A Design Framework
for
Personal Learning Environments

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Ebrahim RAHIMI

Master of Science in Software Engineering

Amirkabir University of Technology, Tehran, Iran

Geboren te Lordegan, Iran

This dissertation has been approved by the promotors:

Prof. dr. W. Veen
Prof. dr. ir. J. van den Berg

Composition of the doctoral committee:

Rector Magnificus	chairman
Prof. dr. W. Veen	Delft University of Technology
Prof. dr. ir. J. van den Berg	Delft University of Technology
Independent members:	
Prof. dr. ir. M.F.W.H.A. Janssen	Delft University of Technology
Prof. dr. I. Buchem	Beuth University of Applied Sciences, Berlin, Germany
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Prof. dr. A. Krokan	Norwegian University of Science and Technology (NTNU), Norway
Prof. dr. ir. R. Fastenau	Delft University of Technology
Prof. dr. J. van den Hoven	Delft University of Technology, reserve Member

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Ebrahim Rahimi
Delft

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1 Research Drivers, Design, and Setup

In our research, we intend to develop a design framework for workplace personal learning environments (or PLEs) aiming at facilitating and supporting learner-led endeavours toward learning and competency development. To this end, we apply theoretical as well as empirical grounding processes through conducting design studies in different learning contexts to produce appropriate design principles required to develop this framework. The resulting design framework can be used as a theoretical and practical roadmap by workplace e-learning designers including IT (Information Technology) and learning professionals.

In this chapter we first explore the trends in workplace learning as the drivers of our research. Then we introduce and define the concept of personal learning environment as the focal point of our research. Thereafter, we introduce and scrutinize a problem regarding the implementation of this concept in the workplace and define the main question of our research accordingly. Finally, we describe our research strategy, its theoretical and methodological underpinnings, and relevant sub research questions that serve collectively to answer the main research question and address the identified problem.

1.1 Trends Influencing Workplace Learning

The relentless changes in today's technological and knowledge landscapes have given rise to several trends, which are profoundly redefining corporations and their learning processes and paradigms. In order to be relevant, any research effort in the field of workplace learning needs to recognize these trends. A summary of these trends and paradigm changes follows below.

1.1.1 Web 2.0 and the Rise of Enterprise 2.0

Web 2.0 represents the latest advancements in the web technologies expressed in a fast-growing and diverse set of emerging social software tools and services including blogs, wikis, and social networking services. These advancements have changed the web from "being a medium, in which information was transmitted and consumed" to a platform, in which content is "created, shared, remixed, repurposed, and passed along" (Downes, 2005, p. 5). The focus of Web 2.0 is on enabling and encouraging participation, social interaction, and creating, using, and sharing content in different contexts. From a learning perspective, Web 2.0 represents a socio-technical trend that has provided unprecedented opportunities for learning. Web 2.0 tools are receiving intense and growing interest across all sectors of the educational industry as means for building learner-centred learning environments and extending the learner's control over the entire learning process (Conole & Alevizou, 2010; Dabbagh & Kitsantas, 2012; McLoughlin & Lee, 2008). These tools and services provide learners with "just-in-time and at-your-fingertips learning opportunities and support a wide

range of teaching and learning activities including creative and collective contribution (Twitter, Facebook), knowledge (co-)producing (wikis, YouTube, Google Docs), communication (Skype), knowledge management and organizing (Delicious, Diigo), self-expressing (blogs), creating and managing personal pages (Netvibes), analysing and developing new concepts and ideas (MindMeister), and sharing and exchanging documents (Google Docs, Dropbox)" (Rahimi et al., 2015, p. 1).

The arrival of Web 2.0 in corporations has led to the emergence of new concepts such as Enterprise 2.0. According to McAfee (2009), 'Enterprise 2.0' refers to the use of emergent social software platforms, or ESSPs, by organizations to pursue their goals. As elaborated by McAfee (2009), implementing ESSPs might provide the following competitive advantages for corporations: First, ESSPs contribute to the success of an organization by enriching its social capital as they enable employees to connect, collaborate and form online communities and strengthen their interpersonal ties in different levels ranging from close groups to the organization level. Secondly, ESSPs are equipped with mechanisms that allow the patterns inherent in employees interactions become visible and evident over time. Consequently, implementing ESSPs might lower organization' risk profiles by making visible the created/exchanged content between employees and turning "the whole workforce into compliance monitors" (p. 3). Thirdly, ESSPs consist of "freeform" software applications which are indifferent to the predefine workflows, structures, roles, hierarchies, responsibilities, or interdependencies among the employees and accept diverse types of data. As a result, adopting and using these freeform applications has potential to transform production in workplaces into knowledge-driven work practices conducted in smaller, more mobile, flat and flexible production units (Littlejohn et al., 2012). All in all, it has been argued that implementing and using ESSPs can contribute to the success of organizations by developing their intangible assets including human, social, organizational, and information capital.

1.1.2 The Changed Nature of Work

Apart from the emerged organizational structures, the convergence of the information age and the technological advancements has profoundly transformed the nature of work within many organizations from physical into immaterial, information-based into knowledge-based, product-based into interaction-based, individualized into team-based, and "hands-on into minds-on" (Benson et al., 2002; Littlejohn et al., 2012). This transformed nature of work is expressed in the increased use of just-in-time processes, a greater emphasis on team working, the adoption of networked technologies as models of organizational and work structures, decentralization of decision making processes, and increased tendency toward participative management techniques such as crowdsourcing to solve novel and complex organizational problems (Littlejohn et al., 2012; Benson et al., 2002). Furthermore, new forms of knowledge-driven work practices have begun to emerge such as bricolaging, which involves sourcing, using, mixing, and creating knowledge resources. In this regard, Littlejohn et al. (2012) have identified four key work practices in the today's organizations: consuming knowledge created by other, connecting with other people and resources

relevant to their own learning goals, creating new knowledge and knowledge structures, and contributing this knowledge back to the collective for others to benefit from. These practices reflect different ways in which the today's employees work and interact with people and resources in the workplace.

1.1.3 The Growing Need for Knowledge Workers

Working in today's organizations and undertaking the transformed work practices require knowledge workers who possess high-level mental competencies involving abstract and critical thinking and working with products such as information, knowledge and networks. As emphasized by Benson et al. (2002) and Littlejohn et al. (2012), knowledge workers should be able to easily understand and transfer the application of new technologies to their business contexts in order to "delegate programmable tasks to technologies" and free their time and effort to concentrate on "value-adding activities that demand creativity and innovation" (p. 1). In line with these changes in the workplace, the recent theoretical and practical approaches to learning emphasize the importance of transferring the responsibility of learning from organization to learners and empowering learners to regulate and take control over entire learning process (Smith, 2003; Freund, 2004). As remarked by Littlejohn et al. (2012), to perform their jobs, today's workers need to develop a diverse range of competencies such as the ability to operate and collaborate in ill-defined, distributed, non-hierarchical, and diverse environments and teams. Benson et al., (2002) summarized the required competencies of the today's workers as: (a) learning to learn, (b) being able to apply problem-solving skills to overcome faced barriers and problems, and (c) thinking creatively when new challenges arise.

This desire to generate more autonomous and self-regulated learners reflects a vital need for individual and organizational agility to quickly adapt organizations in a change-driven world (Tynjälä & Häkkinen 2005, Littlejohn et al. 2012). The success and economic competitiveness of today's organizations depends on their ability to develop a workforce that can quickly learn and adapt to the mainly emergent and unpredictable changes and improve the productivity of their knowledge work. As emphasized by Attwell et al. (2008), today's organizations have a permanent need to increase their agility by harnessing the intrinsic motivation of employees "so that they engage in collaborative learning activities, which can then be combined with new forms of organizational support" (p.1).

1.1.4 Emerging New Approaches to Workplace Learning

Developing agile organization and workforce asks for adopting new means and approaches for supporting workplace learning far beyond traditional class-based training. New approaches to workplace learning are driven by new learning theories such as self-regulated learning (Winne & Perry, 2000), heutagogy (Hase, 2009) and connectivism (Siemens, 2005) that emphasize a profound shift in the definition of learning from mere transferring and acquisition of knowledge to the creation, communication around and application of knowledge as well as developing capacity for more learning. Pivotal implication of these theories for workplace learning states that the effective learning mainly takes place on the

dynamic shop floors of the workplace rather than static classrooms. Hase (2009) refers to workplaces as dynamic learning environments where an enormous amount of learning occurs during plunging in daily activities and facing with and addressing work challenges and problems. He introduces workplace as "an excellent example of a learner-centred, moving curriculum [where] the learner (worker) is constantly placed in situations where he/she has the potential to become aware of knowledge or skill deficits (if he/she is appropriately reflexive) and then design his/her own strategies and processes for bridging the gap" (p. 49).

Work-based learning, an umbrella term for informal and on-the-job learning, is a new trend in corporations rooted in these approaches to learning (Eraut, 2004; Raelin, 1997). Work-based learning is based on this recognition that a major part of learning in organizations takes place in informal situations during performing authentic tasks. Addressing work challenges assists the learner to produce a personal mental model as a representation of reality which its validity and accuracy is continuously evaluated during interaction with the physical and social environments in the workplace. The process of producing, testing, and adapting this mental model provides great learning opportunities for the learner by "bridging the gap between the development of knowledge and the application of knowledge" (Jansen et al., 2008, p. 25). From the perspective of work-based learning, knowledge is not a body of information to be learned once. Rather, knowledge is seen as a "collective activity" the development of which is a shared responsibility of learners (Raelin, 1997). Work-based learning differs from experiential learning. While experiential learning consists of "adding a layer of experience onto conceptual knowledge", in work-based learning theory and practice are blended: theory may be acquired in concert with practice or may "be introduced after rather than before experience in order to question the assumptions of practice. Theory makes sense only through practice, but practice makes sense only through reflection as enhanced by theory" (Raelin, 1997, p. 564).

Another learning delivery approach, which is increasingly becoming pervasive in both formal education and workplace settings, is blended learning (BL). Blended learning refers to the combination of face-to-face and online learning. The attention toward BL has begun to emerge in the workplace in response to the limitations and deficits of e-learning and class-based training methods. The proponents of BL argue that it can boost workplace learning through linking learning and performance, creating more engaging learning environments and bringing learning closer to employees in the workplace. BL also facilitates more instructor-learner and learner-learner interaction than large class-based training sessions. Furthermore, it enhances the accessibility and flexibility of classroom teaching and learning material. Moreover, BL can be seen as a means to increase the time- and cost-effectiveness of workplace learning by reducing "seat time" in classrooms and also decrease the dissatisfaction of online learners caused by lacking a sense of community in their online classes by providing face-to-face interactions (Kim et al., 2009). BL uses a diverse set of instructional strategies including authentic case and scenario learning, coaching and mentoring, problem-based learning, virtual team collaboration and problem

solving, self-paced learning, simulations or gaming. Also, the emerging web technologies are widely used for supporting blended learning including knowledge management tools, digital libraries and content repositories, learning content management tools, online simulations, Web 2.0 tools, cell phones and other mobile and handheld technologies.

1.1.5 The Advent of New Generations of e-Learning Systems

A learning environment is an entirety with physical, technological, psychological, social and cultural resources (Loi & Dillon, 2006). New generations of learning environments are coming to existence in response to the aforementioned trends in workplace learning. Laanpere et al. (2012) have distinguished between three different generations of e-learning systems. Table 1.1 presents and compares these generations of e-learning systems based on six dimensions proposed by Piccoli et al. (2001) to discern e-learning systems, being: technology, pedagogical foundation, content, learning model, interaction model, and learner control.

The first generation of e-learning systems encompasses individual drill and test software packages underpinned by stimulus-response reinforcement instructional approaches. The second generation of e-learning systems involves the mainstream of current organizational e-learning systems including most virtual learning environments (VLEs) and learning management systems (LMSs) such as Blackboard and Moodle and intelligent tutoring systems. Most of these e-learning systems have been designed to be pedagogically neutral so that they provide no "built-in support for a preferred pedagogical model or approach" (Laanpere et al., 2012, p. 1). According to the proponents, this inherent pedagogical neutrality is a desirable characteristic for VLEs as it allows implementing various pedagogical approaches instead of imposing a specific approach.

The third generation of e-learning systems includes cloud-based digital learning ecosystems such as multi-tools Web 2.0-based learning environments. From a technological perspective, the emergence of this generation of e-learning systems is a result of the advancement in Web 2.0 technologies and proliferation of open educational resources (OERs) as a valuable source for learning. From a pedagogical perspective, the third generation of e-learning systems is a response to the limitations and deficits of a majority of VLEs. According to the critics, most of VLEs represent "a virtual extension for physical classes and apply the same unidirectional model of content distribution" which sets learners in a rather passive role as followers and consumers of course modules at a predetermined pace (Casquero et al., 2010, p. 295). As a result in VLE-based learning scenarios learners have very limited freedom in choosing technology and their ways of learning with technology and "there is little innovation in the learning process and learning experience is static" (Downes, 2005; Casquero et al., 2010, p. 295). To address these issues, the design of the third generation of e-learning systems, unlike the second generation, has been grounded in a non-neutral pedagogical approach in order to promote and enforce "desirable pedagogical beliefs, strategies and learning activity patterns while suppressing others"

(Laanpere et al. 2012, p. 1). This implies a shift in the design principles of e-learning systems from focus on "learning from technology" to focus on "learning with technology" and learner's empowerment (Lou et al., 2001). Scardamalia and Bereiter (2014, p. 1) described the rationale behind this shift as below:

At first thought it might seem that the key requirement is a highly intelligent tutoring system, capable of performing sophisticated diagnoses of students' learning strategies, providing sensitive coaching and instruction. Such a system, however, is not only unrealistic, given the state of the art; it may also be heading in the wrong direction … For it is not the computer that should be doing the diagnosing, the goal-setting, and the planning, it is the student. The computer environment should not be providing the knowledge and intelligence to guide learning, it should be providing the facilitating structure and tools that enable students to make maximum use of their own intelligence and knowledge.

Table 1.1 Comparing three generations of e-learning systems
(Based on Laanpere et al., 2012; Piccoli et al., 2001, Rahimi et al., 2014b)

Dimension	1st generation	2nd generation	3rd generation
Technology (software architecture)	Desktop software	Single-server monolithic system	Cloud architecture, mobile clients
Pedagogical foundation	Stimulus-response-reinforcement	Pedagogical neutrality	Social constructivism, connectivism, Self-directed learning
Content management	Integrated content	Separate from software, re-usable, organization-generated	Open, web-based, embeddable, rich metadata, learner-generated
Learning model	Presentation, drill, test	Presentation, assignment	Reflection, sharing, remixing, tagging, mashups, recommenders
Interaction model	Single user	Learner-instructor Learner-learner	Learner-Instructor, Learner-Learner, Learner-group, tool-tool, group-group
Learner control	Choice of learning time	Choice of learning time and place	Choice of learning time, place, and resources + creation of resources
Examples	Individual drill and test packages	Virtual Learning Environments (VLEs), Intelligent tutoring systems	Digital learning ecosystems (consisting of multi (Web 2.0) tools)

1.2 The Personal Learning Environment (PLE) Concept

Personal Learning Environment (PLE) is a fairly new concept in the e-learning domain. The PLE concept emerged from conversations amongst a diverse group of educational technologists over a conceptual model for a new type of learning environments called virtual learning environment of the future (Wilson et al., 2007). The PLE discourse is driven by this common belief that most of the current VLEs are not able to help organizations (either educational institutions or corporations) to address the requirements of

today's learners (Attwell, 2007; Wilson et al., 2007). Belonging to the third generations of e-learning systems, PLEs have been suggested as a solution for addressing the pitfalls of VLEs by providing learners with more control and freedom to choose and deploy different tools and strategies to direct their own learning and pursue their diverse educational goals (Attwell, 2007; Rahimi et al., 2014b,c).

Given the fluid and dynamic nature of learning context in practice-based learning situations such as workplaces, the PLE concept has been suggested as a means to develop effective workplace e-learning systems (Attwell, 2010b). The affordances of PLEs to develop workplace e-learning systems are considered: First, PLE is a mobile, flexible and not context dependent learning environment and enables learners to move from one domain to another and make connections between them. Secondly, a PLE can support and facilitate a greater variety of relationships, interaction, and learning discourses than traditional educational media. Thirdly, a PLE is "able to link knowledge assets with people, communities and informal knowledge and support the development of social networks for learning" (p. 5).

The PLE concept is in its infancy and still there exists no pervasive and commonly accepted definition for it. To reach a clear definition of the PLE concept some of the proposed definitions for this concept are reviewed as follows.

Siemens (as cited in Buchem (2010, p. 10)) suggests that:

PLEs are not an entity, structural object or software program in the sense of learning management system. Essentially, they are a collection of tools brought together under the conceptual notion of openness, interoperability, and learner control. As such, they are comprised of two elements-the tools and the conceptual notions that drive how and why we select individual parts.

According to Downes (2010, p. 5):

The heart of the concept of the PLE is that it is a tool that allows a learner (or anyone) to engage in a distributed environment consisting of a network of people, services and resources.

Buchem et al., (2014, p. 16) define PLE as:

An approach to using technology for learning, focusing on self-directed and self-regulated uses of tools and resources by the learner. It is capturing the personal activity, or how the learner uses technology to support [his] own learning, rather than developing personalised platforms, that lies at the heart of the PLE research.

Based on these definitions, we propose the following definition for a PLE:

Definition 1.1: *A PLE is an activity space encompassing appropriate learning resources including tools, content, and people to support and facilitate personal learning experiences of learners. Each PLE represents one node connected to other nodes and content creation services used by other learners. It is "a personal learning center, where content is reused and remixed according to the learner's own needs and interests. It becomes, indeed, not a single application, but a collection of interoperating applications—an environment rather than a system" (*Downes, 2005, p. 7*).*

At the heart of this definition of PLE lies the concept of personal learning. We define personal learning as follows:

Definition 1.2: *Personal learning refers to the ways the learner pursues to address own learning requirements and gain control over learning taking advantage of the provided learning resources in the learning environment.*

Unlike the technology-driven approach to personalized learning followed by most intelligent tutoring systems, this definitions place the learner as the main epistemic agent at the center of the learning environment to direct own learning. Based on these definitions, personal learning denotes personal agency of learners manifested in organizing their learning and tailoring the learning resources in a PLE to their learning needs.

1.3 The Problem Statement, Research Objective, and Research Question

Taking the aforementioned trends in workplace learning into account, the main driver for our research is to develop a design framework for developing the PLE concept within the workplace. The design of a PLE should not be understood as mere an application design and technological challenge (Kop & Fournier, 2013). Rather, new technologies and learning theories must together serve as catalysts for fundamentally rethinking and redefining what the pedagogical and epistemic practices of organization/teachers and learners can be and should be in a PLE (Rahimi et al., 2014a). There are two factors challenging the design and development of a workplace PLE: (*i*) lack of well-established theoretical constructs to underpin the PLE, and (*ii*) the existence of a technology-driven approach to designing e-learning systems.

Despite the increasing attention toward personal learning and learner's agency notions in the PLE discourse, these notions and the ways to attain them very often remain unanswered, untouched, vague and too general in theory and practice (Fischer & Scharff 1998, Chatti et al. 2010, Väljataga & Laanpere 2010, Buchem 2012, Rahimi et al. 2013a). As a result, the design principles of a majority of workplace e-learning systems have not been adapted to address these notions making them unable to satisfy heterogeneous learning requirements of organizations and employees. In this regard, according to Freund

(2004), there are different reasons for unsuccessful e-learning initiatives within workplace settings including a lack of personalization and considering individual learner's needs in designing learning contents, methods and environment; a lack of collaboration and interactivity; and a lack of enough support for learner-oriented learning approaches and scenarios.

So far, affected by the rapid and pervasive advancements in information and communication technologies (ICT), there exists a dominant technology-driven approach to developing e-learning systems. Following a mere technology-driven approach to developing e-learning systems gives rise to the following problems. First, a common solution to support learners' control over their learning proposed by a mere technology-driven approach is to provide learners with a set of technological tools and services and allow them to select and use these tools in a personal way they deem fit. Following this solution promotes a "gift-wrapping" approach which at its best can provide some technological personalization and add-ons to existing practices of learners rather than supporting their control and improving the quality of learning (Fischer & Scharff, 1998; Väljataga & Laanpere, 2010). Secondly, while Web (2.0) technologies have provided learners with unprecedented opportunities to create learner-centered learning environments, these systems, generally speaking, have failed to align individual learning needs and practices of employees with organizational goals in a systematic way. As asserted by Wang (2011), most Web 2.0 workplace e-learning applications are "performed poorly" in helping employees to acquire/develop required expertise "to improve their performance, or make their social interactions integrated with their learning practices, and ultimately fail to serve the organization's goal for success in the knowledge economy" (p. 192). Along similar lines, Tynjälä and Häkkinen (2005) have introduced the lack of a mechanism to link employees' personal development with organizational learning and development as a main challenge for a majority of the current workplace e-learning systems. Thirdly, following a mere technology-driven approach to designing e-learning systems can undermine the role of learners in the design process by undertaking the main role in the design process by technologists who have little understanding of learner needs and the ways these needs might be met. Furthermore, following this approach leads to developing controlled and highly structured learning environments "with an emphasis on practice followed by immediate feedback, as these are procedures that computers can handle well and involve relatively straightforward programming skills" (Watts, 1997, p. 3). Finally, this approach can promote and establish the "the mentality of add-ons" in developing the e-learning system representing the designers' reluctance to change the design of e-learning system profoundly and just add new technologies to the old structure to address new learning needs (Watts, 1997) .
These observations have led us to formulate the following problem statement:

Currently there exists no design framework that combines theoretical concepts and learning affordances of web technologies in order to design a personal learning environment aiming at supporting learner' agency and development in the workplace.

Accordingly, the main objective of our research is to develop a PLE design framework to direct the design, development and implementation of a PLE within workplace settings. By combining the theoretical concepts and technological affordances, the PLE design framework can be seen as a learning roadmap as well as an information system (IS) artefact. As a learning roadmap, the PLE framework is meant to assist the learning designers to identify desired personal learning capabilities of learners and design appropriate learning interventions to develop these capabilities. As an IS artefact, the PLE design framework is meant to assist IT designers to develop or provide technological functionalities required to serve the designed learning interventions. Also the PLE framework is meant to bridge conceptual and implementation design by providing the designers a blueprint through which they "recognize the utility of various [learning] approaches and perspectives" (Hannafin et al., 1997, p. 102).

Informed by this problem we formulated the main research question to direct our research as below:

Main research question: *How should a technology-based personal learning environment be designed, aiming at supporting learners to gain control over their learning at the workplace?*

To answer this research question we outline and follow a research strategy on the basis of design-based research methodology that is described in the next sections.

1.4 Design-Based Research

Learning, knowing, knowledge, personal development, and context are essentially co-constituted and cannot be considered as isolated notions or processes. This implies that the design of a learning environment should be rooted in an understanding of several psychological, pedagogical, technological, cultural, and pragmatic foundations (Barab & Squire, 2004; Hannafin et al., 1997). Gaining insight into different foundations of an e-learning system asks for adopting change oriented research paradigms such as design-based research methodology or DBR (Reeves et al. 2005). DBR refers to the application of design science in education emphasizing the "systematic implementation of processes and procedures that are rooted in established theory and research in human learning" (Hannafin et al., 1997, p. 102). The focus of these change oriented research paradigms is on systemic engineering and explanation of human learning and development notions as well as exploration of the effects of the learning environment on these notions (Scardamalia & Bereiter, 2014; to Kali et al., 2008). By doing so, these research paradigms are shifting the educational research endeavours from simply observing learning to engineering learning in

naturalistic contexts "to improve and generate evidence-based claims about learning" (Barab & Squire, 2004, p. 2).

As mentioned earlier, our PLE framework should combine learning principles and technological affordances to support personal learning endeavours of learners using technology. To the best of our knowledge there is not a design research approach incorporating the design research practices in both information systems (IS) and education domains. Accordingly, to develop the PLE design framework we need to be aware of the design research approaches in these domains in order to capture and combine their underlying premises and outline an appropriate merged design research approach. It is noteworthy that different terms are used to refer to design research in IS and education domains (i.e. the terms DSRIS (design science research in information systems) and DBR (design-based or development research) are used in IS and education/learning domains respectively). For the sake of simplicity in the rest of this section we use the term DBR to refer to the design research approaches in both IS and education domains.

The main objective of DBR is to reduce the uncertainty of decision making in designing and developing educational interventions, including: products, programs, materials, procedures, scenarios, and processes (Reeves et al. 2005, Van den Akker, 1999). DBR follows an iterative process comprised of four phases: (*i*) preliminary investigation (refers to identifying and analyzing a complex real world learning problem in the research context by researchers and practitioners), (*ii*) theoretical embedding (refers to generating a solution based on reviewing existing theories and consulting with practitioners), (*iii*) empirical testing (i.e. evaluating the solution by gathering empirical data), and (*iv*) documentation, analysis and reflection on process and outcomes to produce design principles, refine the solution, and construct theoretical knowledge. As described by Van den Akker (1999), by following this process, a DBR fulfils three objectives: first, it provides ideas in terms of suggestions and directions for optimizing the quality of the intervention to be developed. Secondly, it generates, articulates and tests 'substantive' and 'procedural' design principles. Thirdly, it stimulates professional development of participants through involving them in the whole research, design/development, and evaluation processes.

The proponents of DBR mention two main reasons to privilege DBR above traditional educational research approaches such as experiments, surveys, and correlational analyses to design learning environments. First, the main focus of the majority of the traditional educational research approaches is on developing descriptive knowledge rather than providing useful prescriptions, guidance and solutions. It has been argued that, the descriptive knowledge produced by the traditional educational research methodologies is insufficient to help designers to address a variety of design and development problems and cope with uncertainties in a dynamic context such as education. The second reason stems from the highly ambitious, multidimensional and complex nature of many educational reforms, particularly in the light of emerging new ICT advancements. Realizing these reforms requires comprehensive and multi-layered endeavours ranging from large-scale

policy changing to small-scale implementing of educational interventions. Supporting these endeavours asks for more integrated and evolutionary (interactive, cyclic, spiral) research approaches such as DBR to support the whole reform process in a forward and backward manner, feed the designers with meaningful and applicable insights to overcome the inherent complexities in this process, and provide more opportunities for "successive approximation of the ideals" (Van den Akker, 1999; Hannafin et al., 1997).

However, it should be acknowledged that there are some ambiguities and concerns regarding DBR needed to be considered and addressed in a design-based study, including: the nature of the outcomes of a DBR, the role of researcher(s) in DBR, the relationship between design research and design practice and the scientific contribution of DBR, the validity of the DBR's results, and the generalizability of the DBR's results (Goldkuhl & Lind, 2010; Van den Akker, 1999). These issues and the proposed solutions to address them are reviewed as follows:

- *The nature of the outcomes of DBR:* There exist different views on the nature and types of DBR's outcomes. According to Hevner et al. (2004), the result of a design research in the IS domain should be a purposeful IT artifact created to address an important organizational problem. In the next section we will explain different types of IT artifacts. Through the lens of the educational scholars, design principles have been introduced as the major knowledge and findings to be gained from a design-based research (Van den Akker, 1999). Design principles represent synthesized and abstracted findings from a variety of design cases and experiences to guide new design (Kali, 2008). Bell et al. (2004, P. 83) conceptualized design principles as:

an intermediate step between scientific findings, which must be generalized and replicable, and local experiences or examples that come up in practice. Because of the need to interpret design principles, they are not as readily falsifiable as scientific laws. The principles are generated inductively from prior examples of success and are subject to refinement over time as others try to adapt them to their own experiences. In this sense, they are falsifiable; if they do not yield purchase in the design process, they will be debated, altered, and eventually dropped.

- *The role of researcher(s) in DBR:* According to Van den Akker (1999), based on the temporal involvement and undertaken roles of the researcher (s) in the design-based research, two types of design-based research can be distinguished:' type I' and 'type II'. In the former "the roles of designer and researcher (partly) coincide within a specific development context" and "such research usually occurs throughout the complete development cycle". In the latter, however, the relationship between researcher and designer/developer" is more loose: the researchers are not involved in the design and development process themselves, but they study those processes (including tools and

models applied) as practiced by others, in order to come to conclusions concerning design principles of generalizable nature" (p. 6).

- *The relationship between research and development activities in DBR:* Goldkuhl and Lind (2010) divided a design research into two inter-related activity layers or parts: an empirical part (or the situational design practice) and a theoretical part (or meta-design). They defined the "abstract vs. situational" dichotomy to differentiate between these activity parts and their outcomes. These two parts produce and exchange situational and abstracted design knowledge, respectively. Situational design knowledge refers to the ideas for optimizing an (educational) intervention in a given situation expressed mainly in situational concrete models and IT artefacts. On the other hand, abstracted design knowledge (or design theory) reflects abstract scientific, scholarly aspirations, or generalizable knowledge expressed mainly in constructs, methods, generic models, and design principles (Van den Akker, 1999; Goldkuhl & Lind, 2010). These design theories are considered as theorized practical knowledge and are meant to support design activities and designers by providing validated design knowledge (Goldkuhl & Lind, 2010). According to Walls et al (1992), an information systems design theory is "a prescriptive theory which integrates normative and descriptive theories into design paths intended to produce more effective information systems" (p. 36).

- *Validity of the DBR's results:* Validity of the results is another issue faced by both IS and educational scholars communities. According to Goldkuhl and Lind (2010), to produce validated abstracted design knowledge three sources of knowledge are required: theoretical knowledge gained from external theories, empirical observations, and abstracted design knowledge of itself. They used these three sources of knowledge to define a multi-grounding approach comprised of three grounding processes to generate valid design knowledge from design research endeavours. As shown in figure 1.1, these grounding processes are considered: Theoretical grounding, empirical grounding, and internal grounding. Theoretical grounding involves grounding the abstracted design knowledge in the theoretical concepts and values. Empirical grounding is defined as grounding of abstracted design knowledge through its application in practice to address practical issues and problems and observations of its utilisations and effects. Internal grounding refers to control of internal cohesion, congruence and consistency in different components of the abstracted design knowledge. To produce valid design knowledge all these three grounding process should be applied to the design research. Situational and abstracted design knowledge continuously emerge and are exchanged during these grounding processes and their exchange is also a part of these grounding processes. Situational design knowledge is used for empirical grounding of abstract design knowledge and abstract design knowledge is used for theoretical grounding of situational results.

- *Generalizability of the DBR's results:* As stated by Van den Akker (1999), unlike statistical techniques, efforts for generalizing the DBR's findings cannot be based on

generalizations from sample to population due to usually small and purposive samples in DBR. Instead, Van den Akker (1999) suggests using and investing in 'analytical' forms of generalization for the DBR's findings where readers are "supported to make their own attempts to explore the potential transfer of the research findings to theoretical propositions in relation to their own context" (p. 12). To support this analytical generalization Van den Akker (1999) emphasizes the key role of design research reports and descriptions. According to Van den Akker (1999), a "thick description" of the processes of a DBR including a clear theoretical articulation of the generated/applied design principles and a careful description of both "the evaluation procedures as well as the implementation context" can facilitate the readers' analogy reasoning. Furthermore, it may increase "the ecological validity" of the DBR' s findings, so that the readers can estimate in what respects and to what extent transferring these findings from the reported problem space to their own is possible.

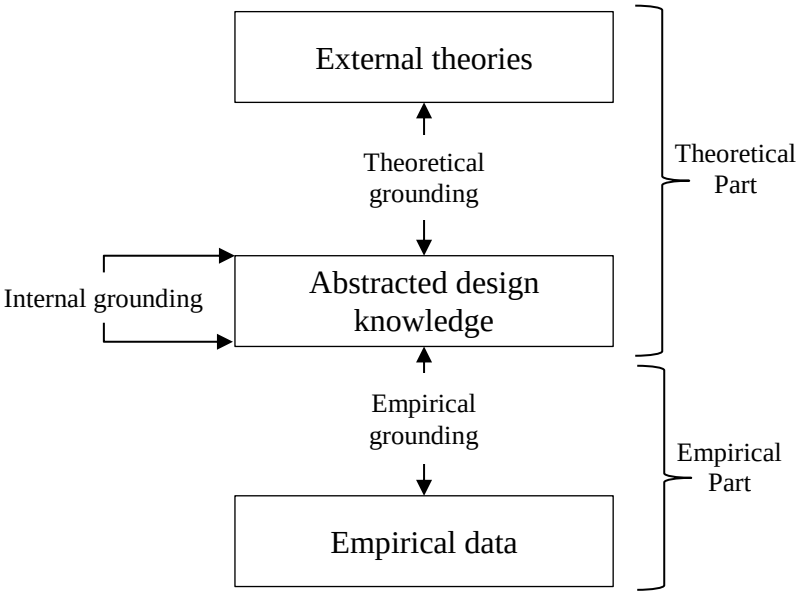


Figure 1.1 The grounding processes required to produce valid abstracted design knowledge (or design theory) (Goldkuhl & Lind, 2010)

1.5 The Definition and Components of the PLE Design Framework

As described earlier, the main objective of our research is to develop a PLE design framework for work-driven learning scenarios. The first step toward developing the PLE design framework is to draw a clear definition of it by determining and describing its constituent components.

From a learning perspective, an e-learning design framework can be thought of as a theoretical basis for guiding instructors/instructional designers to design and implement particular learning interventions (Mishra, 2002; Dabbagh, 2005). According to Hannafin et

al. (1997), an e-learning design framework should support grounded-design of e-learning systems by incorporating theory into practice and assist designers to synthesize and recognize important distinctions among various theoretical perspectives. Dabbagh (2005) has defined three constituent components to develop a theory-based e-learning design framework: pedagogical models or constructs, instructional strategies, and learning technologies. Pedagogical models are the first key component of an e-learning design framework and represent cognitive models or theoretical concepts derived from specific set of knowledge acquisition approaches or learning theories. Some examples of pedagogical models are: open learning, distributed learning, learning communities, communities of practices, and knowledge building communities. Instructional strategies are the second key component of an e-learning design framework derived from the pedagogical models and define what instructors or instructional systems do in terms of plans and techniques to facilitate learning and operationalize their underlying pedagogical models. The third key component of an e-learning design framework are learning technologies meant to enact and implement these instructional strategies and put them into practice.

From a technological perspective, an e-learning design framework can be seen as an IT artefact meant to guide IT and learning professionals to integrate ICT technologies into organizational learning processes. The definition of an IT artefact is still a debatable subject in the IS research community. As summarized by Gong (2012, p. 37), an IT artefact may include: reference model or architecture (i.e. a set of abstracted principal design decisions and implementation guidance for designing and implementing a system), system design (i.e. the description of structure of a system, its component and their relationship), method (i.e. definition of activities to create/interact with a system), algorithm (i.e. "executable description of system behaviour"), guideline (i.e. practical suggestion regarding behaviour in a specific situation), requirements (i.e. statements about a required functionality by the system), and metric (i.e. a measurable value meant to quantify aspects of systems or methods).

From an IS point of view, we argue that a PLE design framework represents a reference model or architecture meant to address the personal learning and human development of learners with organizations. ISO/IEC (2007, as cited in Gong, 2012, p.3) defines an architecture as:

The fundamental organization of a system embodied in its components, their relationships to each other and to the environment, and the principles guiding its design and evolution.

TOGAF (2009, as cited in Gong (2012)) extends the concept of architecture to include (i) a formal description or a detailed plan of a system at component level to guide its implementation, and (ii) the "structure of components, their inter-relationships, and the principles and guidelines governing their design and evolution over time" (p. 27). According to Gong (2012), a reference architecture is the highest level of abstraction

developed by incorporating experiences from various domains to enable "developers to focus on the understanding of the domain, the establishment of an analogy between the new domain and previously investigated architectures and the establishment of the link to corresponding component" (p. 28). Based on this definition, abstraction and analogy are the key factors to develop a referenced architecture.

By incorporating these learning and technological perspectives we define the PLE design framework as below:

Definition 1.3: *A PLE design framework represents abstracted design knowledge comprised of inter-related personal learning principles, design principles, technological components, and implementation guidelines, grounded in theoretical constructs and empirical observations, meant to assist learning and IT professionals to design and implement technology-supported learning interventions to facilitate learner's personal agency and control over the workplace learning processes.*

The description and purposes of the constituent components of the PLE design framework are as follows:

- **Personal learning principles:** Personal learning principles are the first key constituent component of a PLE design framework. They form the roots and foundations of the PLE. Considering the emphasis of the PLE concept on the learner's control and personal agency notions, the focus of these principles is on supporting learner's control and personal agency in the learning process. These principles can be understood as the core requirements of personal learning. Similar to the pedagogical models in Dabbagh's e-learning design framework, the core principles of personal learning should be rooted in appropriate learning theories and views on learner's control. Furthermore, these core constructs should be grounded in the empirical findings to cover and reflect the practical requirements of personal learning. As such, the principles of personal learning can be defined as theory-based and practice-derived learning requirements needed to be supported by a learning environment aiming at enhancing learner's control over their learning. Addressing these learning requirements by the PLE design framework facilitates the first leap from theory into practice.
- **Design principles:** Design principles are the second key component of the PLE design framework. As defined by Van den Akker (1999), design principles are qualitative and heuristic statements to support designers in their task. Design principles have a format such as: "If you want to design intervention X [for the purpose/function Y in context Z], then you are best advised to give that intervention the characteristics A, B, and C [substantive emphasis], and to do that via procedures K, L, and M [procedural emphasis], because of arguments P, Q, and R"(p. 9). Considering the core learning requirements of personal learning as the main learning interventions to be supported by the PLE framework, the design principles are meant to meet these requirements. As such, they facilitate the second

leap from theory into practice by translating the implications of learning theory embedded in the principles of personal learning into learning scenarios, plans, or activities aimed at obtaining a specific goal.

- **Technological components:** Technological components refer to the required technological functionalities to enact the design principles. The PLE design framework describes the key technological components and their inter-relationships at an appropriate level of abstraction.
- **Implementation guidelines:** Implementation guidelines represent requirements such as organizational support needed to adopt and implement the PLE design framework in a specific organization.

1.6 Research Strategy, Phases, and Sub Research Questions

Based on the design research approach proposed by Goldkuhl and Lind (2010) and Dabbagh (2005), we outlined and followed a research strategy shown in figure 1.2 to develop the PLE design framework. The research strategy consists of three main phases to apply theoretical, empirical, and internal grounding processes to the development of the PLE design framework. The specifications of these phases are described below.

1.6.1 Phase 1: Examining the Theoretical Background of the PLE Concept

The first phase of the research strategy is concerned with applying the theoretical grounding process to the PLE design framework. PLE is a fairly new concept and still there exists no clear picture of its characteristics, objectives, and theoretical basis. Furthermore, considering the notions of learner's control and agency as the centrepiece of the PLE concept, there is no robust theory-based model to explain how to attain and support these notions within a learning environment using technology. Accordingly, in this phase the theoretical background, characteristics, and objectives of the PLE concept are examined. The results of this phase then serve to provide appropriate theoretical constructs to inform the design practice (phase 2) and underpin the PLE design framework (phase 3). This phase is driven by research sub question #1.

Research sub question #1: *What are the theoretical constructs, characteristics and perceived objectives of the PLE concept useful to underpin the PLE design framework?*

To answer this research question we conduct a literature review study in chapter 2.

1.6.2 Phase 2: Examining Users' Views on the Requirements of Personal Learning

The second phase covers the design practices and empirical part of the design research to apply the empirical grounding process to the PLE design framework. Three main dimensions shape this phase, being: choosing relevant design cases, defining purposeful units of analysis (or sub design case) for each design case, and performing appropriate design practices in each design case.

Considering the limitations of the research time and cost, we opted to conduct two design cases. Design case 1 pertains to the Amadeus Lyceum secondary school and design case 2 is related to the Customer Contact Centre (CCC) of the Achmea Company, both located in the Netherlands.

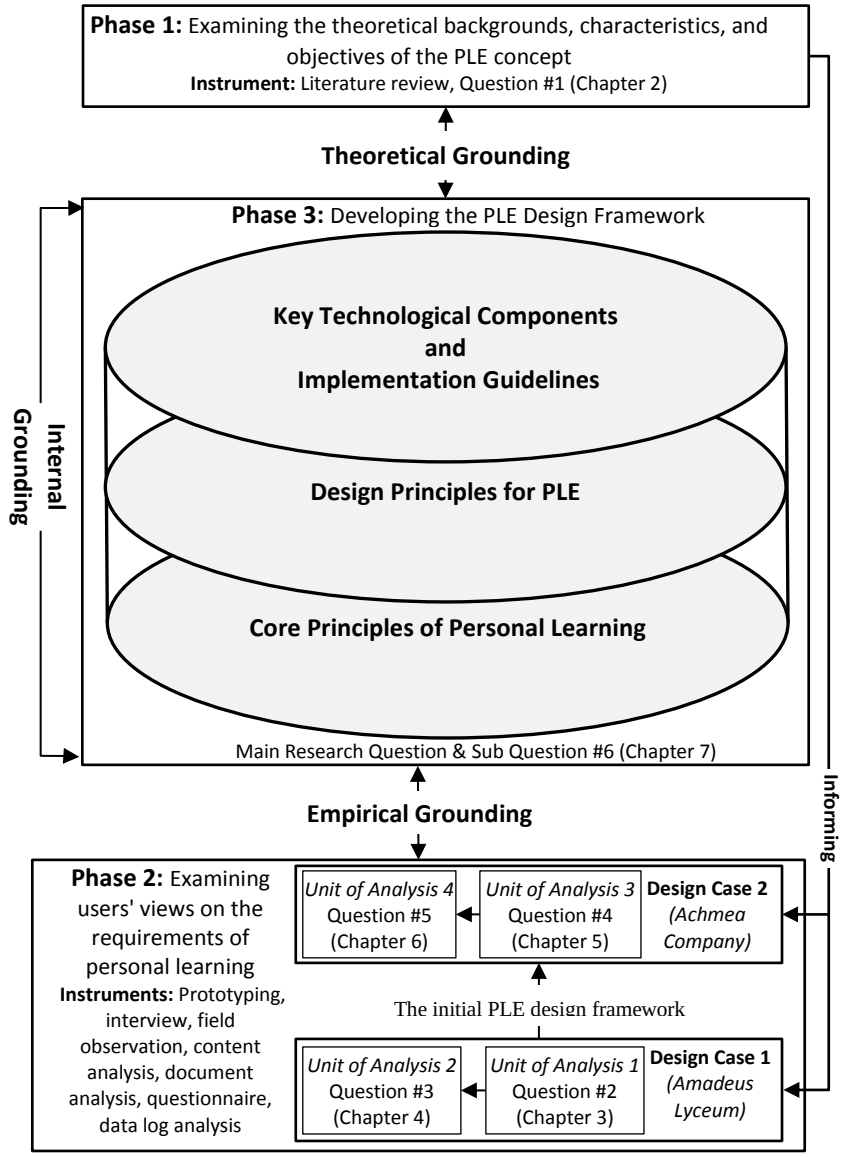


Figure 1.2 The outlined research strategy to develop the PLE design framework (Based on Goldkuhl & Lind (2010) and Dabbagh (2005))

There are four main reasons behind choosing these two design cases: The first reason stems from the willingness of the responsible people in these contexts to participate in a design-based research. Secondly, in both contexts facilitating/encouraging technology-enhanced personal learning and enhancing learners' control over their learning process were perceived as important learning issues. Thirdly, the combination of the results from these two contexts arguably provides a comprehensive picture of factors affecting personal learning in the workplace settings.

While design case 1 pertains to a formal education context, the project-based and learner-centric instructional approach followed in this context has created patterns of interconnected working and learning processes available in many workplace settings including the context of design case 2. From this perspective, as asserted by Eraut (2004), "formal education can be also viewed as a workplace and uses a discourse in which the term 'work' is normally quite prominent. Students are given work to do and described as good or hard 'workers'. Moreover, it is usually the work that is structured and not the learning. A great deal of informal learning has been observed to take place in or near formal education settings, but research into the outcomes of such informal learning is very limited" (p.1). Fourthly, study 1 is conducted in a structured learner-centric context, while study 2 is conducted in an informal and totally learner-driven context. This might help us to capture and compare situational design knowledge from different contexts and experiences and provides deeper insight into the learning dynamics in both learner-centric and learner-led learning environments beneficial to develop a more abstract and generic PLE design framework.

For each design case two units of analysis (or sub design cases) are defined: Learners and organization. Learners are the key actors in a PLE. Accordingly, analysing the personal learning experiences of learners to gain a deep insight on their learning requirements and preferences is essential to underpin and develop the PLE design framework. In this regard, as emphasized by Kop and Fournier (2013), what makes the design of a PLE a challenge is the uniqueness of learners and their learning experiences, strategies, motivations, triggers, and objectives. To address this PLE design requirement, we define one unit of analysis in each case (i.e. units of analysis 1 and 3 in design cases 1 and 2, respectively as shown in figure 1.2) to examine and capture learners' views on the PLE-based learning. In addition to the learners, the views and requirements of the organization should also be considered and incorporated in the design of the PLE. According to Whitworth (2009), two orientations toward e-learning systems can be identified within the majority of organizations: "top-down" (or organization/designer-generated) and "bottom-up" (or learner-generated) orientations. As remarked by Whitworth (2009), "the differences in the objectives, procedures, tacit knowledge and conceptions of the value of workplace e-learning between these orientations have led to conflicts that have damaged real e-learning projects in the past" (p. 1). Decreasing these conflicts asks for capturing and reconciling learners' as well as organization's views to underpin the design of e-learning system

(Whitworth, 2009). To address this design requirement, the units of analysis 2 (in design case 1) and 4 (in design case 2) are chosen to capture teachers/school and managers/company views on the requirements of PLE-based learning, respectively.

To perform design practices in each design case, we adapt and follow the DBR process (Reeves et al., 2005) consisting of four phases: (*i*) preliminary investigation to identify a learning problem in the research context by researchers and practitioners), (*ii*) theoretical embedding to generate a solution based on reviewing existing theories and consulting with practitioners, (*iii*) empirical testing and evaluating the solution by gathering empirical data, and (*iv*) documentation and reflection on process and outcomes to produce situational and abstract design knowledge. The detailed specifications of the design practices in each design case are follows:

- **Design practices in design case 1:**

Figure 1.3 represents the followed steps to conduct design practices in design case 1.

