey, addresses questions regarding the learning environment and raised issues that in general are related with: students' sharing beliefs when in open learning contexts and the level of control and availability of the course resources. Also addresses students' beliefs towards open communication and open learning processes reliability and credibility.

Students' Attitudes Towards the Open Learning Environment – students' seem to agree that a blog-based learning environment is a good learning tool and don't mind that other's can read their coursework materials (44,83%). Also the majority agrees that a blog-based learning environment makes the learning process transparent and shareable (37,93%).

Students' Sharing Beliefs towards the Open Learning Environment – student's don't mind sharing the resources (files, references, my personal notes) collected and created in the process of study on the public Web (31.03%). Not even mind if someone (e.g. her boss, 10 years from now) will find his or her old homework submissions on the public web (44.83%).

Students' Beliefs towards the Level of Control and Availability of the Course Resources – most students strongly agree that prefer to have their learning resources available on the public Web (31.03%) and not locked into an online learning environment (20.69%). Some though, seams undecided about keeping or not teacher's homework comments private by default or not. But, agreed that a student should be able to define access restrictions to his/her resources (41.38%) although seam neither agree or disagree if learners should have control over some learning main components like defining learning goals, selecting learning strategies, finding learning resources, choosing evaluation methods and indicators, choosing topics (44.83%).

Students' Beliefs towards the Learning Processes Reliability and Credibility – majority believes that by keeping all learning activities open attracts other Web users (especially external experts and practitioners) to participate in the course and share

their knowledge (37.93%). But, somehow they seam undecided if by keeping their homework submissions public, others students can then make their valuable comments. Next and final group of questions aims to understand users' attitudes towards online learning environment affordances, specifically towards the learning cooperation and collaboration related practices; and of the technologies features.

Students' Attitudes towards Technological Related Features – from the technological point of view 37,93% of students consider very important for an online learning environment to include possibilities like: searching and annotating artefacts (e.g. tagging). Also is very important to include tools that allow creation and editing features (34.48%) or allow uploading and managing files (44.83%). Asynchronous text-based communications (e.g. forum), Self-tests (no record, no grading); Multiple-choice tests and content package and concept mapping tools are also considered as important features for online learning environment affordances.

Students' Attitudes towards the Learning Cooperation and Collaboration Related Practices – from a more cooperative and collaborative perspective students' consider important to provide Collaborative writing and drawing (e.g. online shared whiteboard) tools, built-in workflows (e.g. reviewing and publishing), self-reflection are referred as important features of an online learning environment. Providing tools for versioning of documents, or possibilities to practice in virtual labs; or to simulate experiences; or practicing with interactive models should also be included. As well as the possibility for forming sub-groups, group assignments and for Project/time management.

6 Conclusions

The main contribution of this study is exploration of intersection of areas such as trust, personal learning environments and learners' attitudes towards open learning environments.

For designing LePress course environment, the most important and promising results of survey is preference of the students to use learning resources available on the public Web and readiness of students to use for distributed PLE tools like LePress. On the other hand results point out that trust is an important factor in the learning process. An online learning environment should facilitate the learner in determining the quality of the relationship, i.e. if the other person acts in an honorable way and respect the relation, if they share similar interest are important issues to trust someone online. Trust affects also the learner's perceiving if other person behavior, especially if they are friendly, transparent and honest will help them to be more willing to share. And finally, the learners with higher levels of trust seem to be more willing to engage themselves in sharing activities online.

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V

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Enhancing Learning Analytics in Distributed Personal Learning Environments

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Abstract — **This paper describes LePress, a WordPress plug-in that enhances blog-based personal learning environment (PLE) with features and semantics that facilitate planning, implementation, and analysis of learning flows. The paper introduces learning flows in LePress, and then explains learning semantics the LePress supports. In order to demonstrate the advantages of LePress for learning analytics, we describe how it can facilitate explicit data collection and analysis of learning activities in blog-based PLEs. In order to demonstrate the advantages of LePress for learning analytics, we describe how it can facilitate explicit data collection and analysis of learning activities in blog-based PLEs.**

Keywords - Learning Analytics, Learning semantics, PLE.

I. INTRODUCTION

The data sources for learning analytics can be either formal or non-formal [1]. In non-formal settings, the data is drawn from open social networks like Mendeley, Delicious, and Slideshare is used. On the other hand, the institutional LMSs like Moodle and BlackBoard are the most common formal data sources. In both cases, the data used for analysis is structured by the source system. Blog-based personal learning environments (PLE) are usually built with various tools not specifically designed for learning. Such tools (e.g., WordPress, Blogger.com, Drupal, Elgg) often have no learning-related semantics in the data that can be collected. Gathering the required data from such heterogeneous environments can be difficult without modifying the source code of the tools that generate the data. And, even when the data can be extracted from distributed PLEs, there will be a new challenge: how to interpret such data in the context of any pedagogical or learning theory?

One possible way to address such an issue is the use of ontologies to bind together data from different vendors. Semantic technologies can link learning content with learning activities and other participants of learning process [2]. Unfortunately, there are still no good solutions to extract pedagogically meaningful data from distributed informal learning environments.

This paper aims to identify the problems related to gathering meaningful learning-related data from PLEs, so that such data can be used for learning analytics.

II. PERSONAL LEARNING ENVIRONMENTS

While the impact of online classroom to learners is examined well enough today [3], conducting formal courses in distributed PLEs still is a new kind of activity. Razavi & Iverson [4] proposed the concept of a learner's personal learning space, which particularly consisted of e-portfolios, blogs, and social networking functionalities. Schaffert & Hilzensauer [5] defined PLEs as "Web sites or services where learners are able to produce learning content or reflections, and store documentations about their learning processes (e.g. Weblog postings)." So far, weblogs are widely accepted as an important PLE tool, and widely used by educators in different settings. This is, of course, not an obligatory condition, as a PLE is itself a collection of different online and (or even) offline tools.

Two most popular use cases of weblogs in education today are e-Portfolio of a learner, and course provision platform of educators. However, an educator who tried to adapt a blog for managing an online course has likely faced many issues because blogs were originally designed as a publishing platform, without any support for learning tasks. We fully agree with the claim of Kim that "Current educational blogs are normally not customized for educational purposes in terms of user interface and, functional features" [6] When designing the LePress, we made an attempt to solve this issue by adding some features for learning flow.

III. LEPRESS

We consider LePress as a tool that plays a "course coordination space" (CCS) role, which was introduced by Scott Wilson [7]. CCS acts as a mediator between a personal system and enterprise institutions with all their formal requirements. The main actors in such interactions are institutions, teachers (facilitators), and students (learners). LePress is designed to cover most requirements of teachers and learners, with a less attention paid to institutional requirements.