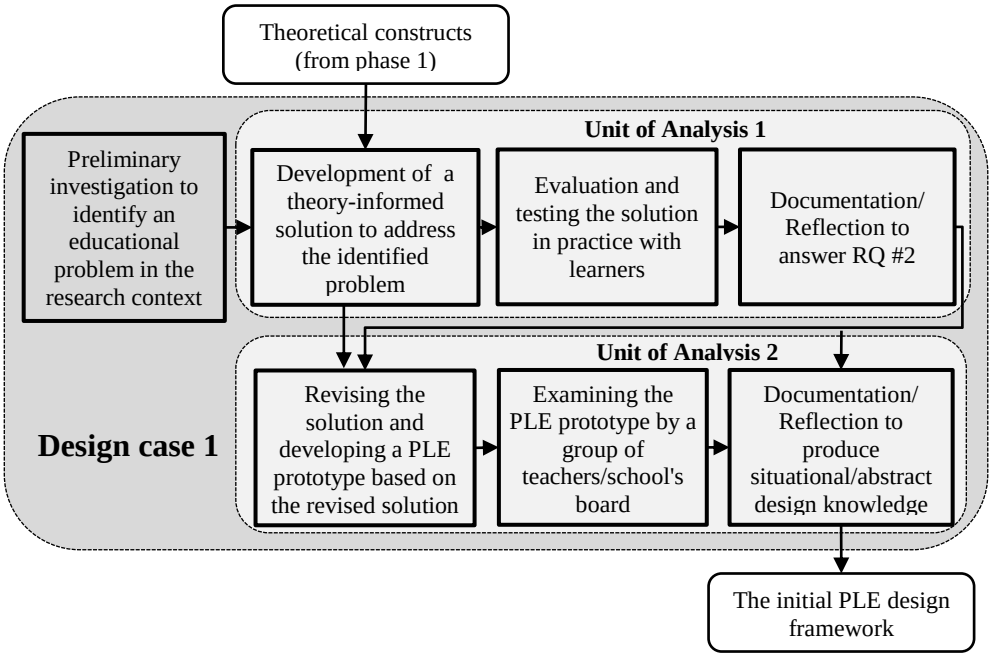


Figure 1.3 Conducted design practices in design case 1

The main learning problem in this context is the lack of a framework for integrating Web 2.0 technologies into the educational practices in order to enhance learners' personal learning and agency and facilitate their engagement in constructing the learning environment. This problem is closely related to the PLE concept as facilitating learners' engagement in constructing the learning environment has been remarked as a key requirement for equipping them with the relevant competencies they need to gain control

over their learning (Scardamalia & Bereiter, 2006; Valtonen et al., 2012; Väljataga & Laanpere, 2010; Drexler, 2010). Accordingly, we argue that a solution to this problem is beneficial to produce appropriate design knowledge to underpin the PLE design framework.

After identifying this problem, in this context, the theoretical constructs derived from phase 1 are used to develop a solution for this problem. Then this solution is evaluated and tested by a group of learners (unit of analysis 1). Finally, the whole process and results are analysed in order to answer research sub question #2:

Research sub question #2: *How do learners configure their learning process when constructing the learning environment using Web 2.0 tools?*

The main reason for choosing this research question stems from this argument that any learning scenario aiming at encouraging and facilitating learners' involvement in constructing the learning environment should recognize and support the natural and emergent ways the learners follow to experience and learn a concept. To answer this research question the information about the personal learning experiences of the learners is captured and analysed using different instruments including interview, field observation and content analysis. This part of research is elaborated in chapter 3.

After the specifications of the learning process of learners have been identified, in the next step we shift our focus from learners' side to the organization's side (unit of analysis 2). To this end, first the proposed solution is revised based on the situational design knowledge derived from the unit of analysis 1. Then a PLE prototype is developed based on the revised solution. This prototype then is used to introduce the PLE concept to a group of teachers and members of the school board to examine and capture their views on the requirement of the PLE-based learning. Afterwards, the learners' and teachers' view are synthesized to develop an initial model of PLE design framework and answer research sub question #3:

Research sub question #3: *How to incorporate students' and teachers' views on the design of a PLE in order to develop an initial PLE design framework?*

Answering these research questions (i.e. RQ #2 and RQ #3) has implications both for producing situational and abstracted design knowledge. On one hand, getting deep insight into the specifications, process, and requirements of personal learning might provide the organization (i.e. teachers and school board) with appropriate situational design knowledge to design and create a learner-centric learning environment and improve the learners' perception about the learning environment. On the other hand, comparing the specifications and requirements of the learning process derived from this design case expressed in the initial PLE design framework with the outcomes of design case 2 makes it possible to produce abstracted design knowledge and underpin the PLE design framework.

- **Design practices in design case 2:**

Figure 1.4 represents the followed steps to conduct the design research in the second design case in the customer contact centre (CCC) of the Achmea Company.

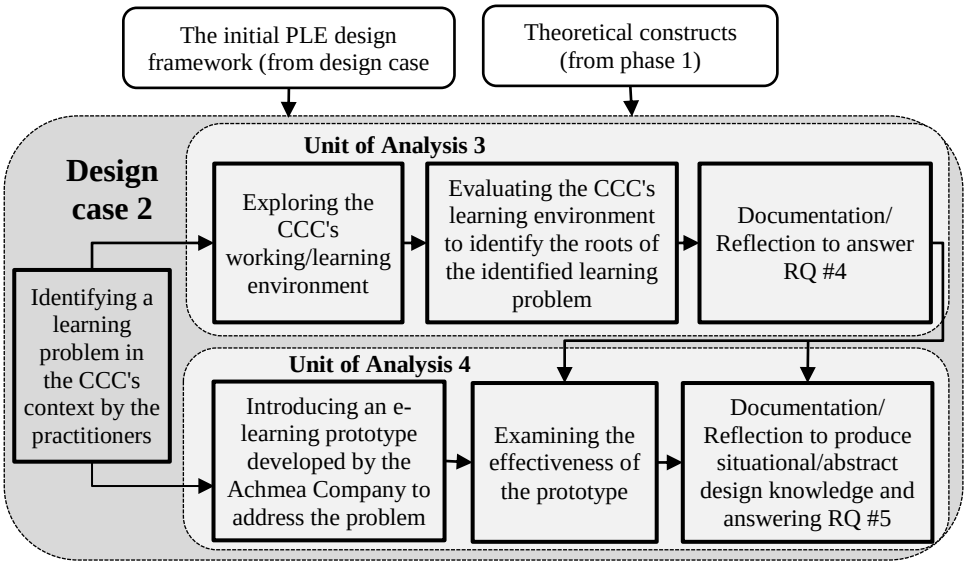


Figure 1.4 Conducted design practices in design case 2

The results of the previous steps of the research provided input for the design research in the CCC context. While the theoretical constructs derived from phase 1 inform the evaluation process in this design research, the role of the initial PLE design framework is to provide some hypotheses derived from the previous design case to be tested in this context.

The design research in the CCC starts by recognizing a learning problem in this context by the practitioners. The recognized learning problem in this context is the slowness of the insurance knowledge acquiring and updating processes. Continual updating their insurance knowledge is an essential requirement of learning and competency development of the call agents and directly affects their job performance. After the learning problem has been identified, our research starts by exploring and analysing the learning environment in the CCC's context (unit of analysis 3) and the learning experiences of call agents supported by this learning environment in order to scrutinize this problem and get insight into its roots and causes. Thereafter, the effectiveness of the learning environment to address the identified learning problem is evaluated. The theoretical constructs derived from phase 1 are used as an analytical framework to conduct this evaluation process. We utilize different research methods to perform this part of research including: field observation, interview, and document analysis. Next, the whole research process and results are documented, reflected and analysed in order to answer research question #4:

Research sub question #4: *What factors do influence personal learning and competency development in a workplace setting?*

The answer to this research question has a twofold contribution in producing abstracted design knowledge required to develop the PLE design framework: First, the CCC context represents a mainly learner-led and informal learning environment. Accordingly, gaining insight into the factors influencing the learning experiences and competency development of learners in this context is essential to designate the core personal learning principles of personal learning as the first key component of the PLE design framework. Secondly, scrutinizing the learning process supported by the learning environment in the CCC's context is a main focus of this research question. As a result, the answer to this research question makes it possible to compare the followed learning processes by the learners in both design case 1 (derived from research sub question #2 and expressed in the initial PLE design framework) and design case 2. In addition to providing abstracted design knowledge, answering research sub question #4 provides situational design knowledge useful to develop and evaluate e-learning initiatives.

To address the identified learning problem in the CCC context in parallel to our research in the unit of analysis 3, an e-learning system called PowerApp was developed by the Achmea Company. Considering this system as an organization-provided or designer-generated (Whitworth, 2009) e-learning system allows us to investigate the organization's views on the requirements of personal learning in this context. Accordingly, in the unit of analysis 4 we shift our focus from learners' side to the organization's side by introducing and exploring the features and characteristics of PowerApp. Thereafter, the learning effectiveness of this prototype is evaluated by performing a pilot study by a group of learners in the CCC's context. In addition to the organization's views, the insights gained from the learners' side (unit of analysis 3) are used as the evaluation criteria to inform this evaluation process. To conduct this part of research different research methods, including interview, document analysis, experiment, data log analysis, and questionnaire are utilized. Finally, similar to the previous design case, at the end of the design case 2 the gained insights into the requirements of personal learning from the organization's and learner's perspectives are synthesized to answer research sub question # 5:

Research sub question #5: *What are the components of a workplace e-learning system facilitating learner-driven acquisition, updating and generating knowledge in a workplace setting?*

The answer to this research question provides both situational and abstracted design knowledge. The produced situational design knowledge can be used by the designers of PowerApp to improve its functionalities and learning effectiveness. On the other hand, the answer to this question can produce abstracted design knowledge to refine the initial PLE

design framework derived from the design case 1. The research pertaining to the units of analysis 3 and 4 is explained in chapters 5 and 6 respectively.

As described earlier, two types of DBR, type 'I' and type 'II', can be defined based on the temporal involvement and undertaken role of researcher (s) in the design/development and research processes. In design case 1, the researcher team was involved in whole design/development and research processes. Accordingly, design case 1 can be categorized as a DBR type I. Unlike design case 1, in design case 2 the role of the research team is focused on the research rather than design/development part. Accordingly, the conducted study in design case 2 represents a 'type II' DBR where there is a distinction between the researcher and designer/developer roles.

1.6.3 Phase 3: Developing the PLE design framework

This phase, explained in chapter 7, deals with applying the internal grounding process to develop and propose abstracted/theorized design knowledge for PLE expressed in the key components of the PLE design framework and their relationships.

We follow an internal grounding process consisting of the below steps to produce congruent and consistent abstracted PLE design knowledge: First, a cross-case analysis is performed to review and compare the practical/situational design knowledge derived from these design cases. Then the results of this cross-case analysis in addition to the theoretical constructs from phase 1 are used to designate the core principles of personal learning as the first key component of the PLE design framework and answer research sub question # 6:

Research sub question #6: *What are the core principles of personal learning within workplace settings?*

As discussed earlier, the core principles of personal learning can be understood as the main learning interventions required to empower learners to gain control over their learning. By combining theory and experiences from different domains to derive the core principles of personal learning it is likely that the derived principles transcend the boundaries of a specific context.

The designated learning principles then serve to define the second key component of the PLE design framework, being: the design principles for PLE. To define the PLE's design principles, first these core learning principles are synthesized and aligned in an appropriate and creative way to create a theory-informed/practice-derived design foundation for the PLE. Then the situational design knowledge and findings from the two design cases will be synthesized, abstracted, and mapped into this foundation to define relevant prescriptive design principles to address the identified core principles of personal learning. The determined design principles can be thought of as design paths needed to be followed to develop the PLE.

After defining the design principles for PLE, the empirical and theoretical findings derived from the two previous phases are scrutinized and utilized to determine the technological requirements and implementation guidelines as the third key component of the PLE design framework.

1.7 Theoretical Contribution

Gregor (2006) has classified five types of theories related to information systems: (i) theory for analysing, (ii) theory for explaining, (iii) theory for predicting, (iv) theory for explaining and predicting, and (v) theory for design and action. Theory for design and action prescribes how to do something by giving explicit prescriptions such as methods, techniques, principles of form and function, guidelines, and justificatory theoretical knowledge for designing and developing an artefact. Design theories provide knowledge support for designers by theorizing practical knowledge (Goldkuhl & Lind, 2010). In this sense the abstracted design knowledge manifested in the PLE design framework can be seen as a design theory. On one hand, this design theory is meant to increase the e-learning designers' reflexive "awareness of the theoretical basis underlying the design" (Bednar et al, 1992) by assisting them to understand the utility, synthesize across, and recognize important distinctions among various theoretical approaches and perspectives. On the other hand, grounded in empirical observations and situational knowledge, the design theory intends to provide the designers with relevant learning design paths and instructional prescriptions to conduct the design process of a workplace personal learning environment.

2 Reviewing the PLE Literature and Developing a Learner's Control Model [1]

This chapter follows three objectives: the first objective is to draw a picture of the key characteristics of the PLE concept by reviewing the PLE literature. The second goal aims at identifying the objectives of the PLE concept that can be used for underpinning the final PLE design framework. By doing so this chapter answers research sub question #1: "What are the theoretical constructs, characteristics and perceived objectives of the PLE concept useful to underpin the PLE design framework?" The third objective is to explore the theoretical principles and concepts useful for supporting the implementation and evaluation of the PLE concept in both design cases introduced in the previous chapter.

The gained insights into the characteristics, objectives, and theoretical groundings of the PLE concept then will be synthesized in order to develop a theoretical model for implementing and analyzing the PLE concept in practice.

Please note that in this chapter the terms student and learner are used interchangeably.

2.1 Literature Review Methodology

To draw a comprehensive picture of the characteristics attributed to the PLE concept we reviewed and studied the PLE literature. To this end, we chose publications and articles describing the definition, characteristics, objectives and application of the PLE concept in formal education and corporate domains. It is noteworthy that the majority of the PLE research has been conducted in formal educational and particularly in the higher education and there are few PLE research conducted in the corporate domain. However, there are several research trends within the corporate domain, which are very close to the PLE concept including learner-generated contexts (Luckin et al., 2011; Whitworth, 2009), Web 2.0-based learning, Self-directed/Self-regulated learning, and informal learning (Eraut, 2004). Accordingly, we chose the publications discussing these topics and trends in the workplace as another input to do the literature review.

To conduct the literature review the English publications from below sources were collected:

- Scientific journals (i.e. Computers & Education, British Journal of Educational Technology, Journal of Workplace Learning),
- Books (i.e. Control and Constraint in E-Learning: Choosing When to Choose (Dron,2007a))
- The proceedings of conferences and workshops (i.e. the PLE conferences)
- Expert blog posts (i.e. Steve Wheeler, Fraser, Stephen Downes, Graham Attwell)

[1] This chapter is (partially) based on Rahimi, van den Berg, Veen (2014b).

- Presentations (i.e. Slideshare)

Google Scholar, Google and Science Direct were used to search and collect relevant publications. A variety of keywords were used, individually or combined, to search in these repositories including: 'Personal learning environment', 'learner-generated context', 'learner-generated content', 'web 2.0-based learning', 'technology-enhanced learning', 'technology-based learning environment', 'personalization', 'personalized learning', 'personal learning', 'learner-driven learning', 'self-directed learning', 'e-learning', 'e-learning 2.0' and 'self-regulated learning'. Also, snowballing technique was used to track related citations in the collected publications and find more relevant publications.

2.2 The Identified Characteristics of the PLE Concept

When the PLE concept is implemented in or powered by institutions (i.e. schools or workplaces), the resulted learning environment is referred to as institutional/organizational PLE, or iPLE (Casquero et al., 2010). In a basic level an iPLE can be examined through four dimensions, being: organization, personal/ learner, learning, and environment. Accordingly, to identify and examine the characteristics of the PLE concept we used an analytical framework consisting of 'Organization', 'Learner', 'Learning', and 'Environment' dimensions as shown in figure 2.1. Using this framework allows us not only to identify the characteristics attributed to these four dimensions, but also to explore the characteristics pertaining to the interplay between these dimensions (i.e. 'O-E' notation in figure 2.1 represents the PLE characteristics that pertain to the interplay between 'Organization' and 'Environment' dimensions).

Figure 2.2 depicts and maps the identified characteristics of the PLE concept into 'Organization', 'Learner', 'Learning', and 'Environment' dimensions and their interplays.

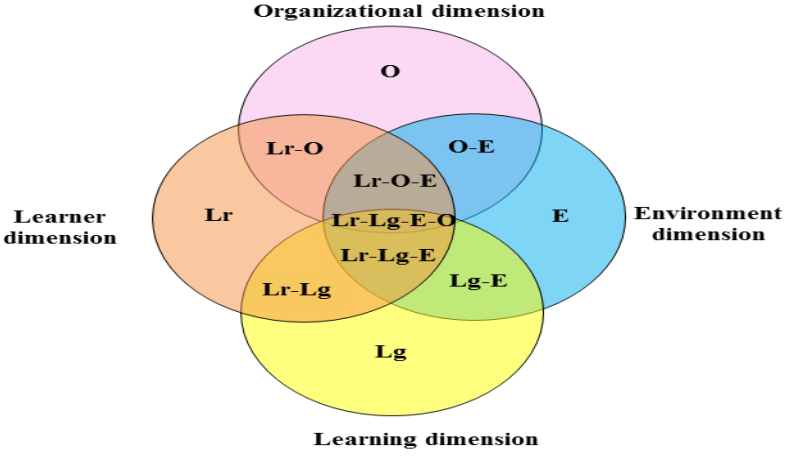


Figure 2.1. The analytical framework for identifying the characteristics of the PLE concept

2.2.1 Organization Dimension

- *PLE as a means to facilitate the shift from adaptive-to customized-to dynamic personalization*

Fraser (2007) has discerned three types of personalization in learning environments, being: adaptive, customized, and dynamic personalization. An "adaptive personalization" system or organization tracks learners' activities to identify items of their potential interest and control what is made available to them. The aim of "customized personalization" is to enable the learners to engage with institutional provisions where the selection, inclusion and exclusion of options is under the direct control of the learners. "Dynamic personalization" is a learner-led personalization where production, reception and relationships of choices or learning resources are supported by the system but determined by the learners. According to Fraser (2007), learners' empowerment and development in PLEs can be facilitated by a shift from adaptive personalisation to dynamic personalisation. Facilitating this shift, according to Attwell (2007), requires a paradigm shift in educational process from learners' engagement with the institution-provided learning resources to the institution's engagement with the learners-provided learning resources. Leadbeater (as quoted in Fraser, 2007) has proposed a general level definition of end user-driven personalization that focuses on empowering end users not just by providing them with a set of services, but by facilitating their active participation in designing services and determining what those services deliver and how. The Leadbeater's definition of personalization has strong similarities to the approach of the PLE concept in providing learners with choices and empowering them to employ these choices to design and develop the learning environment tailored to their preferences and learning needs (Buchem et al., 2014; Rahimi et al., 2011, 2014a).

- *PLE as a means to transfer the responsibility of learning from the institution to learners*

This characteristic pertains to the interplay between the learner and organization focused on shifting the responsibility of learning from the organization to the learner. In this regard, as reasoned by Fournier and Kop (2010) and Casquero et al. (2010), the learners instead of the organization should build, own, and suit the learning environment to their learning needs. According to Green et al. (2005), the essence of personalisation is to reverse the logic of education systems so that instead of having learners to conform to the educational system, the educational system should conform to the learners. To this end, any attempt to support personalizing learning must consider and take advantage of the learners' diverse abilities, strengths, needs, and interests as a means to foster engaged and independent learners able to reach their full potential (Green et al., 2005).

- *PLE as a means to replace/supplement institutional VLEs*

The main characteristic of the PLE concept pertaining to the interplay between the organization and environment dimensions has focused on the relationship between PLEs, as learner-generated contexts, and VLEs, as organization-generated contexts, including learning management systems (LMS) and course management systems (CMS). There are

different views on the relationship between PLEs and VLEs ranging from 'PLEs as a replacement of VLEs' to 'PLEs as a supplementary for VLEs'. According to Valtonen et al. (2012), "the strongest visionaries of PLEs suggest that they are the next step in the development of educational technology, a replacement for learning management systems (LMS), providing tools and learning practices to meet the needs of the knowledge society" (p. 1). According to these visionaries, rooted in the objectivist learning models, in most of the current VLEs learning is perceived as "the transfer of knowledge from the instructor to the learner; the instructor controlling the learning process and assessing whether knowledge transfer has occurred" (Wang, 2009, p. 193). The proponents of PLEs, however, describe PLEs as activity spaces in which learners interact and communicate with each other and experts the ultimate result of which is the development of collective learning (Attwell, 2007). According to these proponents, PLEs can set learners in more central roles in two ways: by allowing and encouraging them to build and administrate their learning environment and tailor it to their learning needs and interests, and by giving more active roles to learners in the learning process (Attwell, 2007, Valtonen et al., 2012). According to Chatti et al. (2010), the superiority of PLEs over VLEs is due to characteristics such as supporting personalization and informal learning, openness and decentralization, bottom-up approach, creating and sharing knowledge and developing the learning environment, knowledge-pull, and ecological learning in which the distributed PLEs can be loosely connected to build a knowledge ecology.

In spite of these proponents there are several authors arguing that organizations cannot fully replace VLEs with PLEs. According to Wang (2009), the emergence of Web 2.0 technologies has provided learners with opportunities to create learner-generated and personal learning environments. In addition, these technologies are increasingly used and integrated with education and workplace e-learning applications to improve social interaction and knowledge sharing. However, existing social learning systems within workplaces fail to align individual learning needs and practices of employees with organizational goals in a systematic way. In other words, most Web 2.0 workplace e-learning applications are performing poorly in helping employees to acquire/develop the required expertise "to improve their performance, or make their social interactions integrated with their learning practices, and ultimately fail to serve the organization's goal for success in the knowledge economy" (p. 192). As a result, it has been stated that instead of replacing VLEs by PLEs, they should supplement each other (Wang, 2009; Tynjälä and Häkkinen, 2005; Whitworth, 2009).

2.2.2 Learner Dimension

- *PLE as a means to enhance learner sense of control and ownership*

The learner is the main subject and actor in a PLE. Most of the definitions and discussions around the PLE concept share a common objective for the PLE: corroborating learner's sense of control and ownership in the learning environment. From a theoretical perspective, the core emphasis of the PLE concept on learner's control is in line with the orientation of

the current learning theories such as constructivism, social constructivism, and more recently, connectivism aiming at establishing "a theoretical shift from instructor or institution controlled teaching to one of greater control by the learner" (Siemens, 2005). In this regard, PLEs have been defined as activity spaces under the control of leaners to presume and support an active role for learners by placing them in the center of their learning processes, corroborating their sense of ownership, and enhancing their control on the educational process (Attwell, 2007; Downes, 2007; Buchem et al., 2011). According to Van Harmelen (2006), a PLE has to provide support for learners to set their own learning goals, manage their learning including content and process, communicate with others in the process of learning, and achieve their learning goals.

Buchem et al., (2011) defined the learner's ownership in terms of a "technical sense" (refers to the learner's responsibility for aggregating and configuring tools/services), a "legal sense" (refers to the legal ownership of the data/content by the learner), and a "psychological sense". As argued by Buchem et al., (2011), the learner's control refers to the provided choices for the learner to manage the environment and select tools and sources of information to reuse and remix content. Buchem et al., (2011) have differentiated between learner's ownership and learner's control on the learning environment. According to them, controlling the learning environment by the learner does not mean the learner owns the learning environment. In other words, the learner's control is more associated with "personalization", "adaptation", "negotiation" rather than "personal ownership" and "autonomy". In an empirical study Buchem (2012) examined the relationships between "ownership", "control" and "learning" in the context of web-based ePortfolios. As shown by Buchem (2012), the "control of intangible elements of a ePortfolio, such as control of content or personal data, is more related to the feeling of ownership of one's ePortfolio than the control of tangible elements, such as technical tools" and, accordingly, she concluded that "the perception of a learning environment as a Personal Learning Environment is related to perceived ownership of intangible elements" (p.1). On the basis of this study, Buchem (2012) associated the learner's control in PLEs with (*i*) learner's perceived possibilities to manipulate the learning environment, and (*ii*) learner's capacity to make choices and impose those choices on her learning.

- *PLE as a means to increase learner agency in the learning process*

Ownership and control are closely linked to the notion of personal agency defined as the "human capacity to make choices and to impose those choices on the world" (Buchem et al., 2011, p. 13). PLEs have been introduced as learning tools meant to empower learners with a sense of personal agency in the learning process (Dabbagh & Kitsantas, 2012; Cigognini et al., 2011, Valtonen et al., 2012**).** According to Valtonen et al. (2012), developing PLEs allows learners to play the role of administrators of the learning environment and modify the ways they learn resulting in more meaningful learning experience for them. According to Dabbagh and Kitsantas (2012), a key feature of a PLE is that the learner develops an online social identity where the learning environment provides

cues for action in terms of affordances or possibilities that prompt the learner about what to/not to share, who they choose to share with, and how to effectively merge formal and informal learning.

2.2.3 Learning Dimension

- *PLE as a means to support informal learning*

PLEs have been defined as a means to connect formal and informal learning within organizations. Informal learning is described as a learner-driven learning process that happens through observation, trial and error, asking for help, independent learning, conversing with others, listening to stories, reflecting on a day's events, or stimulate by general interests (Dabbagh & Kitsantas, 2012). According to Attwell (2009), the use of PLEs can facilitate a new approach to supplementing and supporting formal learning by informal learning:

important concepts in PLEs include the integration of both formal and informal learning episodes into a single experience, the use of social networks that can cross institutional boundaries and the use of networking protocols (Peer-to-Peer, web services, syndication) to connect a range of resources and systems within a personally-managed space (p. 120).

Along similar lines, Chatti et al. (2010) define PLE-based learning as the convergence of lifelong, informal, and personalized learning which provides a natural and learner-centric model to learning that "takes a small pieces, loosely joined approach, characterized by the free form use of a set of learner-controlled tools and the bottom-up creation of knowledge ecologies" (p.4).

- *PLE as a means to trigger self-regulated learning*

The idea of PLE has strong similarities with self-regulated (SRL) and self-directed (SDR) learning models. Boekaerts (1999) defines self-regulated learning as a constructive and self-directed learning process emphasizing learners' metacognitive skills, including: orienting, planning, executing, monitoring and evaluating the processes of learning. Valtonen et al. (2012) introduce a PLE as a collection of different ICT tools to foster self-regulated learning with the main purpose of placing learners in a central role as designers of their own learning environment. Along similar lines, Drexler (2010) attributes two characteristics to personal learning: learner autonomy and increased self-regulation and self-direction. According to Dabbagh and Kitsantas (2012), learning in the context of social media has become highly self-motivated and autonomous. However, as asserted by Dabbagh and Kitsantas (2012), institutions are still relying on VLEs that " do not capitalize on the pedagogical affordances of social media for example allowing learners to manage and maintain a learning space that facilitates their own activities and connections to peers and social networks across time and place" (p. 1).

A few researchers have examined empirically the relationship between PLEs and self-regulated learning. Cho et al. (2010) discovered that in the PLE-based learning scenarios the self-regulating behaviours of learners predict their 'social presence' (i.e. learner's ability to project oneself to others emotionally and socially), 'sense of connectedness', and 'sense of learning'. Also, as argued by Turker and Zingel (2008), "organizing learning resources available at a PLE into meaningful learning activities towards achieving set goals can as well be considered as an act of instructional design" (p.4), corresponding to the forethought phase of Zimmerman's self-regulated learning model. Along similar lines, Mott (2010) stated that the development of PLEs as student-created and administrated matrices of resources might promote student's metacognition and increase their self-regulating role resulting in more meaningful learning experiences for the student. In another study, Dabbagh and Kitsantas (2012) have offered a framework for using social media to support self-regulated learning in PLEs consisting of three levels: personal information management, social interaction and collaboration, and information aggregation and management. As argued by Dabbagh and Kitsantas (2012), involving learners in personal information management activities using blogs and wikis might enable them to engage in self-regulated learning process of forethought. Also, they state that learners' participation in social interaction and collaboration using social software can engage them in the self-regulation processes of self-monitoring and help seeking to identify strategies needed to perform more formal activities. Finally, they suggest that the engagement of learners in synthesizing and aggregating information allows the learners to attain more control over their PLEs and customize and personalize it around their learning goals by engaging "students in the self-regulation process of self-evaluation" (p. 6).

- *PLE as a means to facilitate collaborative learning*

Collaborative learning refers to a situation that people learn together (Dillenbourg, 1999). According to Attwell (2007), an objective of a PLE is to bring together personal learning and collaborative and organizational knowledge development and learning. As asserted by Boyd (2007), the value and real power of Web 2.0 technologies and social software, as the main technological ingredients of PLEs, is in their sociability aspects. This sociability aspect has changed the way that "participations" spread and people behave by making it feasible to build connections and networks between them. Equipped with this sociability aspect, PLEs can foster interaction and collaborative learning between learners. By getting help of social software, learners can participate collaboratively with each other to the "authorship of content", obtain support and guidance from others, work together as a learning community, and share their resources, knowledge, experiences and responsibilities (Bower et al., 2010). Social bookmarking and RSS services can provide a great way to support students to bookmark, tag, and disseminate information, people, and learning experiences. These tags then can be arranged to develop tag clouds to visualize the ways that students are working and learning (Alexander, 2006). Being able to have access to other learners' tags cloud provide the opportunity for learners to see each other experiences and competencies resulting in being aware of the new streams of information, supporting

vicarious and social learning and triggering learners' reflection (Dabbagh & Rick, 2011). Additionally, as pointed out by Dabbagh and Rick (2011), folksonomy as a context-based mechanism to support social tagging and sharing the personal experiences of people can be seen as the "language of a community to form connections" between the members of the community. In classroom settings students can use this language to communicate and support "socio-semantic networking" and create learning environment through tagging, annotating and sharing web resources and learning experiences.

2.2.4 Environment Dimension

- *PLE as a collection of learner-administrated Web 2.0 tools/ services*

From a technological perspective, PLE-based learning follows a constructivist "learning with technology" approach (Jonassen, 1995). From the perspective of this approach, instead of leaving technology to the hands of instructional designers to "predefine and constrain learning process" of learners, it should be given to the learners to use as a constructing tool supporting their personal development and learning by building their learning environments and expressing what they know.

Downes (2007) describes the essential technological elements of a PLE, including (*i*) tools for managing a personal profile, editing and publishing materials and, retrieving external resources and materials from different websites, (*ii*) mechanisms to support learning, communication, scaffolding, and connecting the PLE to external services (*iii*) means to support 'intelligence' by observing learners' habits in PLEs to direct the learners toward appropriate resources and activities. Sclater (2008) offers three different technological perspectives of PLEs. According to Sclater, a PLE might be: a downloadable client software to be used often as an offline tool having the ability to update itself by downloading necessary content when the learners access the Internet; a collection and made up of several types of externally hosted (social) software that learners can freely choose; or the tools like laptop computers, cell phones, different software and online resources that learners already have and use to support their learning.

An overwhelming number of authors introduced the Web 2.0 and its participatory architecture as the main technological basis for constructing a PLE. Web 2.0 refers to the second generation of Web technologies that allow people to create, publish, exchange, share, and cooperate on information and knowledge in a new way of communication and collaboration (O'Reilly, 2005). Web 2.0 tools and services are receiving intense and growing interest across all sectors of the educational industry as means for facilitating the transformation of learning (Alexander, 2006; Couros, 2010; McLoughlin & Lee, 2010). These tools and services can support creative and collective contribution, knowledge producing and the development of new ideas by students (Nelson et al., 2009). Furthermore, they can provide students with "just-in-time" and "at-your-fingertips" learning opportunities in a way that typical learning management systems cannot (Dunlap & Lowenthal, 2011).

Attwell (2007) defines a PLE as an activity space consisting of loosely coupled Web 2.0 tools, collected by learners to interact and communicate with each other and experts. Downes (2010) says a PLE "is not just Web 2.0, but it is certainly Web 2.0 in the sense that it is (in the broadest sense possible) a read-write application" (p. 5). Within formal education, integrating multiple Web 2.0 technologies and creating multi-tools platforms has been considered by educators who focus on the "social," "open," and "network" as the best strategy for learning (Tu et al., 2015). The rationale for underpinning PLEs with Web 2.0 tools and technologies can be seen from the lens of new tendency toward acquiring learning to learn and lifelong learning skills and competencies. According to new approaches to learning, to underpin lifelong learning competencies "people's information behaviour should change from receiving information from a few super nodes on networks to moving into the information stream themselves and pulling just-in-time information off the networks" (Kop et al., 2011, p.3). Furthermore, it has been emphasized that todays' learners either in formal education or workplaces have heterogeneous learning needs therefore they need a diverse learning environment to cater for these needs (Dron & Bhattacharya, 2007).

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

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

There are several technological approaches to developing and implementing PLEs using Web 2.0 tools and technologies. Wild et al. (2008) proposed an approach to developing multi-tools personal learning environments (MUPPLE) on the basis of the mash-up and

"end-user development" concepts. On one hand, the concept of a mash-up personal learning environment provides adaptation mechanisms for learning environment construction and maintenance by allowing learners to reuse existing (web-based) tools and services. On the other hand, a "end-user development" concept is used to develop a design language model, called as the learner interaction scripting language (LISL), for creating, managing, maintaining, and learning about the design of learning activities and learning environment.

- *PLE as a means to support learner as co-designer/co-developer of their learning environment*

Another perceived objective of the PLE concept is to allow and support learners to act as co-designer/co-developer of the learning environment (Buchem et al., 2011, Drexler, 2010). From the perspective of this objective, the development of a learning environment is per se an important learning process. Also, it assumes the learning environment as a dynamic output of, rather than a static input to, the learning process developed and shaped by learners and instructors using different technologies and resources as a community of learners (Drexler, 2010; Fischer & Scharff, 1998). Addressing these approaches asks for providing the learners with different sorts of technologies and information sources to use and build their learning environment and tailor it to their learning needs. Equipped with different technologies such as RSS, SOAP, RDF, JSON, microblogging, and folksonomies Web 2.0 makes it possible for learners to create useful mashups by combining content and/or services from multiple sources as a means to satisfy their heterogeneous learning requirements (Rahimi et al., 2013a,b,c).

- *PLE as a means to support learner role as prosumer of content*

Content is a key element of a learning environment. Within formal education content mainly refers to formal knowledge assets and course materials or what students need to learn in order to be able to address the standard curriculum's objectives. Traditionally, two approaches have been followed in formal education with regard to content: In the first approach, the responsibility of creating and transferring content has been held by institutions and instructors. Two paradigms have underpinned this approach: "content scarcity" and "unknowing learners" paradigms. According to Weller (2011), for a long time "the economic model which has underpinned many content based industries has been based on an assumption of scarcity" (p.1). This assumption has shaped the pedagogy of scarcity resulted in teacher-driven, content-centric and lecture-based learning environments (Weller, 2011). According to the "unknowing learners" paradigm, the teaching and learning processes in formal educational settings are often fitted "into a mold in which a single, presumably omniscient teacher explicitly tells or shows presumably unknowing learners something they presumably know nothing about" (Bruner, 1996 cited in Fischer (2001, p. 2)). Even VLEs, as the mainstream of technology-enhanced learning environments, were built upon these paradigms and being criticized for setting learners in a rather passive role as followers of course modules at a predetermined pace by delivering and organizing institution-made course content (Downes, 2005).

The second approach to content is based on a breach between "know what" and "know how" in formal education. According to Brown et al. (1989), the current structure of educational systems tend to make a breach between "learning" and "use" or "doing", in favour of the former, by separating "know what" from "know how". In other words, while the primary concern of schools often seems to be the transfer of decontextualized formal concepts, "the activity and context in which learning takes place are thus regarded as merely ancillary to learning-pedagogically useful, of course, but fundamentally distinct and even neutral with respect to what is learned". On the contrary, schools should move from a conception of knowledge as possession of facts and figures to one of knowledge as the ability to retrieve information from databases and use it to solve problems (Brown et al., 1989, p. 32). Along similar lines, McLoughlin & Lee (2010) pointed out that a shift in higher education systems has been emerged "with a growing emphasis on the need to enable and support not only the acquisition of knowledge and information, but also to develop the skills and resources necessary to engage with social and technological change, and to continue learning throughout life." In the same vein, Siemens (2005) states in order to keep ourselves updated in a world driven by relentless changes "know-what", "Know-how" and "know-where" should supplement each other to extend our capacity for more learning.

In contrast to formal education, learning content in workplaces is more contextual and dynamic. The learning content in workplaces refers to the knowledge and expertise required by employees to address their workplace requirements. Hase (2009) conceptualizes workplaces as "moving curriculum" where learning and knowledge arises "from employees' daily activities and interaction with the working environment" (Wang 2009, p. 194). Even in workplaces employees and organizations are experiencing an increasing demand to think "new ideas and adjust learning process in the aim of improving" organizational practices and performance. To this end, as remarked by Wang (2009), "knowledge assets (e.g. learning materials, assessment packages, and discussion messages) accumulated through workplace learning processes should be well organized, updated, and maintained for continuous learning, which may refer to co-creation, mixing, and re-publishing of content in Web 2.0 applications" (p. 194).

PLEs are learning environments built upon the "pedagogy of abundance" (Weller, 2011) where learners have an unprecedented access to content in a variety of formats, including: journal articles, videos, podcasts, vodcasts, slidecasts, wikis and user-generated content such as tweets, and blog posts. Furthermore, armed with forums, wikis and blogs, PLEs support learners not only to access content but also to access discussions around content. Moreover, social networking sites connect learners to experts and knowledgeable people beyond their classroom/work settings. The PLE concept emphasizes defining new roles for learners in creating learning content and considering learner-generated content as an important element of the learning environment. In this regard, McLoughlin and Lee (2010)

argue that the conceived goal of the PLE concept is to enable learners, not only to consume content, but to remix, produce, and express their personal presentation of knowledge. In the same vein, according to Rahimi et al. (2015), a PLE should provide learners with a flexible and collaborative learning space to act as active learners or so called prosumers to apply the provided choices and practice the acquired skills (consumer), and then to develop new choices and acquire skills (producer).

The tendency of the PLE concept towards learner-generated content is in line with the new knowledge development approaches such as content appropriation (Jenkins, 2009) and learner-generated content (McLoughlin & Lee, 2008) which underscore the importance of the learners' capacity to know more rather than what they currently know. Appropriation as the "ability to meaningfully sample and remix media content" (Jenkins, 2009) makes learner simultaneously as the producer and consumer of content and can be understood as a learning process in which learners learn through picking several content (sampling) and putting them back together (remixing) to produce new content and knowledge objects such as ideas, discussions, conversations, comments, replies, concept maps, webpages, podcasts, wikis, and blog posts (Jenkins, 2009).

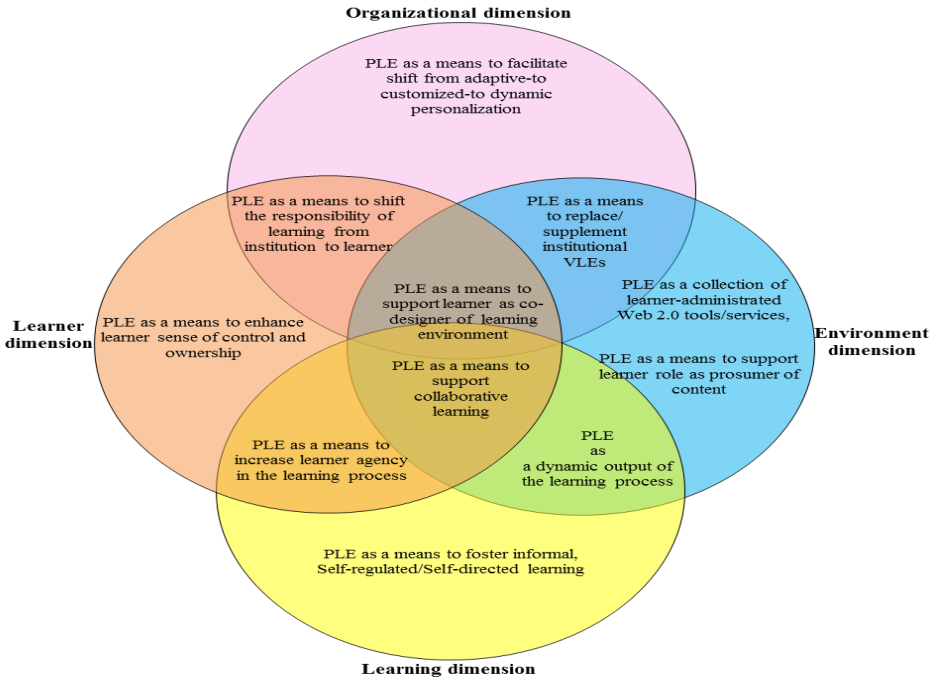


Figure 2.2. The characteristics of the PLE concept

2.3 Answering Research Sub Question #1

Now, we can answer research sub question #1: "What are the theoretical constructs, characteristics and perceived objectives of the PLE concept useful to underpin the PLE design framework?"

After reviewing and analysing the characteristics of the PLE concept we have selected two objectives to be used for underpinning the PLE design framework:

- *Empowering learners to gain control on their learning process,*
- *Facilitating continual development of the learning environment as a shared responsibility of learners and organization.*

These two objectives reflect the characteristics and objectives of the PLE concept presented in figure 2.2. The focus of the first objective is on empowering learner as the main subject of the PLE and the second objective has focused on the co-development of the learning environment as the output of the learning process. There are two reasons behind choosing these two objectives. First, both objectives emphasize the importance of learner agency and activeness in the learning environment. Secondly, the first objective assumes that learners should be supported and empowered to gain control over their learning. This assumption has been echoed by several authors stating that the skills and competencies learners need to gain control over their learning cannot be taken for granted. Rather, developing these skills and abilities goes through a long-term process of interaction between organization/teacher and learners (Zhou, 2013; Valtonen, et al., 2012; Rahimi et al., 2015). These two objectives are complementary and there is a bidirectional relationship between the development of the learning environment and the personal learning and development of the learners. Scardamalia and Bereiter (2006) argue that in order to help learners to acquire the required skills for learning and working in the knowledge-based society, they should participate in designing and developing their learning environments. Along similar lines it has been remarked that the participation of learners in designing and developing their learning environment can strengthen their control on the learning process (Valtonen et al., 2012; Väljataga & Laanpere, 2010; Drexler, 2010).

2.4 Theoretical Groundings for the PLE Concept

The following learning theories and concepts have been suggested in the literature as the theoretical groundings of the PLE concept.

2.4.1 Social Learning Theory

The concept of PLE aligns with the social approaches to learning. The social epistemology on learning suggests "learning occurs through engagement and immersion in authentic social learning situations" (Hutchins, M. & Hutchison, D., 2008, p. 2). From a social learning perspective, "learning is an interactive process of participating in various cultural practices and shared learning activities that structure and shape cognitive activity in many ways, rather than something that happens inside individuals' minds" (Paavola &

Hakkarainen, 2005, p. 538). Also, it has been argued that, optimum cognitive development is a result of the full social interaction of the learners "in a cooperative scenario, [where] the students interchange their ideas for coordinating them to achieve shared objectives. When the problems arise, the combination of activities with communication will conduce to learn" (Vygotsky, 1978).

Jenkins (2009) highlighted a dichotomy between the ways students are trained in educational settings and the learning and working expectations and requirements of workplace settings. Jenkins (2009) argues that many of today's educational institutes follow individual-based rather than social-based instructions approaches to training students as "autonomous problem-solvers". However, when students enter in workplace, they are increasingly being asked to work in teams, share responsibilities, draw on different sets of expertise, exchange and share their knowledge and ideas, and collaborate with others to produce common knowledge and find solutions to solve problems. To address this dichotomy between the instructional approaches of formal education and the learning requirements of the workplace, educational institutes need to adopt social approaches to learning which recognize knowledge building and acquiring of problem solving competencies as "social products" (Chene, 1983).

2.4.2 Self-regulated Learning Theory

Zimmerman (2008) defines self-regulated learning as the learner's ability to independently engage in self-motivating and behavioural process that increase goal attainment. Dabbagh and Kitsantas (2012), described self-regulated learning as a set of skills including setting goals, planning activities to achieve these goals and performing activities to attain the goals. Further, they emphasized the importance of the motivational components of self-regulated learning to help learners persist in the face of difficult tasks and resist other more tempting options. Zimmerman (2008) conceptualized self-regulated learning process as a three phase cyclic model consists of *forethought* (where the learner performs activities such goal setting and planning), *performance* (where the learner begins to engage in behaviours required to attain her goals), and *self-reflection* (where the learner uses the self-monitored outcomes to judge about her learning performance).

2.4.3 Community of Practice (CoP) Theory

Defined by Lave and Wenger (1991), a Community of Practice (CoP) refers to a group of people or members who share a craft, profession, or even a "concern or passion for something they do and learn how to do it better as they interact regularly" (p.1). Downes (2005) has characterized a CoP as "a shared domain of interest" where "members interact and learn together" and "develop a shared repertoire of resources" (p. 6).

Learning in a CoP is occurred informally through "increasing participation", "engagement" and "socialization" where the members learn from each other through the process of sharing information and experiences with the group. This participation gives the CoP's members an opportunity to develop themselves personally and professionally and enhances

their ability to more participate in the CoP (Aarkrog, 2005). As pointed out by Wenger (1998), CoP theory defines engagement in social practices as the fundamental process by which members learn and develop. To this end, each CoP should provide its members with specific individual and collective learning opportunities to reach "full participation" in the CoP through the "socialization process" (Lave & Wenger, 1991). As stated by Lave and Wenger (1998), "Over time, this collective learning results in practices that reflect both the pursuit of our enterprises and the attendant social relations. These practices are thus the property of a kind of community created over time by the sustained pursuit of a shared enterprise" (p. 2).

The centerpiece of the CoP's theory is on the inclusion of the newcomers in the community of practice (Aarkrog, 2005). The newcomer's position and situation as a learner is called "legitimate peripheral participation" (Wenger, 1998). The "legitimate peripheral participation" concept states that a newcomer learns how to participate in the community of practice by listening to, observing, imitating and cooperating with the experienced members of the CoP. Accordingly, from the perspective of this concept, learning is a process of becoming socialized to the CoP and moving from the edge of the community to its center through developing identities and competencies that match that CoP and are required to maintain it (Wenger, 1998).

2.4.4 Knowledge Development Theories

A theoretical basis for learner-driven knowledge advancement is "knowledge creation/knowledge building" concept proposed by Bereiter and Scardamalia (2014). They used the terms "knowledge building" and "knowledge creation" to refer to learner-driven knowledge advancement within formal education and workplace, respectively. According to Bereiter and Scardamalia (2014), both "knowledge building" and "knowledge creation" concepts can be considered as one concept but in different problem spaces, or as they put it: "One Concept, Two Hills to Climb".

When talking about knowledge, a common question coming to mind is about the differences between information and knowledge. Nonaka and Takeuchi (1995) defined information as "a flow of messages" and defines knowledge as "justified information by one's belief". According to Bellinger et al. (2004), information refers to processed data providing answers to "who", "what", "where", and "when" questions, whereas knowledge is the application of data and information to answer "how" questions. Along similar lines, Wang and Noe (2010) considered knowledge as individual-processed information consisting of "ideas", "facts", "expertise", and "judgments" required to support individual, team, and organizational performance. Bereiter and Scardamalia (2014, p. 41) have seen knowledge in three senses: knowledge as a "psychological state-as something in the individual brain" group level knowledge (i.e. knowledge possessed by a sport team), and a "Popperian type of knowledge" implied by terms such as "intellectual property" and "state of the art". This "Popperian type of knowledge", according to Lindkvist and Bengtsson

(2009), "Once created, such knowledge is seen as having something of a life of its own, pregnant with possibilities for further development and use—to be explored collaboratively—in ways which are unimaginable and unfathomable" (p. 1).

Bereiter and Scardamalia (2014) define knowledge as "the product of purposeful acts of creation and comes about through building up a structure of ideas (for instance, a design, a theory, or the solution of a thorny problem) out of simpler ideas " (p. 35). By emphasizing the "purposeful act" aspect in their definition of knowledge they want to make a distinction between "psychological constructivism" and "knowledge creating/building" approaches to developing knowledge. According to Bereiter and Scardamalia (2014), rooted in constructivism learning theories, "knowledge construction is an internal process, usually taking place spontaneously and without awareness" (p. 1). On the contrary, Bereiter and Scardamalia (2014) define knowledge creation/knowledge building as "a type of deliberate, conscious action, which produces knowledge that has a public life" (p. 35). In other words, while the product of "knowledge construction" is individual learning, "the products of knowledge creation are public ideas and artefacts embodying them and that their production is an overt activity that can within limits be planned, guided, motivated, and evaluated much like any other kind of work" (Bereiter and Scardamalia, 2014, p. 36).

From a social perspective, Bereiter and Scardamalia (2014) conceptualize knowledge creation/knowledge building as "the advancement of community knowledge, with individual learning as a by-product" (p. 37). Along similar lines, Paavola and Hakkarainen (2005) define individual learning "as a process of knowledge creation which concentrates on mediated processes where common objects of activity are developed collaboratively" (p. 535). According to Bereiter and Scardamalia (2014), any knowledge creation/knowledge building attempt should support two modes in work with ideas, namely: "belief mode" and "design mode". Belief mode is an inherently individual learning activity comprising evaluation, questioning, arguing, accepting, or rejecting knowledge claims. Design mode is an inherently social learning process that involves all learning activities pertaining to knowledge production and improvement such as "theorizing, invention, design, identifying promising ideas, and searching for a better way" (Bereiter and Scardamalia, 2014, p. 38).

Knowledge management (KM) theory proposed by Nonaka and Takeuchi (1995) describes the process of knowledge creation and transformation within organizations. The main idea conveyed by KM theory states that organizations not only should identify, accumulate and use but also need to create knowledge that enables them to learn and progress (Nonaka and Takeuchi, 1995). KM theory conceptualizes organizations as social learning systems and knowledge management is seen as a wide range of activities used by organizations to identify, accumulate, create, represent, assimilate, and distribute knowledge for reuse, awareness, and learning (Nonaka & Takeuchi, 1995; Chatti et al., 2007).

The centrepiece of KM theory is the SECI model. The SECI model is a knowledge creation model built upon two concepts: distinction between explicit and tacit knowledge, and conversion between these two types of knowledge (Chatti et al., 2007; Wang, 2011). "Explicit knowledge" refers to codified and objective knowledge that can be transmitted in formal and systematic language. In contrast, "tacit knowledge" refers to not codified, subjective, rich and untapped knowledge that resides in individuals such as "know-how", "expertise", experiences and skills (Chatti et al., 2007). The SECI model defines four phases of conversion between tacit and explicit knowledge, namely, Socialization (tacit to tacit), Externalization (tacit to explicit), Combination (explicit to explicit), and Internalization (explicit to tacit). In the 'socialization' phase tacit knowledge is shared among the individuals through informal activities such as observation, listening, imitation, apprenticeship, interaction and plunging in daily activities and challenges. In the 'externalization' phase the acquired tacit knowledge is articulated into explicit concepts including metaphors, analogies, concepts, hypotheses, and models. In the 'combination' phase the explicit concepts are systematized and structured to form explicit knowledge stored in knowledge systems. In the 'internalization' phase the captured and structured explicit knowledge is transferred into action and internalized into different sorts of individual's tacit knowledge through a process of learning by doing (Chatti et al., 2007).

2.5 Developing the Learner's Control Model

As observed earlier, PLEs are increasingly attracting the attention of educational researchers and practitioners as effective technological tools and a pedagogical approach addressing issues of learner's control. Surprisingly, while supporting learner's control appear to be laudable and defensible objectives of the PLE concept, it seems that these notions and the ways of how to attain them very often remain unanswered, vague and too general in PLE literature (Buchem, 2012; Väljataga & Laanpere, 2010). Indeed, affected by the existence of a dominant technology-driven approach to developing PLEs, a common solution proposed to support learner's control is to provide them with a set of Web 2.0 tools and services and to allow them to select and use these tools in a personal way they deem fit. This "gift-wrapping" approach to new technologies and media can at best provide some technological personalization and add-ons to existing practices of students (Fischer & Scharff, 1998) rather than supporting their control and improving the quality of learning (Väljataga & Laanpere, 2010; Rahimi et al., 2014a). On the contrary, as asserted by Rahimi et al. (2014a), to support and enhance learner's control, new technologies and learning theories must together serve as catalysts for fundamentally rethinking and redefining what the pedagogical and epistemic practices of teachers and students can be and should be in PLEs. According to Fiedler and Väljataga (2011), any attempt for corroborating learner's control should facilitate a comprehensive and concurrent shift of control over the full range of crucial instructional components towards an individual learner or a group of them. Based on this view, they conceptualized a PLE as a collection of all the resources that an individual has access to and can turn into instruments to actualize and exert control on the

operational level of crucial instructional components, including learning objectives, strategies, resources, evaluation criteria, and process reflection.

In this section by taking advantage of the above-mentioned learning theories and concepts we propose a learner's control model addressing the perceived objectives of the PLE concept, see Figure 2.3. This model has been developed by adapting the learner's control dimensions model as proposed by Garrison and Baynton (1987). According to Garrison and Baynton (1987), learners' control is not achieved simply by supporting the learners' independency. Rather it can be attained by establishing a dynamic balance between *independence* (i.e. learner's freedom to choose what, how, when, and where to learn), *power* (i.e. cognitive abilities and competencies) and *support* (i.e. learning resources, structures and supports the learner needs in order to carry out the learning process and keep control over learning process) through the process of communication between teachers and learners.

To develop the learner's control model we have taken two steps. First, taking the importance of social learning in the PLE concept into consideration, we decided to extend the *support* dimension in the Garrison and Boynton's model to encompass social support provided by the social context of the learning environment. This decision was based on the understanding that the social context of the learning environment can provide learners with the relevant support they need to keep control over their learning and overcome the difficulties faced during the learning process, and can assist them to make appropriate decisions regarding their learning process. Then, considering the significant emphasis of the PLE concept on learner's engagement and activeness, the power, support and independence dimensions were translated into the active roles a learner should undertake in their learning, namely *knowledge developer*, *socializer*, and *decision maker*, respectively. The learner's control model is based on the assumption that learners in order to be in control of their learning process should act as (*i*) knowledge developer to *achieve control* on their learning by acquiring relevant cognitive capabilities, (*ii*) socializer to *keep control* on their learning by acquiring and utilizing social and help seeking/giving skills, and (*iii*) decision maker to *practice control* on their learning by performing personal learning endeavours and managing and tailoring web tools to their personal needs and preferences. The model also explains how to make a balance between these roles by supporting and encouraging activities for *co-developing knowledge*, *developing personal knowledge management strategies*, *developing personal learning network, and co-constructing the learning environment.* These roles and their interplays will be described below:

2.5.1 Learner as Knowledge Developer

Learning and knowledge development are two sides of one coin (Chatti et al., 2007). By defining the *learner as knowledge developer* the model aims at providing learners with opportunities to use Web technologies to produce different types of content as a means to develop their cognitive capabilities and address their essential need of "mindful engagement" (Watts, 1997). Cognition relates to the conscious mental processes by which

knowledge is accumulated and constructed, such as being aware, seeking answers, knowing, thinking, learning and judging, making generalisations, and testing the hypotheses that they have generated (Barak, 2010; Watts, 1997).

Defining *learner as knowledge developer* aims at preparing learner in response to the rapid and relentless changes in technological, social and knowledge landscapes. As described earlier, these changes have given rise to new challenges to human competence and make it essential to adopt new approaches to knowledge and cognition development manifested in learner-driven knowledge building/ knowledge creation metaphors (Bereiter & Scardamalia, 2014). Built upon these metaphors, recent learning theories are increasingly emphasizing the importance of introducing technology-based learner-centric instructional strategies into education to develop cognitive capabilities of learners by encouraging and scaffolding them to go beyond individual efforts and collaborate for the advancement of knowledge. The pivotal point of far most learning theories and principles states that learning can occur most effectively when learners are actively engaging and participating in making and constructing artefacts that are meaningful to them and can be shared with others (McLoughlin & Lee 2008, Rahimi et al., 2012, 2013a). In the lens of these theories, learning is analogous to an innovative and creative process where something new is created and the initial knowledge is either substantially enriched or significantly transformed during the process. Facilitating this innovative process, among other factors, asks for providing learning resources and support for collaborative knowledge creation (Chatti et al., 2007).

Appropriating and remixing content (Jenkins, 2009) can be used to establish knowledge creation approaches within educational and workplace settings. Empowering and supporting learners to create learning content using Web 2.0 might trigger their individual and social thinking and foster cognitive and metacognitive activities such as analysing, evaluating, synthesizing, and creating digital artefacts. Further, as remarked by Chang, Kennedy et al. (2008) supporting and strengthening learner-generated content approach has the potential to empower learners to negotiate "intellectual authority" with their teachers and improve their control over their learning process. Along similar lines, McLoughlin and Lee (2008) asserted that following learner-generated content approach might trigger individual and social thinking of learners and foster higher level of cognitive and metacognitive activities such as analysing, evaluating, synthesizing, and creating digital artefacts. Web 2.0 technologies have provided unprecedented opportunities to support the learner-generated content approach. Combining the participatory, micro-content, and openness aspects of Web 2.0 facilitates a unique sort of participatory appropriation process known as "collaborative remixability" that recombines the information and micro-content generated by students to create new content, concepts, and ideas (McLoughlin & Lee, 2010; Chen & Chen, 2007; Alexander, 2006). It is noteworthy that the production of content by students should be envisioned as a process rather than an end product aiming at providing opportunities for students to practice higher-order thinking skills using technology. In this regard, Boettcher (cited in Chang et al. (2008)) argues that "the key benefit of learner-

generated content lies in the process of creating, knowledge construction, and sharing as opposed to the end product itself" (p. 168).

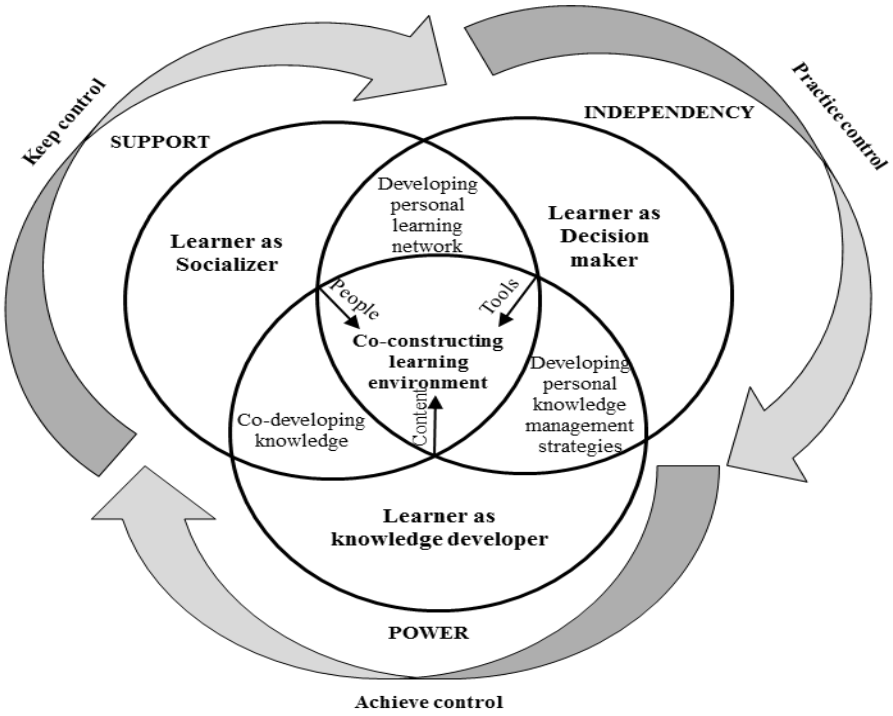


Figure 2.3. The proposed model to support learner's control in the learning process

2.5.2 Learner as Socializer

By defining the *learner as socializer* the model aims to develop social competences and skills among the learners and encourage them to practice and strengthen these capabilities by means of technology. The rationale behind this role says that in order to enhance learners' control they should be provided with appropriate rooms to practice and acquire communication, collaboration, and help seeking/giving skills. Accordingly, by supporting the socializer role the model aims at increasing learner's awareness about the learning potential of the social context in the learning environment and improve his/her ability to exploit this potential to enrich his/her learning experiences. In addition, social supports are needed to succeed knowledge building. On this basis, Bereiter and Scardamalia (2014) define knowledge creation as a cultural practice where learners undertake "collective responsibility for advances in community knowledge" by receiving support to manage different aspects of their learning process including defining problem, setting learning objectives, monitoring advances, and setting work on to a new course.

Interaction is a critical component of social learning. Wagner (1994) defined interaction as "reciprocal events that require at least two objects and two actions. Interactions occur when

these objects and events mutually influence one another" (p. 8). According to Anderson (2003), interaction serves a variety of learning including enhancing learner's control, facilitating the adaptation of the learning environment and programs based on learner input, allowing participation and communication, creation of the learning communities, and realizing one's perspective on a subject. Anderson (2003) describes six types of interaction in online learning including instructor-learner, instructor-content, instructor-instructor, learner-learner, learner-content and content-content interactions. Furthermore, Hillman et al. (1994) presented the concept of learner-interface interaction as a process of manipulating technology by learner to accomplish learning tasks. More recently, Dron (2007b) considered "group*"* as a first class object in social software and Web 2.0 technologies that has an existence in its own rights. Accordingly, he defined four further interactions in Web 2.0-based learning environments, including: learner-group, instructor-group, content-group, and group-group.

While the above interactions are related to the learning environments within formal education, Attwell (2010a,b) enumerated a series of interaction within workplace learning environments including: (i) the interaction between "more knowledgeable other" or MKO and learners. The more knowledgeable other refers to "anyone who has a better understanding or a higher ability level than the learner particularly in regards to a specific task, concept or process. Traditionally the MKO is thought of as a teacher, and older adult or a peer " (Attwell, 2010b, p. 3), (ii) the interaction between learners themselves, (iii) the interaction between learners and the wider community including formal educational institutions, communities of practices, or local or extended personal learning networks, and (iv) the interaction between learners and technology which mediates other interactions and also learning.

2.5.3 Learner as Decision Maker

By defining the *learner as decision maker* the model aims at preparing learners to become autonomous learners by providing them with appropriate choices and confronting them with situations that require them to make decisions about their learning independently. It can be argued that providing learners with appropriate choices and allowing them to practice decision making regarding their learning process can improve their metacognition knowledge and abilities to make informed and wise decisions which are key elements of self-regulated learning process. In this regard, as contended by Boekaerts (1999), one of the key issues in self-regulated learning is an individual's ability to select, combine and coordinate different strategies in an effective way. Dron (2007a) has connected the concept of control to the choices, either made by teacher/manager or learner. On this basis, he commented that one measure of a "mature learner" is to become more capable of making relevant and effective choices with respect to their learning experiences. Accordingly, he concluded that providing learners with decision-making opportunities regarding the educational process is a prerequisite for them to move from a "state of dependence" to "one of independence."

To support the role of the learners as the decision maker there are several opportunities within educational settings, including:

- Providing learners with appropriate choices in terms of pedagogical choices (i.e. subject, learning strategies, learning goals, evaluation methods), social choices (i.e. people with whom to engage in learning, peers to share knowledge, functional role in group, communities to join), and technological choices (i.e. web-based resources, tools, content, content format, time and place for learning) to be used to support and pursue their personal learning pathways (Dron, 2007a).
- Providing learners with a personal space to be used as an activity space to work with web tools and pursue their personal learning experiences; and involving them in choosing, evaluating, and exploiting relevant web artefacts (Rahimi et al., 2014a, 2013a).

In formal education the growing heterogeneity of available web-based tools and resources is influencing the educational process by changing the dilemma of teachers and students from a perceived lack of choice and accessibility to choose wisely from increased options (Couros, 2010). As a result, making decisions regarding to selecting, evaluating, accessing, and exploiting the most appropriate technology to drive teaching and learning process is becoming more and more complicated, prevalent, and indispensable processes in today's learning (Väljataga et al., 2007; Johnson & Liber, 2008). Further, the features and functionalities of Web 2.0 tools are considered to be in "a state of perpetual beta" (O'Reilly, 2005). On this basis, we argue that the permanent and extensive contact of students with web 2.0 tools and technologies besides "unceasing development" of these tools can posit students as pioneer explorers of new learning functionalities and potential of Web 2.0 tools and, consequently, can provide great opportunities for students to negotiate the structure and design of courses with their teacher through finding, assessing, and introducing relevant web tools and artefacts to be used for designing appropriate web-supported learning activities (Rahimi et al., 2014a, b).

2.5.4 The Interplay Between the Learner's Roles

As shown in Figure 2.3, the defined roles are interconnected and have interplays as below:

- *Co-developing knowledge*: refers to the interplay between the knowledge developer and socializer roles, and represents the socio-cognitive activities resulted from individual and collective actions of students such as: questioning about the content, giving and receiving feedback, commenting, content recommending, rating, knowledge presenting, knowledge sharing, and collaborative remixing and authoring of content.
- *Developing personal knowledge management strategies*: relates to the interplay between the knowledge developer and decision maker roles and represents the personal strategies and mechanisms for managing knowledge such as filtering, personal bookmarking, developing a personal strategy to evaluate web content, and developing a personal dashboard of web tools and services to support content producing activities.
- *Developing personal learning network (PLN)*: refers to the interplay between the socializer and decision maker roles and represents the individual-driven learning activities

initiated by learners to enrich and extend their learning experiences through collecting experts and forming connection with them.

- *Co-constructing the learning environment*: refers to the interplay between the knowledge developer, socializer, and decision maker roles. As described earlier, involving learners in constructing the learning environment is one of the objectives of the PLE concept. From the lens of the learner's control model, the learning environment is a dynamic outcome of the learners' shared practices and endeavours around producing/sharing content, using and learning with provided learning choices, and learning with peers and connecting experts and more knowledgeable. This approach to learner-driven constructing of the learning environment conceptualizes the development of the learning environment as a shared responsibility of learners is in line with knowledge building and creating approaches defining leaning " as a process of knowledge creation which concentrates on mediated processes where common objects of activity are developed collaboratively" (Paavola & Hakkarainen, 2005).

Conclusions

Reviewing the PLE literature in this chapter has provided us with a comprehensive picture of 'organization', 'learner', 'learning' and 'environment' characteristics of the PLE concept. As realized in this chapter, there is a duality in the literature between the notions of personalization as emphasized in the PLE research and as referred to in research on adaptive and intelligent tutoring/learning systems. On the one hand, PLE research refers to personal or "tailored by the user" learning to emphasize the importance of personal activity and agency of the learner in the learning environment. On the other hand, in the adaptive learning research personalization refers to "tailored by an external entity" learning where an external entity such as the system, instructor, or organization adapts or personalizes the learning process (Buchem et al., 2011).

As observed in the literature, facilitating and supporting personal learning asks for empowering learners and involving them in constructing and evolving the learning environment. This observation has led us to define two objectives for the PLE concept, being: enhancing learners' control on the learning process, and facilitating continual development of the learning environment as a shared responsibility of learners and the organization. These objectives along with relevant theoretical concepts then served to develop a learner's control model that assumes learners as decision makers, knowledge developers, and socializers in the learning environment. By defining these roles the model seeks to increase personal agency and activeness of the learners in the learning environment and empower them to gain more control on the learning process. In other words, these roles can be envisioned, as the needs learners should address in order to achieve control over their learning.

In next chapter the learner's control model will be used to address two objectives: first, it will be used as an input to a conceptual framework meant to integrate Web 2.0 technologies

into educational practices in the context of a secondary school. Secondly, the learner's control model will be used to examine how implementing this conceptual framework might affect learners' control over their learning and identify the elements in the learning environment enhancing and/or diminishing learners' control.

3 Exploring the Ways Students Configure Their Learning Process When Participating in Constructing the Learning Environment[2]

As elaborated in the previous chapter, enhancing learners' control over the learning process and facilitating their engagement in constructing the learning environment appear to be the essential objectives of the PLE concept. The focus of this chapter is on exploring the ways students configure their learning process when they are supported to participae in constructing the learning environment. Accordingly, in this chapter the research sub question #2 will be answered: *"How do learners configure their learning process when constructing the learning environment using Web 2.0 tools?"* To answer this research question we conducted a design-based research in a first grade class in a secondary school in the Netherlands consisting of 29 students (18 girls and 11 boys, aged 11-13 year).

In this chapter the terms student(s) and learner(s) are used interchangeably.

3.1 Research Design

As described earlier in chapter 1, figure 3.1 represents the followed steps to conduct design case 1 in a secondary school to capture the learners' views (unit of analysis 1) on the design of a PLE and answer to the research sub question #2. Following the phases of DBR (Reeves et al., 2005), first through a cooperation between the researchers and practitioners (i.e. teachers and school's board) a learning problem in the research context is identified. Then, a theory-informed solution for addressing the identified learning problem is proposed. Thereafter, the proposed solution is implemented and evaluated in practice. Finally, the derived empirical results will be used to answer research sub question # 2.

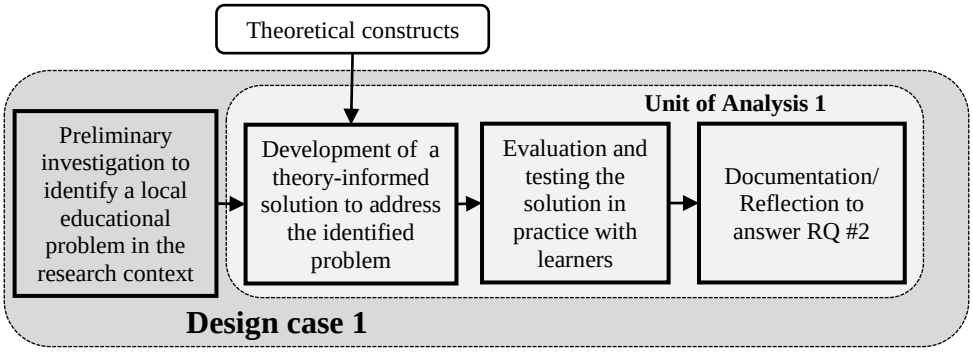


Figure 3.1. The followed steps in the design case 1 unit of analysis 1 (students' views) to answer research sub question #2

3.2 Preliminary Investigation to Identify a Local Educational Problem

As detailed in the first chapter, the first step in a design-based research is about identifying a learning problem in the research context in a joint cooperation between researchers and

[2] This chapter is based on Rahimi, van den Berg, Veen (2015).

practitioners. This research was conducted in the context of the Amadeus Lyceum secondary school in the Netherlands. The Amadeus Lyceum is an innovative school that utilizes culture and art as vehicles for learning by providing education in dance, drama, visual arts, audiovisual design and music. The students of this school learn how to discover the narrative strength of their cultural heritage and the values of different religions and how to use art as a messenger of the modern society. This school has underpinned its educational system by four core values: personal development, self-expression, creativity, and dialogue. Furthermore, shifting from traditional one-size-fits-all educational approach towards individualized and personal learning is one of the educational objectives of this school. To realize its objectives, the school has adopted student-centric instructional approaches such as learning-by-doing and project-based learning, in addition to lecture-based methods. As a part of these instructional approaches, students are challenged and stimulated through learning projects, encouraged to take responsibility over their learning, and assisted by receiving personal supports from their teachers and mentors.

Emerging Web 2.0 technologies have attracted the attention of the school's teachers and board as means for addressing its educational objective. The teachers in this school have been looking for appropriate models to integrate Web 2.0 technologies into their curriculum to enrich the educational practices and get students engaged in shaping and following their personal learning pathways. As the first step, the school has provided students with personal laptops and controlled Internet access to be used during school time to arrange their educational tasks. Further, the school has launched a new electronic learning environment with several functionalities for teachers and students to work around their courses and assignments. However, this new learning environment is following a top-down teacher-driven educational approach and acting like a walled garden. Accordingly, this school lacks an appropriate pedagogy-driven model to integrate Web 2.0 technologies into educational practices as a means to facilitate personal learning and agency of students and get them engaged in constructing the learning environment.

3.3 Development of a Theory-based Solution to Address the Identified Learning Problem

We take advantage of the definition of the PLE design framework (please see definition 1.3 in the first chapter) to propose a theory-based solution to address the identified learning problem in this school. According to this definition, an e-learning solution for supporting personal learning should comprise four main components: core principles of personal learning, design principles, technological components, and implementation guidelines. Based on this definition, a solution for addressing the identified learning problem has been proposed as shown in figure 3.2. The proposed solution consists of four components: the learner's control model, learning scenarios and activities, the learning potential of Web 2.0, and learner-centric instructional approaches.

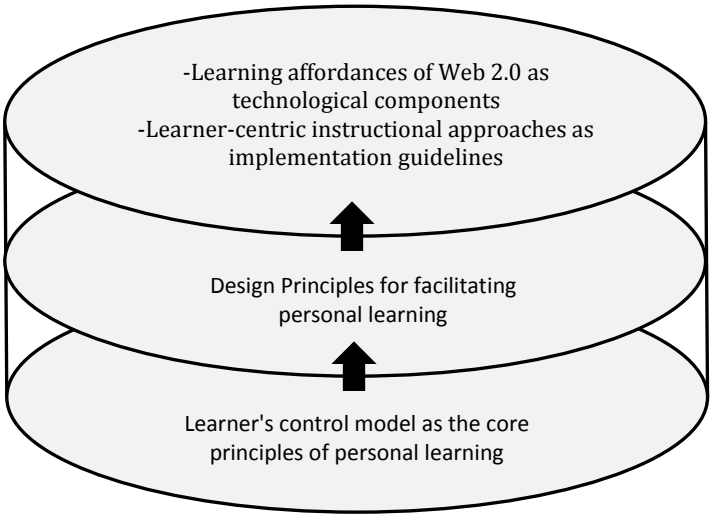


Figure 3.2. The proposed solution to integrate Web 2.0 technologies into educational practices and facilitate personal learning and agancy of students
(Based on the definition of the PLE design framework in chapter 1)

3.3.1 Learner's Control Model

The learner's control model defines the core principles of personal learning in the proposed solution. As described in chapter 2, the learner's control model introduces three interrelated roles for a learner within the learning process, being: the learner as decision maker, the learner as knowledge developer, and the learner as socializer, to facilitate personal learning and empower learners to gain control over their learning process.

3.3.2 Design Principles for Facilitating Personal Learning

To enact the core principles of personal learning expressed in the learner's control model the following theory-derived design principles are suggested:

- Providing students with appropriate learning resources in terms of technological, pedagogical, and social choices to support their role as decision maker, socializer, and knowledge developer (Dron, 2007a),
- Providing each student with a personal activity space to build and manage his/her learning environment and perform personal learning activities (Attwell, 2007),
- Promoting and facilitating learner-(co)generated content approach to support the learner as knowledge developer and socializer role (McLoughlin & Lee, 2008).

These design principles are meant to inform designing appropriate learning scenarios and activities by teachers in order to scaffold and encourage students to act as knowledge developer, socializer, and decision maker.

3.3.3 The Learning Potential of Web2.0 Tools and Technologies to Support Learner's Control Model

The learning potential of Web 2.0 forms a part of the third key component of the proposed solution. As detailed in the previous chapter, the learning potential of Web 2.0 tools and

technologies is expressed in the following key features: Social software (i.e. the architecture of participation), micro-content (i.e. the learner-generated content in terms of blog posts, tweets and so on), openness, folksonomy (i.e. dynamic and socially/collaboratively constructed user-generated taxonomies in contrast to hierarchical taxonomies created by experts in a discipline or domain of study), and sophisticated interfaces (i.e. the drag and drop, semantic, widget-based websites created by using AJAX, XML, RSS, CSS, and mashup services). Figure 3.3 maps these features into the learner's control model and illustrates how the learning potential of Web 2.0 might help students to keep control over their learning process.

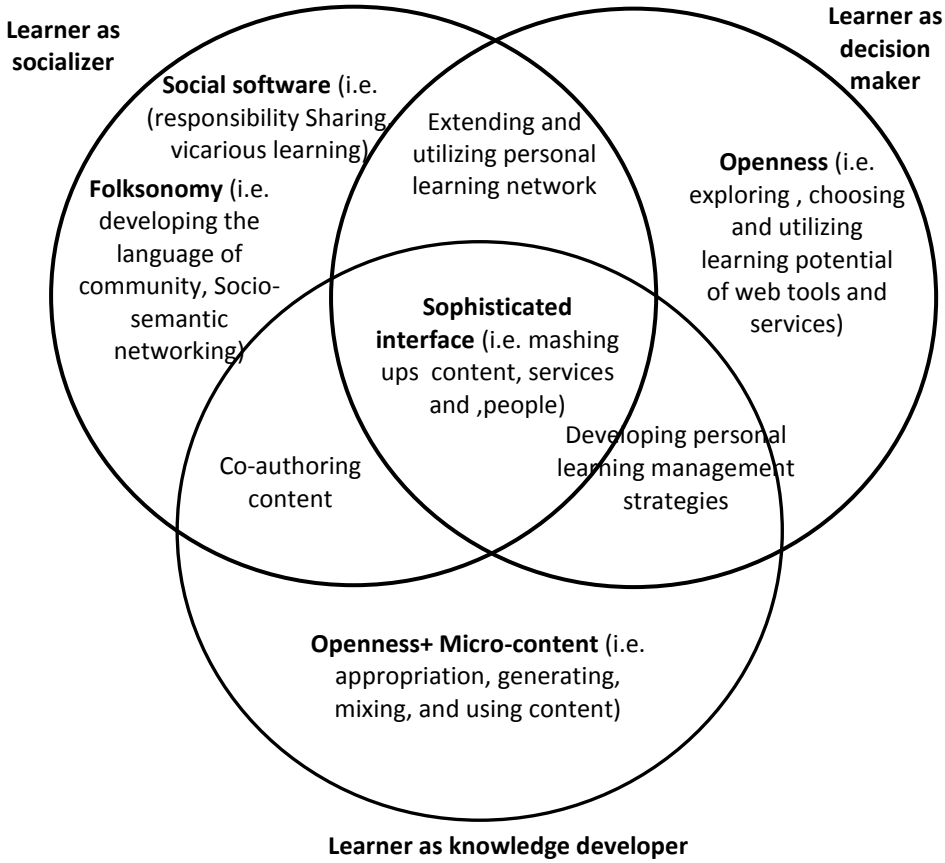


Figure 3.3. Mapping the learning potential of Web 2.0 into the learner's control model (Rahimi et al., 2014b)

According to this mapping, taking advantage of the openness and micro-content features of Web 2.0 tools and services can improve the cognitive capabilities of students by involving them in the active process of appropriating, generating, mixing, remixing and using content (McLoughlin & Lee, 2010). Also, the sociability aspects of Web 2.0 embedded in social software and folksonomies can provide students with appropriate learning materials,

emotional, motivational, and behavioural supports and can stimulate them to act as active seekers of the required support. These sociability aspects offer students learning opportunities that are in line with their normal ways of learning and can enable them to integrate the explicit and tacit dimensions of knowledge (O'Reilly, 2005). Further, the open nature of Web 2.0 provides students with an unprecedented opportunity to explore, choose, and take advantage of the learning potential of web tools and services to be autonomous learners. Finally, the sophisticated interface of Web 2.0 tools and services enables students to easily design, develop and evolve their learning environments by mashing up different sorts of content, services, and people.

3.3.4 Learner-centric Instructional Approaches

Learner-centric instructional approaches are meant to be used as the implementation guidelines of the proposed solution. Supporting learners's control requires adopting activity-based and student-centric instructional approaches by teachers such as project-based learning (Chen & Chen, 2007), problem-based learning (Savery, 2006), and inquiry-based learning (Magnussen, Ishida & Itano, 2000). These learner-centric instructional approaches can enhance the dimensions of the student's control in the following ways: first, they can support the capability dimension through involving students in cognitive activities such as engagement with complex problems and projects and pursuing solutions to them, collecting and analyzing data, drawing conclusions, and creating and presenting artefacts. Second, these approaches can develop the social skills of students through communicating their ideas and findings to others, and promoting them to work collaboratively in groups to develop a viable solution to the defined problems or achieve the projects objectives. Third, they promote students to acquire personal and metacognitive skills such as designing plans or experiments, time and project management, making predictions, selecting appropriate content, choosing relevant web tools, engaging in self-directed learning, applying their new knowledge to the problem, and reflecting on what they learned and the effectiveness of the strategies employed. Finally, by involving students in whole/entire phases of the learning process, these instructional approaches can enhance the student's self-motivational beliefs and ownership and create a sense of accomplishment and control for students (Kearsley & Shneiderman, 1998).

3.4 Implementing and Evaluating the Proposed Solution

To implement the proposed solution and examine its influence on the students' engagement in constructing their learning environment, we conducted a field study in a first grade class of this school consisting of 29 students (18 girls, 11 boys) aged from 11 to 13 year old. As a part of their geography course a learning project titled "designing and building a digital travel guide" for a country of their interest was defined. The experiment lasted 8 weeks. During this period the students were working on their projects in 2-h sessions twice per week. Prior to starting the project, a survey was administrated among the students to collect some information about the participating students including their demographic information, and their previous experience with the PLE concept and using Web 2.0 for learning purposes. The results of the survey revealed that although many of the students were

familiar with Web 2.0 tools such as Facebook, Twitter, and Hyves (a Dutch social networking service), they had no previous experiences with technology-based student-centric learning. All students owned their laptops and could use them to manage their learning requirements during the school time. The teacher was a young, high technology literate man, enthusiastic to adopt and implement new technologies and learning concepts in his courses. At the beginning of the project, the students were grouped in five-person teams and all teams were asked to develop a separate digital travel guide. In order to address students' personal learning interests and to encourage them to participate (partially) in choosing their learning objectives, each team was asked to choose its country of interest to develop the travel guide accordingly. However, all teams selected Egypt. The students' access to the Internet was extended during the project time. Based on the defined design principles, a set of learning activities was designed by the teacher and the principal researcher to orchestrate students' activities around their roles as decision maker, knowledge developer, and socializer (Table 3.1). It is important to notice that these learning activities were not meant to restrict the personal endeavours of the students. Rather, they aimed to provide general guidelines for students during different phases of their learning process. An initial set of Web 2.0 tools was made available and introduced to the students to perform these learning activities. The role of the teacher in the project was that of the facilitator for guiding students whenever and wherever they needed support.

Table 3.1. Suggested learning activities and tools to facilitate personal learning experiences of students

Student's role(s)	Learning activities derived from the design principles	Provided technological choices
Knowledge developer	Observing several web-based travel guides, conducting research about Egypt, aggregating/filtering content and web feeds, building the travel guide	Search engines, Wikipedia, Google reader YouTube, web hosting & building tools
Socializer	conducting group mind mapping to design the structure of travel guide, participating in digital story telling	Email, Twitter, Hyves, Google Chat, MindMeister, Google Docs
Decision maker	Planning and timing the different steps of their project, creating personal set of web tools and resources, Expressing their progress	Google calendar, iGoogle, Blog

3.4.1 Operational Research Questions, Data collection and Analysis Process

The main objectives of this research are to examine the influence of the proposed solution on facilitating the students' engagement in constructing the learning environment and realizing the learning process students go through when constructing their learning environment. To address these objectives we identified three sorts of evidence: (i) the main learning functions of the model as perceived by the participating students and teachers, (ii) the learning activities accomplished by the students, and (iii) the challenges experienced by the students and teachers during the project. Then these findings are mapped onto the learner's control model in order to draw a clear picture of their influence on learner's control dimensions. Accordingly the below-mentioned operational research questions guided the data collection and analysis processes:

- *What are the learning functions or benefits of the proposed solution perceived by the students and teacher?*
- *What are the learning activities accomplished by students during the project?*
- *What are challenges faced by students and teachers during the project?*

For the purpose of this research, we collected data using several methods including documentation (i.e. teacher notes, emails and researcher field notes), physical artefacts (i.e. the PLEs constructed by the students using iGoogle, personal blogs, students' reflections on their experiences during the project, and final travel guides), and direct observation of the class over eight weeks, one 2-h block per week by the research team. Two semi-structured group interviews were conducted with eight students (5 girls, 3 boys) at the end of the project. These interviews lasted between 45 and 65 min. Further, three interviews, lasting between 45 and 75 min were conducted with the teacher and another teacher involved in the project as representative of the school's administrators, at the middle and end of the project. Also, after each session a meeting between the researcher and these teachers was held to evaluate whole session including evaluating the processes that students went through, the challenges and problems faced by the teacher and students, and learnt lessons. Further, we conducted an interview with the teacher six months after finishing the project in order to investigate the possible long term impacts of the PLE project on the structure of the learning environment and learning behaviour of the students.

To answer the first operational research question we went through the following analysis process: The first phase of the analysis procedure included transcribing audio data, entering collected data into Atlas.ti software and conducting the coding process. In order to allow for emergent functions out of the model, no pre-defined categorizations were used to code the data. The analysis process continued by reading the transcripts and assigning freely named codes to the descriptions. This phase resulted in 72 different codes. The second phase of the analysis process involved reading the transcripts organized by codes, writing memos, recoding and merging similar codes as necessary, grouping codes into categories, creating network diagrams by establishing relationships or links between codes, and writing up conclusions. This process was done several times resulted in yielding ten different learning functions. These functions are explained in the next section.

To answer the second and third research questions we followed the below process: First by reviewing the collected qualitative data the learning activities accomplished by the students and also the problems and challenges they faced with during the project were identified. The identified learning activities and problems were categorized, re-categorized and refined several times. These results then informed a questionnaire containing the detailed list of the identified learning activities and problems which was administrated among the students a week after finishing the project. In this questionnaire the students were asked to determine the learning activities they accomplished and the problem they faced with during the project. Furthermore, in this questionnaire the students' perceptions regarding different

aspects and learning impacts of the project was captured. The answers of the students then were analysed and visualized using Microsoft Excel.

3.4.2 Results

- The identified learning functions/benefits of the proposed solution

As described earlier, conducting qualitative research methods and analysis has led to recognizing ten different learning functions for the proposed solution. Additionally, figure 3.4 presents the perception of all participating students regarding different aspects of their learning experiences in the project including the identified learning functions captured using a 5-scale Likert questionnaire. We use these two sorts of results to describe the learning functions and benefits of the proposed solution.

a) Broadening Technological and Content Choices

From the students' perspective, the PLE project had broadened their technological and content choices through extending their access to the Internet. Due to this extended access to the Internet, the students were able to access more web sites which were inaccessible through the school's network before running the PLE project. This fact was reflected in the questionnaire's results in figure 3.4. Surprisingly, this aspect of the project was perceived by the participating students as the most favorite function of the PLE project (i.e. item: *I like the PLE project as it extended my access to the Internet*, Mean = 4.17, SD = 1.07).

b) Feeling ownership and responsibility over learning

The learner-centric and activity-based nature of the project had caused the participating students to take more responsibility over their learning process. Further, participating in the PLE project had provided them with a great opportunity to develop their learning environment and assume ownership over it. The following quotes by two students reflect these perceived learning functions:

When you are provided with more control in accessing the Internet and choosing and planning your learning activities, you feel yourself more independent and responsible and as a person who owns her work. At the beginning, I took pleasure of this extended freedom for fun, but after a while I started to use it for my learning…Using iGoogle is very useful; especially when you find a useful gadget then you can add it to your iGoogle page and work with it. Also you can share your gadgets with your friends and show your iGoogle page to your family and friends as a part of your learning environment (Students #1& #10).

Moreover, this perception has been reflected in figure 3.4 (i.e. item: *I like to be able to show my iGoogle page to others*, Mean = 3.41, SD =1.01).

c) Practicing digital responsibility

The PLE project had provided students with appropriate opportunities to be aware and practice digital responsibility required to become responsible users in using technology. In this regard a student mentioned his reaction in his blog as follows:

Because of the PLE project all sites have been de-blocked for us and if we do well as a class then they [school administrators] will do the same for the whole school! Therefore, we should respect this freedom and not abuse it. (Student #14, blog post)

As shown in figure 3.4, more than half of the participating students perceived the PLE project as an opportunity to practice digital responsibility to be more responsible regarding using the Internet (i.e. item: *The PLE project caused me to feel more responsible in using the Internet*, Mean = 3.55, SD = 0.985).

d) Improving the students' ways of learning

The cloud-based and collaborative functionalities of the introduced web tools including Google Docs and MindMeister have been perceived by students as very useful to support their daily learning tasks. This learning function is expressed in the following quotes:

Previously, during our group working on a document, all group members had to seat around a computer, which was annoying and non-comfortable. Now, by using Google Docs we can work on a same document through our laptops in a more efficient and comfortable way. Also we can continue working on the document at home. (Student #2, interview)….*You can do mind mapping in a piece of paper or on a white board but I think it is more useful when you do it in MindMeister. Because then you have it in a digital format and you can share it or put it in your blog to receive the teacher's or other students' feedback and comments on it.* (Student #3, interview)

In addition to the qualitative results, this learning function has been reflected in the questionnaire results (i.e. item: *the provided web tools made group working much easier*, Mean = 3.72, SD = 1.19).

e) Improving students' technical and web skills

Participation in the PLE project gave the students the opportunity to get acquainted and work with different web 2.0 tools for their learning purposes. This fact has been reflected in the teacher's quote as below:

Undoubtedly they've got technical knowledge in the process of developing and using their PLEs. It is the direct result of working with PLEs. Because they have to work with certain tools and, even though some of them perhaps have little knowledge about these tools and can work with them slightly, they have to learn how to work with these tools, so acquiring the technical knowledge is an evident outcome of PLE-based learning.

The results of the questionnaire confirm the impact of the PLE project on this aspect of the students' learning experiences as well (i.e. item: *the PLE project helped me to work and learn with useful web tools*, Mean = 3.59, SD = 1.11).

f) Supporting collaboration and networking

The social functionalities of Web 2.0 tools provided the students with great opportunities to collaborate and communicate with each other, their teacher, and also people outside of the classroom to develop their projects. Besides supporting within group and class communication, these tools have increased their control over time and place of learning by extending their communication and working outside of the class time and boundaries. Furthermore, the students' perception regarding the usefulness of the provided web tools to support and facilitate group working has been shown by figure 3.4 (i.e. item: *the PLE project provided me great opportunities to practise real group working*, Mean = 3.93 , SD= 0,961).

g) Practicing cognitive activities

From a cognitive perspective, the project was a great opportunity for students to practice several low-level and high-level cognitive skills including searching, reading, brain storming, and storytelling, mind mapping, analysing, evaluating, and creating digital artefacts. With regard to cognitive activities, the project has highly been appreciated by the teacher as he asserted:

In this project the students performed great collaboration, deep brain storming, and complex mind mapping. For example, to help them to create a mind map about the structure of travel guide, I defined a default and simple mind map, and you can see that their mind maps are really great and very complex. It is a result of real group working. It seems that they already are learning how to do research and they are following a scientific process.

h) Promoting communication about technology

Participating in the PLE project provided appropriate opportunities for the students to communicate around technology by finding and sharing many new web tools and gadgets useful to support their learning tasks. The teacher remarked the impact of the PLE project on nurturing and encouraging the social interaction and communication between the students about technology as below:

The PLE project had a great impact on encouraging the students to communicate about technology by finding and introducing tools to each other and their teacher. During the project time the students really were listening to each other and trying to co-explore and-experience the relevant tools. I think that is a logical social interaction which comes out of this kind of technology-based educational form.

In addition to the teacher, the perception of the participating students regarding this learning function was positive as shown in figure 3.4 (i.e. item: *Participating in the PLE project encouraged me to find, describe and share gadgets and web tools*, Mean = 3.43 , SD= 1,06).

i) Supporting the establishment of a student-centric learning environment

The learner-driven and explorative nature of the PLE project had provided appropriate opportunities for the teacher to take advantage of the students' personal endeavours with technology to establish a student-centric learning environment. During the experiment, students were trying to exploit the learning potential of the provided technological choices and suggest their findings to their teacher and peers. Furthermore, as asserted by the teacher, the PLE project has great potential to reveal the ways that students use and learn with technology as well as their technological, cognitive, and social preferences and needs. These insights had promoted the teacher to adjust his teaching process in line with the students' needs and preferences:

It seems that a PLE is not only introducing some tools for students. By using a PLE, everything has to be changed such as assignments, assessment methods and the teaching process. For instance, by introducing Google Docs to the students and realizing its useful functionality and also students' tendency to this tool, I've changed my teaching process and tried to focus and emphasize social and group working activities which could be supported by Google Docs. Further, during observing students' working in class, I realized their tendency towards using animation and graphical content. This triggered me to think that for teaching specific subjects, it is better to use these formats. To do so I've changed my teaching practice and materials.