LePress is built on top of a popular open blog platform WordPress. This allows teachers to implement a formal course without leaving a habitual and friendly WordPress environment.

At first we defined a simple assessment workflow where a teacher assigns homework, a learner works on and submits back to teacher, who grades the works and gives feedback.

We mapped these activities on the blogs of teachers and learners trying to find possible ways for their implementation in blog publishing workflow.

Then we had to make a connection between formal learning activities and blog publication. We identified the main concepts for course artifacts, and mapped them onto con-

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cepts related to blog publication process. We have implemented two types of semantics in LePress:

1) Backend semantics: the course activities

We have defined learning semantics by mapping blog categories to courses, teachers' blog posts to assignments, and students' blog posts to homework. Comments on posts are mapped in parallel to implemented homework and to teachers' feedback.

2) Semantic metadata: enrollment and assignments

We have also implemented hidden data into LePress. This data related to the course participants and dates of assignment deadlines, and can be gathered directly from a blog web site using hCard and hCalendar microformats. Such kind of data in future can be also embedded into the blog by using RDFa, which support an unlimited amount of mixed vocabularies.

IV. Enhancing LePress for Learning Analytics

One of the main challenges of learning analytics is disconnectedness of data types, which are typically stored by LMS from educational theories and pedagogic concepts. Although a typical LMS (e.g. Moodle or BlackBoard) is designed for managing and monitoring online courses, a large part of metrics the LMS provides for learning analytics is quite generic: page views, number and frequency of comments or posts, duration of sessions, time on task, social network formation. There is still a large gap to be filled in if an analyst seeks to interpret the default LMS student tracking data within the context of any learning theory.

This challenge only increases when a distributed blog-based PLE is used instead of LMS. The data that can be collected in blog-based PLE has a limited value for Learning Analytics, as blogs were not designed for the learning purpose. However, we clearly see possibilities to extend and customize these types in accordance with IEEE LOM specification, to make them more useful for learning analytics.

A. Implementing Semantic Learning Annotation in PLE

The foundation for learning-related semantics was laid 5-10 years ago by the learning technology standardization movement, which formalized standards and specifications like IEEE LOM, IMS LD, IMS QTI and SCORM [8]. Collection of similar data from a blog-based PLE is a more complex task, as it requires adding standardized semantic annotation to blog objects. There are two approaches to implementing this goal. The first approach (used in LePress) is based on a special software-mediator, which can act as a superstructure integrated into PLE architecture as an add-in module (plug-in). For systems that do not allow any extensions, but provide public API, an alternative approach can be implemented. A dedicated external service can track all learning-related activities through API, add a semantic annotation to them, and store semantic triples in external repository.

B. Adding Pedagogy to the Semantics in PLE

Even a simple blog affords the implementation of various pedagogical scenarios. A simple blog publishing activity like "writes a blog post" or "writes a comment" can mean different things in different context. For example, a teacher's comment could be a scaffold, formative feedback or summative assessment. If a teacher and students could (or are invited to) define which learning category their post belongs to before submitting it, it would clearly increase the potential of PLE data for deeper learning analytics.

Here is one example. In VLEs like FLE3[1] or IVA[2] has been implemented a collaborative learning method called Six Thinking Hats [9], which develops metacognitive skills of learners by forcing them to select a Hat with a suitable color before they can submit a post to a course forum. Black Hat means that comment is of critical nature, Green Hat indicates constructive proposal etc. The Hat label is added to each post in this discussion, thus enhancing the vocabulary of Learning Analytics. Six Hats labeling can be added also to LePress assignment by installing the FLE4 plug-in for WordPress[3].

V. Conclusion

This paper described the work-in progress on ways of extending the semantic capabilities of the weblog based LePress component for PLE. Initially LePress was designed as a learning flow manager between blogs but after adding the support of learning flows to WordPress, we found that we can add learning-related semantics to WordPress objects also. Now we are about to proceed with extending this semantics in order to get valid and reliable data and enabling learning analytics.

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VI

Tomberg, V., Laanpere, M., Ley, T. & Normak, P. (2013), Sustaining Teacher Control in a Blog-Based Personal Learning Environment. In International Review of Research in Open and Distance Learning, 14, (3), 109-133, Athabasca University Press

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Sustaining Teacher Control in a Blog-Based Personal Learning Environment

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Abstract

Various tools and services based on Web 2.0 (mainly blogs, wikis, social networking tools) are increasingly used in formal education to create personal learning environments, providing self-directed learners with more freedom, choice, and control over their learning. In such distributed and personalized learning environments, the traditional role of the teacher is being transformed into that of a facilitator. This change inevitably means a reduced level of control on the part of the teacher. This is evidenced, for example, in difficulties experienced in retaining the necessary levels of control when the learning process moves away from institutionally maintained systems to blog-based personal learning environments. In conducting a course in a formal education setting however, it is still essential for the teacher to retain control over certain learning activities, such as course enrolment, assignments, and the assessment process.

A course management plug-in for the WordPress blog platform called *LePress* was designed and developed as a possible solution to this problem. By using LePress, teachers are able to more easily manage and coordinate courses in a distributed blog-based environment. Teachers are able to regain control over some important aspects of online course management, while maintaining the learners' freedom and choice for self-directed learning. This paper documents the results of a survey of a group of 37 teachers who used LePress for at least six months. The study demonstrates that by using LePress, teachers experienced an enhanced level of control over several aspects of the course and this reinforced their perception about the ease of use of the system.

Keywords: Teacher control; PLE; LMS; blog-based learning; perceived easy to use

Introduction

In the formal education context, technology-enhanced learning is usually conducted with the help of an institutional learning management system (LMS). Modern learning management systems provide teachers and learners with a set of tools for sharing learning resources, communicating within a study group, course enrolment, assignments, tests, assessments, activity monitoring, and other types of learning or course management activities. Learning management systems provide a secure and highly structured online learning environment, supporting various types of pedagogical approaches. In spite of this, learners and teachers increasingly adopt new types of web-based tools such as blogs and wikis, which are not hosted, provided by, or even recommended by the university. Users are attracted to such tools because they often have higher levels of user participation, openness, and network effects (Zourou, 2012), and often offer high quality learning resources (Ullrich et al., 2008). While some studies reflect enthusiasm about the use of Web 2.0 tools by teachers and learners (Lee & McLoughlin, 2007; Redecker, Ala-Mutka, Bacigalupo, Ferrari, & Punie, 2009; Safran, Helic, & Gütl, 2007), others are more sceptical about this process. Although they do not deny a growing interest in using Web 2.0 tools in the context of formal education, they call attention to the conflict between the participatory and collaborative nature of Web 2.0 learning and the current structures of formal education (Cole, 2009; Clark, Logan, Luckin, Mee, & Oliver, 2009; Conole & Alevizou, 2010; Crook, 2012; Greenhow, Robelia, & Hughes, 2009).