In addition to the teacher, the participating students expressed their positive perception regarding the student-centric nature of the PLE project as shown in figure 3.4 (i.e. item: *I like the PLE project because I had freedom to follow how to study and learn*, Mean = 3.83, SD = 0,96).

j) Increasing the students' awareness about the learning benefits of Web 2.0 tools

As mentioned earlier, in order to investigate the possible long term impact of the project on the students' behaviour the teacher was interviewed six months after finishing the project. The teacher illustrated the long term impact of PLE project as below:

It seems that the PLE project has increased their awareness about the learning benefits of web tools and improved their attitudes toward these tools. What I see is that, now, they do tend to use more digital tools and the PLE project has made them aware of this fact that there are many different tools useful for their learning and they are easily inclined to use these tools such as Google sites, Mindmeister, Blog, Prezi or Google Docs for their learning purposes.

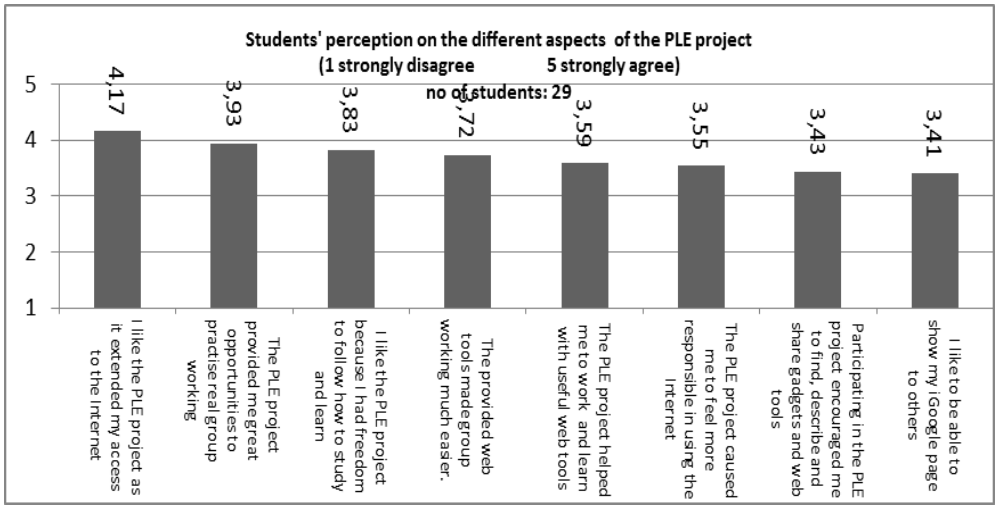


Figure 3.4. The perception of the participating students on different aspects of their learning experience in the PLE project

- The accomplished learning activities by the students during the project:

Figures 3.5, 3.6, and 3.7 present the results of the questionnaire regarding different types of learning activities accomplished by students during the project. The results also include the number of students who accomplished each type of activity. Figure 3.5 presents the accomplished learning activities pertain to the knowledge developer role of students. As shown in this figure, a majority of students participated in performing several cognitive activities including: searching the web to find, read, and use relevant facts, concepts, and procedures about travel guides and Egypt; practicing in mind mapping, storytelling, brain storming and creating web site; synthesizing, mixing, and organizing content; utilizing several formats of information; and blogging.

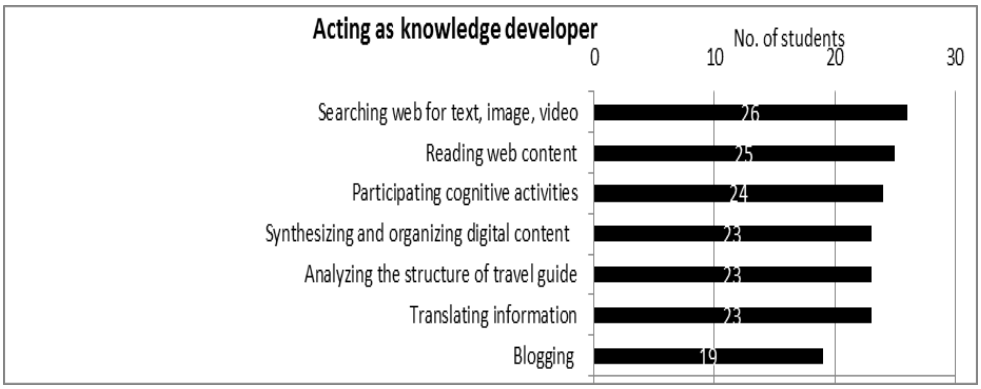


Figure 3.5. The accomplished learning activities by the students pertain to their role as knowledge developer

Figure 3.6 shows the social learning activities accomplished by the students. According to this figure, participating in the project triggered performing six types of social learning activities among the students including: communicating with teacher through blogs, email, and Twitter; job sharing, collaborating and discussing with other students about the structure and content of travel guides; helping each other to solve faced technical problems; and communicating around technology. Surprisingly, in addition to promoting social activities within the classroom setting, participating in the project motivated many of the students to follow informal learning activities by asking support from their family members and students and teachers in other classes.

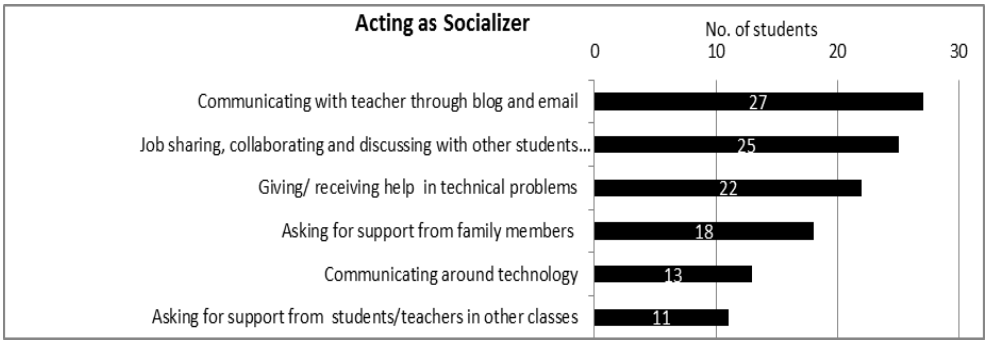


Figure 3.6. The accomplished learning activities by the students pertain to their role as socializer

Figure 3.7 shows the accomplished learning activities by students pertain to their role of decision maker. According to these results, the students had done five types of individual-driven learning activities include (i) *managing technology* through creating accounts, dealing with technical problems, bookmarking, identifying new web tools, (ii) *following instruction* i.e. accomplishing assignments and following guidelines, (iii) *practicing identity building and ownership* through customizing and personalizing their iGoogle pages and blogs, trying to make their own blog attractive, showing their personal page or blog to family or friends, (iv) *self-managing* their learning process through exploring the affordances of web tools and gadgets and using them to support the learning tasks of other courses, and (v) *practicing digital responsibility* through using technology for non-school tasks. In encountering with the distracting situations such as gaming and using technology for non-learning purposes, the teacher always tried to follow an open approach to remind them their responsibility about their work, group and school.

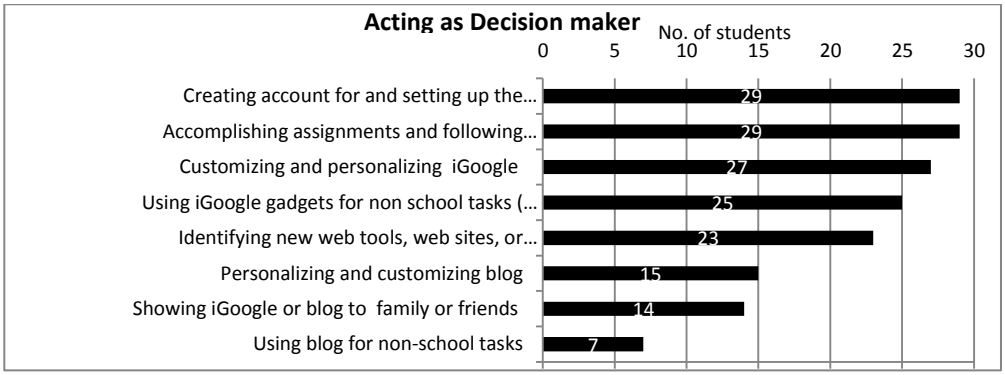


Figure 3.7. The accomplished learning activities by the students pertain to their role as decision maker

- The Challenges Experienced by the Participating Students and Teacher

Conducting the project was not straightforward and trivial for the teacher and students as they faced several problems and issues. Figure 3.8 illustrates the type and frequency of the faced problems by students. Technical problems caused by several sources including having difficulty in creating and managing several accounts for different tools, forgotten passwords, and inconsistency between web tools and operating systems. As asserted by the interviewed students and teacher, the challenges caused by these technical problems were frustrating, stressful, and demotivating for students and teacher, especially at the beginning of the project. The second type of the faced problems by the students and teacher pertains to the social aspect of the project including struggling with job sharing, group coordination, peers' disagreement about the structure and content of travel guide, and social loafing issues. Indeed, this project was the first technology-based group working experience for most of them and they could easily be distracted by difficulties in technology or group working issues.

Content issues were identified as the third category of the faced problems in this project. As shown in figure 3.8, many of the students reported content issues including having difficulty in finding appropriate web content to construct their travel guides, inability to evaluate the quality of web content, and difficulty in translating content from other language to Dutch. As a result, although the Internet provided them with a repertory of content resources to use and build their travel guides, the quality and accuracy of the content they used to build their travel guides has been called into question by the teacher as below:

Instead of focusing in content and quality aspects of it, the students were mainly busy with look and feels and visual aspects of their websites. So they developed very nice and beautiful websites with less quality content within!

Managing time and conducting project according to the defined time conditions was another problem faced by one third of the students. The time limitation of the project, i.e. 8

weeks, struggling with technical and team working problems, and other sorts of unplanned and unpredicted issues served to delay the students' learning process. Having difficulty in understanding the objectives of the project and following the student-driven approach of the project was perceived as a problem by about one third of the students. Indeed, the student-centric approach of the project was new to many of them. They just left the primary school with a strong top-down and teacher-driven instructional approach. As a result, at the start of the project they were heavily dependent on the teacher's guidelines and support. Finally, about one fourth of the students faced with problems in linking the learning usefulness of the provided choices to their learning needs and process. A student mentioned this problem as follows:

We can quickly learn how to use and work with tools such as Google Docs or MindMeister, or iGoogle. But the purpose of using them is not clear for us. What we need is to link the functionalities of these tools to our learning needs. (Student #7, interview)

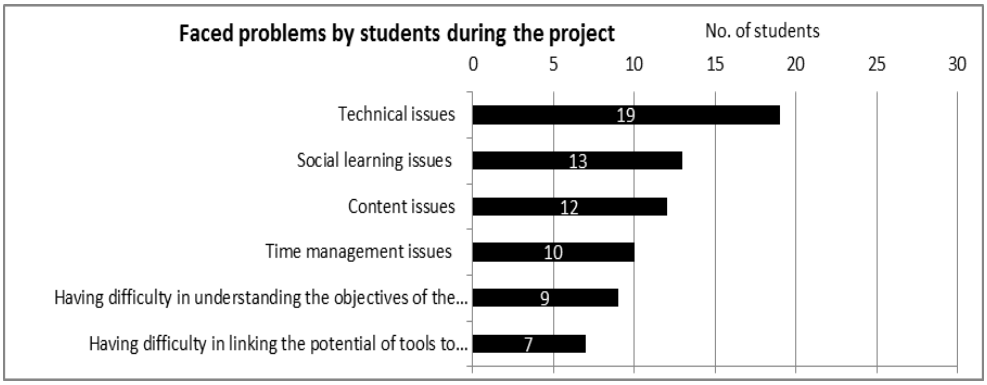


Figure 3.8. The faced problems by the students during the PLE project

In addition to the students, the teacher also experienced three challenges in this project, being: the blurred border between students' personal and educational life, possible abuse of technology by students, and lack of students' triggered reflection on the learning process. These challenges are described below:

Supporting social aspects of the learning process using technology has been perceived by the teacher as the most difficult and challenging part of this project. According to the teacher, the lack of well-defined approaches and rules for implementing social activities using open social tools can hurt the relationship between the teacher and students, as he quoted:

I found it very difficult to implement social tools in the classroom setting. Indeed by using this tools you might stuck in the boundaries of school life and private life which may cause some problems. Perhaps students don't want to combine their personal and educational life. I think riding on the verge of educational and personal life in these tools is very

difficult and I found it as the hardest part of the project. We, as teachers and school administrators, need to make well-defined legislations about these kinds of things.

Another issue was caused by using the provided choices by the students for gaming and non-school related tasks. Due to the provision of extended access to Internet during this project, students were able to access more web sites which were inaccessible through the school's network before the project. Unsurprisingly, while this aspect of the project was appreciated highly by students, it was the main source of concern for the school administrators. For instance, the administrator's representative in this project expressed his concern about providing students with extended access to the Internet as below:

Possible abuses of the Internet like gaming, seeking porno images, and hacking the system make some sort of concerns for school administrators. Indeed, using the Internet for gaming, porno, or other outside-of-learning border is like late coming to school. In late coming we will show a restrictive reaction, so here for abusing of Internet, the same approach is necessary. Otherwise this abusing behavior might be spread and become unmanageable. It poses an important question for school managers that how much freedom in accessing the Internet should be allowed and is sufficient for 12-15 years old students….When we allow students to have full access to Internet, we should consider how it can affect the school reputation in the outside world. For instance, if students write unpleasant things in their blogs under the name of the school it can really affect the reputation of the school and causes parents do not choose and send their kids to our school.

While the project seems to improve practical aspects of the learning process such as access to tools and facilitating group working, its influence on triggering students' reflection on their learning process has been called into question by the teacher as he said:

They can easily learn to work with the tools and they really like to use the tools. But, I think it is important to notice that the students in this age are very pragmatic. They are looking for short-term and immediate benefits of these tools to support their learning tasks. They are not concerned about the whole learning process. I think gaining a reflective ability to reflect on whole learning process is a function of age and experience not mere technology.

3.5 Analyzing the Impact of the Solution on Students' Personal Learning and Agency

In this section the above empirical results are used in order to examine the influence of the proposed solution on students' engagemenint in constructing the learning environment.

The identified learning functions correspond to some extent with the characteristics of PLEs described by Attwell (2007) and Van Harmelen (2006) as well as the learning functions and purposes of PLEs explained by Valtonen et al. (2012), Drexler (2010), and Johnson and Sherlock (2012). According to Attwell (2007), PLEs include tools to support

producing and publishing content and digital artefacts, communication, collaboration and scaffolding learning. Van Harmelen (2006) recognized the integration of multiple web tools and resources as an important student-driven instructional tool that can develop autonomy, ownership, diversity, openness, and connectedness. As asserted by Johnson and Sherlock (2012), introducing the PLE concept into classroom settings can promote communication about technology among the students and increase their awareness about its learning benefits. Drexler (2010) emphasized that the construction of PLEs, informed and driven by student-centric instructional approaches, can facilitate comprehension or deep understanding through the compilation and synthesis of content. Along similar lines, McLoughlin and Lee (2008) asserted that following learner-generated content approach can trigger individual and social thinking of students and foster higher level of cognitive and metacognitive activities such as analysing, evaluating, synthesizing, and creating digital artefacts.

To scrutinize the influence of the model on the students' personal learning and agency we mapped the identified learning functions, activities and challenges onto the main dimensions of student's control, as shown in Figure 3.9. The mapping process was guided by the relatedness between the nature of the learning functions and problems and the specification and intention of each role. According to this mapping, the solution can influence the students' personal learning and agency in two ways: (*i*) facilitating the students' engagement in developing the learning environment, and (*ii*) influencing the communication between teacher and students.

3.5.1 Facilitating Students' Engagement in Extending the Learning Environment

As shown in Figure 3.9, the proposed solution can facilitates the students' engagement in constructing the learning environment through three different but interrelated ways as described below:

- Adding web tools and services to the learning environment:

Student-driven learning approaches such as PLEs center on the *self* and *personal agency* as the main driving forces for directing the learning process. Personal's agency refers to "the capability of individual human beings to make choices and to act on these choices in ways that make a difference in their lives" (Martin, 2004, p.135). As stated by Bandura (1997), the student's *thought* affects her *action* through the exercise of personal agency. We argue that the model by facilitating the students' access to a broad set of technological, pedagogical and content choices (*function a*) has provided students with enough freedom which alongside appropriate structure and scaffolding has enabled them to assume an active role in their learning by accessing and choosing preferred web resources, planning, and performing learning activities and designing content for their learning environments (*function b, and figures 3.5, 3.6, 3.7*). From the personal agency perspective, by mapping *thought* onto the students' planning and choosing of web tools and resources (*function a*) and *action* to the co-construction of travel guides using these tools and resources, it can be claimed that the model has provided students with appropriate opportunities to exercise

personal agency (*functions b, e, g, f*) by getting engaged in different types of learning activities through organization and management of technology. As a result, we argue that providing students with choices and supporting student-driven personalization of learning resources (*functions b*) can involve students in communication about technology and exploring and finding relevant web tools and services to construct the learning environment as a student-created, and administrated matrices of resources (*functions h, j*).

Moreover, this project had provided students a great opportunity to be aware and practice digital responsibility (*function c*) through adhering the school rules and policies regarding using Internet and web technologies and citing used resources in their final travel guides. Digital responsibility is a subset of digital citizenship and refers to appropriate use of all types of media, behaving responsively when interacting with others online, and following school acceptable use policies. However, the extended access to Internet was tempting for some of students who took advantage of it to play game gadgets in iGoogle (*problem S*) which may affect the communication between school, teacher, and students.

Furthermore, the student-driven personalization of learning resources (*functions b, c*) leverages mechanisms useful to enhance the student's feeling of ownership over the learning environment and increase her willingness to practice autonomy over her learning process. In this regard, performing activities such as customizing and personalizing iGoogle and blog pages and showing them to their family and friends and extending the learning process beyond the classroom settings by involving family members and friends, arguably, can be envisioned as evidence on students' feeling of ownership over their learning environment. Furthermore, the project-based and constructivist nature of the model and involving students in the whole/entire learning process including involving (partially) in choosing their learning objectives, choosing tools and content resources, planning and constructing project, asking for support from other people and feeding back can enhance the students' self-motivational beliefs and ownership by creating a sense of accomplishment and control.

Finally, as asserted by Johnson and Sherlock (2012) and Rahimi et al. (2014a), student-driven constructing of learning environment is a long-term and iterative process of tooling and retooling the learning environment. Accordingly, it can be argued that participation in the project can increase students' awareness and understanding of the learning usage of web technologies and can improve their long term tendency toward technology-based learning (*function k*) as a prerequisite to support self-directed learning in digital era. Moreover, providing students with appropriate choices and allowing them to pursue their learning pathways can reveal their technological, pedagogical, and content preferences (*functions i*). This insight into students' preferences provides a great opportunity for teachers to adjust their teaching process, tool and retool the learning environment and establish a dynamic student-centric learning environment based on the students' preferences.

Although, the solution seems effective in providing appropriate *structure* in terms of learning choices and opportunities for students to actively participate in constructing the technological part of their learning environment and feeling *ownership* over it, no clear evidence on triggering students' reflective approach to learning process was observed. Rather, the students have experienced several problems regarding the learning process including having difficulty in understanding the objectives of the project and linking the learning potential of web tools to their learning needs (*problems P and Q*), time management issues (*problem O*), and lack of triggered reflection on the learning process as asserted by the teacher (*problem T*).

- Producing Content:

Creating content resources play a key role in forming learning environments. Following the learner-generated content approach (McLoughlin & Lee, 2008) , the model provided students with opportunities to practice several learning activities using technology such as searching web, reading and evaluating web content, analyzing the structure of travel guide, remixing and appropriating content, structuring the learning materials, and creating final travel guides (*functions e, g, figures 3.5,3.6*). These digital learning activities correspond to lower-order and higher-order cognitive activities defined by Bloom's digital taxonomy map proposed by Churches (2008). From this perspective, we argue that the model supports a novel form of learning that serves a dual process which helps students not only learn the course through the production of content, but also develop their technical knowledge and competencies linked to the course objectives.

However, although the model seems to be effective in providing opportunities for students to practice technology-based cognitive activities, the quality of the produced content by students has been called into question by the teacher (*problem M*). Furthermore, the students faced with several content issues including having difficulty in finding relevant and accurate content and inability in evaluating the quality of the web content. Solving these problems and addressing the teacher and students concern about the quality of the web content requires a collaborative, iterative process to review, amend, comment on, interconnect and tag content (McLoughlin & Lee, 2008).

- Constructing social aspect of the learning environment:

The solution has triggered a *student-driven social approach* to keeping control over the learning process through co-solving the faced technical problems, working collaboratively around their projects, providing emotional support, and connecting to and asking for support from family members, friends and teachers (*functions f, h*). However, the students faced with several problems pertain to the social aspect of their learning including experiencing job sharing and group working problems, distracting by peers, social loafing, and having difficulty in connecting to experts (*problem L*) which might decrease and affect their control over their learning process.

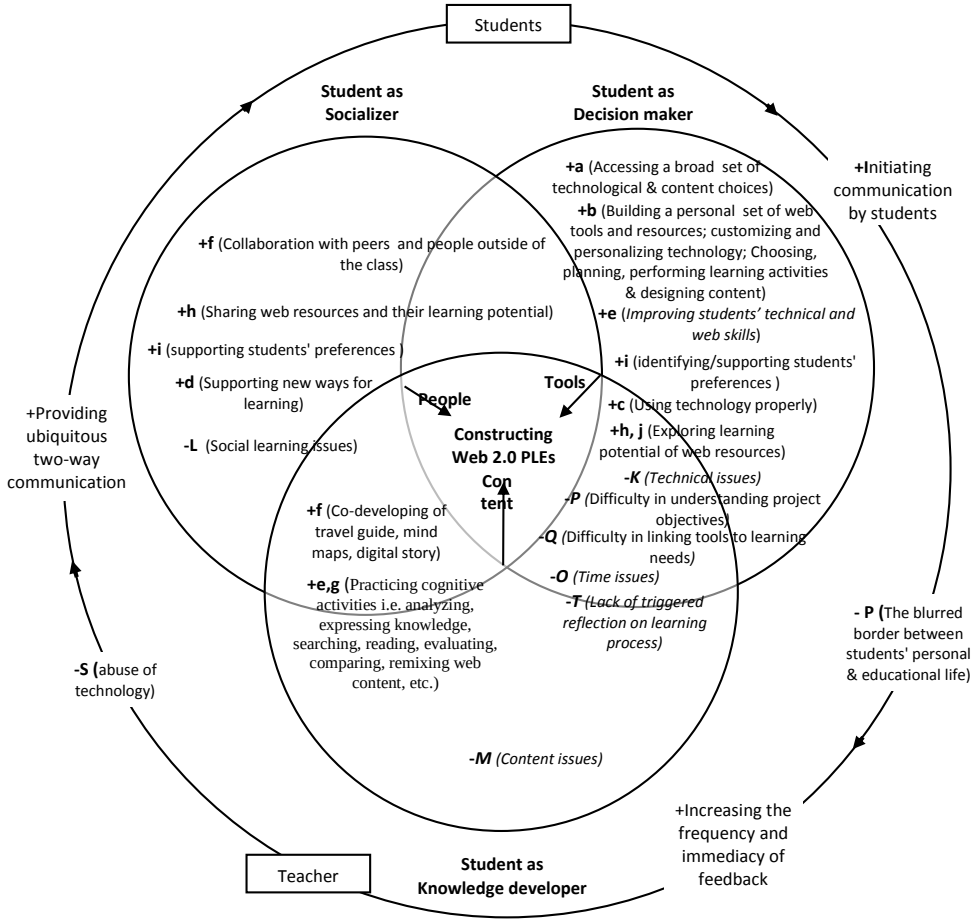
3.5.2 Increasing communication between teacher and students

The solution has influenced the personal agency and control of students over their educational process through increasing the communication between teacher and students. According to Moore (1973), the degree of control that a student has over the educational experience is determined by the communication between the teacher and student during the *negotiation phase*, i.e. planning time to develop the structure of a course, and *dialogue phase*, i.e. instructional time. There are three main factors, which determine the degree of dialogue between teacher and students, including *the type of communication technology*, *the frequency and immediacy of feedback*, and *the initiator of communication* (Garrison & Baynton, 1987). We argue that the model has improved and increased the communication and dialogue between teacher and students by providing students with opportunities to influence these factors as follow:

Firstly, as remarked by Garrison and Baynton (1987), a technology in order to improve the dialogue between teacher and students should support two-way communication and be easily accessible by them. By incorporating two-way technologies, such as Twitter and Blogs, into the educational process the model has provided students and teacher with appropriate two-way communication channels and facilitated *the frequency and immediacy of feedback* between teacher and students, as shown in figure 3.9. Secondly, the model promoted the students to take part in constructing their learning environment by finding, using, and sharing learning resources. As asserted by Rahimi et al. (2014b), following this approach along with the permanent and intensive contact of students with technology and unceasing development of Web 2.0 tools can shift the gravity center of educational practices from content as the teacher's sphere of influence to communication around the content and communication about technology. This shift arguably can provide opportunities for students to be the *initiator of communication* by finding and introducing relevant resources.

In spite of these functionalities, using the model also introduced some problems which might influence and hurt the communication and relationship between teacher and students including possible abuse of technology by students (*problem S*), and the blurred border between students' personal and educational life (*problem P*). Avoiding these problems asks for training students how to use technology properly, emphasizing digital responsibility, and enacting and following appropriate technology usage policy within the school setting.

In summary, it can be argued that a student-driven process of constructing learning environment is a function of the *communication between teacher and students*, the *structure* of the learning environment, students' *ownership*, and their *ability* to take part in this process. In other words, while the structure of the learning environment should provide appropriate level of *choice*, *freedom*, *activity space*, and *adaptation*, the students need enough feeling of *ownership* and *abilities* to utilize these choices to construct their learning environment. The results of this study suggest that although providing students with



Functions: a (Broadening technological and content choices**), b (**Feeling ownership and taking more responsibility over learning process**), c** (Practicing digital responsibility**), d** (*Improving the students' ways of learning*)**, e** (*Improving students' technical and web skills*), **f** (*Supporting collaboration and networking*), **g** (Practicing cognitive activities), **h**(*Promoting communication about technology*), **i**(Supporting the establishment of a student-centric learning environment), **j** (*Increasing the students' awareness about the learning benefits of Web2.0 tools*)

Problems: K (Technical issues), **L** (Social issues), **M** (Content issues), **O** (Time issues), **P** (Having difficulty in understanding project objectives), **Q** (Having difficulty in linking the potential of tools to their learning needs), **R** (The blurred border between students' personal and educational life), **S** (Possible abuse of technology by students), **T (**Lack of triggered reflection about the learning process)

Figure 3.9. Mapping the derived learning functions and challenges onto the learner's control model

appropriate choices and allowing them to perform personal learning activities using these choices is a prerequisite to facilitate students' engagement in constructing their learning environment and enhance their ownership over it, still there are other conditions needed to be considered to increase their *ability* to self-regulate this process. Without careful consideration of developing these abilities, according to Scardamalia and Bereiter (2006), any activity-based learning experiences can easily decline to a form of shallow constructivism or doing for the sake of doing with no significant impact on the students' personal development. Accordingly, to avoid this drawback, appropriate self-regulating and

reflecting learning activities such as peer-based learning, self-evaluating, creating personal meaning from learning experiences, evaluating the quality of online content, and using web tools in different context are required. This type of learning activities can foster internal learning abilities such as self-reflecting and evaluating and develop critical thinking regarding the learning choices and range of possibilities to select and construct the learning environment.

3.6 Answering Research Sub Question #2

After the learning activities accomplished by the students have been identified, we can now answer the research sub question #2: "*How do learners configure their learning process when constructing the learning environment using Web 2.0 tools?*"

The analysis of the results of this design study has led us to identify the following phases in the learning process the students went through in this experiment:

- Preparing phase:

This phase involves activities such as configuring and personalizing web tools, searching web, reading and translating information, creating group on web tools and inviting peers, being concerned about the objectives of the project and so on.

- Performing phase:

This phases includes activities the participating students carried out during the development of their projects as knowledge developer (i.e. mind mapping, synthesizing content, analysing the structure of the travel guide), socializer (i.e. collaboration and communication around their projects, technology and the faced problems, challenging with group working issues), and decision maker (i.e. personalizing blog and iGoogle, using web tools for non-school tasks, showing their projects to their family members).

- Reflecting phase:

This phase represents students' thinking and reflective activities during the project such as blogging, realizing and being concerned about time management, content and group working issues and asking about the usefulness of the provided web tools.

- Feeding back phase:

This phase refers to the activities the students tried to influence and adapt the learning environment such as giving feedback about different aspects of their learning experience and discovering the learning affordances of web tools and resources and introducing them to the teacher or peers.

According to these results, when students are provided with appropriate learning choices they go through a learning process including preparing, performing, reflecting, and feed back phases. We referred to this phases as personalizing (or personal) learning process. One can easily map these phases onto the Zimmerman's model of self-regulated learning, or SRL, (Zimmerman, 1989). SRL refers to those active and volitional behaviours on the part of students to achieve in their learning (Barnard-Brak, Paton et al. 2010). According to self-regulated learning theory (SRL), "Students can be described as self-regulated to the degree

that they are metacognitively, motivationally, and behaviorally active participants in their own learning process" (Zimmerman, 1989). SRL theory defines the process in which self-regulation is achieved in cycles consisting of *forethought*, *performance*, and *self-reflection* phases. Furtheremore, these results suggest that in order to establish a learner-centric learning environment, as an objective of the PLE concept, students need to be encouraged to give feed backs about different aspects of their learning environment. Also, there should be mechanisms to evaluate these student-generated feedbacks and adpat the learning environment accordingly.

Conclusions

In this chapter a theory-informed solution to facilitate personal learning and agency of students was proposed and evaluated. To this end, we conducted a design study in a first grade class in a secondary school in the Netherlands consisting of 29 students (18 girls and 11 boys, aged 11-13 year). The results suggest that the model can facilitate personal learning and agency of students through facilitating their engagement in constructing the learning environment and improving the communication between teacher and students

This study has provided us with the following insights into personalizing learning processes and students' engagement in co-development of the learning environment using Web 2.0 tools:

- The results have revealed the students' tendency toward flexible, open, interactive and social learning environments. They also were keen and looking for ways to take ownership for their learning and connect individual learning to collective learning.
- Skills and abilities students need to construct their learning environment using Web 2.0 tools cannot be taken for granted. Rather, developing these skills and abilities goes through a long-term process of interaction between teacher and students and requires teacher's scaffolding.
- Empowering students with the required competencies and enabling them to take more control over their learning process is mainly an outcome of a student-centric instructional process and requires a self-regulating learning process consisting of preparation, performing, reflecting, and feedback phases.
- Building a student-driven learning environment requires: (*i*) adopting a student-centric instructional approach by teachers to seed the learning environment with relevant resources (initial seeding), (*ii*) increasing students' willingness and abilities to participate in designing and building the learning environment (bottom-up evolving), and (*iii*) reseeding the learning environment according to the students' feedback and preferences (flexible structure of the learning environment). Addressing these requirements, in addition to following appropriate pedagogical approaches, calls for appropriate technological platform.
- There have been several challenges implementing the model including managing students' social activities using Web 2.0 tools and social software, the lack of adequate digital and self-regulated learning skills in the part of students, blurring the borders between students' personal and educational activities, technical problems and inconsistencies, and

lack of appropriate technology to monitor and analyze the personal experience of students with different technologies. Addressing these challenges, among other factors, requires training students how to use technology to develop their social, help-seeking, and self-regulating skills, defining and enacting appropriate Internet usage policy and legislation to make an appropriate balance between students' freedom and school's expected level of control, and choosing reliable and consistent web tools.

- Students need teachers' support and scaffolding to discover the learning affordances of Web 2.0 tools and linking them to their learning requirements. Using these tools by different teachers in different subjects and context can assisst students to observe their applications in different learning scenarios and use them to meet their current and future learning needs.

Inspired by these insights, we suggest the following guidelines to inform the design of a learning environment aiming at facilitating students' engagement in constructing the learning environment:

- supporting an appropriate level student's control over the learning process,
- facilitate the personalizing learning process as a means for empowering students to acquire required skills they need to participae in developing the learning environment,
- providing mechanisms that allow students to modify and influence the structure of the learning environment.

In the next chapter we take advantage of these guidelines to develop a PLE prototype as a means for examining the teachers' views and perceptions on the PLE concept.

4 Incorporating Teachers' and Students' Views to Develop an Initial PLE Design Framework[3]

Through the results of the previous chapter, we now have insight into the ways students configure their learning process when constructing the learning environment using Web 2.0 tools. In this chapter we shift our focus from students to teachers as the main agents of change in their classrooms in order to: (*i*) explore teachers's views on the design of a PLE and then, (*ii*) incorporate teachers' and students' views to develop an initial PLE design framework. In so doing, this chapter answers the research sub question #3: "*How to incorporate students' and teachers' views on the design of a PLE in order to develop an initial PLE design framework?*"

4.1 Research design

The research presented in this chapter was conducted in the same context as the previous chapter (unit of analysis 2 in design case 1). Figure 4.1 describes the followed steps in this chapter.

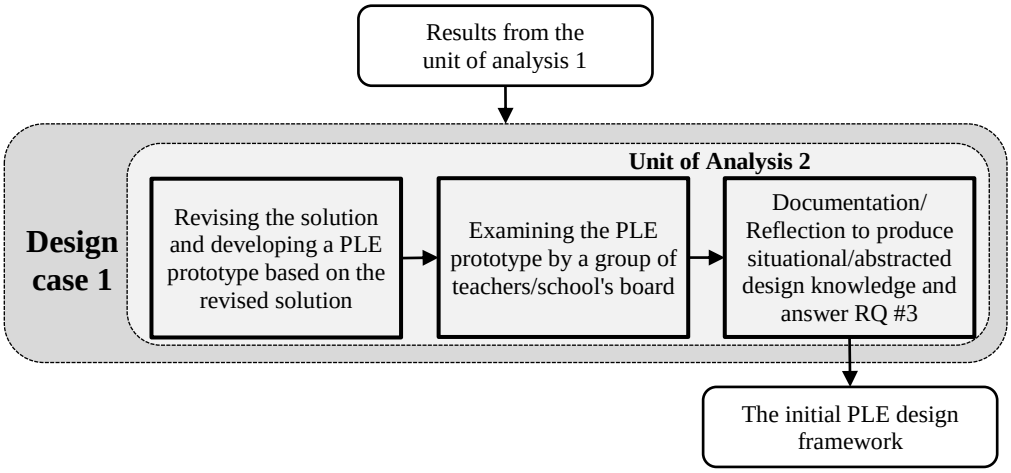


Figure 4.1. The followed steps in unit of analysis 2 (teachers' views) to answer research sub question #3

As shown in figure 4.1, we utilize the gained insights from the unit of analysis 2 as well as the answer to the research sub question #2 to revise the solution proposed in the previous chapter for addressing the identified educational problem in the Amadeus Lyceum secondary school (see chapter 3 for more detail about the identified educational problem and the proposed solution). The revised solution then is used to underpin a PLE prototype which is meant to introduce the PLE concept to a group of teachers/school's board in this school and explore their views on the design requirements of a PLE. For the purpose of this chapter we opted to create a vision prototype, a minimalist prototype that can be developed

[3] This chapter is based on Rahimi, van den Berg, Veen (2013a, 2014a)

quickly and supports a few scenarios enough to answer the associated research question (Ma and Harmon, 2009). The PLE prototype is developed using the functionalities of Google Apps for Education platform. To develop the PLE prototype the participatory design (PD) approach was followed. The participatory design approach pioneered by researchers from Scandinavian countries focuses on collaborating with the intended users throughout the design and development process, rather than designing a system "for" them (Ellis & Kurniawan, 2000).

Thereafter, the PLE prototype is evaluated by a group of teachers and members of the school's board. The evaluation process is guided by two following operational research questions:

From the teachers' perspective, what possible benefits/challenges to educational practices has PLE-based learning on offer?
From the teachers' perspective, what are the requirements to be fulfilled to implement and sustain PLE-based learning?

Due to the exploratory nature of this research, the qualitative research methods were chosen to support data gathering and analysis processes. For the purpose of this study, the interview was selected as the main method to collect data. Twelve teachers (5 female and 7 male, aged from 25- to 50-year-old) with a variety of background and disciplines (i.e. mathematics, geography, foreign languages, chemistry) and with a different amount of teaching experience (ranged from 3 to 20 years of teaching experience) and familiarity with technology-based instruction were selected. Five interviewees were members of the school's board with the main responsibility of making decision about, directing, and transforming any changes in the school's pedagogical and technological visions. By involving the members of the school's board we sought to realize the potential, challenges, and requirements of the PLE-based learning from the school's perspective.

For data collection, six interviews with these participants were conducted. The following procedure were followed to conduct each interview: A few days before each interview an account to access to the prototype was created and sent to the interviewees along with a brief description of the PLE concept and process. Due to the unfamiliarity of the most of the interviewees with this concept, the interviewees were asked to explore the prototype before the interview session to gain an initial perception of the PLE concept and prototype. Each interview lasted between one to two hours. During each meeting, we first started by introducing and explaining the PLE concept and prototype. Then we described the different functionalities of the prototype and presented different scenarios to explain how these functionalities can support their teaching practices as well as the learning process of students. Then the interviewees were asked to link these scenarios to their previous educational experiences. As emphasized by Ma and Harmon (2009), linking a concept or model to the past experience of interviewees can mentally prepare and trigger them to evaluate the concept or model according to their personal experiences. Then the final

reactions, feedbacks, thoughts, perceptions, and expectations of the interviewees about the PLE prototype were received.

After collecting the data, the first phase of the analysis procedure consisting of transcribing audio data, entering collected data into Atlas.ti software and conducting the coding process was conducted. In order to allow for emergent findings out of the prototype, no pre-defined categorizations were used to code the data. The analysis process continued by reading the transcripts and assigning freely named codes to the descriptions. This phase resulted in 95 different codes. The second phase of the analysis process involved reading the transcripts organized by codes, writing memos, recoding and merging similar codes as necessary, grouping codes into categories, creating network diagrams by establishing relationships or links between codes, and writing up conclusions. This process was done several times resulted in yielding six perceived advantages, three challenges, and four types of requirements on the PLE-based learning. These items will be detailed in section 4.4.

After the teachers' perceptions regarding the benefits, challenges and requirements of the PLE-based learning have been realized, in the fourth step, these perceptions are combined with the students' views derived from the previous chapter to develop a unified PLE design framework to support and sustain personalizing learning in the school settings as well as to answer research sub question #3.

4.2 Revising the Proposed Solution for Developing the School's PLE

The empirical insights derived from the previous chapter have led to the following revisions in the key components of the solution proposed in chapter 3 to develop a PLE in the Amadeus Lyceum secondary school.

4.2.1 The Revised Core Principles of Personal Learning

In the proposed solution the learner's control model was used to define three theory-derived core principles of personal learning including the learner as knowledge developer, decision maker, and socializer. Through the empirical results derived from the previous chapter now we have insights into the phases of personalizing learning process or the way students configure their learning process consisting of preparing, performing, reflecting, and feeding back phases. Accordingly, we extend the initial set of the core principles of personal learning to include the phases of the personalizing learning process. This leads to formulate the core principles of personal learning as below:

- Theory-derived core principles of personal learning: strengthening the learner's role as decision maker, knowledge developer, and socializer,
- Practice-derived core principles of personal learning: facilitating preparing, performing, reflecting, and feeding back phases in the learning process.

4.2.2 The Revised Design Principles of Personal Learning

The revised design principles for addressing the aforementioned core principles of personal learning are as below:

- Providing appropriate learning resources in terms of technological, pedagogical, and social choices to facilitate preparing phase and support student's role as decision maker, socializer, and knowledge developer,
- Providing each student with a personal activity space to build and manage his/her learning environment and perform personal learning activities,
- Developing a unique social space to facilitate collaboration and trigger reflection,
- Enabling teacher to facilitate and manage this social space,
- Implementing mechanisms to encourage and get students feedback on the learning affordances, advantages, and disadvantages of the provided learning choices and adapt the learning environment accordingly,
- Adapting the structure of the learning environment according to students' feedback and preferences.

4.2.3 The Revised Technological Components of the Solution

To address and implement these design principles a set of technological components and functionalities were identified including: social space, a repository of learning resources, the shared learning stream, teacher and school announcements/shared calendar, and a personal activity space.

- *The social space:* is a public and shared place between all students and the teacher(s) where they might observe each other learning experiences, access the provided learning resources, share their experiences, findings and thoughts, stay in contact with each other, and be aware of the whole learning context. The social space contains three components: a set of learning resources seeded and managed by teacher(s) to support the personalizing learning process, teachers' and school announcements and a shared calendar, and the shared learning stream.
- *A repository of learning resources:* the theory of transactional control (Dron,2007a) suggests that control is concerned with choices and a "mature learner" is more capable of making relevant and effective choices in his or her learning journey. Hence, providing students with proper learning resources and allowing them to use these resources to define their learning aims and methods are prerequisite steps for them to achieve control over their learning by moving from a "state of dependence to one of independence" and have the potential to enhance their feeling of ownership, personal agency and self-motivational beliefs (Rahimi et al., 2014a,b). To this end, the model provides a repository of learning resources. The learning resources repository is a directory of learning choices in terms of content, web tools, links, services, OERs, and communities provided or introduced by teachers or students aligned with the curriculum objectives. Each learning resource is accompanied by its pedagogical and learning affordances and examples and guidelines to integrate it into educational practices.

- *Learning Stream:* Casquero et al. (2010) defined learning stream as a module to collect and aggregate collective information pertains to learning activities performed by students in different web tools. Students might select learning activities they want to share with others in the learning stream. Learning stream seeks to enhance students 'awareness about the whole learning context and encourage them to reflect on their learning process by comparing their learning practices with their peers. Furthermore, this shared learning stream is meant to be used a source of collaboration, and interaction.
- *Teachers' and school announcements/shared calendar:* to let students and teachers to set their personal or class-wide learning goals, plan the educational events, and monitor their educational process.

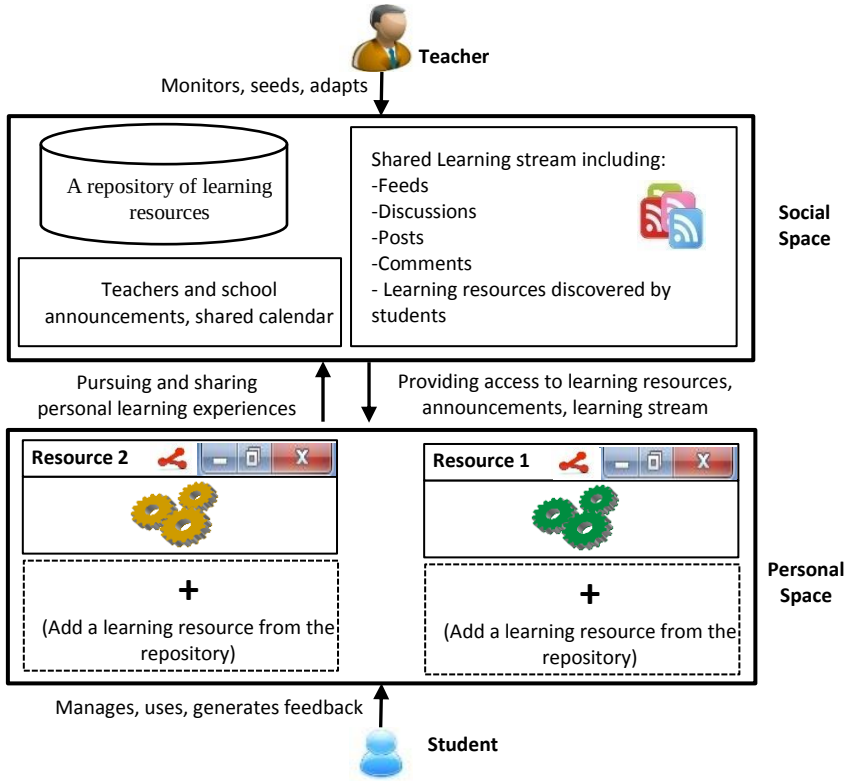


Figure 4.2. The technological components of the revised solution

- *Personal activity space:* each student has a unique personal space which can be used as an activity space to pursue his/her learning experiences by accessing, using, and managing the provided learning resources in terms of content, figures, tools, contacts, services. The provided learning resources are delivered by means of drag-and-drop and manageable widgets or gadgets. Personal learning space seeks to enhance students' autonomy and ownership by exposing the provided learning resources as learning choices and allowing students to choose their personal set of learning resources. Students then might use these

choices to define their learning objectives and plan a set of learning activities to achieve these objectives as a part of the forethought phase. Furthermore, personal learning space can be seen as a flexible activity and working area enriched by appropriate learning resources to support performing phase and assist students to attain their learning objectives. This combination of social and personal spaces to construct the learning environment is in line with the conceptualization of PLEs defines them as activity spaces in which students interact and communicate with each other and experts the ultimate result of which is the development of collective learning (Attwell, 2007).

4.3 Implementing the PLE Prototype

In this section the process of developing and implementing the PLE prototype on the basis of the revised solution is elaborated. During the development phase, a group of end users including a number of teachers and school's board members along with the research team were participating to address issues including: choosing a development strategy, choosing an appropriate technological base to develop the PLE prototype, and implementing the required functionalities of the PLE prototype. These issues and the taken solutions to address them are described below:

4.3.1 Choosing a Development Strategy

As described in the second chapter, one of the challenges of PLEs is the lack of an agreement on what mechanisms can underpin their development (Chatti et al., 2010). As noted by Wilson et al. (2007), several very different strategies may be feasible to develop PLEs. The authors state that "a single PLE application may be possible, or on the other hand, the coordinated use of a range of specialized tools may achieve a satisfactory result" (p. 33). Sclater (2008) offers three different visions for developing PLEs. First, PLE as a downloadable client software to be used offline by students and be updated with institutional content via the Internet (i.e. PLEX as described by Wilson et al. (2007)). Second, PLE as a made up of several types of externally hosted software, mainly Web 2.0 and social software, that students can freely choose and make use to address their specific learning purposes. The third vision states that PLEs are already here and in active use embodied in personal digital devices and different software and online resources that students use to support their learning. In the same direction with the Sclater's second vision for PLEs, Siemens (2007) describes PLE as a collection of tools integrated under the conceptual notion of openness, interoperability, and learner control. Along similar lines, Attwell (2007) asserts that PLE is not an application; it is rather a collection of all the different tools we use in our everyday life for learning.

Due to the cost and time issues of developing a prototype from scratch, we opted to adopt the model of a collection of externally hosted free tools to develop the PLE prototype.

4.3.2 Choosing an Appropriate Technological Base to Develop the PLE Prototype

After choosing the PLE development strategy, the next issue was to select an appropriate platform to assist students to collect and bring together all the tools and services they need to build and manage their PLEs. There are several models to build and manage a personal set of web tools and services including blog-based PLE, e-mail-based PLE, RSS-based and mashup PLEs. A mashup is a website or application that combines content or functionality from different sources into an integrated service. A mashup PLE enables users to choose the applications and services that constitute their PLE from a set of predefined choices, create their own services and widgets, arrange the learning tools according to a grid layout, and integrate different services to produce a new service (Al-Zoube, 2009). Currently, there are several personal portal technology and mashup tools such as My Yahoo, Netvibes, Symbaloo, Pageflakes, or Google Apps's start page that are useful to aggregate different tools and services into a personal space, through RSS feeds and widgets. Due to the existence and use of the Google Apps for education platform and the observed familiarity of teachers and students with it, this platform was selected as the main technological base to develop and build the PLE prototype. Google apps for education is a popular cloud-based service consisting of a collection of web-based messaging (e.g., Gmail and Google Talk), event managing (Google Calendar), productivity and collaboration tools (Google sites and Google Docs: text files, spreadsheets, and presentations) without advertisements.

4.3.3 Implementing the Identified Functionalities of the PLE Prototype

After selecting the technological base, the next step was to implement the functionalities of the PLE mentioned in the previous section. Google Apps provides numerous technological functionality to address these requirements. First, it provides students with a gadget directory consisting of thousands built-in or third parties gadgets such as feed reader, multiple searches, bookmarks, to-do lists, notes, local weather forecasts, email, and dictionary to fulfill heterogeneous learning needs. Gadgets are HTML and JavaScript applications that can be embedded in webpages and other apps. Also, Google Apps for Education platform provides users opportunities to build, use and share their own gadgets. To create a safe learning environment and control which gadgets appear in the gadget container, Google apps has provided a tool called Feed Server Client Tool, or FSCT. The admin user can use this tool to create a white list consisting of suitable gadgets and a black list including unsuitable gadgets and configure the platform to only provide end users with the gadgets in the white list.

Secondly, to provide each student with a personal activity space we used the Google sites capabilities. Google sites support the development of a specific type of start page consisting of two parts, namely, a public and a private part, accessible via a unique URL. The public part is only manageable by the admin of the page and is visible for all allowed users, while the private part is only visible and manageable by the associated user. These functionalities define the start page as an appropriate option to build the PLE interface by using the public part as the social space and the private part as the personal activity space of the PLE

interface. The personal space provides the student's access to the Google gadget container to support her learning purposes by accessing, using, adding, customizing, sharing or removing gadgets. Also, Google Calendar lets students and teachers to set their personal or class-wide learning goals, plan the educational events, and monitor their educational process. Moreover, Google sites allow student to create their own private or public websites to publish and present their thoughts and findings. Google Apps also provide the institution with the option to use customized friendly names for email rather than use the traditional student ID number. Google Apps also enable students to use their mobile devices in order to access their emails and save their documents remotely.

Thirdly, the public part of the start page can be used as a social space for the PLE prototype. Google Apps for Education provides several possibilities to support online collaboration and social learning. For instance, Google Drive, Google Docs and Spreadsheets allow the creation of content, documents and spreadsheets with more collaborative capacity and enable students to communicate around content. Google Apps for Education also supports different accessibility scenarios including individual, team, school and public level with different permissions. For instance, the page-level permissions allow users to control who can view and edit their Google Site on a page by page basis. Using page-level permissions, users can make some pages private for certain users while keeping other pages public for everyone to see. These flexibilities in accessibility and permission levels can be used by teachers and students to extend the borders of the learning environment by inviting and involving other relevant people to their PLEs. Finally, Google spreadsheets, forms and Google sites along with scripts and HTML coding provide appropriate functionalities to implement a feedback mechanism and support the reseeding phase. This mechanism allows teachers and students to introduce and share their personal teaching and learning experiences supported by web tools and resources, their preferred web tools and learning resources and their learning benefits and affordances, and rate them based on a set of criteria.

Figure 4.3 shows the interface of the PLE prototype for each student. The interface is divided into two parts: a personal space and a social space. Via social space students can access and use tools such as bubbl.us (i.e. a social mind mapping tool) or Wikipedia to set their leaning goals and read or collect data about a subject. Also, they can access and use 'Diigo' or 'Google docs' to create and share content, collaborate, and extend their network. 'Blog' can be used as a personal portfolio to support personal reflection as well as peer-based and teacher assessment. 'Class Dojo' is a tool which can help teachers to motivate students to build a preferred behavior and evaluate their learning behaviors. To create the shared learning stream, FriendFeed service was used. FriendFeed is a feed aggregation software that aggregates and presents activities and experiences of students accomplished in different tools. Furthermore, the social spaces provides the students' access to teachers' announcements, a shared class-wide calendar and more learning resources provided by the teachers. The bottom part of the interface represents the personal space for each student

where the students can easily access to a repository of learning resources and add them to his/her personal space or share them with other students.

Figure 4.3. The interface of the PLE for each student

As shown in figure 4.4, for each learning resource (i.e. web tools) there is an introduction page which illustrates the tool, its specifications, and related learning scenarios. Also, the students are encouraged to evaluate the tool based on some defined criteria and explain the learning affordances of the tool derived from their personal observations or experiences with the tool. This information then can be used by teachers to reseed and adapt the learning environment and design appropriate learning tasks.

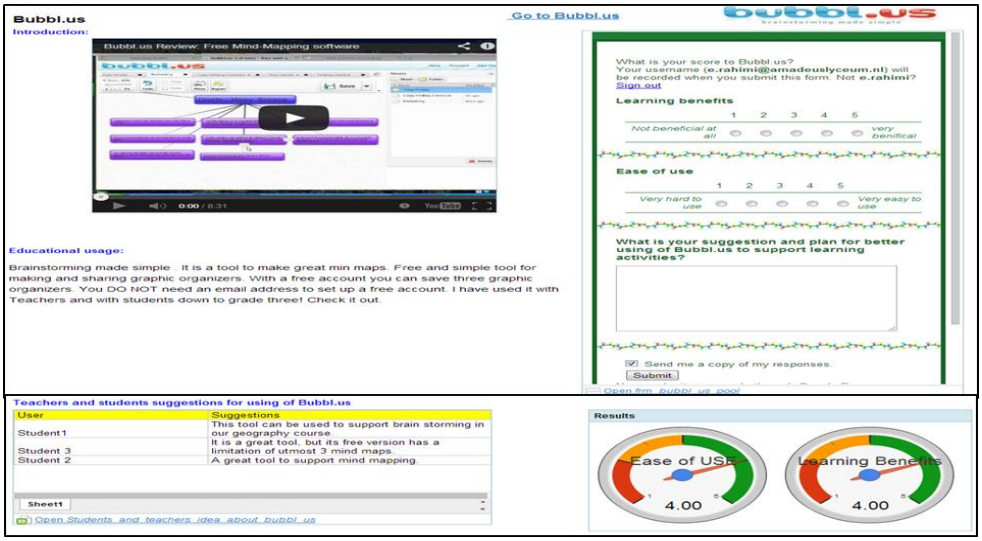


Figure 4.4. A page for introducing each web tool and receiving students' feedback about the tool

To enhance the participation of the students in reseeding and (re)shaping their learning environments, the students are encouraged to introduce new learning resources they have found useful, as shown in figure 4.5.

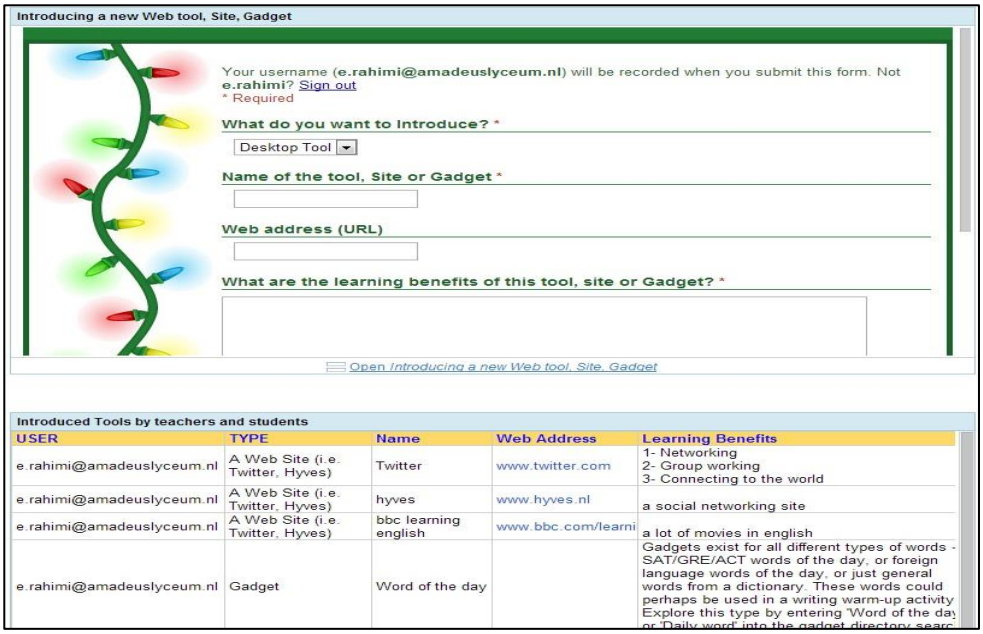


Figure 4.5. A page for introducing new learning resources by students/teachers

4.4 Examining the Teachers' View on the Requirements of PLE-based Learning

This section explains the evaluation of the PLE prototype from the teachers' perspective guided by the following operational research questions:

From the teachers' perspective, what possible benefits/challenges to educational practices has PLE-based learning on offer?

From the teachers' perspective, what are the requirements to be fulfilled to implement and sustain PLE-based learning?

4.4.1 The perceived learning benefits/challenges of the PLE prototype

The participants mentioned the following benefits that the PLE-based learning may present to their educational practices:

- *Broadening teachers and students' access to relevant learning choices:* according to the interviewees, providing teachers and students with a repository of relevant teaching and learning resources in terms of web tools and content is an enviable outcome of the PLE prototype and implementing and participating in the PLE-based learning.
- *Involving students in constructing their learning environment:* The participants remarked that PLE-based learning has the potential of involving students in configuring and forming the learning environment. In the words of the interviewees, by providing students with appropriate learning choices and personal activity spaces and scaffolding students to make use of these choices for their learning purposes, it is more likely that they start to tailor these choices to their personal learning needs and interests. As a result, this personalization can provide opportunities for students to explore and discover the learning affordances of web tools and exchange their good practices with technology. This insight, gained through students' exploration and personalization, then can be used by teachers and other students to improve their educational practices.
- *Promoting a student-centred learning approach:* Monitoring the personal part of the PLE prototype might help teachers to realize the students' preferred tools and the ways they use and learn with web tools. The teachers can use this insight to design appropriate technology-based learning tasks and reseed the learning environment accordingly. Furthermore, allowing students to use and learn with their personal set of web tools can increase their feeling of independence, ownership, and responsibility.
- *Enriching students' learning process:* As asserted by the interviewees, the PLE-based learning might contribute to enrich the students' learning process. In this regard, the teachers stated that introducing and integrating productivity tools such as Google Docs and mind mapping tools into the educational process can facilitate co-authoring and sharing of content by students. Furthermore, using and harnessing the sociability aspects of social Web 2.0 tools and services can facilitate collaboration and social interaction among the students. Also, it might create an interactive environment to work and learn with technology and collaborate around content and technology. Moreover, the PLE prototype can provide students with appropriate tools to support personal learning management such as calendar, local and social bookmarking tools, and RSS feeds readers. Finally, as

remarked by the interviewees, participating in the PLE-based learning and working with and utilizing different web tools and technology can improve the technological knowledge of students and increase their awareness about the pedagogical affordances of these technologies.

- *Improving technological and pedagogical knowledge of teachers and their willingness toward technology:* Implementing and participating in the PLE-based learning might improve the technological and pedagogical knowledge of teachers. Participating in PLE-based learning might assist teachers in identifying the usefulness and learning values of web tools through sharing their experiences, good practices, and success stories. According to participants, identifying the usefulness and learning values of web tools has an enviable position in improving educational practices and increasing the teachers' willingness toward technology and improving their technological and pedagogical knowledge. Furthermore, identifying the usefulness and learning values of web tools can support teachers in the selection of appropriate web tools, resulting in the design of appropriate technology-based learning tasks as the cornerstone for facilitating and scaffolding the PLE-based learning process. One teacher emphasized this point as below:

Teachers have always some ongoing educational activities and projects. They have an unceasing need to know about web tools to support these activities. The social hub of PLE might provide a place to share tools, content, experiences and ways they integrate them into one teaching process. This insight might be very helpful for other teachers with same needs and projects.

- *Supporting school's development plan:* as perceived by participants, implementing the PLE-based learning can support the ICT development plan of the school by providing guidelines for utilizing and improving the school's ICT infrastructure. This was pointed out by one of the participants as below:

We already have Google Apps for education platform as a part of our ICT infrastructure. Our expectation from the PLE project is to show us how to utilize and harness its functionalities to improve our educational practices.

Despite the perceived advantages of the PLE-based learning, the implementation of the PLE-based learning was perceived by the teachers as a complex approach consisting of the below challenges:

- *Difficulties in managing students' interactions with technology:* This challenge is caused by several factors. First of all, some of the teachers and members of the school's board expressed their concerns regarding the possible abuse of technology by students based on their previous experiences. Secondly, the open nature of the Internet and Web 2.0 tools allows students to go beyond the school's walls digitally. According to some of the participants, opening students' access to the Internet and possible abuse of this opportunity by students might cause some problems such as damaging the school reputation or

distracting students from their learning. Thirdly, there was no consensus among the teachers about the appropriate level of students' control over their personal part where they access and work with web tools. This lack of consensus can be observed in the following debate between two of the participants:

Teacher A: As a parent I would not send my children to school where there is no control. If there is not a certain level of control there would be always the risk of falling in some problem.
Teacher B: It would be great to have some selective and protective mechanism and blocking certain gadgets like porno, gaming, and gambling tools. But technically achieving full control is impossible! Because when we allow them access the Internet they can access every page and gadget they want by just 3 clicks!

- *Technological issues:* Dealing with technological issues was another perceived challenge for implementing and supporting the PLE-based learning. Technological issues might be caused by many factors including introducing several web tools to the educational practices, possible inconsistency between the introduced web tools and the problems of the school's ICT infrastructure such as insufficient bandwidth or hardware and network equipment's failures. These issues can largely affect the teachers and students motivation to uptake the concept of the PLE-based learning.
- *Pedagogical issues:* according to the participants, a main challenge for implementing the PLE-based learning in their classroom is the restrictions set by the standard curriculum of the school. Teachers, particularly in higher grades, should prepare their students to pass the formal exams and achieve the defined goals in the curriculum. These restrictions can largely increase the teachers' resistance against adopting new approaches such as PLE-based learning. Another identified challenge for implementing the PLE-based learning was the lack of clear models and examples of PLE-based learning as well as practical advices to integrate web tools into educational practices and designing appropriate technology-enhanced learning activities/scenarios to empower students with appropriate digital competencies. Furthermore, according to the teachers, supporting student-centric learning approaches using technology might impose significant changes and modifications in their teaching material and practices and requires more time and efforts than normal lecture-based teaching.

4.4.2 The Perceived Requirements for Implementing and Sustaining the PLE-based Learning

The following requirements on implementing and sustaining a full-fledged model of PLE-based learning were identified out of the research:

- *Pedagogical requirements:* as emphasized by participants, empowering and motivating students to undertake and practice their roles as decision maker, socializer and knowledge developer using technology asks for new form of student-centred instructional framework, assessment, and interactions. Furthermore, it has been remarked that facilitating the

personalizing learning process asks for following a personalizing teaching process consisting of four iterative phases of providing learning choices, scaffolding, assessing, and adapting. This personalizing teaching process should facilitate and motivate students engagement through providing appropriate learning choices, defining authentic learning activities, assisting students to realize the learning affordances of web tools and resources and utilize these affordances to perform the learning activities, stimulating their critical reflection, and encouraging and acknowledging their involvement in designing the learning environment and directing the educational process.

- *Content requirements:* the participants were unanimous on the fact that social software and Web 2.0 tools and services give students opportunities to practice several lower-order and higher-order cognitive activities such as searching web, reading and evaluating web content, remixing and appropriating content, structuring the learning materials, and creating digital artefacts. However, the participants considered the development of a framework to help students to evaluate and ensure the quality of online and student-generated content as a determining factor to implement and sustain PLE-based learning. One important question posed in the PLE literature is about the relationship between PLE and CMS (content management system) (Bogdanov et al., 2012). This study has shown that the participants expressed the similar need of clarifying the relationship and connection between the current CMS and PLE. From the lens of the participants, the PLE should not be envisioned as an alternative to CMS, but rather as complementary to CMS. In other words, while the CMS provides formal content PLEs comprised of different tools that facilitate students' working, learning with, and communicating around this content. Supporting this complementary relationship calls for providing content in appropriate formats and chunks that promote remixing and sharing and facilitate tracing content.
- *Technological requirements:* the participants emphasized the key role of the technological requirements in implementing and sustaining the PLE-based learning process. The identified technological requirements are associated with a wide area of technological adjustments ranged from modifications in the design and functionality of the developed PLE prototype to improvement in the school's ICT infrastructure and policies. Among other factors, improving the scalability of the PLE prototype, providing single-sign on (SSO) mechanism, and improving the flexibility of the personal and social spaces were considered as important technological factors needed to be addressed. Also, the teachers stated that they need to know students' technological preferences and the ways they use web tools in order to implement a student-centric teaching and learning approach and support their professional development process. At the school's level, in addition to improving the ICT structure of the school, the participants suggested that there is a need to create an inventory of appropriate web tools and learning resources as learning choices to be used by students. Also they emphasized the importance of developing a rubric to evaluate and choose relevant web tools and services to be added to this inventory.
- *Organizational requirements:* running appropriate professional development programs, creating a supportive community of teachers, allowing more flexibility in the curriculum, and school's leadership were mentioned by the participants as the key organizational

factors influencing implementing and sustaining the PLE-based learning process. Also, as remarked by the participants, a main issue affecting teachers' willingness to adopt any technology-based instructional approach is their estimation about the required changes in their teaching materials and processes. Furthermore, the participants asserted that implementing the PLE concept in educational settings requires redefining the commonly accepted roles of teachers and students in the educational settings.

4.5 Answering Research Sub Question #3

Through the examination of the PLE concept in the units of analysis 1 and 2, we have now the students' and teachers' views on the benefits, issues and requirements of the PLE-based learning to answer research sub question #3: "*How to incorporate students' and teachers' views on the design of a PLE in order to develop an initial PLE design framework?"*

We use the definition of the PLE design framework to formulate the answer to the research sub question #3. As detailed in chapter 1 a PLE design framework consists of four key components: core principles of personal learning, design principles for facilitating personal learning, technological components, and implementation guidelines. Figure 4.7 represents the components of the initial PLE design framework and their relationship.

4.5.1 The Core Principles of Personal Learning Underpinning the Initial PLE Design Framework

The theoretical and empirical grounding processes conducted in chapters 2,3,4 have led us to designate two categories of core principles for personal learning including (i) the learner's control model consisting of the learner's roles as decision maker, knowledge developer, and socializer, and (ii) the personalizing learning process consisting of preparing, performing, reflecting, and feeding back phases. As remarked by the participants, addressing these core principles asks for a personalizing teaching process consisting of providing appropriate learning choices, scaffolding, assessing the learning process, and adapting the learning environment.

4.5.2 The Design Principles for Facilitating Personal Learning

Design principles are the second key component of the PLE design framework. Figure 4.6 illustrates how we derived the design principles for facilitating personal learning by combining the core principles of personal learning As shown in this figure, this combination process has led to defining five categories of design principles as described below:

(i) "Preparation" design principles:

The focus of these design principles is on helping students to take advantage of Web 2.0 tools and technologies to plan their learning, provide them with appropriate choices and equip them with the skills they need to gain more control and personalize their learning. To do so, the following preparation design principles have been defined:

• Defining/introducing personal learning management strategies: In order to nurture and develop students' autonomy and metacognitive skills, the teacher defines and introduces a set of web-based personal learning and knowledge management skills such as setting learning goals, aggregating and filtering content, evaluating the quality of web content, and planning, monitoring and evaluating learning progress by using Web 2.0 tools.
• Defining/introducing knowledge developing strategies: These activities aim to empower students with appropriate web-based cognitive abilities and learning techniques. Accordingly, the teacher defines or introduces a set of cognitive choices (i.e. learning methods such as conducting digital mind mapping, brain storming, blogging, co-authoring and storytelling by using Web 2.0 tools) to be chosen and applied by students during their learning journey.
• Defining/introducing social learning strategies: The teacher provides an appropriate set of social learning guidelines and resources such as group working structure, peer-based scaffolding and assessment, technological tools and (online) community experts to be used by students to keep control over their learning.

These design principles are meant to inform defining appropriate learning scenarios and activities to encourage and help students to set their learning goals, choose their learning strategies and prepare them to achieve these goals.

(ii) "Implementation" design principles:
After students have selected their learning goals and planned their learning process, in performing phase the students use the provided learning choices to perform learning activities to achieve their learning goals. To do so, the students might undertake the role of knowledge developer, socializer, and decision maker (see chapter 3). The teacher scaffolds students to undertake these roles by scaffolding their working and learning with the provided choices, performing assessment for learning to analyze the students' learning process, and evaluating the quality of online and student-generated content. As a result of performing these teaching and learning activities, the learning environment will start to grow through personal and collective learning experiences, discoveries and expressing of the students and teacher.

(iii) "Reflection" design principles:
According to Strampel and Oliver (2007), there are four levels of reflection leading to deep levels of learning including stimulated reflection, descriptive reflection, dialogic reflection and critical reflection. The preparation design principles stimulate reflection by increasing students' awareness through presenting them with new choices in terms of new learning objectives, techniques, information, communities, resources and experiences. After becoming aware of new choices, students become stimulated and feel they must make sense of these choices by using them in meaningful ways and "until the new choices can be assimilated and accommodated, they are in a state of disequilibrium" (Strampel & Oliver, 2007). This disequilibrium stage can facilitate further reflection and can lead to conceptual

change, but only if the students are properly motivated, supported and encouraged. Prompting and scaffolding deep reflection are challenging tasks that require teacher's effort and support. It also requires designing appropriate TEL activities in terms of questions, tasks, problems and objectives and incorporating them into the design of PLEs. These activities should trigger students' reflecting on the *cognitive*, *social* and *personal* aspects of learning process. For example, activities such as evaluating their own learning capabilities and process, evaluating the content or digital artefacts developed by student or his or her peers and developing criteria to evaluate the quality and credibility of online content can trigger students' reflecting on the *cognitive* aspect of their learning process. Also, performing activities such as identifying the strengths and weaknesses of their group working and commenting on the ideas of their peers can trigger students to reflect on the social aspect of their learning process. Moreover, accomplishing activities such as evaluating the taken personal time management, knowledge gathering, learning monitoring strategies, creating meaning and interpretation from personal learning experiences and evaluating the learning potential and affordances of the provided choices can trigger students' reflecting on the *personal* aspect of their learning process. This type of learning activities can foster internal learning abilities and develop critical thinking regarding the options and range of possibilities to develop and use PLEs (Valtonen *et al*, 2012).

(iv) "Feeding Back" design principles:

In the feedback phase students are stimulated to explore and evaluate the learning affordances of the provided choices based on their personal learning experiences and then express and share their findings and thoughts regarding these learning affordances. These feedbacks then might be used by the teacher to revise the provided learning choices and reseed and adapt the learning environment. The model uses the concept of affordances as a feedback loop to support a bottom-up and end user-driven mechanism to change and evolve the learning system. Salmon (1993) describes affordances as "the perceived and actual properties of a thing, primarily those functional properties that determine just how the thing could possibly be used" (p.51). Conole and Dyke (2004) argued that digital technologies have several affordances for learning including fostering communication and collaboration and encouraging reflection. According to Conole and Dyke (2004), the benefit of articulating technological affordances, derived from personal experiences of practitioners with technology, is that it enables them to reveal the different attributes of a learning technology so that they can determine its suitability for use in a particular learning context to achieve a set of intended learning outcomes. As a result, as asserted by Rahimi et al. (2014a), providing students with learning choices and allowing them to pursue their personal learning experience using these choices and share their experiences can unpack the affordances of these choices and provide them opportunities to take part in shaping and evolving the learning environment. This feedback mechanism aims not only to increase the student's control through developing a student-centric learning environment and considering the students' preferences, but also to impart the teacher to this improved control. In fact, in a PLE-based setting, teacher and students are both learners (Rahimi et

al., 2013a) and in order to improve his or her teaching practices, the teacher has an unceasing need to learn how to teach with new technologies. The active engagement of the students with technology can reveal the ways that they learn with technology and provides a valuable source of technological, content and pedagogical knowledge (Koehler & Mishra, 2009) that the teacher needs to know to instruct with technology and build a student-centric learning environment.

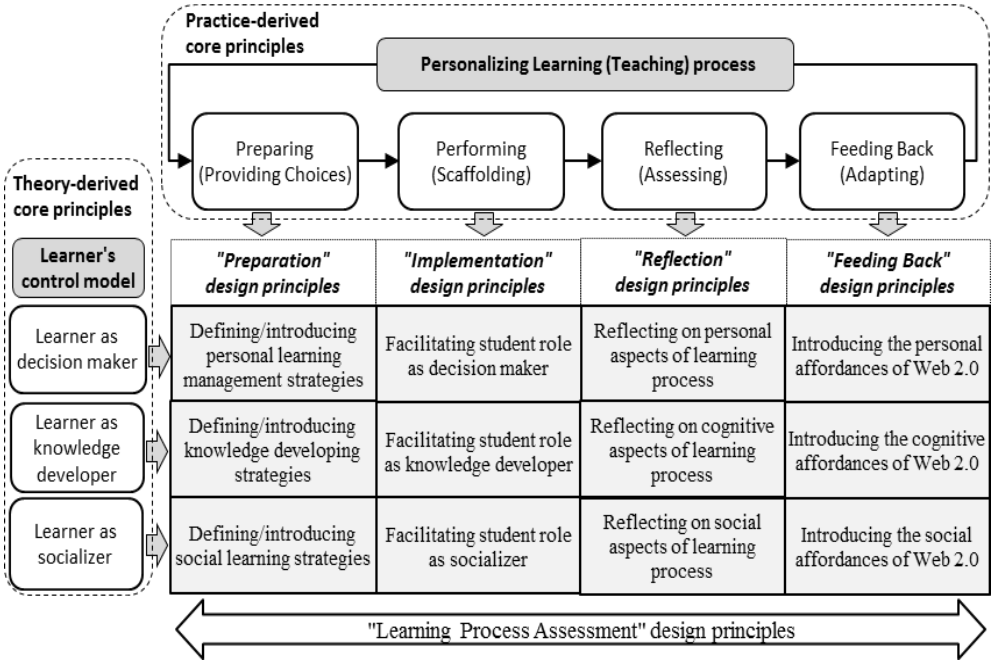


Figure 4.6. The pedagogical part of the PLE model

(v) "Learning process assessment" design principles:

According to the participants, creating an appropriate assessment rubric is a key factor in encouraging and motivating students to follow the personalizing learning process. In personalizing learning the gravity of learning activities is shifted from reading and memorizing content to analyzing, communicating around, and constructing content, and undertaking new roles as producer of content, socializer, and decision maker (Rahimi et al., 2013a). Students' personal development as the core part of the personalizing learning is manifested in the so called "21st century skills" including critical thinking, problem solving, meaning making, communication, collaboration and decision making. None of these skills are easily measured using "assessment of learning" approaches such as current product-based assessment techniques such as multiple choice tests or standard exams. Instead of assessment of learning, supporting personalizing learning calls for "assessment for learning" which separates assessment from attainment and embeds assessment within the teaching and learning processes to assess and gauge actual cognitive, social and personal development of students while building and applying their learning environment

(Attwell, 2010a). As observed in the previous chapter, the learning environment should be considered as an important learning outcome co-developed by students and teacher. Accordingly, the learning environment and its co-development process can provide appropriate means to support assessment for learning approach and trigger students' reflective thinking. The technological procedures for supporting assessment for learning approach will be discussed in the next section.

4.5.3 The Technological Components of the Initial PLE Design Framework

Figure 4.7 illustrates the technological part of the PLE design framework. These technological components represent an extension of the revised solution presented in figure 4.2. As described in figure 4.2, the initial technological part consists of personal and social spaces, a repository of learning resources, learning stream, teacher and school announcements, and a shared calendar. Examining the initial solution from the teachers' perspectives has led us to add two additional modules to the technological part including: learning resources' quality evaluation and learning analytic modules. Moreover, in order to support the pedagogical part some adaptations were applied in social and personal spaces as well as the structure of the repository of the learning resources as described below:

- *Learning analytic module:* aims at addressing the learner-centred characteristic of PLE-based learning as well as supporting "assessment for learning" approach by collecting implicit student-generated feedbacks on their learning process. New data collection and data mining technologies, manifested as Learning Analytics (LA), are making it possible to capture and analyze massive amounts of data about the students' interaction with the learning environment, generated through the students' activities in different Web 2.0 tools and technologies (Blikstein, 2011). Learning analytics can be seen as a means to facilitate learner-centered design which shift the perspective in educational data mining from that of the institution gathering data about learners in order to inform organizational objectives, to that of providing new tools for the learner and teacher, with the intention of measuring, collecting, analyzing, understanding and optimizing not only learning but also the environments in which it occurs (Siemens & Long, 2011; Ferguson & Shum, 2012). To this end, this module should monitor and keep track of every learning activity the students accomplish in their personal or social learning spaces and render visible the complex pattern of their personal learning experiences. Learning analytic module should provide different analytic functions including social network analytic (i.e. to analyze interpersonal relationships between students), content analytic (i.e. to analyze students' interactions with content items), and tools analytic (i.e. to analyse students' interactions with web tools and services). The teacher might take advantage of the results of this module to realize the learning pattern and the real level of personal development of students and provide them with appropriate scaffolding and guidelines. Also, the teacher can use the output of the learning analytic module to realize the usage pattern for different learning resources and understand students' preferences to be used as a means for rethinking her teaching practices and revising the learning resources and establish a student-centric learning environment.

Furthermore, students might use the output of the learning analytic module to reflect on social, contextual, and cognitive aspects of their learning process.

- *A repository of learning resources:* each learning resource should have unique index and identifier to be traced by the learning analytic module. Content items, mainly derived from the CMS, form an important part of the learning repository. Content items should be categorized according to their learning objectives, level of difficulty, or related learning activity. Content items should be provided in rich formats that promote remixing and enable learning analytic module to realize their usage pattern and students interaction with them. A key characteristic of content items is to facilitate communication and collaboration around them. One simple way to facilitate communication around content is by means of folksonomies or end-user generated tags. Creating folksonomies allows students to give their personal meaning and understanding to a content item and make sense of content in a collective way. Web tools such as Facebook, Twitter, Diigo, or Blog might be a part of the learning resources students need to access and utilize. Students might use Blog as their personal portfolio and Diigo as their personal library. Easing students' access to several web tools necessitates implementing an effective Single Sign On (SSO) mechanism to enable students to take advantage of a single username and password for different web services. As detailed in Casquero et al. (2010), to implement a SSO mechanism, a bunch of web services and protocols are required including OpenId (a decentralized global identity provider that provides a unique digital identity to simplify the access to different web services by bypassing remembering several usernames and passwords), a SSO system such as simpleSAMLphp (an open source implementation of Web SSO and several federation protocols), and OAuth (a web protocol that provides a secure communication between APIs by exchanging user credentials in a secure way).

The learning resources repository should address the following pedagogical objectives: first, it should provide students with numerous evaluated and trusted learning choices which they can use to personalize their learning process. Secondly, it aims at encouraging and promoting students' and teachers' social activities around these learning resources such as exchanging experiences and success/failure stories, rating and evaluating the resources and increasing teachers' and students awareness about the usefulness and pedagogical benefits of these resources. Thirdly, it aims at enhancing the students' role in constructing their learning environment and educational decision making process and fostering a learner-centric and bottom-up approach to developing the learning environment through encouraging students' involvement in exploring and introducing appropriate learning resources. Fourthly, it seeks to create an updating inventory of appropriate learning resources and personal experiences and knowledge attached to these resources as a valuable resource to enrich the educational practices. Finally, exposing learning choices might trigger students' reflection. After becoming aware of new choices, students become stimulated and feel they must make sense of these choices by using them in meaningful ways and "until the new choices can be assimilated and accommodated, they are in a state

of disequilibrium" (Strampel & Oliver, 2007). As stated by Rahimi et al. (2014a), this disequilibrium stage might facilitate further reflection and can lead to conceptual change.

- *Learning resources' quality evaluation module:* students might access and use the provided learning resources via their personal spaces, evaluate, tag and rate them and even add their discovered/preferred learning resources to this directory. To add a learning resource by students to the learning resources repository, the quality of the resource needs to be confirmed by the learning resources' quality evaluation module. A possible way to implement the quality evaluation mechanism is by sending a request from the student who wants to add a learning resource, as an explicit student-generated feedback, and then evaluating the quality of that learning resource by a group of teachers or even a selected group of students. The student might be asked to explain the pedagogical and learning affordances of the introduced resources as a part of this request. Figures 4.3 and 4.4 present simple samples of this module. After evaluating the quality of the introduced learning resource on the basis of appropriate criteria, it might be added to the learning resources repository by the teacher to be used by other students and teachers.

The personal part of PLE should provide students with appropriate technological choices. The level and scope of these choices is an important factor influencing the students' control. While a restricted personal part can lead to poorly tailored learning experiences and students' boredom and demotivation, a limitless freedom will lead to the teachers' loss of control on the students' interaction with technology. In this situation dialogue between teacher and students is the best solution to make decision about the scope of students' technological choices.

4.5.4 The Organizational Part of the Initial PLE Design Framework

Examining teachers' views on the PLE-based learning has suggested that implementing the PLE-based learning in addition to pedagogical and technological support asks for appropriate organizational support and cultural changes at the school level. The insight gained from the participants has led us to designate a set of organizational supports, as shown in figure 4.7, to implement and facilitate the PLE-based learning including: improving teachers' TPACK (Technological, Pedagogical, and Content Knowledge), providing clear models of the PLE-based learning, creating a supportive Community of Practice (CoP) for teachers, adapting the curriculum objectives, and the school's leadership.

- *Improving teachers' TPACK:* as remarked by the participants, a main issue affecting teachers' willingness to adopt the PLE-based learning approach is their estimation about the required changes in their teaching process. As suggested by Rahimi et al. (2013b), improving teachers' TPACK might increase their willingness toward technology-based instruction. TPACK model (Koehler & Mishra, 2009) defines the kinds of skills and knowledge teachers need to acquire to effectively integrate technology into education, include: (i) content knowledge, (ii) pedagogical knowledge, (iii) technological knowledge,

(iv) pedagogical content knowledge which refers to knowledge about how a particular content should be taught in order to be comprehensible for others, (v) technological content knowledge which refers to knowledge about the possibilities and constraints of different technologies to represent content, (vi) technological pedagogical knowledge which refers to knowledge of affordances of different types of technologies to support teaching practices, as well as knowing how teaching process can be affected by particular technologies, and (vii) technological pedagogical content knowledge. One way to equip teachers with appropriate TPACK skills is by involving them in situated professional development programs. "Situated professional development" addresses teachers' specific needs within their specific environments by allowing them to gain "new knowledge that can be applied directly within their classrooms" (Ertmer & Ottenbreit-Leftwich, 2010). In this regard, Kennedy (cited in Ertmer & Ottenbreit-Leftwich, 2010) noted that the most important feature of a professional development approach is its strong focus on helping teachers to understand how students learn specific content, and how specific instructional practices and tools can support student learning outcomes. This approach to the teachers' professional development conforms to the recently emerged paradigms in pedagogy emphasizing that teaching and learning are intertwined practices and calling for teaching theories that consider teachers as co-learner (Vermunt & Verloop, 1999).

- *Providing inspiring models and examples of the PLE-based learning:* another identified organizational challenge for implementing the PLE-based learning was the lack of a clear pedagogical model and examples of PLE-based learning. In fact, beyond some technologically oriented approaches, there are not clear references and well-established pedagogical models of PLE-based teaching and learning as well as practical advices to support it available (Fiedler & Valjataga, 2011). Research has shown that the new technology or pedagogy adoption decisions are mainly influenced by teachers' individual attitudes towards the technology or pedagogy, which in turn are formed from specific underlying personal beliefs about the consequences of the adoption (Sugar et al., 2004; Ma & Harmon, 2009). Therefore, they must be personally convinced of the feasibility and benefits of the new technology or pedagogy before adoption and integration occur (Lam, 2000). Research has suggested that one of the best ways to convince and motivate teachers to adopt a new technology or pedagogy is by providing opportunities for them to witness and perceive the benefits of these changes. In this regard, Ertmer and Ottenbreit-Leftwich (2010) asserted that observing examples and models of a technology integration or a pedagogical approach by teachers can increase their knowledge, change their belief system and, convince them to adopt the new technology or pedagogy by helping them to understand what looks like the approach or tool in practice and to make judgment about whether that approach or tool (*i*) is relevant to their goals, (*ii*) supports different teaching and learning scenarios, (*iii*) enables them to meet student needs, and (*iv*) addresses important learning outcomes.

- *Creating a supportive Community of Practice (CoP) for teachers:* teaching with technology in a world of relentless technological innovations is a challenging process which always is in a state of flux. In this regard, Ertmer and Ottenbreit-Leftwich (2010, p. 260) remarked that:

Unfortunately, learning about technology is equivalent to asking teachers to hit a moving target. Teachers will never have complete knowledge about the tools available, as they are in a state of flux. This often results, then, in teachers being perpetual novices in the process of technology integration.

Accordingly, teachers need permanent support to deal with relentless technological changes and explore the pedagogical affordances of the emergent technologies. Creating a supportive community of practice (COP) and participating in this COP might provide teachers with the opportunities to be aware of new technological changes, observe or hear about other teachers success and failures, exchange "good teaching" practices, and get enough confidence to integrate technology in their teaching practices. In this regard, as asserted by Ertmer & Ottenbreit-Leftwich (2010), "observing successful others can build confidence in the observers who tend to believe if he/she can do it, then I can too." Cochrane (2014) has shown that underlying all of the critical success factors for transforming pedagogy with Web 2.0 is by "creating sustained interaction that facilitates the development of ontological shifts, both for the lecturers and the students" (p.73). Cochrane (2014) suggestion to ease this Web 2.0-based pedagogy transformation is to establish a combined lecture and student community of practice (COP) for implementing Web 2.0-based projects, supporting continuous professional development of teachers, reinventing traditional classroom interactions, rethinking commonly accepted roles for teachers and learners, and redesigning established assessment activities.

- *Adapting the curriculum objectives:* in addition to the identified organizational support, implementing the PLE concept in educational settings requires adapting the curriculum objectives to redefine the commonly accepted roles of teachers and students in the educational settings. The traditional procedures of teaching assume students as not sufficiently knowledgeable individuals to take full control over their learning. This assumption strengthens the role of the teacher as the main controller of the educational practices with the main goal of transferring predefined content to the students (Dron, 2006) resulting in too much teacher's control in the educational process and leading to poorly tailored learning experiences, students' boredom and demotivation (Garrison & Baynton, 1987). In line with these findings Ertmer & Ottenbreit-Leftwich (2010) asserted that when teachers are asked to use technology to facilitate learning, some degree of change is required along any or all of the following dimensions (a) beliefs, roles, attitudes, or pedagogical ideologies; (b) content knowledge; (c) pedagogical knowledge of instructional practices, strategies, methods, or approaches; and (d) novel or altered instructional resources, technology, or material. In practice these changes and adaptation are not

straightforward and require time and effort. As asserted by Guskey (1995), the amount of change individuals are asked to make is inversely related to their probability of making the change. Hence following a step-by-step technology integration approach by focusing on teachers' and students' immediate needs and facilitating small changes within teaching and learning practices appears to be an effective long-term strategy to adopt and implement the PLE concept within the school's settings.

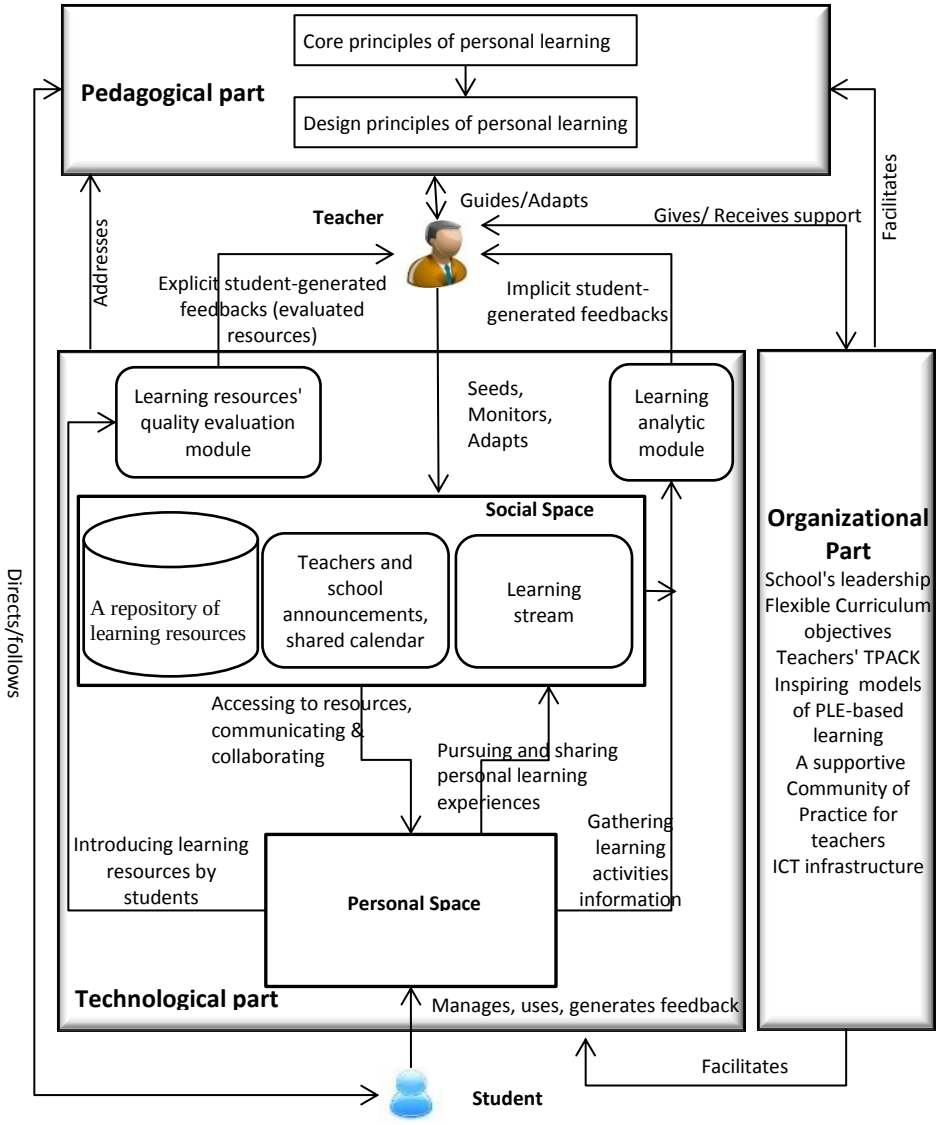


Figure 4.7. The components of the initial PLE design framework and their relationships

- *ICT infrastructure and policies:* in light of the huge reliance of the PLE model on the Internet and web services, addressing the identified technological and pedagogical requirements asks for a robust, safe and scalable ICT infrastructure. Also, addressing the observed challenges regarding students interaction with technology calls for training students how to use technology to develop their social, help-seeking, and self-regulating skills, defining and enacting appropriate Internet usage policy and legislation to make an appropriate balance between students' freedom and school's expected level of control, and defining transparent mechanisms to collect data pertaining to students learning activities and act on the data.

- *School's leadership:* providing and sustaining these organizational supports requires school's leadership. In principal, teachers are not "free agents" and their innovative use of technology for teaching and learning depends on the "interlocking cultural, social, and organizational contexts in which they live and work" (Ertmer & Ottenbreit-Leftwich, 2010, p.264). Accordingly, to implement and sustain any fundamental change in an organization such as school, "it is necessary to change not only individuals but also systems" (Fullan, 2006, p.1).