An opportunity to have more control over one's own learning process and environment is another incentive for using alternative online tools outside of an institutional LMS. By reflecting the hierarchical organizational structures of universities, LMS is built on a strict top-down approach, giving absolute administrative control to technical specialists in an IT department, while giving less control to the teachers. Steel and Levy have found that integrating the use of LMS into teacher practices presents a significant challenge in which teachers routinely try to reconcile their internal tacit beliefs with LMS environments (Steel & Levy, 2009). The students in LMS are placed at the "bottom rung of the ecological hierarchy" (Dron, 2007): They have only limited opportunities to implement those learning activities, tools, and resources, which have been pre-defined by teachers (McLoughlin & Lee, 2007; Siemens, 2006). By contrast, when using Web 2.0 tools, a student or teacher is able to build a *personal learning environment* (PLE), which gives their owners high levels of choice and control over their learning activities.

An example of this kind of environment is a blog-based environment in which students publish reflections about course materials, discuss with others, and submit their assignments through personal weblogs (Pata & Merisalo, 2009). Another example of adapting blogs as a PLE is demonstrated by the widespread use of blogs as the main personal tool in massive online courses (Fini, 2009; Kop, 2011). Kim (2008) provided several reasons for using blogs instead of traditional computer-mediated communication applications, such as the sense of ownership, the support of both social and individual learning, the less intrusive "pull" RSS technology, and the possibility to

archive user data (Kim, 2008). As students have control over their personal weblogs, they also have greater control over their learning.

To differentiate the PLE from any other common set of Web 2.0 services, several technical and educational attributes of the PLE can be identified. Among educational attributes, Salinas et al. (2011) proposed considering the ability of students to define learning goals, manage learning content and process, and communicate with others during the learning process (Salinas, Marín, & Escandell, 2011). According to Attwell (2007), another important feature of the PLE is that it allows learners to configure and develop a learning environment that suits and enables their style of learning (Attwell, 2007). Control by the learner over the choice of learning activities, resources, and tools perfectly corresponds with the self-regulated learning theory (Zimmerman, 1990) and encourages the shift from teacher-centred to learner-centred learning. Yet, the teacher must keep a balance between teacher control and learner autonomy in order to retain the effectiveness of self-regulated learning (Drexler, 2010). Similar arguments have been presented in organizational and workplace learning domains where a balance between individually driven learning and organizational guidance has been captured in concepts of knowledge maturation (Kaschig et al., 2012; Schmidt et al., 2009).

The requirement for combining LMS and PLE functionalities stems from the different kinds of affordances they offer. While LMS have more affordances for course management, Web 2.0 tools and social media have more affordances for individual expression of students, self-directed learning, expression of ideas, and group collaboration.

One way to achieve this balance is by integrating external Web 2.0 tools with formal LMS, which is increasingly being applied in universities (Dron, 2007; Meccawy, Blanchfield, Ashman, Brailsford, & Moore, 2008; Sankey & Huijser, 2009), thanks to powerful APIs of the most popular LMSs. The problem with this approach is that the LMS is still in a dominant role and learners cannot avoid using two completely different environments in parallel.

An alternative scenario is based on conducting learning activities completely outside of the LMS, yet providing enhanced support for course management in Web 2.0 based personal learning environments. For example, one problem in the blog-based scenario referred to above is that getting an overview of all course activities is difficult, and, hence, teachers have no control over the learning environment (Attwell, 2007; Dron, 2007). Consequently, the authors have been researching and developing a software solution that could act as a course coordination space (Wilson, 2007) in blog-based learning environments. The course coordination space was proposed as a lightweight system that sits "between the personal system and the enterprise" (PLE and institution) and introduces a common course related view and semantics in an otherwise distributed PLE environment. For example, the course coordination space can play the role of a central point for gathering data from distributed Web 2.0 tools, provide required learning semantics for student's activities (such as course enrolment, homework

submission), and provide features for monitoring and analysis (such as a grade book, an overview of students learning activities). After considering such functionalities, the authors developed a software plug-in called LePress[1] (Learning with WordPress) for the most popular blogging platform, WordPress. By conducting several design-based research iterations (Tomberg & Laanpere, 2008, Tomberg & Laanpere, 2009, Tomberg, Kuli, Laanpere, & Normak, 2010, Tomberg, Laanpere, & Lamas, 2010), a balance was achieved between learner autonomy and teacher control in the blog-based personal learning environment. This study presents the final iteration of a major design-based research exercise. The study focused on the following question: Can a dedicated course coordination tool such as LePress sustain the teacher's control over learning management activities in blog-based personal learning environments?

It is important to mention that this research does not suggest all the possible ways for using Web 2.0 tools in the context of education (e.g., group work of students), but concentrates on issues related to a teacher's and individual learner's interactions.

This study begins with a review of recent research on issues related to teacher control and then introduces LePress as a possible solution for improving course coordination in a blog-based PLE. A description of the design of the survey conducted among teachers is presented, followed by a discussion of the survey results.

Teacher Control and the Blog-Based Learning Environment

Teacher Control

While the majority of studies on the locus of control in the context of learning are concerned with issues of learner control, this study focuses on the less-studied perspective of teacher control.

Garrison and Baynton (1987) interpreted control as an opportunity and ability to influence, direct, and determine decisions related to the educational process (Garrison & Baynton, 1987). The concept of control in distance education has been elaborated by Moore's transactional distance theory (Moore, 1993). The theory describes the psychological distance between learners and teachers that depends on three types of variables: (1) the autonomy of learners, (2) the dialogue between teachers and learners, and (3) the course structure. The last two types of variables describe the relationship between the learner and teacher and are directly interrelated – when the structure decreases, the amount of dialogue increases and vice-versa; these changes happen dynamically to maintain the stability of a student-teacher communication system (Saba,

[1] http://wordpress.org/extend/plugins/lepress-20/

2002). Such a dynamic shift of balance between the dialogue and the structure influences the levels of both learner and teacher control.

The locus of control becomes visible through decision-making: "who is making the choices about where to go next at any given point in a sequence of learning activities" (Dron, 2007). Learner control is an important condition for successful self-regulated learning and it is supported by the PLE. Dron noted that even when the learner chooses a particular option, this choice could still be suggested or predefined by the teacher or the software. A homework assignment is a typical case in point because deadline, format (e.g., 500 word essay), and topic are predefined by the teacher. Therefore, providing possibilities for structuring and pre-defining online learning activities might enhance the teacher's sense of control.

The concept of learner control is related to the approach of self-directed learning (Hiemstra, 1994; Knowles, 1975). In the case of self-directed learning, the balance of control can dynamically change between the learner and the teacher, depending on the specific situation, personal capabilities of the learner, and the readiness of the teacher to provide support (Candy, 1991). Dron (2007) illustrated the unstable nature of control by describing control as "a constant and dynamically changing variable, not just because it is a negotiable quantity, but due to the nature of people and their diverse needs as learners" (Dron, 2007).

Modern learning theories promote reducing teacher control: "the locus of control in a social-constructivist system shifts somewhat away from the teacher, who becomes more of a guide than an instructor, but who assumes the critical role of shaping the learning activities and designing the structure in which those activities occur" (Anderson & Dron, 2011). To support the balance of control between the teacher and the learner, Candy (1991) proposed using various instructional strategies that could be placed at intervals along the learning "continuum" (Candy, 1991).

For successful implementation of the formal course in the informal learning environment, learning activities that are chosen for implementation should be defined in terms of formal learning that is familiar to the teachers. Teacher control becomes apparent in the context of different teaching activities and choices (Dron, 2007) that occur over time (Figure 1).

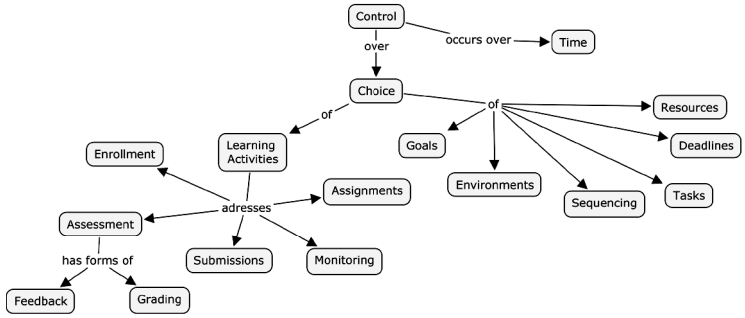

Figure 1. Model of teacher control in the context of formal learning.

The figure shows that by following Dron, we define control as *choice* over different *learning artefacts* such as *tasks*, *resources*, *deadlines*, and so on, and as choice of different *learning activities*. In the context of formal learning (even if it is carried out in an informal learning environment), teachers expect to control such learning activities as *the enrolment* of students into a course, official *announcements*, *assignments*, the collection and assessment of *homework submissions,* and the *monitoring* of the overall learning process in the course. *Formative assessment* of learning outcomes can be implemented in the form of written *feedback* from the teacher, while *summative assessment* is usually provided in the form of a *grading scale*.

Learning Environments as Determinants for the Locus of Control

Dron (2007, p. 12) argued that new Web 2.0 tools can never be ideal for teaching:

> It would generally be difficult to base an entire sequence of learning transactions on such tools as they are unable, on their own, to perform or to support the full range of functions that might be expected of a teacher.

They defined some issues, which were addressed in the design of LePress:

- *Loss of control*. Dron and Bhattacharya identified specific issues of control over tools, services, and data. LePress serves WordPress data by maintaining learning metadata. This allows the implementation of specific learning activities that are required for formal learning. LePress also addresses concerns regarding personal data safety. For example, personal grades of students are only accessible privately.

- *Loss of monitoring*. Monitoring is an opportunity of the teacher to track interactions of students. LMSs have tools for initiating, directing, and monitoring every student's action. PLEs have a bottom-up approach, where the student decides not only when and with whom to interact but also whether to make these interactions invisible to the teacher. LePress allows teachers to monitor course enrolments and submissions of homework.

- *Assessment issues*. In a PLE the teacher has difficulty in *keeping records of students*. Assessing results in dispersed blogs of students can be a time-consuming task. LePress enables student submissions to be combined to form a class book. The teacher can access all submissions from one designated interface. The same interface can be used for proving the validity of course results by allowing an institutional auditor to verify consistency and fairness of assessments.

The structure of an environment influences the behaviour of users (Dron, 2007; Senge, 1991). Taking the previous framework of control, one can assess the impact of different learning environments on the locus of control in teaching. The teacher and the learners can have very different levels of control over the same type of choice. In a Web 2.0 learning environment the student can have almost unlimited control over the choice of *goals*, *tasks,* and *resources,* depending on personal experience and level of self-direction. In contrast, the teacher has maximum control over *learning activities* such as *course enrolments*, *assignments,* and *assessments* in an LMS. Closed environments like LMSs allow limited, often predefined paths of learning. LMSs are designed to implement the requirements of institutional learning and reflect institutional structure. "Most universities and other higher education academies are natural hierarchies, with the learner at the bottom of the chain" (Dron & Bhattacharya, 2007). Highly structured, top-down managed hierarchies in an LMS induce highly structured pedagogical behaviour, which cannot be changed by the students. In contrast, in a PLE the learner uses bottom-up design: The learners are free to adapt the system for their tasks. In Web 2.0 learning environments the user is less directed and has much more freedom of choice.

While freedom of choice supports the constructivist approach and self-regulation of learners, it conflicts with the structural requirements of formal learning and limits control by the teacher, who has no tools to implement required learning activities. Pata et al. (, 2012) argued that it is essential to design elements that enable self-organization of the course as an ecosystem, as well as to regain some control over what is happening in the system. Attwell (2007) also argued that there is an increasing need to formalize the outcomes of informal learning, which until recently received little attention from researchers (Attwell, 2007).

The teacher in a blog-based PLE today is not so much a designer of the environment but a fellow navigator (Bhattacharya & Dron, 2007). Hughes (2009) proposes that teachers

work *with* a set of circumstances rather than trying to control or alter them. However, in the case where students are not prepared to make use of a PLE, teacher control over the course is highly welcomed. Notice also that effective use of a blog-based course assumes certain technical skills on the part of learners and teachers as well as regular feedback to learners (Tammets & Normak, 2012).

Based on the concept of teacher control, we designed LePress, a software solution aimed at supporting teacher control in blog-based courses. This will be presented in the next section.

LePress: Sustaining Teacher Control in Blog-Based Course Environments

Kim (2008) noted that current educational blogs are normally not customized for educational purposes in terms of user interface and functional features (Kim, 2008). LePress was designed to sustain teacher control in blog-based courses by adding some course management functionalities to WordPress. LePress is a meta-mediator, that is, it mediates the learning-related mediators (*enrolment requests*, *participants' lists*, *assignments*, *submissions*, *feedback*) seamlessly between the teacher's blog and the blog-based PLEs of learners (See Figure 1).