Conclusions

In this chapter we first focused on the teacher's side of personalizing learning. The results of this chapter have led us to conclude that facilitating personalizing learning is based on a new definition of "good teaching" or teaching that facilitates student learning by leveraging relevant web resources as meaningful pedagogical tools. Personalizing learning is a challenging, complex, and long term process often requiring ontological shifts in teachers and students. As suggested by Cochrance (2014), the key requirement to facilitate this ontological shift is "sustained interaction" between teachers, students, and technological and environmental elements. Deploying and sustaining PLE-based learning across classroom settings calls for the development of shared strategies, coordination and mutual understandings of teachers, students and schools around participation, collaboration, social interactions, content authoring, reflection, and feeding back using Web 2.0 technologies. Implementing and sustaining PLE-based learning requires not only empowering students to act as self-regulated learners but calls for changes in the whole school system including adapting the curriculum to support assessment for learning, putting more emphasis on informal learning process, and finally creating a learning climate where everyone takes risk and learns from her or others' failures, mistakes and experiences.

After the teachers' and students' views on the requirements of personalizing learning have been explored, we have answered the research sub question # 3: "*How to incorporate students' and teachers' views on the design of a PLE in order to develop an initial PLE design framework?*"

To answer this research question and develop an initial PLE design framework we incorporated theory into practice through performing theoretical and empirical grounding

processes. As a result, the generated framework provides practical as well as theoretical implications. In one hand, the developed PLE design framework provides situational design knowledge for the practitioners to address the identified educational problem in the context of this research (the Amadeus Lyceum Secondary school). On the other hand, the PLE design framework provides abstracted design knowledge useful for both IT and learning professionals to design and develop technology-based learner-centric learning environments.

Although the developed PLE design framework provides implications to support personalizing learning in guided and formal learning settings (i.e. in schools), it still needs to be complemented with insights on personalizing learning process in informal and learner-led learning settings. To this end, in next chapter the personalizing learning process in a workplace setting is scrutinized to evaluate the derived framework and revise it to fit the personalizing learning process in the workplace settings.

5 Specifying Factors Influencing Personal Learning and Competency Development in the Workplace

While the results of the two previous chapters have revealed the specifications, triggers/barriers, and requirements of personal learning in a guided learner-centric learning environment (i.e. the school setting), this chapter allows investigating factors influencing personal learning in an informal and learner-led learning environment. A significant amount of research on designing workplace e-learning systems has focused on facilitating personal learning and supporting greater learner control over their learning experience. The need for adopting learner-led approaches in designing e-learning systems has been raised by recognizing this fact that the success of today's organizations is highly depends on their ability to develop an agile workforce that can quickly learn and adapt to rapid and relentless changes in the technological, knowledge and socio-political landscapes.

This research was conducted is the customer contact centre (hereafter called CCC) at the Achmea Insurance Company in the Netherlands. To meet their frequently changing learning requirements, the employees of the CCC have to constantly learn and update their professional knowledge. Accordingly, the CCC context provides us appropriate opportunities to investigate and analyze the nature of personal learning and competency development within the workplace settings and to answer research sub question #4: "What factors do influence personal learning and competency development in a workplace setting?"

Please note that the terms in the following categories have been used interchangeably in this chapter: (*i*) learners, call agents, CCC's staff, employees, users, and participants, (*ii*) client and customer.

5.1 Research Design

The answer to the research sub question #4 has been structured in the steps depicted by figure 5.1.

1) As a design-based research, our research starts with identifying a learning problem in the research context. This learning problem will be discussed in section 5.2.
2) After recognizing the learning problem our research continues by exploring the research context to get deep insight into the roots of this problem. As the research context is a workplace setting where learning and working are intertwined and inextricable processes, we need to analyse the employees' learning and competency development in a broader perspective as a part of the work and organization context by getting insight into organization's objectives and working procedures. Accordingly, we asked these questions: What are the defined organizational objectives for the CCC? And how are the work

procedures in the CCC's context defined and performed to address these organizational objectives? This part of the research is explained in section 5.3.1.

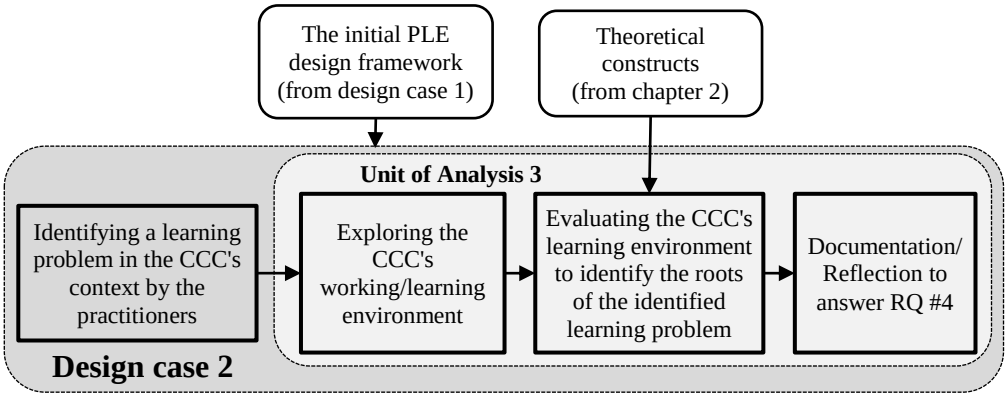


Figure 5.1. The followed steps in the design case 2 unit of analysis 3 (employees' views) to answer research sub question #4

Then, the core competencies the CCC's staffs need to develop in order to support their work are identified and then the relationship between the development of these competencies and working performance of the CCC's staff is examined. This question direct this step: What are the core competencies the CCC's staffs need to develop to support their work and meet the organization's objectives? This part of the research is explained in section 5.3.2. After that, we describe the constituent elements of the employees' learning environment in the CCC's context. Then the opportunities and barriers in the learning environment influencing the learning and competency development of the employees are identified. These questions direct this step: What elements of the CCC's context might influence the learning process and competency development of the employees? what learning activities do the employees perform using these elements in this context? What are the barriers against employees' learning and competency development in this context? This part of the research is detailed in sections 5.3.3, 5.3.4, and 5.3.5.

3) Finally, the identified opportunities and barriers are mapped into learner's control model, described in chapter 2 as the core part of personalizing learning process, to answer research sub question 4.

As the employee-driven learning and competency development in this context was not well understood we opted to choose the qualitative research methods to support data gathering and analysis processes. Yin (2009) identified six possible sources of evidence including: documentation, physical artifacts, interviews, direct observations, participant-observation, and archival records. Due to the exploratory nature of this research, we used three methods: direct observation, studying the organizational documents and reports, and interviewing the CCC's staff.

Direct observation is a qualitative research method that allows researchers to observe people in their environments to realize the ways they interact with their social structures and environments including peers, clients, and systems and so on. For the purpose of this research four direct observation sessions were conducted by the principal researcher. Each session lasted between 30-45 minute and during each session the principal researcher was sitting passively and recording accurately what was going on in a place where the call agents were working. To allow for emergent findings out of the observations the observation was done totally free without any predefined code or structure.

Studying organizational documents and reports was another research method used in this research. These sorts of documents and reports were used: call agents' performance reports, the working and learning challenges faced by the call agents, the working procedures of the CCC, the organizational vision and missions. It is noteworthy that most of these documents were written in Dutch language. Given the limited knowledge of the researcher of Dutch language, this part of research involved translating these documents to English and then analyzing them. During the research there was a continuous cooperation between the principal researcher and people of the Achmea Company to decrease any language bias and confirm the final results.

Interview was used as the third research method in this study. A purposeful sampling technique (Patton, 2005) was adopted to select the interviewees. Fourteen interviewees including 6 female and 8 male aged from 24- to 57-year-old with different working experience ranged from 1 to 25 year were selected. Four interviewees (1 female and 3 male) were the learning managers of the Achmea Academy with the main responsibility of running and supporting learning and competency development initiatives within this company. Three interviewees (2 female and 1 male) were knowledge and content experts with the main responsibility of providing learning content for the call agents and addressing their insurance knowledge issues. Three interviewees (1 female and 2 male) were team managers with the main responsibility of managing one or more teams of call agents. Four interviewees (2 female and 2 male) were call agents. In total fourteen semi-structured interviews were conducted in face to face, phone or Skype meetings. Each interview lasted between 15 minutes to two hours. The focus of each interview session was to realize the ideas, experiences and reflections of the interviewee on different aspects including the nature of the learning process in the CCC's context, learning opportunities and barriers, the elements of the learning environment, and so on.

After the required data to answer the research question has been collected, we started the analysis procedure. The first phase of the analysis procedure included transcribing audio data, entering collected data into Atlas.ti software and conducting the coding process. To allow for emergent findings out of the collected data, no pre-defined categorizations were used to code the data. The analysis process continued by reading the transcripts and assigning freely named codes to the descriptions. The second phase of the analysis process

involved reading the transcripts organized by codes, writing memos, recoding and merging similar codes as necessary, grouping codes into categories, creating network diagrams by establishing relationships or links between codes, and writing up conclusions.

5.2 Recognizing a Learning Problem by the Practitioners in the CCC's Context

The Achmea holding is one of the top 3 insurance groups in the Netherlands and is active in providing insurance and financial services. The staffs of the CCC, or call agents, create and maintain the connection between customers and the rest of the company. Customers contact the call agents to buy the company's insurance products including car, home, health, travel, and damage insurance or ask their questions regarding to the insurance products and services. To perform their job effectively, these call agents are highly dependent on receiving and acquiring accurate and updated insurance information and knowledge. Accordingly, any change in the insurance information and knowledge can affect their performance. Like other knowledge-driven businesses in the information age, this company is experiencing the relentless and quick changes in its source of information and knowledge caused by several factors including: enacting new or adapting current national and international rules, defining new or adapting current products and services, continuous changes in the internal procedures of the company, and emerging new technological and business trends in the market. As a result, there is this perception among the managers of this company that these frequent and rapid changes in the insurance information have resulted in the slowness of the insurance knowledge acquiring and updating process among the call agents.

It has been acknowledged by the managers of this company that solving this problem asks for defining and following personal learning approaches aiming at developing agile employees and organization and accelerating the insurance knowledge acquiring and updating processes within this company. As a result, continuous learning and competency development are receiving more attention as means for improving call agents ability to serve customers and address the organization's objectives. A part of these learning improvement efforts has been focused on developing an e-learning system called PowerApp by the Achmea Company which will be explained in the next chapter. While PowerApp is meant to support employee-driven learning and knowledge updating, there exists no clear picture of the personal learning process of the call agents in the CCC's context. Accordingly, the main objective of this research is to explore the ways the call agents learn and acquire knowledge and identify the factors influence their ways of learning. These insights into the personal learning of the call agents then can be used to evaluate and improve the effectiveness of this e-learning system as well as answer research question #4.

5.3 The Working and Learning Processes in the CCC's Context

In this section we aim to scrutinize the specifications and influential factors of learning and competency development in the CCC's context. As learning in workplace settings is meant to support and is driven by organization's objectives and working processes, we first need to identify and realize the organization's objectives and its supportive working processes. After the organization's objectives and working processes have been identified, we identify the competencies the CCC's staffs require to address these objectives and analyse the learning process they go through to develop these competencies.

5.3.1 The organizational objectives and working process

The core activity in the CCC context is serving customers and selling insurance products and services including car, home, travelling, and health insurances. CCC has two main objectives: achieving the defined sale targets and increasing customers' satisfaction. Also, to balance possible competition between these objectives an index called standard *AHT* (average handling time of calls between call agents and clients) has been defined. These objectives and the rationale behind them will be explained later on in this section. These objectives inform and direct the call agents' activities and working processes in the CCC. Also, these objectives are used to measure the performance of the call agents. As stated by Argyris and Schon (1974), organization's objectives can be considered as "governing variables" or "dimensions that people are trying to keep within acceptable limits" and the working processes defines "the moves and plans used by people to keep their governing values" within the acceptable range. Figure 5.2 illustrates the activities and working processes the CCC's staffs go through to achieve these objectives.

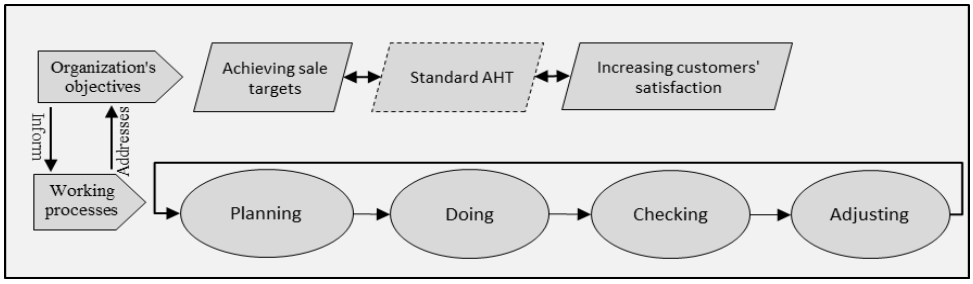


Figure 5.2. The organization's objectives and working processes of the CCC

The working process follows a cyclic continuous improvement process consisting of four phases: planning, doing, checking, and adjusting. To perform this working process call agents are grouped in twenty-person teams coached by a team manager. In the 'planning' phase the members of each team set their weekly or monthly individual and team sale targets in terms of number and type of insurance products to sell informed by the organization's sale objectives. In the 'doing' phase each team goes through a process of serving customers and selling insurance products while the team managers support and monitor this process and coach team members. Figure 5.3 illustrates the procedure that call agents follow in the 'doing' phase. In the 'checking' phase the call agents and managers

measure, evaluate, and reflect on the individual and team performance. Finally, in the 'adjusting' phase the call agents and managers adjust their targets, plans, and strategies. This process resembles a PDCA (Plan, Do, Check, Action) cycle proposed by Deming (1986) to support continuous quality improvement programs in industrial settings. Similarly, by following this working process the CCC's managers sought to facilitate continuous improvement in the performance and outcomes of their teams.

The procedure in figure 5.3 starts when a customer makes a call to the CCC or a call agent calls a potential customer to sell the insurance products. When a customer starts this procedure by calling the CCC, after assigning a call agent to this call by the call management system, the call agent starts to serve the customer's request. The detail of each call is recorded in the call management system to facilitate further call analysis performing by the team managers. After finishing the call, the call agent wraps up the call by writing a report or initiating required extra activities associated to the call. For each call there is a call handling time parameter (HT) including the speaking time with the customer and the required afterward wrapping up time. The average of these HT values for each call agent in a specific time duration (i.e. week or month) determines the value of his/her average handling time or AHT which is used as a key parameter to measure the performance of the call agents and their associated teams. Currently, there is a standard AHT number, i.e. 600 seconds for a call. The rationale of this standard AHT number is to adjust the talking behaviour of social-oriented and commercial-oriented call agents and make it in line with the organization's objectives. In other words, there is this belief in this organization that social-oriented call agents tend to put more time for each customer, which in general might result in more customer's satisfaction and less sold products, while the commercial-oriented call agents tend to put less time for each customer and talk with more customers in order to sell more products which may result in less customer's satisfaction but more sold insurance products.

In addition to answering customers' questions and request, the call agents also can contact potential customers via phone, email, and even social media to sell the insurance products. The Achmea Company tries to make a balance between customers' satisfaction and benefits and its sales objectives. There is this belief in the Achmea Company that a high level customer's satisfaction can largely help the company to achieve its objectives and improve its reputation, while unsatisfied customers can impose several costs on the company including the increased number of the customers call back for the same questions and the damaged reputation of the company. Accordingly, the level of customer's satisfaction is meant to recognize and involve the customers voice as part of the criteria used to measure the performance of the call agents and their teams. To determine the level of customer's satisfaction for a specific call agent, the customers who contacted the call agent recently are surveyed by sending email after their calls. In this survey the customers are asked about their level of satisfaction regarding criteria such as the accuracy and relevance of the

received information, their waiting time, and the commitment of the call agent to solve their problems and support them.

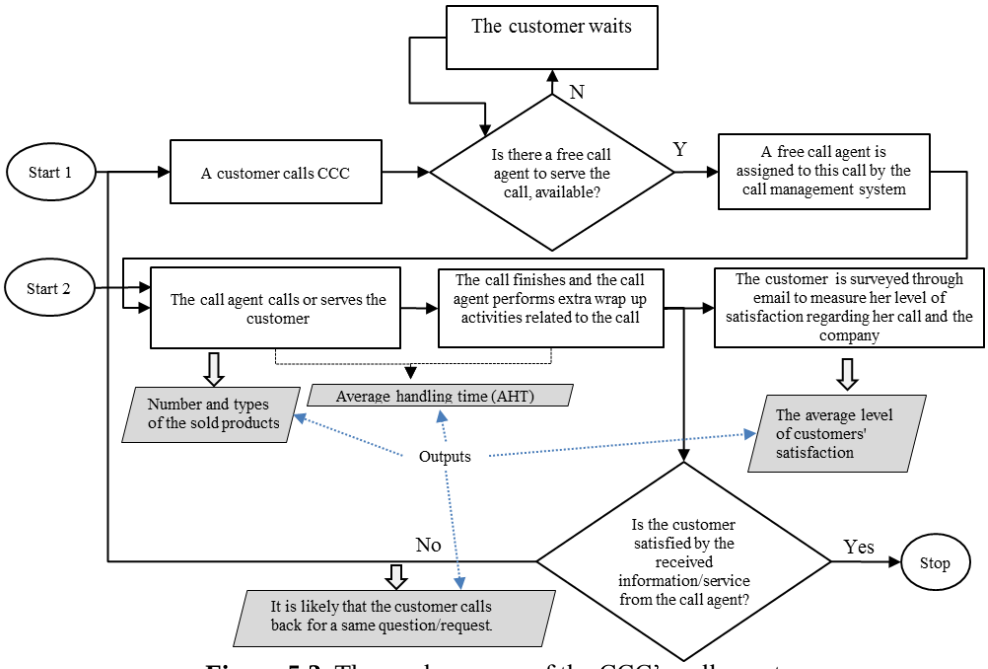


Figure 5.3. The work process of the CCC's call agents

5.3.2 Relationship between the call agents' competency development and the organization's objectives

After the main objectives of the organization have been identified, in this section the relationship between the call agents learning and competency development and the achievement of these objectives is scrutinized. Interviewing the managers and call agents has shown that the call agents in order to address the organization's objectives require at least two core competencies: (*i*) the ability to sell insurance products and serve customers' needs and requests, and (*ii*) quick acquiring and updating insurance information. Development of the first competency has a close link with acquiring skills such as communication, listening and questioning skills. This point was voiced in almost all interviews. In this regard, a manager expressed her idea as follows:

In phone-based communication there exists no facial contact and the communication can become more difficult for call agents if they do not have appropriate listening and questioning skills. Indeed, many clients do not have enough information about insurance products and they do not know what to ask. Therefore, our call agents should be able to ask the right questions to help the client to realize her tacit and hidden needs and find a link between their needs and the company products.

The second core competency the call agents need to develop is the ability to quick acquire updated insurance information including changes in government rules and policies in financial and insurance domain and changes in the company' s insurance products, services, and procedures. The importance of this competency can be seen from the AHT and customers' satisfaction perspective. There is a general conception within this context that the call agents with accurate and fresh insurance information and willingness toward updating their knowledge might answer the customers' questions more quickly and accurately. In this regard, one manager expressed her opinion as below:

There are several ways to initiate and trigger the knowledge updating process of our call agents. The most time consuming and undesirable way is by customers. Indeed, when a customer asks a question about a product or services and the call agent does not know the correct answer, the call agent should follow a time consuming process including searching the Brein system or asking colleagues or knowledge experts to find the correct answer while the customer is waiting. But if our call agents keep their insurance knowledge updated through self-initiating and personal learning they can increase the customer's satisfaction and decrease their call time….the outdated insurance knowledge of the call agents leads to the clients' dissatisfaction. For example, last week I had a client who asked me to send the insurance documents of his damaged car by email. There is a new government policy which allows customers to send their documents by email. But I was not aware of this policy and rejected the client's request.

5.3.3 The Elements of the CCC's Context Influential in the Employees' Learning

Learning in workplace settings is a context-based process and should be evaluated and understood in its context (Smith, 2003). According to Rogoff (1984), context is "... the problem's physical and conceptual structure as well as the purpose of the activity and the social milieu in which it is embedded" (p. 2). Choi and Hannafin (1995) mentioned three roles for the context to support learning: (*i*) acting as framework to support everyday cognition, (*ii*) supporting authentic and meaningful learning, and (*iii*) transferring knowledge and skills into action through involving learners in realistic and relevance problem-solving scenarios. Situated cognition perspectives to learning recognize an inextricable link between thinking and the context and the significant impact of real-life contexts in learning. In the light of these perspectives, knowledge can be seen as dynamic by-product of unique relationships between an individual and her surrounding environment and learning is conceptualized as a natural by-product of individuals' engagement and interactions within contexts in which knowledge is embedded naturally (Choi & Hannafin, 1995).

Understanding the learning dynamics within a learning context plays a key role in identifying and designing the components of a technology-based learning environment aiming at addressing the learning needs and objectives of this context. Considering a

technology-based learning environment as an IS (Information System) artefact, the importance of the learning context can be seen from a IS design perspective. According to the "Information system research framework" suggested by Hevner et al. (2004), understanding context is one of the main issues in design science research. The context defines the problem space, where resides the interest of various stakeholders, and consists of people (i.e. their roles, capabilities, and characteristics), organization (i.e. strategies, structure, culture, and processes), and technology (i.e. infrastructure, applications, and development capabilities) (Hevner et al., 2004). On the basis of this definition of context, figure 5.4 illustrates the components of the CCC's learning context that shape learning and competency development of the call agents.

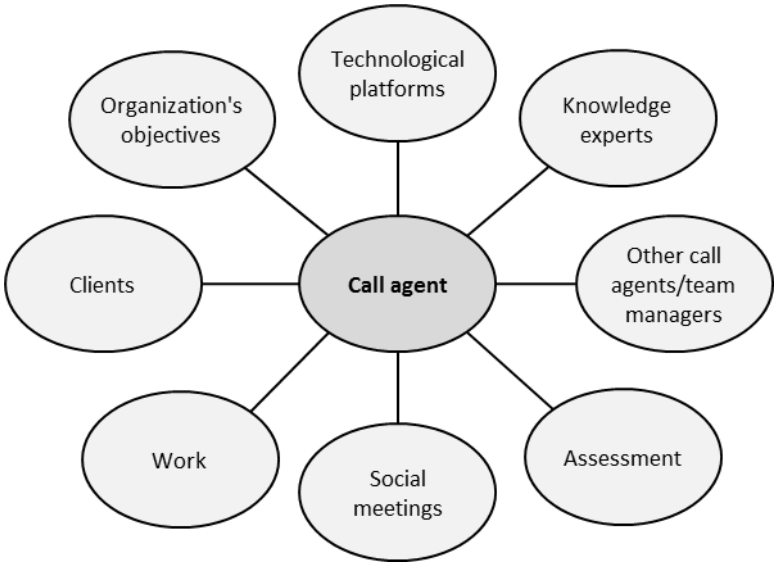


Figure 5.4. The components of the CCC's learning context

Each call agent before starting his/her job as a call agent, takes part in specific basic training courses where s/he learns and acquires basic "ready-to-go" insurance knowledge and skills. After starting their job, the call agents use several technological platforms including Brein (a central content base), Yammer (an organizational social networking platform) and communication tools such as email to perform their tasks as well as to learn and support their competency development. They use these technological platforms to find an answer to the customers' questions, being informed about any changes in the insurance information and events, and communicate with other call agents, their managers and knowledge experts. Further, they can collaborate with each other in regular daily and weekly social meetings to discuss their problems, exchange their experiences and solutions, and receive advice and feedback from their colleagues and team's managers. Also, there is a team of knowledge experts who are responsible to support the call agents by answering their questions, providing appropriate content and updating the content base system (i.e.

Brein). Finally, contacting customers and plunging in daily activities and facing with working challenges play an essential role in learning and competency development of call agents.

There exist two types of learning assessment mechanisms to assess the insurance knowledge and competency level of the call agents: a standard test-based assessment and a process-based assessment. The standard test-based assessment is conducted every 1.5 year with the main purposes of assessing and evaluating the call agents' insurance knowledge level. The process-based assessment is conducted by team managers by listening to the recorded calls between the call agents and customers. Through this process-based assessment the manager can get insight into the call agent's level of knowledge and competencies in terms of the accuracy of the transferred insurance knowledge and the call agent's communication, listening and selling skills. This insight then can help the manager to coach the call agents.

5.3.4 Learning and Competency Development in the CCC Context

After identifying the main elements of the learning environment in the CCC's context, in this section we analyse the process the call agents go through to learn and develop their competencies using and interacting with these elements. Due to the team-based structure of working and learning, we opted to use the communities of practice (CoP) and legitimate peripheral participation concepts (Lave & Wenger, 1991) as analysis framework to investigate learning and competency development process in this context. Furthermore, according to Whitworth (2009), CoP theory provides empirical descriptions of learner-generated contexts. For more detail on this theory please see chapter 2.

As was mentioned earlier, there are two core competencies the call agents need to develop in order to address the organization's objectives: (*i*) ability to sell insurance products and serve customers' requests, and (*ii*) quick acquiring and updating insurance knowledge. In following we will analyze the development process of these competencies in this context by applying the CoP theory.

- **Competency 1- ability to sell insurance products and serve customers:** Within this context serving customers competence refers to the call agents' ability to serve and communicate with customers involves talking, listening, questioning, handling complex situations, predicting customers' needs and selling skills. To gauge the development of this ability in the call agents, the team managers use two mechanisms namely the process-based assessment mechanism and the call agents' performance reports. Surprisingly, the interviewed managers were unanimous that the new call agents show a higher AHT and lower sales number and customers' satisfaction level in compare with their experienced peers. This fact can be described by the legitimate peripheral participation notion of the CoP's theory. On the basis of this notion at the beginning a new call agent does not have enough competencies required to reach full participation in the CoP, i.e. better serving of

customers. Although new call agents learn basic ready-to-go insurance knowledge and skills during basic training, the best place to develop this competency is in the workplace through talking with real customers, apprenticing, observing, listening to, imitating and cooperating with the experienced call agents. In other words, newcomers cannot develop this competency through learning *about* the community of practice (i.e. in basic training courses). Rather, they must learn *in* the community of practice (i.e. in workplace) to develop this competency. In the same vein, as asserted by Brown et al. (1989), an essential aspect of work-based learning is becoming a practitioner, not learning about practice. Each CoP provides specific learning opportunities for its members and makes it possible for them to reach full participation in the CoP through a socialization process (Lave & Wenger, 1991). Within the CCC's context, a significant part of this socialization process is shaped around serving customers and performing and dealing with the daily tasks and challenges. Figure 5.4 presents different types of learning activities accomplished by call agents during their daily interactions with each other to address their daily tasks and challenges.

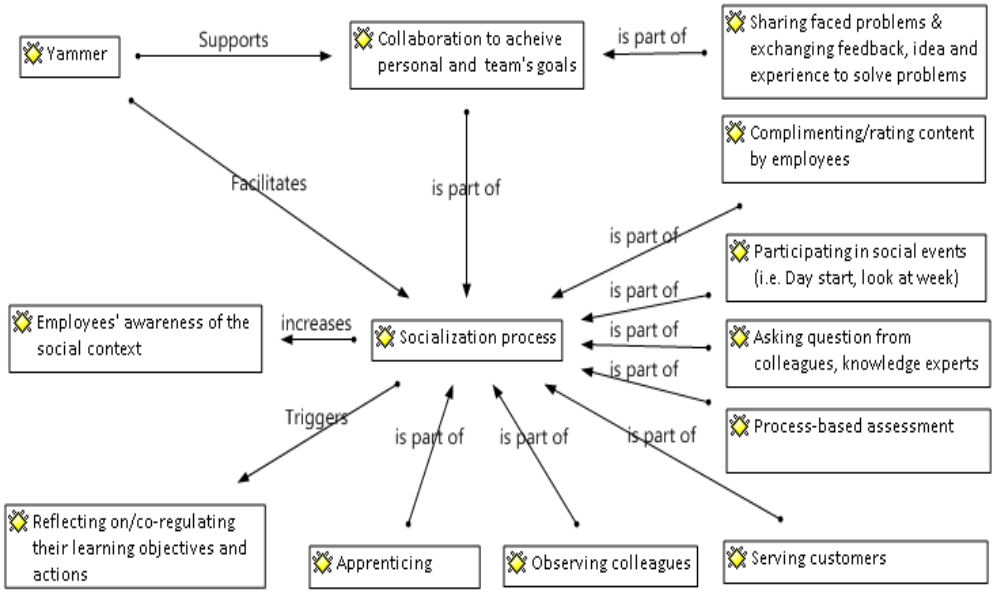


Figure 5.5. The elements of the socialization process in the CCC context

According to figure 5.5, the socialization process in the CCC's context involves performing activities such as apprenticeship and observing peers' actions (mainly by junior call agents), process-based assessment (by teams' managers), asking questions from peers or knowledge experts, participating in social events, and complimenting or rating content in Brein (mainly by middle call agents), mentoring, sharing and exchanging experiences, idea, and feedback to address the faced individual and team's issues and collaboration to achieve team's goals (mainly by senior call agents). This socialization process not only serves to address the daily problems and challenges faced by call agents, but also might increase call agents' awareness of the social context and stimulate them to reflect on the accuracy and level of

their insurance knowledge and regulate their learning objectives and activities. One call agent expresses her experience in this regard as below:

Sometimes you are just listening to the conversation between two colleagues. During this conversation you might hear something which is new to you and you do not know about it. This stimulates you to go and search for it to learn it. Indeed, this kind of socialization imposes a significant impact on our competency development process.

In addition to the socialization process happening in the physical workplace, the technological platforms such as Yammer and Email have facilitated online socialization process among the call agents. Yammer is an enterprise social network service which is used to support communication between employees within Achmea Company. The call agents mainly use Yammer to support and manage their team working activities. Each team has its own page where the team's members can share and exchange their information. Figure 5.6 shows how the call agents use Yammer. According to this figure, Yammer is mainly used to perform different sorts of activities in the CCC's context including: (*i*) collaboration and exchanging ideas, experiences, problems, and solutions between call agents to solve individual and team problems and achieve individual and team's targets, (*ii*) accessing short term and daily basis information such as team schedules and reports inside and outside of workplace, and (*iii*) endorsing active employees through distributing clients' compliments.

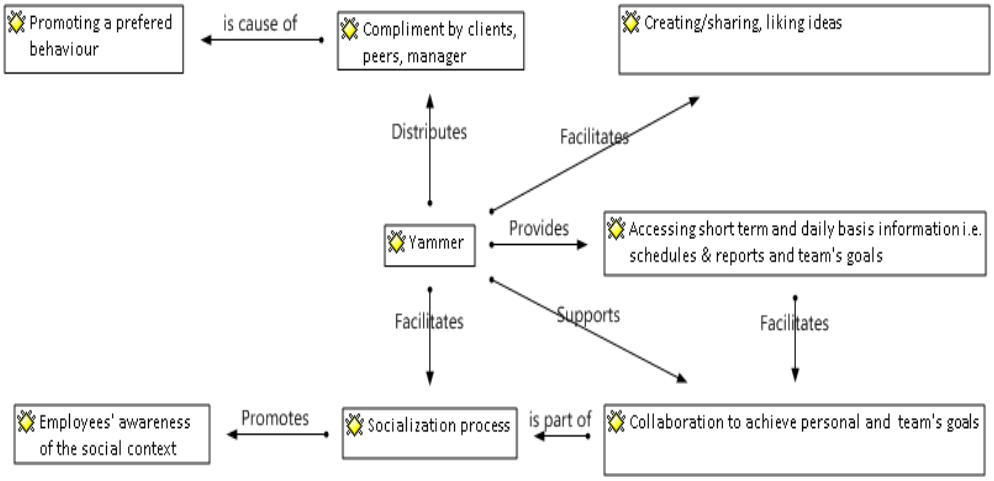


Figure 5.6. The use of Yammer within the CCC context

- **Competency 2- acquiring updated insurance information:** The second core competency the call agents need to develop is concerned with acquiring updated insurance information. The development of this competency imposes a significant impact on achieving the organization's objectives through influencing the rate of clients' call back for

a same question/request, AHT, customers' satisfaction, and the organization's reputation (see figure 5.3). Three are three sorts of insurance information to be learned by call agents: (i) Achmea-specific information (i.e. changes in financial and procedural information and changes in the products, services and procedures of the organization), (ii) changes in legislation and government rules and policies that affect the insurance and financial domains, and (iii) changes in information about the insurance industry and market (i.e. industry-wide trends, news, competitors approaches, etc.). Although, the basic knowledge the call agents learn in their formal courses plays an important role in helping them to step forward in their work, the rapid and relentless changes in insurance information has made it necessary for them to update their insurance information continuously. This point has been emphasized by an interviewed knowledge expert as follows:

We are working in a very dynamic environment where everything relating to our business is changing continually and rapidly. As a result, our insurance knowledge in this evening is different from of which in the morning. For example, if the government released a new policy about insurance today morning, our call agents should know and apply it today afternoon.

Although, the socialization process assists call agents to develop their skills to serve customers, this rapid and frequent change in insurance information has called the ability of this process to keep the insurance information of call agents updated into question. In this regard a manager expressed his idea as below:

Social activities provide good opportunities for call agents to share their experiences and problems and learn from each other. But when it comes to specialized information and knowledge, this socially gathered information and knowledge should be evaluated and controlled by experts before transferring it to customers. They cannot learn these type of knowledge from each other rapidly. Therefore, to satisfy clients and improve our performance we should always revise and update our information about the insurance products and services systematically and quickly.

Brein is a centralized digital content base within the Achmea Company containing insurance information and documents. Brein is meant to help the call agents to keep up with the rapid changes in insurance information. Figure 5.7 illustrates how Brein fulfils this role. As shown in this picture, the CCC staff access the Brein to read insurance information in a daily-basis manner. The call agents and managers use these documents and information to update their information and answer to the customers' questions. There is a team of knowledge experts who choose, create and upload relevant content in Brein. Also, the employees can rate the quality of the provided content in Brein.

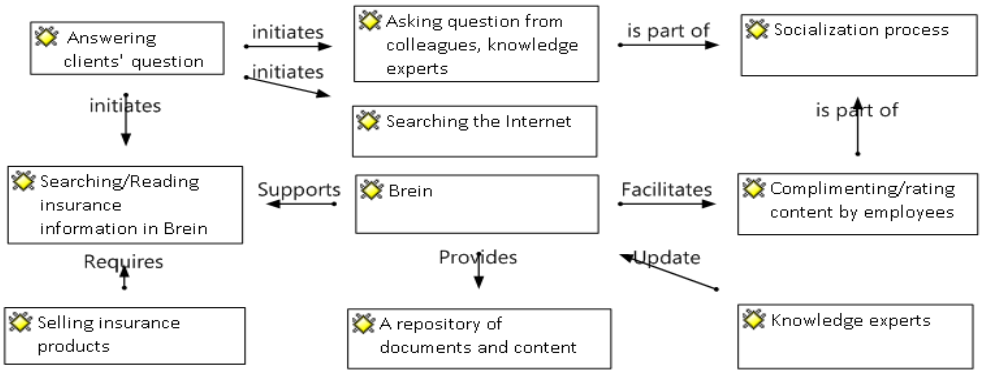


Figure 5.7. Using Brein to access insurance information

Although Brein provides a rich repository of insurance content, still its functionalities are not effective to help call agents to keep up with the speed of insurance information changing. As a result, there is a delay between the emergence of new insurance information and acquiring and updating this information by the call agents. This slow process of insurance information acquiring/updating impacts the organization in two aspects: first, inability of the call agents to provide customers with the accurate insurance information might result in several costs including damaged reputation of the organization, customer's satisfaction issues, increased customer's call back rate for the same call, and increased AHT. Secondly, inability to provide accurate information for customers contradicts the compliance rules and policies enacted by government for financial organizations.

5.3.5 Factors Slowing the Insurance Information Updating Process in the CCC Context

This section scrutinizes the roots and causes of the identified problem within the CCC context. The exploration of the learning environment in the CCC's context has led us to identify three sorts of factors causing the slowness of insurance knowledge updating by the call agents including: (*i*) information factors, (*ii*) technological factors, and (*iii*) personal and organizational factors.

- **Information factors:** as shown in figure 5.8, there are four information factors slowing the process of acquisition and updating information by call agents in CCC context including inappropriate format/size of content items in Brein, information with no practical implications in Brein, existing inconsistent/inaccurate information, and missing information in Brein. A perceived problem with Brein is related to the low quality of its content in terms of format (i.e. lack of rich format content such as graph, video) and size (i.e. providing large documents which are difficult to read in short time). Further, in general the provided information by Brein are not appropriately contextualized and do not offer useful implications for practice and connection to the context-based situations and challenges. The existence of this issue is due to the lack of an effective mechanism to support learner-

generated content (LCG) approach to creating insurance content by call agents. Another factor slowing the call agents' knowledge updating process is the existence of inaccurate insurance information because of the availability of several information systems with redundant and even inconsistent information and also call agents' participating in the socialization process. The availability of several content systems such as Brein, Yammer, and related web sites was perceived as a reason to propagate inconsistent and inaccurate information. Another perceived problem with the Brein was about missing information in Brein due to several reasons including large amount of information to read in a daily basis, inappropriate presentation and classification of information, and lack of a notification mechanism to inform call agents about new content items in Brein.

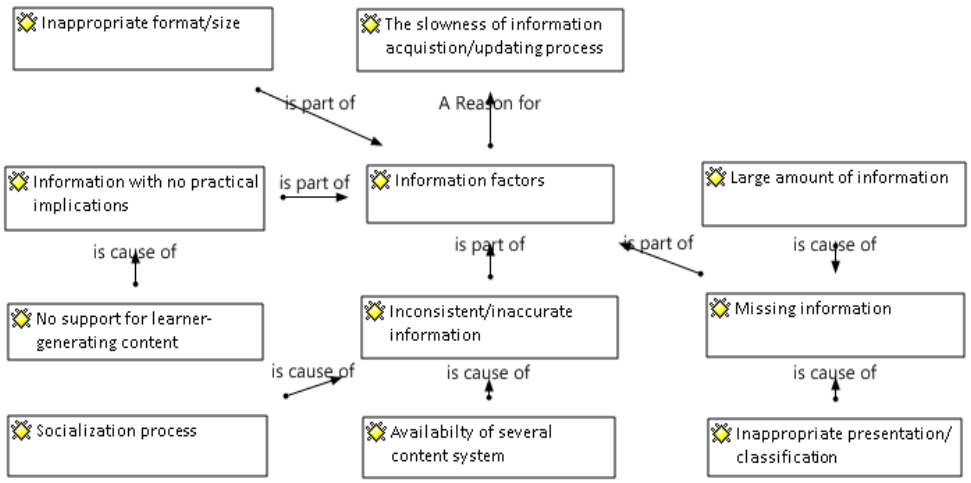


Figure 5.8. Information factors causing the slowness of insurance information updating process in the CCC context

- **Technological factors:** Figure 5.9 shows the technological factors that slow the process of acquisition and updating insurance information by call agents. These factors include lack of appropriate functionalities in Brein to support call agents to use their short free time between calls for learning purposes, impossibility of accessing and using Brein outside of the company and via personal tools such as cell phone and tablet, and lacking an appropriate assessment mechanism in Brein to evaluate the insurance information held by call agents which significantly decreases their awareness about the accuracy and freshness of their insurance information. One call agents illustrated his opinion in this regard as following:

Brein acts as an archive system rather than a learning system. It cannot assess your information. As a result, you are not sure about the accuracy and freshness of your information particularly when the speed of changing and updating information is high.

Furthermore, the current technologies meant to support learning process in the CCC context do not provide appropriate mechanisms to promote and encourage self-directed and self-initiated learning and are not enough attractive to motivate call agents to update and refresh their insurance information independently. In other words, these systems mainly support and facilitate a customer-caused rather than a call agent-initiated information updating process. In this regard one manager expressed her opinion as below:

Currently, the call agents are pushed to use Brein by customers' questions and requests rather than their curiosity or initiative. Any learning technology should make learning a fun and engaging process for learners to motivate them to access and use it even in Sunday morning. Otherwise they do not adopt it.

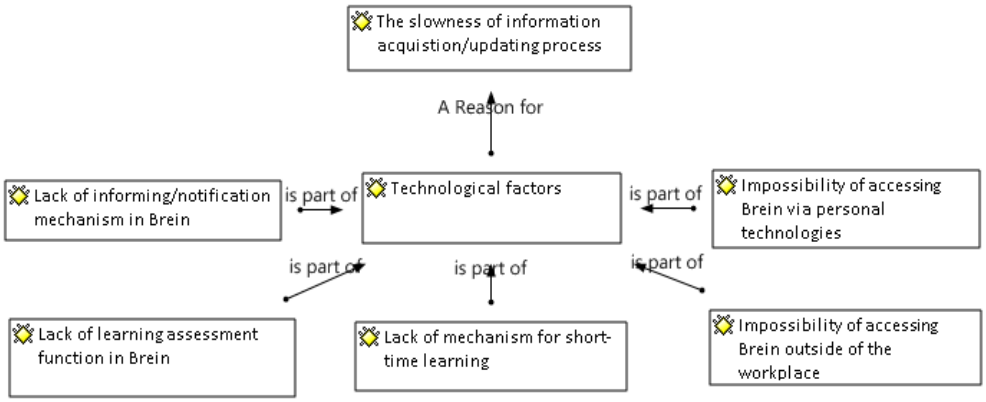


Figure 5.9. Technological factors causing the slowness of insurance information updating in the CCC context

- **Personal and organizational factors:** There are several personal and organizational factors, as illustrated in figure 5.10, that slow the acquiring and updating insurance information process including low attitude of call agents toward updating their insurance knowledge, lack of enough learning time, insufficient technical skills to work with systems and find information quickly, unawareness of the call agents about their lack of insurance knowledge, and lack of enough motives for self-initiating knowledge updating process. One interesting fact pointed by some call agents and managers states that in general the senior and more experienced call agents are more likely to be unaware about their lack of knowledge than junior and new call agents. In this regard one manager made the following point:

One problem with call agents, in particular, senior call agents is that they think that they know everything. Therefore, they do not put enough time and effort to update their knowledge.

As can be seen in figure 5.10, these factors are resulted from other underlying organizational factors such as organization sale targets, the affected relationship between call agents and their managers, the formal assessment process, and technological factors. The current formal assessment process evaluates the knowledge level of employees every 1.5 year using standard tests. If a call agent does not pass this exam he will be removed from the front line of contact with customers.

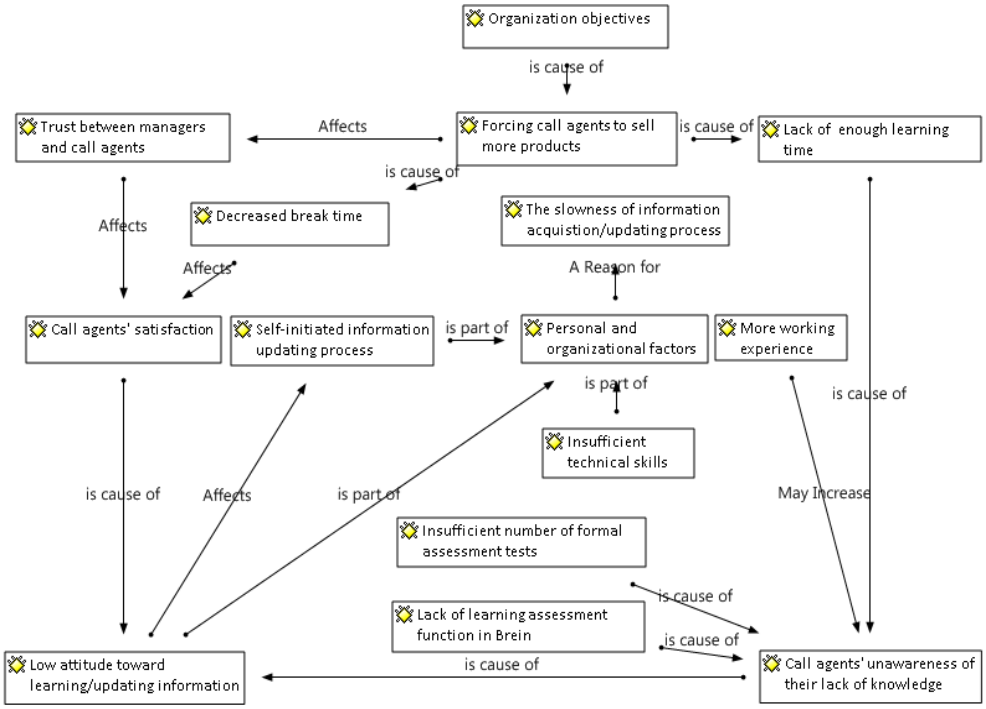


Figure 5.10. Personal and organizational factors causing the slowness of insurance information updating process in the CCC context

5.4 Answering Research Sub Question #4

In this section we use the findings derived from the exploring the CCC's learning environment to draw a picture of the personal learning model in the CCC context and answer the research sub question #4. To this end, we use the learner's control model as our analytical framework. As described in chapter 2, the learner's control model defines three roles for a learner (i.e. decision maker, knowledge developer, and socializer) to facilitate personalizing learning. Accordingly, the learner's control model is used to scrutinize how the identified learning opportunities/barriers in the CCC context affect undertaking these roles by the learners in this context.

Our observations of the CCC context suggest that learning and working are intertwined processes and learning is a by-product of working mainly achieved through informal personal or collective learning experiences. To scrutinize this interconnected nature of working and learning processes in the CCC context and investigate their influence on the learner's control model, we incorporated the Eraut's model of working/learning (Eraut, 2004) and the learner's control model (Rahimi et al., 2014a) as shown in figure 5.11. This figure represents the different working/learning roles undertaken by an employee and associated activities accomplished by the employee in a performance period. A performance period might be a call to serve a customer or a whole working week. As proposed by Eraut, a performance period "instead of a static model in which all decisions and plans are made at the beginning of a period, has a dynamic model in which a constantly changing environment provides a changing input that leads to the constant modifications of plans" (p. 257).