LePress is an add-on module (plug-in) installed on top of WordPress that makes use of a subset of native interface elements, communication protocols, and other features of WordPress with minor user interface enhancements (additional sub-menu on WordPress dashboard, additional checkbox in blog post editing view, front-end widget).

In Figure 2 the front-end widgets for the teacher (a) and for the student (b) are shown. While all learning activities provided by LePress are available through a WordPress dashboard, these widgets allow course participants to interact with the course directly in the blog web-page. Using the widget, the students can select the required course and register instantly.

Figure 2. LePress sidebar widgets for a student (a) and for a teacher (b) (family names are shaded).

Besides a calendar showing deadlines for submissions, the teacher and the students have access to a list of the course participants, which refers to students' homepages and email addresses. Students can immediately subscribe to the course by entering the URL address of their own blog, or in the case where they are already logged in, just by clicking the "Subscribe" button. The students can initiate a homework submission by selecting an appropriate assignment in an "Assignments" list. In turn, the teacher can use the "Assignments" list to view the names of students who have already begun an assignment.

While use of blogs in education makes the assumption of group work based on communications of students, the focus of the current study is limited to teacher-student relationships. There are certain design approaches that could support group-based assessments in the blogs, but these functionalities are planned for future development. Nevertheless, there are other research and development activities that can be used for this purpose. One example is the software project EduFeedr, which allows monitoring of the feedback given by one student to another (Põldoja, Savitski, & Laanpere, 2010; Põldoja & Laanpere, 2009).

LePress is designed with the aim of implementing workflow that is the least disruptive to the existing blogging workflow of WordPress. While LePress adds some learning-related features to WordPress, all the original publishing functionalities of WordPress remain intact after installing the LePress plug-in.

LePress shares some characteristics of a *course coordination space* as suggested by Wilson (2007). Figure 3 shows how LePress coordinates what we call *learning flow* between blogs of teachers and students involved in the course. The diagram illustrates the learning flow between the teacher and the student. Both participants have LePress installed in their personal WordPress blogs. As shown in Figure 3, WordPress is used for implementing existing blogging activities like *posting* and *commenting*. LePress adds learning semantics to these activities and turns traditional blog communication flow into learning workflow.

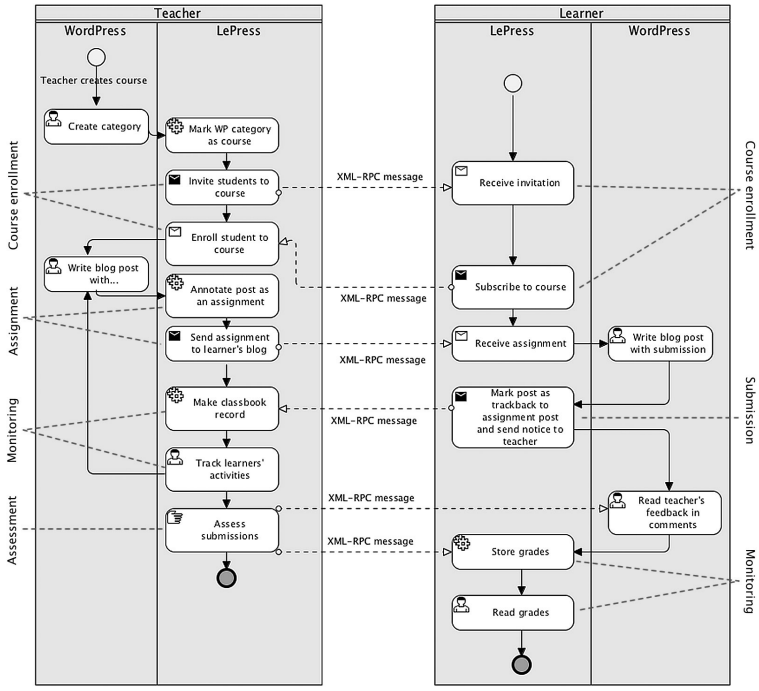

Figure 3. Learning activities of LePress.

LePress specifically adds several functionalities to WordPress to address challenging issues related to teacher control (see Figure 1) in an existing blog-based environment. Any WordPress category in the blog of the teacher can be *marked as a course*, allowing the teacher to organize course activities and learning content around it. Using LePress, the teacher can *enrol students* in a course in an open or controlled manner, turn any blog post into an *assignment*, set *submission deadlines*, *monitor* submissions of students, provide *formative assessments* in the form of feedback using the WordPress

comment field, and provide *summative assessments* using the LePress private grading system. LePress also enhances the productivity of teachers by allowing them to save course content as a template and to reuse it in future courses.

LePress is positioned as a tool, which can balance control between the teacher and the learner in PLE. In Figure 4, a diagram is presented that illustrates the speculative distribution of control between teacher and student (horizontal axis) in different learning environments. The vertical axis shows the structure to dialogue ratio, where we consider the amount of dialogue proportional to the amount of choice, as proposed by Dron (2007). This picture is intended to situate LePress in the context of other popular tools. In addition, this diagram illustrates the role that learning environments play in the distribution of control between teacher and learner.

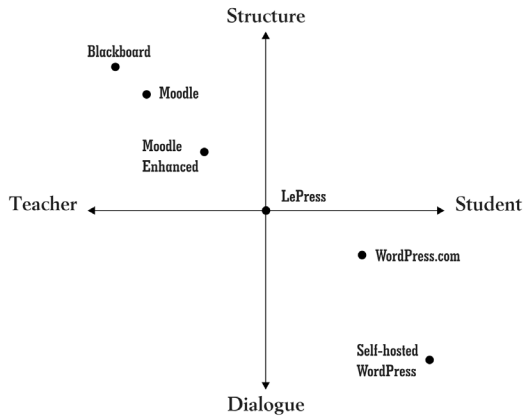

Figure 4. Speculative distribution of control over learning flows between the teacher and the student in different learning environments.

A comparison is made here of several environments that have different levels of structure and dialogue. In the top left corner Blackboard LMS is placed as the most structured and the least controlled by the student environment. Blackboard is a closed environment based on proprietary software. There is only a minimum amount of customizing of the environment available and only for the teachers. All learning flows are strictly predefined and cannot be modified. Another example of the traditional LMS is Moodle, which is a less structured and a more open environment that is more adaptable to students' needs. Thanks to open source code and the extendable architecture of Moodle, possibilities for customization increase dramatically by means of plug-ins. Lots of Moodle plug-ins have been developed that allow the use of different forms of dialogue between the teacher and the learner (e.g., a blog plug-in, which gives students more control).

The authors consider a blog installed on the wordpress.com platform as a tool that provides more possibilities for dialogue, thereby shifting control to the student's side; thus it can be used as a PLE. However, the hosting policies of wordpress.com are very strict concerning the installation of plug-ins and therefore the possibilities for customization of the environment and the adaptation of it to learning flows are limited. These limitations do not apply when using the self-hosting WordPress blog, because many diverse plug-ins are available. In this situation, the student has almost unlimited possibilities for customization and almost full control over the environment. At the same time, the amount of teacher control vanishes.

LePress is intended as an add-on to the self-hosted WordPress blog. It provides the teacher with more control over the dialogue by providing control over feedback, assessment, and grading. As the diagram shows, LePress balances control between the teacher and the student and between structure and dialogue.

The authors conducted a survey to examine both usability and perceived teacher control in a course in which LePress had been used. The results of this study are presented in the following sections.

A Survey on Perceived Teacher Control Using LePress

The development of LePress has been accompanied by iterative design-based research (DBR) (Barab & Squire, 2004; Sandoval & Bell, 2004; Van den Akker, Gravemeijer, McKenney, & Nieveen, 2006; Wang & Hannafin, 2005).

According to Banathy (1996), in design science "methods are tools for creating and changing human artefacts" (Banathy, 1996). An artefact created as a result of a pedagogical design study could be, for instance, a piece of educational software, digital content, curriculum, or a project. DBR is often used for research in learning environments. The main goal of such research is not the production of a software product per se, but rather that the exploration of research questions about learning or teaching are reified, explored, and tested by the design and use of the software/learning environment (Kelly, 2006).

Several different pedagogical and technological questions relating to the design of LePress have been examined in previous iterations. These include the problem statement and idea (Tomberg & Laanpere, 2008), issues of semantic interoperability (Tomberg & Laanpere, 2009), technological implementation of test-based assessments in a blog-based environment (Tomberg, Kuli, Laanpere, & Normak, 2010), and the design of learning workflow and semantics (Tomberg, Laanpere, & Lamas, 2010). Each result was the basis for another iteration of redesigning LePress. In the current iteration, the authors focused on the perceptions of teacher control in PLEs that are enhanced by LePress. The results of this study could be reused in designing not only the

next version of LePress but, more importantly, could address the impact of learning environments on teacher control in a more general sense.

Research Questions and Design

A questionnaire was designed that asked teachers for their perception of the amount of control they felt they had when using LePress as compared to teaching in blog-based learning environments. They were also asked for their perception of the usability and ease of use of LePress.

The reason for focusing on usability is that *perceived ease of use* is assumed to be one of the main determinants of intention to use, and the future adoption of, an eLearning system (Davis, 1989; Hu, Clark, & Ma, 2003; Teo, 2009; Teo, Lee, & Chai, 2008). This is especially relevant for PLEs as there is usually a much higher degree of freedom and choice for teachers to adopt them or not. Accordingly, Gillet (2010) noted usability as one of the most challenging features of a PLE (Gillet, 2010). Clearly, any solution that is designed as a superstructure over a PLE, such as LePress, needs a critical level of usability and learnability. The additional superstructures require users to change their habitual patterns of using the software and extra effort is required when learning new features. In cases where the software is too complex, teachers will not adopt it.

The authors hypothesized the following: (1) LePress would be *perceived as easy to use* by its users, and (2) LePress would be perceived as enabling a higher degree of teacher control. Finally, in order to establish the importance of teacher control in the context of online learning, it was also hypothesized that (3) *perceived teacher control* would be a significant factor to contribute to *perceived ease of use*.

Participants

The sample of this study consisted of 37 teachers (30 female and 7 male) from different Estonian, K-12 vocational and higher education institutions. The sample was relatively homogenous concerning their prior e-learning experience, related attitudes, and behaviour. Their teaching experience was between 1 and 34 years (median 18 years). Seven teachers had already used LePress before in more than one of their regular courses within the last year. The rest of the respondents had participated in a 6-month staff-training programme, where they actively used LePress. Twenty-nine respondents had prior experience of teaching with traditional blogs. Therefore, they were well able to compare teaching with and without LePress in a blog-based PLE.

Questionnaire

A questionnaire was created consisting of two demographic, 26 Likert scale, 16 multiple choice, and two open response questions. An online questionnaire was implemented in the Estonian language using an open-source survey tool called Limesurvey[2]. The items

[2] http://www.limesurvey.org/

were grouped into three parts: respondent's background information, perceived usability of LePress, and perceived teacher control in LePress.

The second part of the questionnaire focused on the usability of LePress and consisted of three sub-groups:

a) The items related to the usability of LePress in general (e.g., " The user interface of LePress is intuitive ");

b) The items related to affordances of LePress regarding learning and teaching tasks (e.g., " -I don't mind if assignments are submitted as blog posts");

c) The items related to perceived ease of use of LePress with specific learning activities (e.g., " Assessment of students' submissions is easy in LePress').

In the last part of the questionnaire, respondents were asked to assess the perceived *level of* teacher *control* in LePress in comparison to blogs without LePress. The respondents were asked to indicate their agreement or disagreement with six claims on a 5-step Likert scale. One of these claims was generic (" LePress enhances teacher's control over the course), while others focused on specific aspects of teacher control (e.g., " LePress enhances teacher's control over course enrolments).

Procedure

One week after completion of the staff-training programme, the participants were then asked by email to complete the online questionnaire anonymously during a one-week period. Forty-two requests were issued; after one week, 37 surveys had been completed online. Following that, the data was pre-processed and analysed using MS Excel and SPSS software.

Only very few teachers had completed the open questions, so these revealed little further qualitative insights. Therefore, the results are not reported here.

Results

The following section examines the results pertaining to the following three hypotheses:

(1) LePress is perceived as easy to use by its users
(2) LePress enables a higher degree of teacher control, and
(3) Perceived teacher control significantly contributes to perceived ease of use.

Perceived Ease of Use

LePress has gone through a number of design iterations. Within these iterations, considerable feedback has been taken into account in order to improve the perceived ease of use of the software. To validate the hypothesis, eight items were included to measure perceived ease of use (Cronbach □= 0.840). Each item was answered on a five-point Likert scale with a neutral midpoint (0) and two levels of agreement (1, 2) and disagreement (-1, -2).

The eight items were included in a composite variable, perceived ease of use (mean = 0.78, std = 0.54, N = 36). A one-sample t-test indicated that the mean was significantly higher than the neutral midpoint (t = 8.68, df = 35, p one-tailed < 0.0001).

For each of the eight items, one-sample t-test was then performed to check for significant differences to the neutral midpoint. For these analyses, one-tailed tests were performed and the critical alpha level was adjusted according to the Bonferroni correction ($\square_{crit}$ = 0.00625) to take into account the multiple tests performed. Table 1 shows the results of these analyses. Six of the eight scales give a significant value difference, while two do not reach critical p levels (The user interface of LePress is intuitive and creating a new course is an easy task in LePress).