According to Eraut (2004), in a performance period employees accomplish three activities: acting, thinking, and communication. To combine the Eraut's model of working/learning with the learner's control model three activities of acting, thinking, and communicating can be used to define three roles for an employee, namely, worker, thinker, and socializer respectively within an working/learning environment. Then the thinker role is divided into two distinct roles of knowledge developer, and decision maker. As a result, this combination defines four interconnected roles for an employee in a working/learning environment: employee as worker, employee as knowledge developer, employee as decision maker and, employee as socializer. It is noteworthy that these roles are overlapping and together serve to assist the learners to achieve more control over their personal learning and competency development. To answer the research sub question #4 the identified learning support/barriers in the CCC's context are mapped into these roles:

- **Employee as performer (or worker):** this role represents working activities accomplished by employees as part of their working process consisting of planning, doing, checking, and adjusting activities. The conditions of workplace setting are continuously changing through inputs from either external or internal factors (i.e. increased organization's sale targets, rapid changing of insurance information). The employees are continuously influenced by these changed conditions through sensing and receiving inputs and feedbacks from them. The practice-driven nature of working processes provides the employees with great learning and competency development opportunities. The employees' learning and competency development process is triggered by their worker role and once they face a working challenge such as raising a new question by customers, facing with unknown and challenging situations, aligning themselves with the organization's and their teams' objectives, values, and norms, and applying and transferring their knowledge into action. In response to a faced challenge, the employees undertake one or a combination of knowledge developer, socializer, or decision maker roles to learn and address the faced challenge.

- **Employee as Knowledge developer***:* this role pertains to the learning activities performed by employee to acquire, update, apply, and produce insurance information and knowledge. As shown in figure 5.11, as a knowledge developer the employee takes part in several learning activities informed by their role as performer. The junior learners in addition to Brein system are mainly dependent on their learning and content from the basic training. Direct contact with customers triggers the learners to follow a customer-initiated process of searching, understanding, and applying insurance content in different knowledge resources and asking knowledge experts or team's managers to address the customers' questions and needs. Also, encountering with challenging tasks and situations stimulates the learners to reflect on the accuracy and quality of their insurance knowledge and assists them to transform their acquired knowledge into action and make sense of it. Recording the call agents' contact with customers and evaluating the recorded call by teams' managers is akin to a process-based learning assessment. This assessment can provide valuable insight into the knowledge level of the learners and might trigger them to reflect on their knowledge level and learning and regulate their learning objectives and actions accordingly. Finally, there are some opportunities for call agents to contribute in insurance content creating through expressing and sharing their ideas and experiences via Yammer or rate and evaluate the quality of content in Brein.

In spite of these learning opportunities, there are several hindrances to undertake the role of knowledge developer by the learners in this context including information, technological, organizational, and personal barriers. The rapidity of changing the insurance knowledge and availability of large amount of information to read in addition to dealing with information inconsistency and lack of effective presentation and classification of information are information barriers that reduce the learners' ability to update their insurance knowledge. Furthermore, insufficient number of formal assessment tests and lack of a learning assessment mechanism might diminish the learners' ability to reflect on their knowledge level. Finally, the lack of an appropriate mechanism to promote, acquire, evaluate and circulate learner-generated content might decrease the role of learners in constructing and enriching the learning environment by creating new knowledge out of personal experiences.

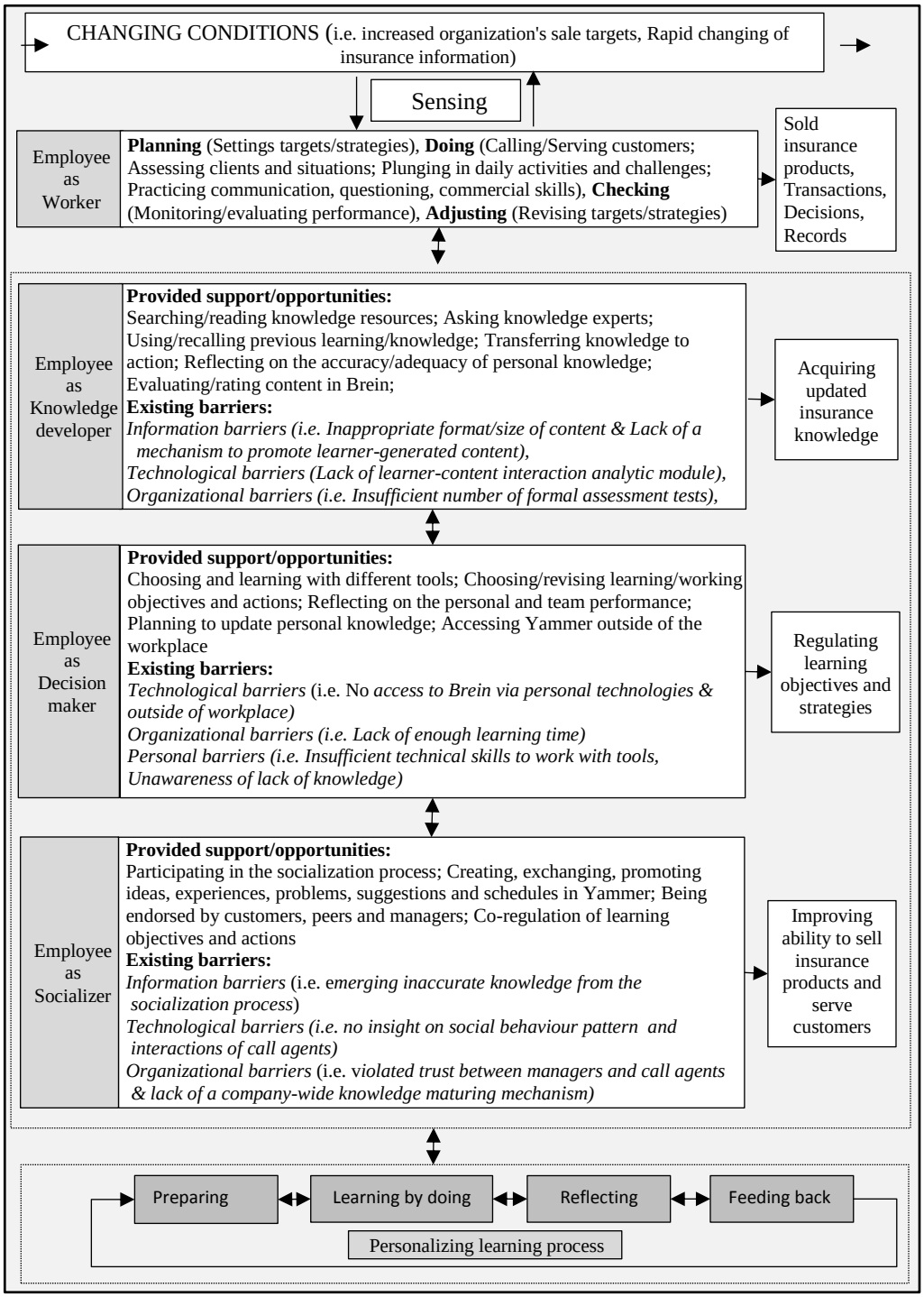


Figure 5.11. The learning process of call agents (adapted from Eraut (2004) and Rahimi et al. (2014a))

- **Employee as decision maker:** the individual-driven nature of working and learning in the CCC's context calls for decision make role of the employees to plan, manage, pursue, orient, and regulate their learning and competency development. From the learner's control perspective, by assuming decision maker role the learners practice more autonomy and responsibility to pursue personal learning and development. The learners perform several learning activities to manage and direct their learning and personal development including: choosing, working and learning with different tools; choosing learning objectives based on personal needs and requirements; using personal knowledge to organize a problem, interpret the situation, and define and choose relevant information for solution; revising and regulating learning objectives and actions by receiving feedback from customers and peers and personal reflection; and planning learning opportunities to update insurance knowledge by reading Brein in free time and accessing Yammer outside of workplace. The core part of acting as decision maker is to set and define personal learning objectives and choose learning strategies to achieve these objectives. The results of this study suggest that in the workplace the personal learning objectives might be changed, revised, or replaced by new objectives once the employees realize their lack of knowledge/learning or being exposed by new learning objectives. Along similar lines, Littlejohn et al.(2012) state that in workplace settings learning goals are individually set, with influence from the collective, workplace, or organization and from other people's goals. "Therefore goals may be shared with or related to the goals of other network members. Consequently goals are likely to be emergent rather than predefined" (p.2). Furthermore, the results of this study suggest that, the learners need to be provided with appropriate learning choices to define and follow their learning strategies as a part of their decision maker role.

In spite of the existence of these opportunities to assume more autonomy over learning, there are several barriers in the CCC context that prevent the learners to practice independency and pursue their personal learning. The lack of enough learning time in addition to the unawareness of the learners of their knowledge level affects their motivation, confidence and willingness towards planning and pursuing personal learning and competency development. Furthermore, there are technological, information, and organizational issues that reduce the learners' ability and willingness to manage their personal learning, including: no access to Brein via personal technologies and outside of workplace, lack of appropriate informing/notification and tracing mechanisms in Brein, insufficient technical skills among the learners to work and learn with different information systems, unstructured content and lack of a mechanism or tool to support fast reading/learning and cope with tight work structure in the CCC's context, and lack of an encouraging and inspiring learning model. Furthermore, due to the lack of a tracing and learning analytic module there exists no data-driven insight on learners' personal development and learning preferences in terms of content usage, and interactions.

- **Employee as socializer:** this role is concerned with the social aspect of the learning process. From the learner's control perspective, by undertaking the socializer role the

learners keep control over their learning process by participating in a collective action of competency development, communicating, sharing problems, experiences, and feedbacks, and giving/receiving support. As a socializer, a learner takes part in several social learning activities including: apprenticing, observing, listening to and discussing with peers; exchanging ideas, problems and experiences; collaboration and communication around defined goals; increasing social awareness; and co-regulation of their learning objectives and actions. Furthermore, teams' managers assist the learners to realize their level of competencies and knowledge by monitoring and assessing their contact with the customers. Moreover, receiving endorsement from customers and peers might increase their confidence and motivation for more competency development and learning. The team-based working structure of the CCC acts like an intentional community of practice with shared objectives and benefits which calls for the socializer role of the employees. While the main focus of the employees' role as knowledge developer is on acquiring and updating insurance knowledge through reading and learning formal and explicit knowledge existing in knowledge resources, acting as socializer provides the learners with informal and incidental learning opportunities to acquire tacit knowledge and residing in the CoP. Engaging in the CoP and the socialization process assist the learners to acquire appropriate skills and capabilities and transit their position from peripheral to the centre of the community.

In spite of these learning functions, there are several hindrances to undertake the socializer role by learners in the CCC's context such as violated trust between managers and call agents, lack of a company-wide learning endorsement mechanism, lack of insight on the social behaviour pattern and interaction of learners, and lack of an effective mechanism to promote, validate, and share learners-generated experiences and ideas. Interestingly, while the socialization process (see figure 5.5) plays an essential role in developing customers' serving competencies in call agents, the findings of this study have called the usability of this process to update and transfer systematic or specialized insurance knowledge into question. In other words, while participating in a specific CoP can assist learners to transfer their acquired knowledge into action; it cannot guarantee acquiring and transferring this knowledge into the CoP. Furthermore, while the CoP and the legitimate peripheral participation concepts rely and emphasize on the role of more experienced members in running, directing and maintaining a specific CoP, this study has shown that the more experienced employees are more likely to be unaware of their lack of knowledge and show more resistance to update their insurance information than junior employees. In line with these findings, Seely Brown and Duguid (1998) pointed out that CoPs can "turn core competencies into core rigidities" (p. 97). Also, Whitworth (2009) stated that CoPs might lead to parochialism by insulating "themselves against outside inputs, and thus changes to practice, whether these come from sideways from other CoPs inside or outside the organisation, or from the technostructure and management above" (p. 8).

Similar to the learners' experience in the design case 1 as expressed in the initial PLE design framework, the employees go through a personal learning process consisting of *preparing* (i.e. reading information about an insurance product before calling/serving customers, defining/revising learning objectives), *learning by doing* (i.e. searching Brein in response to customers' questions or participating in the socializations process), *reflecting* (i.e. reflecting on the accuracy and adequacy of personal knowledge and regulating and revising personal learning objectives and strategies), and *feeding back* (i.e. expressing personal ideas, experiences, faced problems, and findings). This personalizing learning process is a function of the employee's acting as worker, knowledge developer, decision maker, and socializer and the organizational, technological, and working structure of the CCC's context.

Conclusions

In this chapter we have explored and scrutinized personal learning and competency development of employees in a workplace setting in order to answer the research sub question # 4: "What factors do influence personal learning and competency development in a workplace setting?"

This chapter has led to the following results:

- The workplace setting offers a moving and continuously changing curriculum where enormous learning and competency development opportunities occur through facing with and addressing daily challenges and aligning with the changes in the organization's objectives, values, and rules.
- Regulating and revising personal learning objectives and strategies as the core part of personal learning and competency development is provoked through three ways: acting as worker (work-driven regulating), acting as socializer (co-regulating), and acting as knowledge developer and decision maker (self-regulating). These findings call for rethinking the premises of self-regulated learning theory (SRL) for designing the workplace e-learning systems. Indeed, historically, SRL has been conceptualised from an individual perspective within formal settings with disconnected individuals resulted in the reduction of the regulating process to the individuals "with little consideration of the vertical infiltrations from higher systemic levels (i.e., interpersonal interactions, relationships, social structures, sociocultural structure" (Voelt et al., 2009, p. 6). Any reductionism to either the individual or the social levels can neglect important aspects of actual learning settings and undermine the design of the e-learning system.
- Another aspect of learning in the CCC's context is about the use of several information resources to support informal learning activities of the learners. Informal learning involves a complex array of learning activities and uses several different types of knowledge when employees are in action. This puts 'ready-to-use' knowledge at a premium, sometimes irrespective of its quality (Eraut, 2004). Accordingly, knowledge resources such as Brein and Yammer which provide the employees with different sorts of 'ready-to-use' knowledge play a key role in addressing employees' daily activities, challenges and supporting their

informal learning. However, these systems need appropriate integration and content evaluation mechanisms to support learners to undertake knowledge developer, socializer, and decision maker roles and facilitate the personal learning process.

- To be effective process-based working/learning assessment should be supplement by product-based learning assessment mechanisms such as standard test-based assessment.
- Participating in a community of practice (CoP) provides great informal learning opportunities for the learners. However, when it comes to acquire formal content mere relying on the CoP might slow the knowledge acquisition and updating process. In this regard, Aarkrog (2005) stated that "this kind of knowledge presupposes teaching and teaching is not part of the community of practice in the workplace setting" (p.7). Accordingly, the CoP requires an effective mechanism to accelerate transferring and acquisition of formal content among its members. In the next chapter we will introduce and evaluate an e-learning prototype developed by the Achmea Company to address this requirement.

6 Identifying the Components of a PLE Design Framework Facilitating Learner-driven Acquisition and Updating Knowledge in the Workplace[4]

As elaborated in chapter 5, plunging in daily activities and participating in social and learner-generated contexts such as CoPs provide great personal learning and competency development opportunities for the CCC's staff. However, it has been observed that to keep pace with the rapid changes in the insurance information resources they need to access accurate and fresh specialized content coming from outside of these CoPs.

The results of chapter 5 have provided us with insights on the learners' views on the specifications, barriers, and requirements of personal learning and competency development in the CCC's context. In this chapter we shift our focus to scrutinize the organization's views on the specification and requirements of personal learning and competency development in the workplace. To this end, in this chapter first an e-learning prototype, called PowerApp, developed by the Achmea Company to accelerate the process of insurance knowledge acquisition/updating in the CCC's context is introduced and evaluated. We consider this prototype as an organization/designer-generated context that represents the organization's views on the learning and technological requirements of facilitating learner-driven insurance knowledge updating process. Accordingly, examining the features and characteristics of this prototype and incorporating them into the learners' views on personal learning, derived from the previous chapter, allows us to figure out a unified set of design characteristics for an e-learning system on the basis of both organization's and learner's views. By so doing, we answer research sub question # 5: "*What are the components of a PLE design framework facilitating learner-driven acquisition and updating knowledge in a workplace setting?*"

In this chapter the terms learner, user, employee, call agent, and participant have been used interchangeably.

6.1 Research Design

As mentioned earlier, the context of the research in this chapter is the unit of analysis 4 in design case 2 (or the CCC's context in the Achmea Company). Figure 6.1 represents the followed steps in this context to answer the research sub question #5.

In the first step we introduce the learning principles and concepts that underpin PowerApp as well as the technological architecture of PowerApp to address these principles. As mentioned earlier, PowerApp was developed through cooperation between the Bright alley and Achmea companies in the Netherlands to facilitate learner-driven insurance knowledge acquiring/updating in the CCC's context.

[4] A part of this chapter has been published in paper Rahimi et al., (2014c).

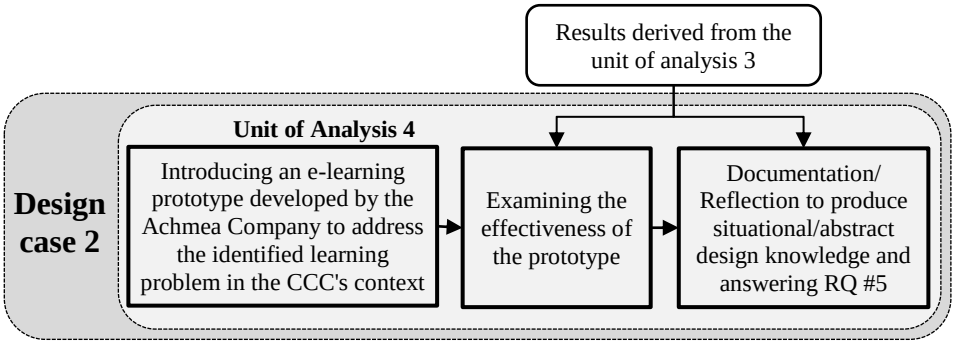


Figure 6.1. the conducted development research in this chapter

In the second step we focus on evaluating the performance of PowerApp based on the following metrics:

- The actual usage and uptake of PowerApp by the call agents,
- The impact of PowerApp on stimulating and facilitating insurance knowledge updating process,
- The perception of the call agents regarding the effectiveness of different features of PowerApp.

The performance of PowerApp was evaluated by a pilot group consisting of 385 users consisting of 363 call agents and 22 team managers belonging to 22 teams from 5 different divisions in the CCC's context. The users consisted of 65% female (n=250) and 35% of male (n=135) aged from 18 to 63, with a mean age of 36.5 year. Their working experience ranged from 2 months to 34 year, with a mean of 5 year. Before starting the evaluation process, the users had been informed by their managers about the functionalities of PowerApp and the purposes of the pilot study through workshops, presentations or standard instructional material. The participants could access and use PowerApp inside and outside of the company via the Internet. Participating in the pilot study was voluntary and the users were encouraged to access and use PowerApp at their free time especially between consecutive calls in order to reduce its influence on their job's productivity. There was a team of technical and content experts available to support users and solve their possible technical or content-related problems. The evaluation phase lasted 45 days beginning from September 23, 2013 to November 8, 2013.

The following operational research questions guided the PowerAPP's performance evaluation process:

(i) **Operational research question 1:** How PowerApp had been accessed and used by the participants during the evaluation period?

This question aims to realize the actual uptake and use of PowerApp by the participants. To answer this question we retrieve and analyse the information pertain to participants' activities stored in the PowerApp's data logs to calculate the following indexes:

- *The participation rate:* due to the voluntariness of participating in this study, this index sought to determine the participation rate in accessing and using PowerApp.
- *Accomplished learning activities:* refers to the number and types of different learning activities accomplished by participants in PowerApp. This insight can be used to realize the tendency of participants toward different types of learning activities to guide future improvement in the design of PowerApp.

(ii) **Operational research question 2:** How using PowerApp might trigger the learner-driven knowledge updating process by the participants?
The purpose of this question is to explore the ways PowerApp triggers learners to regulate and direct their knowledge updating process. Zimmerman and Schunk (1989) define self-regulated learning in terms of self-generated thoughts, motivations and actions that are systematically oriented toward the attainment of learners' goal. Drawing upon this definition, we first focus on realizing how using PowerApp might motivate the participants to update their insurance knowledge. Then we investigate the ways that PowerApp might facilitate the participants' learning and knowledge updating process.

Analyzing PowerApp's data logs and conducting interview with the participants were used to answer this question. To this end, six semi-structured interviews were conducted with 10 team managers, knowledge experts and call agents participated in this study to get more insight on the rationale behind the emerged patterns in using PowerApp and answer the second operational research question. The interviews were accomplished in face-to-face, Skype or phone meetings. Each interview lasted from 15 minutes to 1.5 hours. The analysis phase started after collecting qualitative data through the interviews. The first phase of the analysis procedure included transcribing audio data, entering collected data into Atlas.ti software and conducting the coding process. The results and insights from the previous chapter were used to code the qualitative data. The analysis process continued by reading the transcripts and assigning codes to the descriptions. This phase resulted in 150 different codes. The second phase of the analysis process involved reading the transcripts organized by codes, writing memos, recoding and merging similar codes as necessary, grouping codes into categories, creating network diagrams by establishing relationships or links between codes, and writing up conclusions. This process was done several times.

(iii) **Operational research question 3:** How the participants have perceived the effectiveness of different features of PowerApp?
This question intends to realize the perceptions of the participants about their experience with different aspects of PowerApp and their impact on their learning process. To this end, a 5-point Likert scale questionnaire consisting of the following constructs was developed. These constructs and their associated items were informed by the results from the previous chapter as well as the design specifications of PowerApp:

- *System quality:* adapted from Wixom and Todd (2005) and Wang et al. (2007) to measure the functional quality of PowerApp including its navigability, reliability, and accessibility, ease of use, response time, and service support quality items.
- *Content quality:* adapted from Wixom and Todd (2005) to measure different aspects of the content quality of PowerApp including completeness, ease of understanding, accuracy, currency, format, and relevance items.
- *Learning usefulness:* adapted from Venkatesh and Bala (2008) to measure the perceived usefulness of PowerApp to encourage continuous learning and updating insurance information including items such as stimulating critical thinking, self-initiating of learning, and time management.
- *Learning model:* adapted from Martínez-Torres et al. (2008) and Barki et al. (2008) to measure the learners' perception regarding the PowerApp's learning model including learning enjoyment, diverse complexity, learning assessment/feed backing, learning objectives, and learner's control.

The questionnaire was adjusted on the basis of PowerApp features and contextual conditions through close cooperation between the research team and learning managers of the Achmea Company. Then the questionnaire was translated to Dutch and administrated among the participants after closing the pilot project online using Collector software.

In step 3 we utilize the results from examining the PowerApp performance along with the findings from the unit of analysis 3 elaborated in chapter 5 to answer research sub question #5. To this end, different functions/shortages of PowerApp identified in step 2 are mapped into the phases of the personal learning process derived from the previous chapter. This mapping produces two sorts of outcomes: abstracted design knowledge expressed in the required components of a PLE design framework for facilitating learner-driven knowledge updating in the workplace, and situational design knowledge in terms of improvement suggestions and guidelines for the next versions of PowerApp.

Several tools including Collector, Microsoft Access, Microsoft Excel, Microsoft Word, SPSS, and Gephi were used to facilitate the processes of conducting and administrating the questionnaire, interviews, retrieving, collecting, analysing data, and visualizing the results.

6.2 Introducing PowerApp

This section describes the underpinning learning principles and technological architecture of PowerApp.

6.2.1 The Learning Principles Underpinning PowerApp

PowerApp have been underpinned by the following learning principles and concepts:

- *Flexible delivery:* this principle states that training and learning methods need to be more responsive to changing requirements of organizations, fulfil diverse learning needs,

interests, and preferences of learners, and increase their control over what, where, when and how to learn (Stewart and Winter 1995; Smith, 2003). Informed by this principle PowerApp does not prescribe a fixed learning path. Rather than, PowerApp provides a wealth of learning resources (or learning choices) in terms of content items and learning activities to allow learners to make their choices, pursue their learning paths and meet their needs. Content items are provided in form of short and rich format brain snacks, brain breakers, and poll questions to support fast and easy reading and learning. The learners can access and learn these content items to suit their convenience. With this principle, PowerApp seeks to address the highly structured working processes and limited learning time in the CCC context.

- *Social game-based learning:* the social context of workplace can be a powerful learning environment. Supportive social and emotional learning environment and interpersonal relationships are important elements to initiate and sustain self-regulated learning processes in workplace settings. Accordingly, one function of a workplace e-Learning system should be the development of a good emotional and motivational atmosphere in a working group through playful learning activities. One possible way to fulfil this functionality is by combining educational games with collaborative-based learning scenarios. This combination introduces a fun element to the learning environment and can stimulate competition-based learning and motivate learners to actively participate in the learning activities by promoting their desire to improve, interacting with information and tools as well as by collaborating with other learners within the game, and exciting awe and pleasure (Tynjälä & Häkkinen, 2005; Kim, Park et al. 2009). Informed by these principles, PowerApp implemented a duel-learning game to encourage colleagues to invite and trigger each other to learn together in a fun and competition-based way.
- *Instant learning assessment:* this principle states that learning should be measurable and learners should be immediately informed about the outcomes of their learning actions and their impact on their learning growth. In this regard, Edwards (2004) has shown that using automated grading and feedback generation to provide for frequent, quick-turnaround assessment of learners performance helps to encourage and reinforce desired behaviours. Informed by this principle, PowerApp records all learning activities done by learners in PowerApp and assesses and shows the immediate impact of these learning activities on the learners' growth graphs. Furthermore, the collected information about the learners' growth are meant to help Achmea Company to meet its compliancy regulation requirements.
- *70:20:10:* initially developed by the General Electric (GE) Company, this concept describes a framework in which effective learning in workplace settings might happen. According to this framework, 70% of learning is due to the on-the-job learning experiences, 20% of learning is done in interaction with others including colleagues, managers and customers and only 10% of learning takes place through formal and structured training. Informed by this concept, PowerApp provides call agents with contextualized content derived from real problems and challenges and triggers them to learn with and from each other.

6.2.2 The Technological Architecture of PowerApp

This section dealt with the implementation of PowerApp built upon the mentioned learning principles. During the development phase a team of managers, call agents, knowledge experts, program managers along with system designers and developers together were working and making decision about the different aspects of design, content, and functionalities of PowerApp. Figure 6.2 illustrates the architecture of PowerApp consists of nine modules, namely: content-base, content categorizer, learning subsystem, screen, event monitoring, learning assessment, learning score visualizer, learner profile, and ranking list.

The content repository provides the learners with a wealth of various learning content in terms of brain snack, brain breaker, and poll questions, where they can choose and learn according to their needs and preferences. To make learning meaningful and context-based, the content items are developed by content experts on the basis of input from the organizational objectives, external resources such as the government rules, faced challenges, problems and practices of the work environments, and the insurance products' portfolio. To support fast learning and comply with the limited learning time of employees, each content combines small amount of information in text or graphic formats to be read or answered in short time periods. Also, each learner is provided with personalized learning content based on criteria such as the learner's previous activities in PowerApp and organizational parameters derived from the learner profile.

The content categorizer subsystem fetches content items from the content repository and categorizes and sends them to the screen of the learners. To support this categorization, each content item has three features: (*i*) the type of the learning activity, (*ii*) the category of insurance information and (*iii*) the time indicator.

- **The type of learning activity:** a learning activity refers to the way that the content item can be practiced and learned by the learner. There are four types of learning activities supported by PowerApp: brain snack, brain breaker, poll question, and duel-learning game. Brain snacks (BS) are content items that provide a kind of did-you-know information on a particular topic. Brain breakers (BB) are content items that go more in depth than BSs by providing some information in a particular topic to be read by learners, and then assessing and evaluating their understanding about the content through asking some questions. Poll questions are multiple-choice questions aiming at knowing the employees' opinions about a specific topic. With the Duel-learning game items the learner can select a peer to challenge each other knowledge in a specific topic by asking a series of multiple-choice questions that come from the content-base.

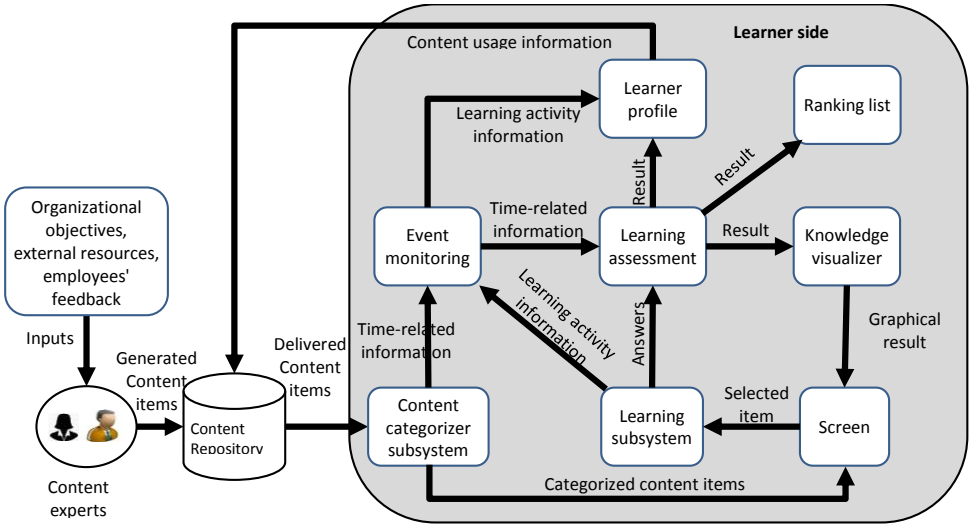


Figure 6.2. The technological architecture of PowerApp

To play a duel-learn game, first the challenger should invite an opponent peer to the duel-learning game and then to choose a knowledge category in which the questions would go. After accepting the invitation request by the opponent, the duel-game starts and the challenger and opponent both answer the same questions in a specific time sequence and get a score based on the number of right answers and the speed of their answering. After answering all questions the peers immediately will be informed about the result of the game. The final scores are shown in a public ranking list to be seen by other users. If one of peers does not answer her question within specified time duration, the duel-learning game will be cancelled. Figure 6.3 shows samples of these learning functions.

- **The category of insurance information:** different categories of insurance information that the learners need to learn in the CCC's context include information about: insurance market, insurance procedures and rules, communication and selling skills, and organizational culture. Each content item contains information pertain to one of these four categories. These main categories are divided into the below subcategories:
  - Insurance market: organization's news, insurance market trends,
  - Insurance procedures and rules: car insurance, travelling insurance, accident/traffic insurance, living insurance, and care insurance,
  - Communication and selling skills: commercial skills, serving customers skills,
  - Organizational culture: organization's vision, missions and objectives, organizational behaviour.

Figure 6.3. Four samples of learning functions

- **Time indicator:** time management is a key element of self-regulated learning process. Due to the call agents' high working pressure and limited learning time, developing effective time management skills and facilitating the use of short time periods between consecutive calls for learning purposes was one of the main functional requirements of PowerApp. Therefore, to develop the time management skills and encourage call agents to access content items rapidly, as a part of learning schedule, a time-based scoring mechanism was implemented in PowerApp. Based on this mechanism, the event monitoring subsystem receives the time-related information about the learner's learning activities and sends them for the learning assessment subsystem. The learning assessment subsystem then calculates the learning scores of the learner based on her performance in learning subsystem and time variable. In other words, if a learner answers a content item correctly in the first week of releasing the content, she will receive more score than a learner who answers the same question correctly in the second week after releasing the content. Incorporating time factor in the assessment mechanism makes it possible for PowerApp to support not only product-based assessment, i.e. the accuracy of the given answers, but also to facilitate the process-based assessment.

PowerApp provides each learner a personalized screen where s/he can manage and direct his/her learning activities. Figure 6.4 illustrates different parts of this screen. As shown in this figure, the screen consists of two main parts, including learning score visualizer (the top part) and a scrollable part to be used as an activity space to select, manage, and learn content items (the down part). Each puppet in the learning score visualizer part is assigned to a knowledge category and presents the learning score of that knowledge category earned by the learner through reading or answering related content items. By passing time, the filled level of each puppet diminishes slowly. By reading and answering content items or doing duel-learning games the puppets will be filled up based on the level earned learning score. This visualizing mechanism follows two purposes: (i) to encourage the learner to update her knowledge continuously, and (ii) to build learner's internal motivation by satisfying her feeling of accomplishment and reputation.

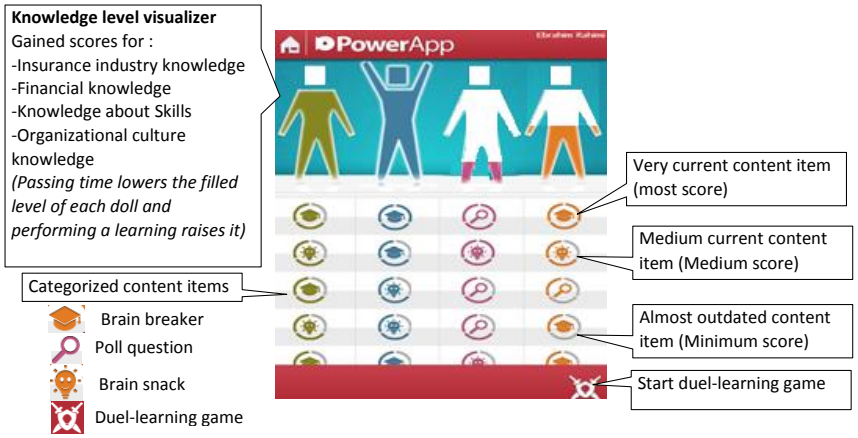


Figure 6.4. The personalized screen of PowerApp

6.3 Examining the Performance of PowerApp

In this section we evaluate the performance of PowerApp in facilitating learner-driven knowledge updating in the CCC's context. It is noteworthy that during the evaluation process a new batch of content items was uploaded to PowerApp weekly and in total, 184 content items including 59 brain snacks, 48 brain breakers, 53 poll questions and 24 duel-learning games were uploaded to PowerApp.

6.3.1 The Actual Use of PowerApp by the Participants

The below metrics show the pattern of accessing and using PowerApp by the participants during the evaluation process.

- *The participation rate:* among 385 users who initially involved in the pilot group, 177 users consisting of 105 female (59.32%) and 72 male (40.68%) accomplished at least one learning activity in PowerApp resulting in the participation rate of 45,97% (=177/385). During the interview sessions different reasons were mentioned by the interviewees for this fairly moderate participation rate including lack of sufficient time, inadequate promotion of PowerApp by the organization and team managers, and not being accessible via tablet and smart phones. It is noteworthy that due to the unpredicted delays in the PowerApp development process, launching PowerApp was postponed from the beginning of the summer, with a light working pressure, to the beginning of the autumn, with a heavy working pressure.

- *Accomplished learning activities:* table 6.1 summarizes the different learning activities accomplished by participants in PowerApp. According to this table, among the whole 177 participants, 173 participants (97,7%) accessed and read the 59 brain snacks. In total they accessed and read brain snack items 3776 times resulting in an average of 21,34 (=3776/177) brain snacks for each participant. Also, 136 participants (79,8%) accessed and

answered the 48 brain breakers in total 2864 times resulting in an average of 16,18 (=2864/177) brain breakers for each participant. Moreover, 98 participants (55,36%) accessed and answered the 53 poll questions in total 2612 times resulting in an average of 7,38 (=2612/177) poll questions for each participant. Finally, as illustrated in table 1, in total 256 duel-learning games were initiated between 88 participants (49,7%). The participants accomplished the duel-learning games can be categorized into two types of initiators, who initiated a game by inviting other participants, and followers, who had been invited to a game by an initiator. Among the initiated 256 duel-learning games 203 games were continued and completed while 53 games were cancelled. According to these results, in average each participant played 1.14 duel-learning games (=203/177).

Table 6.1. The accomplished learning activities by participants using PowerApp

	Reading Brain Snack	Answering Brain Breaker	Answering Poll Question	Playing Duel Game
Total number of content items	59	48	53	24
Total number of accomplished learning activities by all participants	3776	2864	2612	256 (203 completed, 53 cancelled)
Average number of accomplished learning activities by participants	21,34	16,18	14,76	1.14
Total number of participants performed each type of activity	173	136	98	88 (35 initiators,53 follower)
The rate of participants involvement in each type of learning activity	97,7%	76,8%	55,36%	49,7%

While reading brain snacks and answering brain breakers and poll questions are individual-based learning activities, playing dual-learn games is a peer-based learning activity and can signify a direct network structure (Wasserman & Faust, 1994) as shown in figure 6.5. In this network, the nodes represent the game players and ties depute the started dual-learning game(s) between two players. The direction of a tie shows the initiator of the game and the thickness of the tie represents the number of dual-learning games played between two peers. Each node has two degrees: out-degree which represents the number of duel-learning games initiated by participant and in-degree or the number of received duel-learning games requests by the participant.

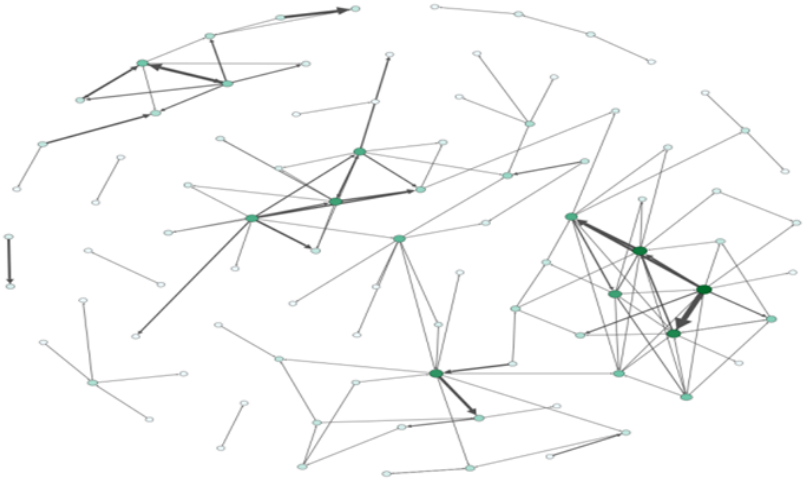


Figure 6.5. The pattern of the played duel-games between the participants

The duel-learning game mechanism allows the participants to choose their learning peers from any team and division they wish. Figure 6.6 presents the pattern of teams' interaction emerged from playing duel games between peers from different teams and divisions. Not surprisingly, while 71.4% of dual-learning games (145 out of 203) had been played by peers within same teams, just 28.6% (58 out of 203) of the duel-learning games were played between peers from different teams.

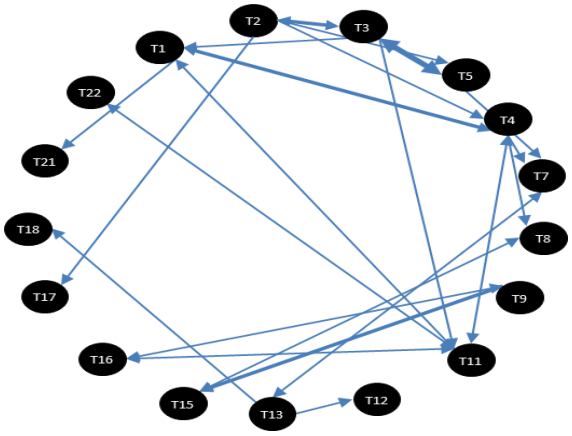


Figure 6.6. The pattern of the played duel-games between the teams

6.3.2 Exploring the Influence of PowerApp on Learner-driven Knowledge Updating Process

Figure 6.7 illustrates the factors motivated participants toward learning with PowerApp. In this figure, the first number between parentheses indicates groundedness (that is, the

number of times mentioned in the interviews), the second number indicates density (that is, the number of codes to which it has a relationship). These motivating factors can be categorized as the system quality (i.e. fast response time, ease of navigation, knowledge visualizer), content quality (i.e. learning choices, bite-sized content in multimodal format), learning model (i.e. innovative way of learning, duel-learning games, learning assessment mechanism) and team's influence (i.e. manager promotion).

As asserted by the interviewees, the system functionalities of PowerApp played an important role in drawing participants' attention and motivation toward using PowerApp. 'Ease of navigation' and 'fast response time' of PowerApp were perceived influential to assist the participants to control 'learning sequence/pace'. Furthermore, the functionality of the 'knowledge visualizer' module was perceived useful in increasing the 'feeling of accomplishment' among the participants. As remarked by the interviewees, providing diverse and contextualized 'learning choices' facilitates 'interest-driven learning' by allowing the learners to choose and tailor the learning choices to their learning needs and interests. Also, it was asserted that providing rich format and bite-sized 'learning choices' can support 'flexible and easy learning' which is highly demanded by the participants due to their limited learning time.

The PowerApp's 'innovative model of learning', expressed in 'duel-learning games' and the 'learning assessment' mechanism were perceived influential in triggering participants' motivation toward using PowerApp. For example, several team managers used 'duel-learning games' to invite and encourage their team members to use PowerApp. As asserted by these managers, the competitiveness and 'fun learning' characteristics of the duel-learning games have the potential of initiating 'interest-driven learning'. Moreover, the functionality of the 'learning assessment' mechanism to provide instant feedback on the participants' learning activities was perceived useful for 'realizing lack of knowledge' of participants and triggering a 'need-driven learning' process.

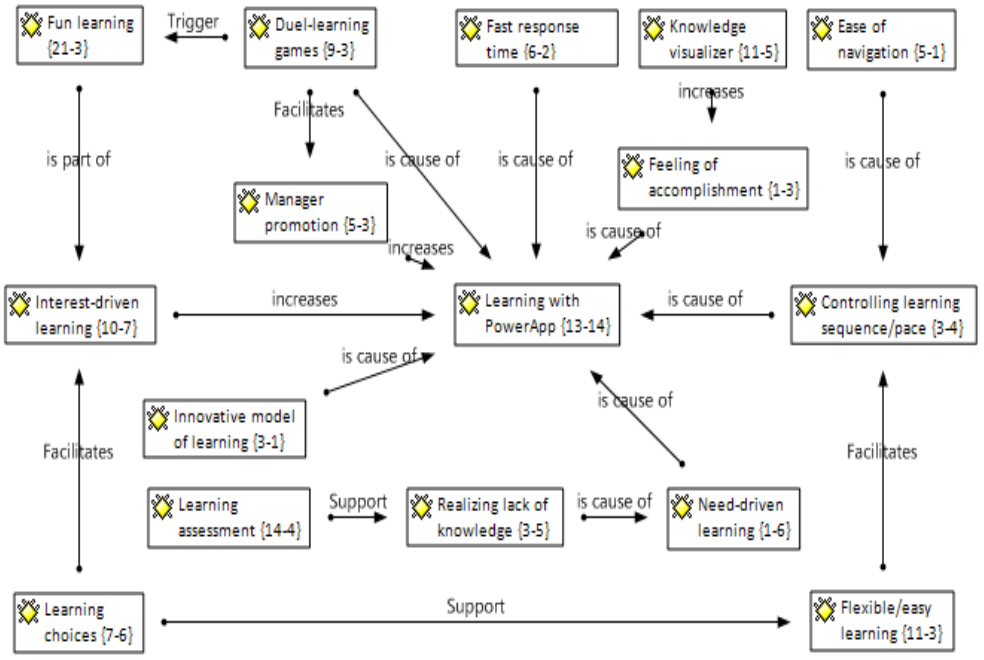


Figure 6.7. The factors influencing participants' motivation toward using PowerApp

Figure 6.8 shows how using PowerApp might facilitate the learner-driven knowledge updating and developing process. According to this figure, the learner-driven knowledge acquiring/updating process is a direct function of four factors: 'interest-driven learning', 'need-driven learning', 'team's influence', the employee's 'permanent contact with customers'.

As illustrated in this picture, PowerApp triggers the insurance knowledge acquiring/updating process by confronting the learners with a repository of learning choices. The diversity, playfulness and rich format of these choices supported with the flexible delivery mechanism fulfil the participants' sense of freedom and autonomy and increase their interest to pursue learning and knowledge updating process.

This 'interest-driven learning' along with the 'team's influence' then result in the 'active engagement' of the participants with the provided learning choices. After the participants get engaged with the learning choices the 'learning assessment' mechanism serves in 'realizing lack of knowledge' of the participants as a means to trigger them to reflect on their knowledge level as well as support 'personalized coaching' with team managers. Furthermore, the output of the 'learning assessment' mechanism can be used to create detailed 'learning analytic reports' to provide insight into different aspects of the participants' learning process and knowledge level. As a part of the 'personalized coaching' the team managers might use this insight as a road map to direct the participant's 'use of Brein for knowledge updating' and facilitate a 'need-driven learning' approach. As

mentioned earlier, coaching and mentoring the call agents by their managers plays a key role in learning and competency development in the CCC's context. Providing a personalized picture of call agents' knowledge level and learning can effectively improve this coaching process. Furthermore, the learning 'analytic reports' might be used to satisfy the organization's compliance purposes and requirements informed by the government policies and rules. Accordingly, one of the key benefits of PowerApp as perceived by the managers is its ability to create these sorts of learning analytic reports. A sample of these analytic reports is explained in figure 6.9.