We conclude from these results that users perceive LePress as being easy to use. The detailed analyses also show that it is perceived to be easy to learn and user-friendly and that it is easy to add students, to give assignments, to find submissions, and to assess students' work. This is remarkable since new software is often judged as being more difficult to use than the customary software to which it is compared.

Table 1

Perceived Ease of Use of LePress by Teachers

	n	**Mean**	**Std. Dev.**	***t***	***p****
Perceived ease of use (Composite value)	36	0.78	.540	8.680	**<.0001**
LePress is easy to learn for a novice teacher	35	0.89	.676	7.750	**<.0001**
LePress is user-friendly	35	0.86	.733	6.915	**<.0001**
The user interface of LePress is intuitive	30	0.37	.765	2.626	.0067
Creating a new course is an easy task in LePress	25	0.48	.918	2.613	.0076
Addding a student to a course is an easy task in LePress	25	0.80	.764	5.237	**<.0001**
Giving assignments for students is an easy task in LePress	27	0.89	.801	5.769	**<.0001**

It is easy to find the students' submissions in LePress	33	1.06	.788	7.730	**<.0001**
Assessment of students' submissions is easy in LePress	27	0.78	.934	4.328	**<.0001**

* one-tailed, adjusted $\square_{crit}$ = 0.00625

Perceived Teacher Control

The second hypothesis was that users would perceive LePress as enhancing teacher control over the course. Five items (Cronbach $\square$ = 0.891) asked users to estimate their level of control to blog-based courses. Again, each item was answered on a five-point Likert Scale with a neutral midpoint (0) and two levels of agreement (1, 2) and disagreement (-1, -2).

The five items were included in a composite variable, perceived teacher control (mean = 1.06, std = 0.65, *n* = 33). A one-sample t-test indicated that the mean was significantly higher than the neutral midpoint (*t* = 9.386, *df* = 32, *p* one-tailed <0.0001).

As in the case of perceived ease of use, a one-sample *t*-test was performed for each of the five items. For these analyses, one-tailed tests were performed and the critical alpha level was adjusted according to the Bonferroni correction ($\square_{crit}$ = 0.01). Table 2 shows that *means* in all scales were significantly higher than the neutral midpoint.

We conclude that LePress is perceived to increase teachers' opportunities to exert control in the course. Users were in considerable agreement that LePress improves control over the course and enrolments, enhances the monitoring of activities, and gives a better overview of assignments, feedback, and grades.

Table 2

Perceived Teacher Control Results

	n	Mean	Std. Dev.	*t*	*p*
Perceived teacher control (Composite value)	33	1.06	.647	9.386	**<.0001**
LePress enhances teacher's control over the course	28	1.04	.744	7.362	**<.0001**
LePress enhances monitoring of course activities	29	1.21	.675	9.628	**<.0001**
LePress gives students better overview of assignments	32	1.16	.954	6.855	**<.0001**
LePress shows grades and feedback to	33	1.18	.846	8.024	**<.0001**

students in more convenient way					
LePress enhances teacher's control over course enrollments	23	0.83	.834	4.750	**<.0001**

* one-tailed, adjusted $\square_{crit}$=0.01

Perceived Teacher Control Increases Perceived Ease of Use

The results so far indicate that LePress has good usability and increases the teacher's control during the course. The last hypothesis will attempt to establish that there is a relationship between these variables. If perceiving *higher control* leads to higher *ease of use*, then this will also lend credence to the assumption that teacher control is an important factor in how favourably learning software is judged by teachers and, hence, how likely it is that they will adopt LePress in their course.

The validity of this hypothesis was tested by performing a linear regression analysis. The independent variables were the five items from the perceived teacher control scale. The dependent variable was the composite variable, perceived ease of use. The linear regression with all the predictors entered into the model gave a highly significant result (F = 5.226, p = 0.005) with an overall R = 0.788 (R^2 = 0.620). A stepwise regression shows that the item *LePress enhances teacher's control over the course* is the most important predictor. When only this variable is entered into the model, the model is significant (F = 21.20, p < 0.001) with an overall R = 0.717 (R^2 = 0.515). Due to the high inter-correlation of the items, the rest of the items do not add any significant amount of predictive variance to the model. The two items that come the closest to being entered as well are (a) *LePress enhances teacher's control over course enrolments* ($\square$ = 0.384, p = 0.053) and (b) *LePress shows grades and feedback to students in a more convenient way* ($\square$ = 0.310, p = 0.075). This could be interpreted as meaning that teachers placed special importance on being able to control enrolments and grades when judging ease of use. However, due to the high inter-correlations of predictors, beta weights should be interpreted with caution, and additional research is needed to establish the relative importance of different factors of teacher control for judging ease of use.

Conclusion

The students and teachers continue to escape from walled gardens of institutional learning environments to the "Web 2.0 jungle" (Dron & Bhattacharya, 2007). They like to use new services with elements of social media, improved usability, and extensive learning content. The amount of learner control goes up at the expense of a lower level of teacher control. An effect of these circumstances is the inability of teachers to control learning activities that are required in the context of formal institutional learning.

This study tested three hypotheses about the course management plug-in, LePress, for use on the WordPress blog platform:

1. LePress would be perceived easy to use by its users;
2. LePress would be perceived as enabling a higher degree of teacher control; and
3. Perceived teacher control would contribute to perceived ease of use.

We found that teachers perceive LePress as being easy to use. Teachers consider creating a new course, adding a student to a course, giving assignments, finding the students' submissions, and making assessments of students' submissions as easy tasks when using LePress. They also consider LePress as easy to learn for a novice teacher, user-friendly, and intuitive.

While there are several other studies that are concerned with issues of learner control in the context of self-directed distance learning, this study explored the issue of teacher control in blog-based distributed environments. Today teachers and educational institutions are facing a choice between closed institutional LMSs and distributed, open, weakly controlled, but very powerful PLEs based on Web 2.0. This study shows that teachers who move to blog-based PLEs can be supported by designing additional features in a PLE that sustain their control over learning activities.

The results show that specifically designed lightweight software tools like LePress can be used for coordinating courses taught in a PLE in a formal education context. When allowing the learners to use available resources in Web 2.0 environments, meta-mediator tools like LePress could help teachers sustain a feeling of control over managing the course activities. Additional results show that this may be especially so for less experienced teachers. We observed a negative correlation (r =-0.334, $p < 0.01$) between teaching experience and the inclination of the teacher to teach using blogs, and a positive correlation (0.395, $p < 0.01$) between the inclination of the teacher to teach using blogs and the belief that LePress enhances teacher control over the course. We assume that teachers with - shorter teaching experience perceive LePress to be more helpful which in turn increases their inclination to teach with blog-based environments. It is likely that teachers with - longer teaching experience have developed alternative methods to control the course workflow.

We also found evidence that teacher control is an important factor in determining how favourably learning software is judged by teachers. The regression model has substantiated the perception of control as an important predictor of ease of use. Following the claims and research of the technology acceptance model (Liao & Lu, 2008; Ma, Andersson, & Streith, 2005), it is assumed, therefore, that teacher control will also be a key factor in determining the adoption of LePress and the intention to use it continuously. While the latter should be subject to further research, it has become

evident that *teacher control* is an important factor to be considered by designers in the future development of PLE.

Clearly, there are other actors besides teachers and learners who are involved in control over choice in the context of formal learning. Garrison and Baynton (1987) considered *teacher*, *student,* and *content* as the transactional elements that determine the balance of control Dron (2007) extended this list by adding the *group of students* as a separate element, arguing that a group can have a different amount of control compared to individual members (Dron, 2007). We would argue that in addition to these elements, the technical environment used for course management constitutes an element that needs to be considered. Another important element that is seldom considered is the level of control exerted by the *national educational policy* on stakeholders. While this element is not the most prominent, it still defines many rules that the teachers and the learners must abide by. The role of the national educational policy makers as the stakeholders in *control* corresponds with Dron's (2007) ideas about different levels of scale as it relates to control. We consider this topic as one of interest for future research. Understanding new ways of supporting control can help in the development of dedicated tools for administrators or dashboards for universities since these could track the success of implementing education policies.

The next steps in the research are experimental and ethnographic studies. These could help to investigate typical learning activity flows and specific needs of teachers in personal learning environments and support better scaffolding of learners while retaining opportunities for implementing formal institutional requirements.

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KOKKUVÕTE

Käesoleva doktoritöö eesmärgiks on töötada välja lahendus, mis võimaldaks ajaveebipõhise kursuse ning kursusel osalevate õppurite ajaveebid integreerida üheks terviklikult toimivaks õpikeskkonnaks.

Töö eesmärk oli tingitud asjaolust, et viimastel aastatel on tasemekoolituses järjest populaarsemaks muutunud ajaveebide kasutamine. See on võimaldanud suurendada õppurite iseseisvust oma õpingute kavandamisel ja läbiviimisel, mitmekesistada õppuritevahelise diskussiooni võimalusi ning andnud õpetajale paremad võimalused õppurite iseseisva töö jälgimiseks. Paralleelselt on aga oluliselt vähenenud õpetaja võimalused õppetegevuse suunamiseks ning õppuritele vajadusel toe pakkumiseks. Vähe sellest, asjaolu, et õppurite ainekursusega seonduvad materjalid – kodutööd, reflektsioonid jmt – asusid hajutatud personaalsetes ajaveebides, tegi kogu kursuse haldamise õpetajale väga kohmakaks ja aeganõudvaks.

Selleks töötati välja kursuse koordinatsiooniruumi kontseptsioon, loodi vastav töötav prototüüp ning katsetati reaalses (ülikooli) õppetegevuses. Et nimetatud prototüüp teostati Wordpress pluginina, siis sai ta nimeks *LePress*.

See integreeris kõik ainekursuse läbimiseks vajalikud elemendid – kursusele registreerumine, õppeülesannete andmine, koduülesannete esitamine, hindamine, tagasiside – ka ajaveebi-põhiste kursuste korral ühtseteks nn töövoogudeks. See võimaldas õpetajatel mitte ainult õppurite õpitegevust paremini jälgida, vaid seda paremini ka suunata. On mõistetav – ja seda näitasid ka meie poolt läbiviidud empiirilised uuringud – et õpetajate suurenenud võimalused õppetegevuse juhtimiseks ajaveebipõhises õppes parandas õpetajate suhtumist õpitarkvara kasutamisse.

Töö käigus loodud lahenduse piloteerimisel ilmnesid ka mõningad ajaveebide tasemeõppes kasutamise puudused, mis seni ei olnud laiemalt teadvustatud. Olulisimaks neist oli, et ajaveebide avalik jälgitavus pärssis oluliselt osa õppurite poolt oma ajaveebides materjalide avaldamist ning kaasüliõpilaste materjalide kommenteerimist. See tingis vajaduse luua ka hajutatud ajaveebide jaoks õiguste süsteem ja see kursuste koordinatsiooniruumis realiseerida, mis võimaldaks anda õppes osalejate ajaveebidele erineva ligipääsu.

Töö koosneb sissejuhatusest, viiest sisupeatükist, käesolevast kokkuvõttest ning kasutatud kirjanduse loetelust. Lisadena on esitatud kuue käesoleva tööga enim seotud teadusartikli tekstid.

Esimeses peatükis antakse ajalooline lühiülevaade töös käsitletud problemaatika uurimisest ning sõnastatakse ja põhjendatakse uurimisülesanded.

Teises peatükis põhjendatakse töös kasutatud uurimismeetodi – arendusuuring – valikut, tuuakse välja arendusuuringute põhijooned ning esitatakse käesolevas töös kasutatava arendusuuringu iteratsioonide lühikirjeldus.

Kolmas peatükk on kõige mahukam ning selles käsitletakse läbiviidud uuringute teoreetilisi aluseid. Seejuures järgib käsitlus uuringute tegelikku käiku, mis seisnes järjestikuses liikumises üksikult üldisele ja üldiselt üksikule. Kõigepealt uuriti ajaveebides vaid ühe õpitegevuse elemendi (hindamine) kasutamise võimalusi, seejärel üldistati saadud tulemused terviklikele töövoogudele ning järgnenud empiirilises osas keskenduti õpetaja rollile ja tegevusele ajaveebi-põhiste kursuste läbiviimisel.

Neljandas peatükis esitatakse töö autori osalemisel valminud kuue artikli lühikirjeldused. Kõik need artiklid on teostatud töö autori juhtimisel (kuigi ühel juhul on ta märgitud teise autorina).

Viiendas – kokkuvõtvas – peatükis kirjeldatakse lühidalt läbiviidud uuringute käiku, saadud põhitulemusi ning markeeritakse edasised võimalikud uurimissuunad.

Lõpetuseks olgu mainitud, et kuigi *LePress* loodi vaid käesoleva töö jaoks vajalike uuringute läbiviimise töövahendiks ning seda edasi ei arendada, osutus tema katsetamisel saadud kogemus väga väärtuslikuks järgmise põlvkonna e-õppe platvormi *Dippler* arendamisel.

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