In addition to accessing and learning the organization-provided content items, PowerApp should allow the participants to share and add their knowledge to PowerApp. As asserted by the interviewees, due to their 'permeant contact with customers' the call agents are aware of the customers' needs and preferences and ,therefore, allowing and encouraging them to add new content items or evaluate the provided content items is a key requirement to address learner-driven knowledge updating process. One interviewee asserted this point as below:

> *The call agents are in direct contact with customers and have a deep insight into their needs, problems, questions, and preferences. Also, the call agents have rich sources of valuable contextualized knowledge and experience. They should be allowed to contribute in developing, sharing and evaluating this knowledge through PowerApp.*

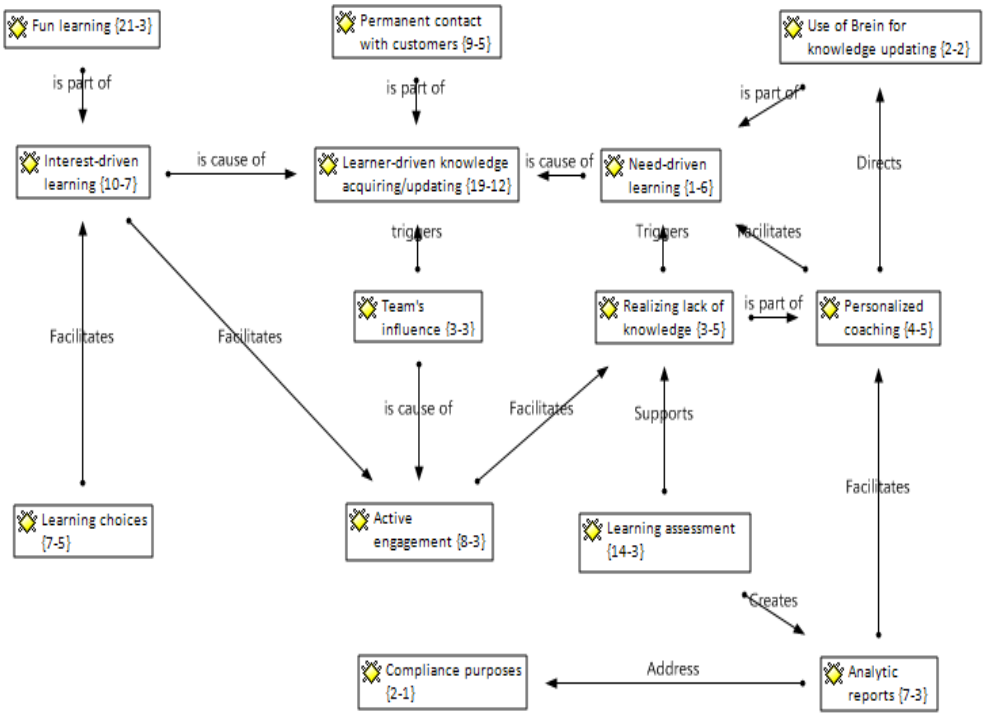


Figure 6.8. The factors facilitating learner-driven knowledge acquiring/updating process using PowerApp

Figure 6.9 present a sample of the learning analytic reports resulted from analysing the output of the learning assessment mechanism. This figure draws a picture of knowledge strengths and weakness of the members of team 1. As represented in this figure, in total 18 participants from team 1 answered 249 questions pertain to four content categories (i.e. insurance market, insurance procedures/rules, insurance skills, and organizational culture) and 10 associated subcategories. Among the answered questions, 95 questions were answered correctly, while 151 questions received wrong answers. These sorts of analytic reports might enrich the learning process in several ways including: supporting individualized coaching and mentoring, recommending appropriate content or professional development to the learners, stimulating learners' reflection and critical thinking, identifying knowledgeable learners, and creating learning group consisting of knowledgeable and unknowledgeable peers.

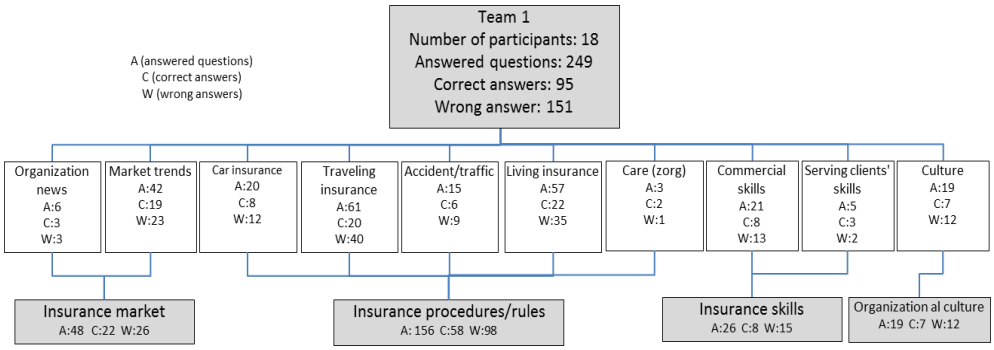


Figure 6.9. A learning analytic report out of the PowerApp's learning assessment mechanism

6.3.3 The Participants' Perception Regarding the Learning Effectiveness of PowerApp

To evaluate the effectiveness of different features of PowerApp, a questionnaire was distributed among the participants at the end of the evaluation process. The questionnaire examined the participants' perception on different aspects of PowerApp including: content quality, system quality, learning model, and learning impact. Among the 177 participants 60 participants completed the questionnaire. Figure 6.10 depicts the summarized results of this questionnaire.

The learning model of PowerApp was evaluated from five aspects: assessment mechanism, learning choices, learning enjoyment, clear learning objectives, and diverse complexity. According to the participants the most prominent aspect of the PowerApp's learning model is the learning assessment mechanism (Mean=4.1), followed by learning choices (Mean=3.90), learning enjoyment (Mean=3.70), clear learning objectives (Mean=3.59), and appropriate diverse complexity (Mean=3.50).

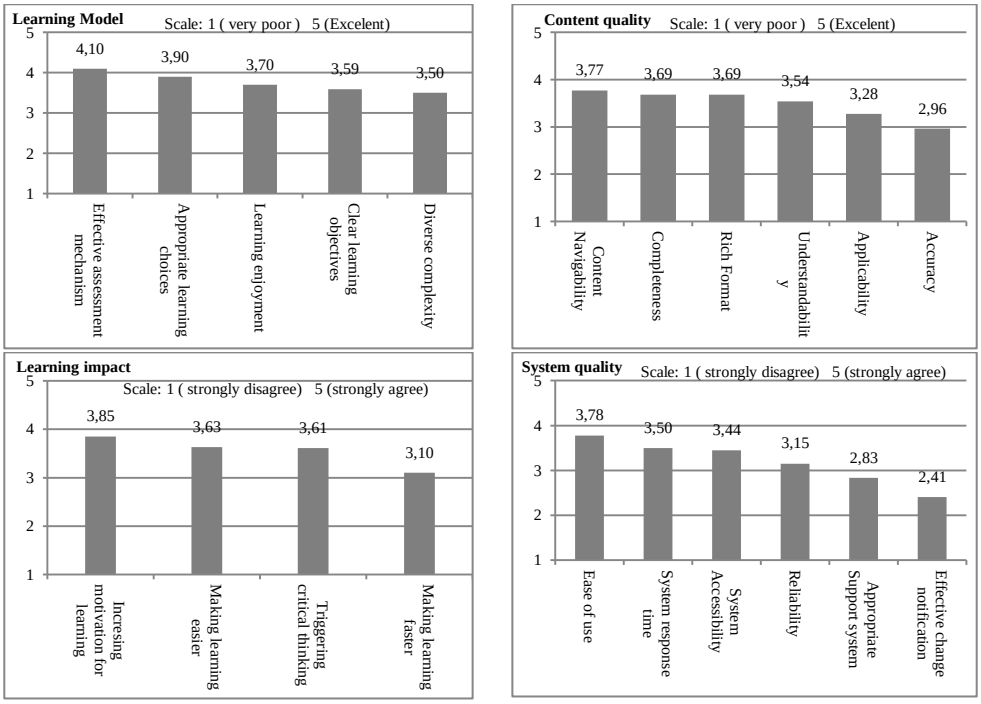


Figure 6.10. The perception of the participants regarding the learning effectiveness of PowerApp

The content quality of PowerApp was evaluated from different perspectives: the most effective aspect of the provided content was the content navigability (Mean=3.77), followed by completeness (Mean=3.69) and rich format (Mean=3.69), understandability (Mean=3.54), and applicability (Mean=3.28).

PowerApp influenced the participants' learning through increasing their motivation for learning (Mean=3.85), making learning easier (Mean=3.63), triggering critical thinking (Mean=3.61) and making learning faster (Mean=3.10).

The system quality of PowerApp was perceived as the weakest aspect of the participants' experience with PowerApp. While the participants expressed their satisfaction about the ease of use (Mean=3.78) and response time (Mean=3.50) of PowerApp, they were unsatisfied by the quality of received support from the responsible people (Mean=2.83) and PowerApp's notification mechanism (Mean=2.41).

On the basis of these results it can be argued that while the elements of the PowerApp's learning model played an important role in attracting the participants to use PowerApp, the fairly low quality of PowerApp's system served to decrease the users' willingness toward PowerApp. These findings call for further improvements in the different aspects of

PowerApp's design including notification mechanism, accessibility, and customization features.

6.4 Answering Research Sub Question #5

In this section we incorporate and reflect on the learners' as well as organization's views on the specifications and requirements of personal learning to answer research sub question #5. By such doing, in addition to producing abstract design knowledge required to answer research question sub question #5, we suggest appropriate situational design knowledge to support future improvements in the design and functionality of PowerApp.

As elaborated in the previous chapter the personal learning process that the CCC's staff go through to address their working/learning requirements consists of four phases: 'preparing', 'learning by doing', 'reflecting', and 'feeding back'. Through this chapter it we observed that PowerApp partially supports this process through the following mechanisms: *providing learning choices* and *stimulating learners to access and adopt these choices* (to support the 'preparing' phase), *facilitating active learning with the provided learning choices* (to support the 'learning by doing' phase), *triggering reflection on personal knowledge* (to support 'reflecting' phase), *capturing implicit learner-generated feedback* (to support 'feeding back' phase). To answer research sub question #5 we mapped the perceived learning benefits, requirements, and shortages observed in PowerApp's performance to the personal learning process as shown in figure 6.11. In this figure the perceived learning benefits of PowerApp are shown by '+' sign while its perceived shortages are shown by '-' sign. It is worthy to note that the perceived shortages of PowerApp to support the personal learning process were realized in the PowerApp's performance evaluation process or by comparing the lacking features of PowerApp with the learning opportunities existing in the CCC's context observed in the unit of analysis 3.The identified shortages then will be used to propose improvement suggestions for the future developments of PowerApp.

- *Providing learning choices*: as described in the previous chapter, a reason for the slowness of insurance knowledge acquiring/updating process in the CCC's context stems from insurance information issues (see figure 5.8 in the previous chapter). To address the identified information issues PowerApp has provided a repository of evaluated, bite-sized, and contextualized content items. Furthermore, these content items were delivered in different sorts including brain snacks, brain breakers, poll question, and duel-learning games. Providing the learners with these learning choices and defining clear learning objectives for each content item have been perceived by the participants useful to accelerate their insurance knowledge updating process and gain control over it.

However, PowerApp still lacks the below key functionalities regarding to the provided learning choices:

-A personalized mechanism to deliver content items based on the learners' preferences, needs, knowledge level, and organizational position,

-Using standalone graphics and videos in content items,

-Content preview and search functionalities,
-Content error-detecting and reporting mechanism,
-Linking learning choices in PowerApp to relevant resources in Brein and Yammer,
-Appropriate system and content customization features,
-Sufficient number of content items for all types of insurance information (i.e. trends, finance, skills, and organizational culture).

- *Stimulating learners to adopt PowerApp*: after providing and exposing the learning choices, the next step dealt with stimulating the learners to access and learn these choices. The findings of this study suggest that providing diverse and heterogeneous learning choices with clear learning objectives were perceived useful to satisfy different learning preferences and interests of the learners and allow them to tailor these choices to their personal learning requirements and objectives. Furthermore, the flexible learning delivery mechanism of PowerApp has helped the learners to cope with the tight working structure by easing learning when and where suit them. Moreover, providing interactive and social learning choices (i.e. duel-learning games) and introducing social-based motivational aspects to the learning environment (i.e. winning a game, fun elements, competition-based learning, and freedom in choosing peers) were perceived useful by the participants to stimulate and facilitate interest-driven or desire-based learning. In this regard, Huang (2002) stated that the practice of learning is a desire-based function motivated and triggered by the interactivity.

Despite of these stimulating mechanisms, the findings suggest that these mechanisms are not still enough to encourage the majority of employees to adopt and use PowerApp (i.e. the medium participation rate in using PowerApp, the results of table 1, figure 6.7). Below are the main identified reasons for fairly medium participation of the learners in accessing and learning with the provided learning choices by PowerApp:
-Lack of an effective notification mechanism to announce new content items or duel-learning games,
-Lack of appropriate social learning mechanisms: in PowerApp there is an over-emphasis on the individual learner and there exists little group and social learning opportunities. While the duel-learning game mechanism seems appropriate to initiate a peer-to-peer learning, its functionalities should be extended to support group-based collaboration and communication.
-No access to PowerApp via personal technologies such as cell phone and tablet,
-Insufficient promotion of PowerApp in the organization's level,
-Insufficient promotion of PowerApp by the team managers: one emerged theme from the interviews, as shown in figures 6.7 and 6.8, is about the high influence of the team managers and peers on the participants to adopt and learn with PowerApp. In other words, the active approach of the team managers toward PowerApp can attract more team's members to access PowerApp which in turn increases the level of team's activeness.

However, the analysis of PowerApp data logs has shown that among the 22 teams initially participated in PowerApp pilot just 13 teams' managers accessed and used PowerApp.
-Lack of enough learning time.

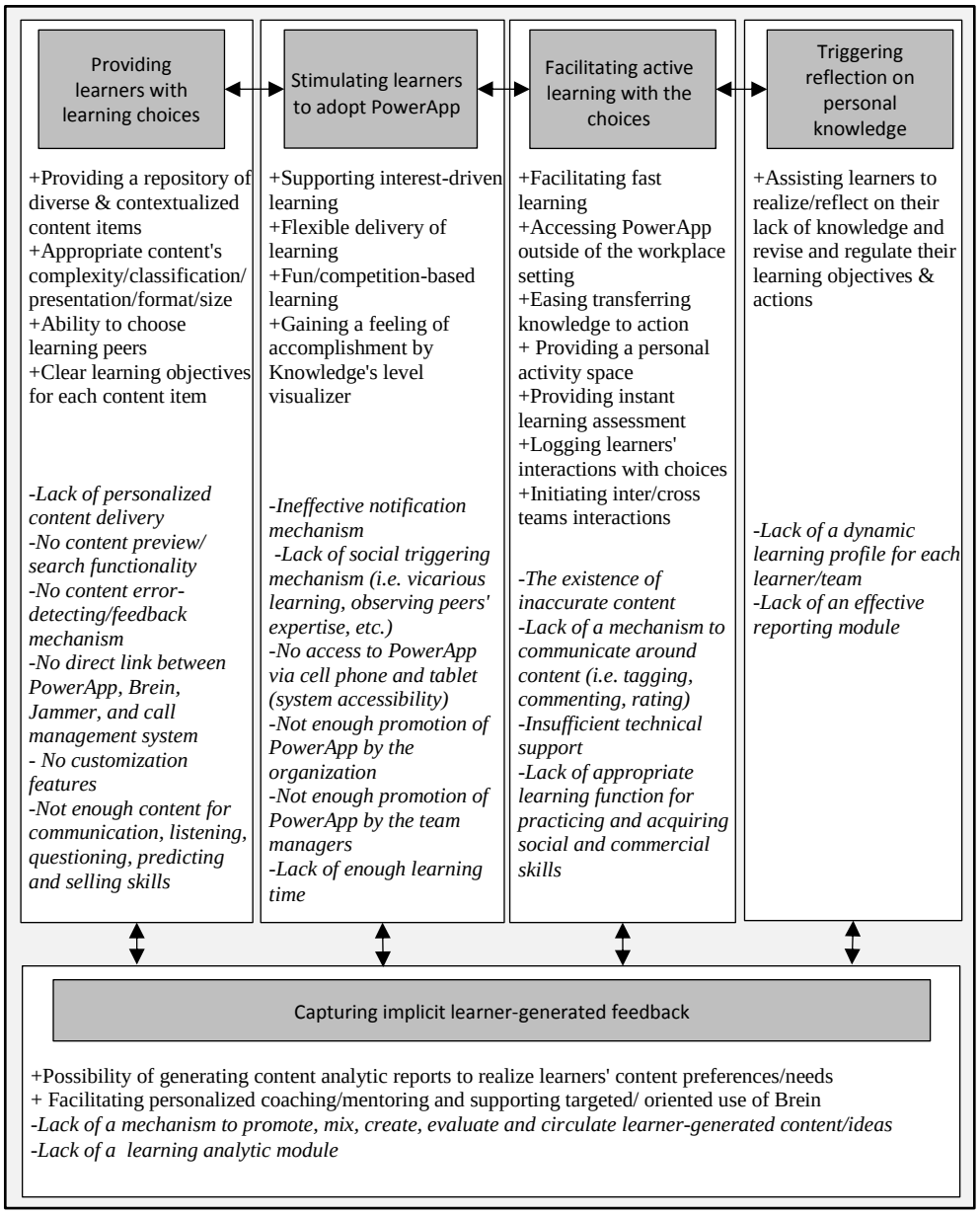


Figure 6.11. The provided mechanisms, functions (+) and shortages (-) of PowerApp influencing learner-driven knowledge updating process in the CCC's context

- *Facilitating active learning with the learning choices*: after stimulating the learners to access and learn with the provided learning choices, this phase concerns with facilitating the active involvement and learning of the learners with these choices. To this end, PowerApp capitalized on several features including: supporting fast and easy learning by providing bite-sized content and simple learning model, providing a personal activity space to learn content, easing transferring knowledge to action by providing contextualized content, accessing PowerApp outside of the workplace setting, inviting learners to play duel-learning games by their peers or managers, triggering learners' feeling of accomplishment through knowledge visualizer, using the learning assessment module to give instant feedback on their learning and knowledge level, and logging data pertains to all aspects of their learning process. An interesting finding in both units of analysis 3 and 4 pertains to the influence of the social context on triggering active learning and engaging of the learners with the provided choices. In other words, it has been observed that both individual- and social-based learning process can contribute to regulating personal learning and competency development of the learners. In this regard, as illustrated by Littlejohn et al.(2012), self-regulated learning in knowledge intensive workplaces appears to be a highly social process, structured by and deeply integrated with work tasks and could be enhanced through mechanisms that allow experts and novices to create and share knowledge by connecting with each other and the broader collective.

However, the following shortages diminishing PowerApp's ability to support active learning have been perceived by the interviewees and surveyed participants:
-The existence of inaccurate content,
-Lack of a mechanism to communicate around content (i.e. tagging, commenting, rating),
-Some technical problems in PowerApp and insufficient support to address these problems
-Lack of appropriate learning functions for practicing and acquiring social and commercial skills: in this regard, it was emphasized by the interviewees that although using learning functions such as brain snacks and brain breakers might be helpful for learners to acquire or evaluate their financial knowledge, providing merely information about communication and social skills is not an effective way to acquire and practice these skills.

- *Triggering reflection on personal knowledge:* PowerApp took advantage of several mechanisms to trigger learners' reflection and critical thinking on their knowledge: first, by providing and exposing new learning choices PowerApp sparks the learners' curiosity and stimulate them to realize, understand and make sense of these choices. In this regard, as stated by Strampel and Oliver (2007), providing learners with new learning choices in terms of new learning objectives, techniques, information, communities, resources, and experiences can stimulate their reflection by increasing their awareness. After becoming aware of new choices, they become stimulated and feel they must make sense of these choices by using them in meaningful ways and "until the new choices can be assimilated and accommodated, they are in a state of disequilibrium" (p. 974). This disequilibrium stage can facilitate further reflection and can lead to conceptual change, but only if the

learners are properly motivated, supported and encouraged. Secondly, active engagement of the learners with the learning choices provides the learners with a reliable picture of their knowledge gap (see figure 6.9). Encountering learners with their knowledge gaps triggers them to reflect about and regulate their learning objectives and process and initiates need-driven learning. According to Brown and Duguid (2000) people learn in response to a (personal) need and when they cannot see the need for what's being taught or delivered, they simply ignore and reject it, or fail to assimilate it in any meaningful way. Conversely, when they have a need, then, if the resources for learning are available, people learn effectively and quickly.

To increase the effectiveness of these reflection mechanisms, the interviewees and surveyed participants suggested the following features to be added to PowerApp:
- A dynamic learning profile for each learner,
-An effective reporting module.

- *Capturing implicit learner-generated feedback:* learner-generated feedbacks have an indisputable influence on improving a learning environment through making visible the learning processes and opportunities. Hattie (2009, as cited in Reeves (2011, p.7)), after synthesizing over 800 meta-analyses related to learning achievement, describes his insight into the importance of learner-generated feedback as below:

I discovered that feedback was most powerful when it was from the student to the teacher rather than from the teacher to the student as commonly viewed…feedback from students as to what students know, what they understand, where they make errors, when they have misconceptions, when they are not engaged- then teaching and learning can be synchronized and powerful. Feedback to teachers helps make learning visible.

A prominent aspect of PowerApp perceived by the participants was its potential for making learning visible by monitoring and logging participants' interactions with different learning choices. The collected data then might be used by a learning analytic module to provide valuable insight into participants' learning process including their level of activeness, learning time pattern, social interactions, content interactions, learning preferences, and knowledge gap and needs. These sorts of insight then might be used by the content developers and system designers to produce and provide individualized learning choices. Secondly, as shown in figure 6.9, analyzing learning process of learners reveals their lack of knowledge in a specific subject which is a key requirement to support personal competency development and mentoring/coaching in the CCC context. Also, getting insight into personal knowledge gap was perceived useful to help the employees to plan and orient their use of other organizational information systems such as Brein.

Despite of the possibilities to take advantage of these implicit learner-generated feedbacks, still PowerApp lacks the below functionalities to facilitate and benefit from learner-generated feedbacks:

-A content development/evaluation mechanism to allow the learners to use, create, share, evaluate, and circulate content items on the basis of their personal learning and working experiences.

- A learning analytic module that monitors and keeps track of the employees' learning activities accomplished in different tools. This learning analytic module is meant to bridge existing learning supportive tools to realize individual/collective pattern of learning process within these tools. The output of this module can provide two sorts of learner-generated feedback: learning diagnostic (i.e. individual and collective learning needs and lack of knowledge) and learning opportunities (i.e. identifying experts in a specific subject). Figure 6.12 presents an conceptual framework of a learning analytic module for the CCC's context. This conceptual framework aims to bridge the employees' formal and informal learning activities accomplished using PowerApp, Brein, and Yammer. According to this framework, analysing employees' interaction with Brein provides relevant insight into their informal learning activities, behaviour and needs including their search pattern and keywords. Furthermore, analysing the employees' learning in PowerApp reveals their lack of knowledge or their expertise in a specific type of insurance knowledge. Moreover, analysing the employees' interactions in Yammer provides valuable information on the social interaction of employees in Yammer. By combining and analysing these sorts of information the learning analytic module can create a comprehensive and 360 degree picture of learning for each employee. The output of such learning analytic module can be used by employees, team managers, content developer, and PowerApp designer/developer to improve the whole learning environment. The content developer may use this output including searched keywords in Brein and employees' lack of knowledge in PowerApp as guidelines for creating relevant and contextualized content items and feeding both Brein and PowerApp with validated 'ready-to-use' content. The team managers might take advantage of this output to create a picture of learners' learning needs and expertise and coach and orient them accordingly.

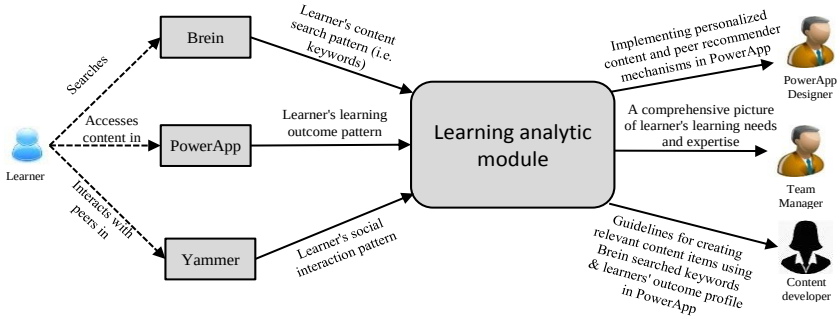


Figure 6.12. A conceptual framework for a learning analytic module bridging PowerApp, Brein, and Yammer

Furthermore, the designers and developers of PowerApp might use this output to implement personalized content delivery mechanism based on the learner's learning needs. Also, identifying employees' expertise and lack of knowledge in a specific topic makes it possible to develop a peer recommender mechanism in PowerApp to connect experts and inexperienced employees in a specific subject and form learning group.

Conclusions

In this chapter we combined the organization's and learner's views on learning and competency development to identify the design specifications of a workplace e-learning system aiming at supporting the knowledge developer role of learners in the workplace settings.

The results of this chapter and chapter 5 suggest that supporting the knowledge developer role of learners is achieved through facilitating a personalizing learning process consisting of five phases: 'providing learning choices', 'stimulating learners to learn with the learning choices', 'facilitating active learning with the learning choices', 'triggering reflection', and 'facilitating learner-generated feedback'. These findings are in line with the recent shifts in learning practices in workplace emphasizing on increased choice in learning activities; increased learner responsibility for learning; more focus on informal than formal learning, problem-based, and social learning; and reciprocal feedback between designers/managers and learners (Hase, 2009, Willmott & Barry, 2002). The results of this chapter have suggested the below guidelines for designing a workplace e-learning system:

- Given the diverse learning needs and interests of the learners in the workplace a fixed and liner curricula is an inappropriate option to deliver learning. Instead, by providing learners with appropriate and heterogeneous set of learning choices and resources, informed by the organization's objectives, it is likely that these choices attract the learners by addressing their personal interests and requirements.
- Learning is a desire-based function. Defining and applying inspiring and motivating learning models such as game-based learning is essential for motivating and facilitating learners to use and work actively with these choices. Also, content quality and system quality play key roles in adopting and using a workplace e-Learning system by users.
- Learning in the workplace goes through working with different learning/working supportive tools. A learning analytic module is required to bridge these tools and trace employees learning activities accomplished in these tools in order to create a comprehensive picture of formal and informal learning pattern of the learners.
- Any e-learning system aiming at empowering learners, in addition to providing and transferring formal content required to improve their job performance, should provide them with opportunities to practice and acquire higher-order thinking skills such as evaluating, analysing, and creating knowledge and take part in constructing and shaping the learning environment.

7 Developing the Workplace PLE Design Framework

The goal of this chapter is to answer the main question of our research: "*How should a technology-based personal learning environment be designed, aiming at supporting learners to gain control over their learning at the workplace?*" The answer to this question is structured in a workplace PLE design framework consisting of four key elements: core principles of personal learning, design principles, technological components, and implementation guidelines.

To answer the main research question we first answer research sub question #6: "*What are the core principles of personal learning within workplace settings?*" To this end, we take advantage of the insights on the requirements of personal learning in the workplace derived from the theoretical observation (see chapter 2) and empirical explorations and investigations (see design cases 1 and 2 described in chapters 3, 4, 5, 6). Accordingly, we do a cross-case analysis, as summarized in table 7.1, to compare and analyze the factors influencing personal learning within the workplace. We argue that the combination of the results of these design cases provides a comprehensive picture of factors affecting personal learning process in the workplace. Although the design case 1 pertains to a formal educational setting, its project-based and learner-centric nature resembles patterns of interconnected working and learning process available in many workplace settings including design case 2. In this regard, Eraut (2004) asserted that "formal education can be also viewed as a workplace and uses a discourse in which the term 'work' is normally quite prominent. Students are given work to do and described as good or hard 'workers'. Moreover, it is usually the work that is structured and not the learning. A great deal of informal learning has been observed to take place in or near formal education settings, but research into the outcomes of such informal learning is very limited" (p.1). In other words, in formal learning situations where learner-centric instructional approaches such as project-, problem-, or inquiry-based learning direct the educational practices, learning can be envisioned as a by-product of work activities alike workplace settings.

After the core principles of personal learning have been designated, we identify a set of design principles as well as technological components and implementation guidelines derived from our theoretical and empirical explorations to address these principles.
Please note that in this chapter we may use the following categories of terms interchangeably: (i) PLE and e-Learning system, (ii) user, learner, employee.

7.1 Cross-Case Analysis

In this section we do a cross-case analysis to compare the factors affecting personal learning processes in two conducted design cases. The first design case is the Amadeus Lyceum secondary school consisting of unit of analysis 1 (representing learners' views on personal learning) and unit of analysis 2 (representing teachers' views on personal learning). The second design case is the customer call centre (CCC) of the Achmea

Company consisting of unit of analysis 3 (representing learners' views on personal learning) and unit of analysis 4 (representing organization' views on personal learning). The cross-case analysis is performed based on the following dimensions: learning objectives, the learner's control model (or the impact on the learner's roles of decision maker, knowledge developer, and socializer), and the facilitated learning process. Table 7.1 represents this cross-case analysis.

7.1.1 Learning Objectives

Informed by their contextual conditions and requirements, the following learning objectives were set in these design cases: facilitating learners' engagement in constructing their learning environment using Web 2.0 tools in design case 1 and facilitating personal learning and competency development of learners in design case 2 including the competency to serve customers (unit of analysis 3), and the competency to acquire and update insurance knowledge (unit of analysis 4). Despite of their different contextual conditions, these two design cases share a common learning objective: facilitating the learners' control and personal agency over their learning and competency development.

7.1.2 Supporting Learner's Control Model

In each design case there were several support/barriers affecting the learner's control model comprising of the learner as decision maker, knowledge developer, and socializer roles. In table 7.1 the provided/existed supports for the learner's role in each design case are presented using '+' sign under the category of 'provided support' and the barriers, required supports, or conflicts are presented using '-' sign under the category of 'barriers/required supports'.

- **Supporting learner's role as decision maker:** as detailed in the specifications of the learner's control model in chapter 2, facilitating the decision maker role of learners deals with providing the learners with appropriate learning opportunities and choices to make decisions about their learning process. Different approaches were followed in each design case to support the decision maker role of learners. In the unit of analysis 1 the learners were provided with extended access to the Internet, web tools and online content items. Also, each learner had a flexible personal activity space to customize technology, plan, manage, direct, and pursue his/her learning activities. This freedom in accessing, choosing, and customizing technology in addition to the project-based nature of the learning had generated a sense of autonomy, ownership, responsibility and accomplishment for the learners. However, the learners faced with several challenges to support their autonomy and independence including unclear learning objectives of the project, difficulty in linking the learning potential of the provided technological choices to their learning needs, lack of appropriate time management and technical skills, technological issues (i.e. sign-in and lack of connectivity between different tools), and lack of the triggered reflective thinking on the learning process. These challenges served to decrease learners' control and autonomy over

their learning activities. Furthermore, by examining the teachers' perception on the PLE-based learning in the unit of analysis 2 different pedagogical, technological, and organizational requirements of personalizing learning have been identified including: school's leadership, a supportive community of practices of teachers, scalable ICT infrastructure and policies, and appropriate mechanisms for encouraging and capturing learner-generated feedbacks. See chapter 4 for more details on these requirements.

In the unit of analysis 3 in the design case 2 the learners had access to the organizational knowledge resources via the Internet, knowledge experts, Brein and Yammer. Furthermore, direct contact with customers had provided them with unique learning opportunities to perform personal and social learning activities required to address their working challenges, regulate and revise their learning objectives and actions continuously, plan learning opportunities to update personal knowledge, reflect on individual and team's performance, and feel a sense of autonomy and shared ownership. In despite of these opportunities, there were several issues observed in this unit of analysis challenging the learners to feel more autonomy over their learning process including organizational issues (i.e. lack of enough learning time due to the tight working structure), technological issues (i.e. no access to Brein outside of the workplace setting), and personal issues (i.e. no clear insight into lack of knowledge, lack of enough technical skills such as using appropriate keyword to search Brein or email skills).

PowerApp, introduced in the unit of analysis 4, followed a top-down choice-based approach to supporting the decision maker role of the learners. PowerApp provided several means to support the learners' role as decision maker including providing contextualized and bite-sized content items, flexible delivery of learning, defining clear learning objectives, triggering interest-driven and need-driven learning, triggering reflection on personal knowledge and learning process, and the feasibility of realizing learners content preferences and needs. In spite of these functionalities, PowerApp still lacks several features to support the learners to feel a greater sense of autonomy and ownership over their learning including the lack of a content/peer recommender mechanism, lack of co-learning functionalities, lack of connectivity between different learning tools such as Brein, Yammer, and PowerApp, lack of appropriate learning analytic module to bridge and orchestrate learning activities in Brein, Yammer, and PowerApp, and system quality issues such as accessibility and reliability of PowerApp.

In both design cases some differences in the learners' and organization' orientation toward the desirable structure of the learning environment have been observed. In the first design case while the learners showed more tendencies toward open and flexible learning environment, the teachers were inclined toward a more controlled and closed learning environment. Similarly, in the design case 2 while the learners work and learn in a multi-tools and flexible learning environment where the learners mainly define the learning

objectives, PowerApp represents a single-tool learning environment driven by the organization-defined learning objectives.

- **Supporting learner's role as knowledge developer:** to improve the cognitive capabilities of the learners and support their role as knowledge developer, in both design cases the learners were provided with a repository of content items (i.e. online content in units of analysis 1 and 2, Basic training and Brein content in unit of analysis 3, and content items in unit of analysis 4). In all cases the learners performed fairly similar lower-order cognitive activities including searching, reading, understanding, and applying content. Furthermore, the learners in unit of analysis 1 performed higher-order thinking activities including remixing, creating, and publishing content. Direct contact with customers in unit of analysis 3 provided the learners the opportunity to transfer their knowledge into action, critically reflect on their knowledge and regulate and revise their learning objectives and actions. In unit of analysis 4 the learners performed cognitive activities including reading, answering, and reflecting on their knowledge level. In both unit of analysis 1 and 3 teacher/team managers to assess the learners' knowledge and learning process followed a formative and process-based assessment approach. On the other hand, PowerApp supported a summative test-based assessment approach to stimulate the learners to reflect on and realize their lack of knowledge and facilitate personalized coaching and mentoring.

In both cases 1 and 3 the quality of the learner-generated content (i.e. the final travelling guides in case 1 and the created knowledge in CoP) had been called by the interviewed teachers and team managers into question. Actually, while learner-generated content was perceived essential for assisting the learners to acquire procedural skills and competencies, its validity and quality to support formal learning objectives (i.e. standard tests in units of analysis 1 and 2 and addressing customers information needs in unit of analysis 3) was questioned by the interviewees. Also in unit of analysis 3 information issues such as inappropriate content in Brein served to decrease the learners' ability to undertake the role of knowledge developer. Surprisingly, in units of analysis 2 and 4 the importance of a supportive mechanism for facilitating learner-generating/evaluating content has been emphasized by the teachers and team managers. Furthermore, in unit of analysis 4 issues pertain to the structure of content items such as lack of personalized content delivery and lack of connectivity between content items in different content resources were identified as challenges for the knowledge developer role of learners. Examining the teachers' perception on the requirements of the PLE-based learning has identified different requirements for supporting learner's role as knowledge developer including content requirements (i.e. a repository of evaluated learning content), pedagogical requirements (i.e. flexible curriculum objectives, inspiring learning models), and technological requirements (i.e. learning analytic module).

Comparing the learner's and organization's views on the knowledge developer role of learners in design case 2 shows a difference between learners and organization orientation

toward content: the learners show more interest in contextualized and ready-to-use content useful to address their daily working/learning challenges. On the other hand, the organization prefers to feed the learners with formal and strictly evaluated content.

- **Supporting learner's role as socializer:** with regard to the socializer role, the social learning opportunities provided for the learners were quite different in each unit of analysis. In units of analysis 1 and 3 there were group- and community-based opportunities to facilitate co-learning processes (i.e. co-development of projects and participating in the CoPs). In both units of analysis 1 and 3 the social context of the learning environment had provided the learners with numerous opportunities to share their experiences, findings and problems, co-regulate their learning objectives and actions, and feel a shared sense of ownership. On the other hand, PowerApp in case 4 supported merely peer-to-peer learning interactions through playing duel-learning games.

The challenges affected the learners' role as socializer were different in each case. In unit of analysis 1 the main social challenge pertained to the inability of learners to manage their interactions using technology and resolve their conflicts. In unit of analysis 3 the informal and CoP-driven nature of working and learning had caused two main social challenges include core rigidities and parochialism (please see section 5.3 in chapter 5 for more detail on these issues). In unit of analysis 4 lacking appropriate co-learning mechanisms and a common social space to create, evaluate, and collaborate around content were identified as the main social challenges.

By comparing the learner's and organization's views on the social aspects of personal learning in the design case 2 it can be concluded that there is a *socially-oriented learning* vs *individual-oriented learning* contrast between the learners and organization orientation on the design of the learning environment.

Table 7.1. The Cross-case Analysis Results

	Design case 1: The Amadeus Lyceum school		**Design case 2: The customer call centre (CCC) in the Achmea Company**	
	Unit of analysis 1 (discussed in chapter 3)	**Unit of analysis 2 (discussed in chapter 4)**	**Unit of analysis 3 (Informal learning in the CCC's context discussed in chapter 5)**	**Unit of analysis 4 (PowerApp discussed in chapter 6)**
Learning Objective	Facilitating learners' engagement in constructing the learning environment		Improving learners' competency to serve customers and acquire and update their insurance knowledge	
Learner as decision maker	*Provided support:* +Project-based learning +Extended learners' access to web tools/resources +Flexible personal activity space +Opportunities for planning/ managing personal learning and exploring/discovering the learning potential of web resources *Barriers/required support:* -Time management, goal setting, reflection, and technical skills -Appropriate mechanisms for encouraging/capturing/applying learner-generated feedbacks	*Provided support:* +A repository of learning resources +Opportunities to realize the learning potential of web tools/resources +Opportunities to develop learner-centric learning environment by realizing learner's preferences +Flexible personal activity space *Barriers/required support:* -School's leadership -Teacher's TPACK -A supportive CoP for teachers -Connectivity between different learning tools -Scalable ICT infrastructure & policies -Flexible curriculum objectives -Learning analytic module	*Provided support:* +Direct contact with customers +Plunging in daily activities and challenges +Supporting need-driven learning +Planning, reflecting on and regulating personal learning objectives and actions +Using several tools to support working/learning *Barriers/required support:* -Organizational issues (i.e. Lack of enough learning time) -Technological issues (i.e. no access to Brein via personal tools and outside the workplace) -Personal learning issues (i.e. no insight into personal knowledge level, Lack of technical skills)	*Provided support:* +Flexible delivery of learning +Defining clear learning objectives +Supporting interest-driven learning +Triggered reflection on personal knowledge using instant assessment module +Recording personal learning *Barriers/required support:* -Lack of learning analytic and recommender modules -Lack of connectivity between learning activities/content in different learning tools -System quality issues
	Difference between learner's & teachers/school orientation: *open* vs *controlled* learning environment		Difference between learner's and organization's orientation: -*Learner-defined* vs *organization-defined* learning objectives -*Multi-tool* vs *Single-tool* learning environment	
Learner as knowledge developer	*Provided support:* +Broadening access to online content +Practicing lower and higher order cognitive activities +Increased technological awareness/competencies *Barriers/required support:* - Learner-generated/ Online content quality issues -A repository of appropriate learning content	*Provided support:* +Possibility for performing formative assessment *Barriers/required support:* -Learner generated/online content quality issues -A rubric for evaluating the quality of online learning resources	*Provided support:* +Accessing contextualized & ready-to-use knowledge resources +Opportunities to transfer knowledge into action +Performing formative assessment by team managers *Barriers/required support:* -Information barriers -Technological barriers -Organizational barriers	*Provided support:* +Accessing a repository of evaluated, contextualized content items +Supporting fast/easy content learning +Instant assessment mechanism +Assisting learners to realize/reflect on their lack of knowledge +Facilitating personalized coaching/mentoring *Barriers/required support:* -Content items issues -Lack of supportive mechanism for learner-generated content
			Difference between learner's and organization's orientation: *Contextualized/ready-to-used content vs formal content*	
Learner as Socializer	*Provided support:* +Accessing knowledgeable people +Group-based learning +Exchanging/sharing learning resources +Co-developing of learning projects *Barriers/required support:* -Learners interaction issues	*Provided Support:* +Social learning space *Barriers/required support:* -Clear and effective Internet usage rules and policies	*Provided support:* +The socialization process & CoPs +Being endorsed by customers, peers and managers +Co-regulation of learning objectives and actions *Barriers/required support:* -Core rigidities & Parochialism	*Provided support:* +Game-based Peer-to-peer interaction *Barriers/required support:* -Lack of co-learning around the provided content items
			Difference between learner's and organization's orientation: *socially-oriented* vs *individually-oriented learning*	
Learning process	preparing, learning by constructing project, reflecting, feeding back		preparing, learning by doing, reflecting, feeding back	Accessing & learning content items, reflection on own knowledge

7.1.3 Facilitated Learning Process

There are similarities and differences between the learning processes followed by the learners in these design cases. In unit of analysis 1 a sequential and linear pattern of personal learning process consisting of preparing (or forethought), performing (i.e. learning by constructing projects), reflecting, and feeding back was followed by the learners. In this case the preparing phase involved accomplishing learning activities such as setting personal learning objectives informed by top-level learning objectives of the project, planning learning activities to achieve these objectives, choosing and preparing technology, and defining learners' roles in group. The performing phase involved learning activities including practicing lower and higher cognitive activities, co-development of projects, and customizing technology. In the reflecting phase the learners evaluated and reflected on the quality of their developed travel guides and their group interactions. In feeding back phase the learners tried to adapt the learning environment through sharing their findings, faced problems, solutions, and experiences with their peers and the teacher.

Similarly, the supported learning process in unit of analysis 3 consists of preparing, learning by doing, reflecting, and feeding back phases. However, unlike the linear and sequential pattern of self-regulated learning process in unit of analysis 1, the regulating learning process in unit of analysis 3 had not followed a linear and sequential pattern of self-regulated learning. In PowerApp the learners followed a highly structured designer-defined process consisting of accessing provided learning choices, learning with these choices, reflection on own knowledge level, and adapting the e-Learning system by providing implicit learner-generated feedbacks.

7.2 Answering Research Sub Question # 6

In this section we answer research sub question # 6: "*What are the core principles of personal learning within workplace settings?*"

The core principles of personal learning are learning concepts and constructs that underpin and inform the design of an e-learning system aiming at facilitating personalizing learning within the workplace. As described in chapter 1, these core principles of personal learning are resulted from incorporating theory into practice through applying theoretical as well as empirical grounding processes on the design cases. After scrutinizing the learning processes in both design cases it has been realized that, apart from their differences, a similar pattern of learner-driven learning process consisting of forethought (or preparing), performing, reflecting, and feeding back phases can be observed in both design cases. This personal learning process is initially informed by the organization learning objectives and supported by the organization-provided learning resources and structures. Then this process is driven by the learners through translating the organization objectives into their personal learning needs and using the provided learning resources to support their roles as knowledge developer, decision maker, and socializer. Finally, the learners try to adapt the learning environment by finding, creating, and introducing new learning resources or objectives.

These observations have led us to conceptualize an organizational personalizing learning process as a continuous and cyclic transformation of organization-defined learning objectives, actions and resources and learner-defined learning objectives, actions and resources. On the basis of these observations, there are four main factors influencing this transformation process: (*i*) the quality of the organization-provided learning support, (*ii*) the ability and willingness of learners to take advantage of the provided support to address their learning objectives, (*iii*) the assumed and supported roles for the learners in the learning environment, and (*iv*) the bottom-up adaptability and evolvement of the learning environment based on the personal learning experiences of the learners. Together, these four factors inform eight core principles of personal learning include: *Learning support* (informed by factor *i*), *Forethought*, *Performing*, and *Reflecting* (informed by factor *ii*), and *Learner as knowledge developer*, *Learner as socializer*, *Learner as decision maker* (informed by factor *iii*), and *Feeding Back* (informed by factor *iv*). Below these core principles and the rationale behind selecting them are explained.

- **Learning support:** learning support refers to the resources that the learner need to access in order to carry out the learning process and support their role as worker in the workplace. These resources may include but not limited to accessibility and availability of learning materials, preparation, content, structures, policies, facilitators, community experts, and technological, emotional and organizational support. Choosing *Learning support* as a core principle of personal learning is based on two main reasons stemmed from our observations from the design cases: the first reason stems from this observation that generally speaking the learners did not possess the required technical and learning skills to use technology to regulate and direct their learning and personal development. The second reason implies the importance of supporting, structuring and orienting the learner's personal learning and goal actuation endeavours around shared organizational learning needs, objectives, rules, and structures. From this perspective, *Learning support* can be seen as a means to align and orchestrate the learning and working objectives and actions of employees and organization "to improve performance for the benefit of the organization and the learner" (Wang, 2011, p. 194) and to define learning as a shared responsibility of employees and organization.

- **Learner as decision maker:** the concept of *Learner as decision maker* was designated as a core principle of personal learning, because of the importance of nurturing decision making and self-regulating capabilities in learners to become autonomous learners and feel a sense of ownership over their learning. As observed in the second design case, each learner has a unique set of learning needs, objectives, preferences, strategies, and experiences based on his/her working requirements or personal interests. Providing learners with appropriate learning choices and allowing them to make decision on their learning process improves their metacognitive knowledge and abilities as the key elements of personalizing learning and makes learning as a meaningful activity. In this regard, as contended by Boekaerts (1999), one of the key issues in self-regulated learning is an

individual's ability to select, combine and coordinate different strategies in an effective way. Dron (2007a, b) has connected the concept of learner's control to the choices and commented that one measure of a "mature learner" is to become more capable of making relevant and effective choices with respect to their learning experiences. Accordingly, providing learners with decision making opportunities regarding their learning is a prerequisite for them to move from a "state of dependence" to "one of independence."

- **Learner as knowledge developer:** the concept of *Learner as knowledge developer* was designated as a core principle of personal learning due to the key role of learner-led knowledge development activities in improving the learners' cognitive capabilities and evolving and enriching the learning environment using the learner-generated knowledge. Cognition relates to the conscious mental processes by which knowledge is accumulated and constructed (Barak, 2010). Cognitive capabilities refer to the cognitive abilities and competencies, such as being aware, knowing, thinking, creating, applying, learning and judging, the learner requires to participate in particular learning experiences and acquire power to gain control over his/her learning process. The pivotal point of this core principle states that learning can occur most effectively when the learner is actively engaging and participating in making and constructing knowledge that is meaningful to him/her and can be shared with others, "rather than something that happens inside individuals' minds" (Paavola & Hakkarainen, 2005).

- **Learner as socializer:** the concept of *Learner as socializer* was designated as a core principle of personal learning, due to the importance of the social context in deepening/shaping personal learning and providing support to assist learners to keep control over their learning process. The results of both design cases have revealed that personal learning and competency development is strongly influenced by the social interactions between the learners within the learning environment. From the perspective of this principle, learning is driven by personal or collective problems, needs or interests and shaped through participating in various shared learning activities that provide clues for action and improve cognitive and metacognitive capabilities in many ways.

- **Forethought:** as the first phase of the personal learning process observed in both design cases, the concept of *Forethought* (or preparing) was designated as a core principle of personal learning because of its importance in nurturing personal development through personal goal setting and preparing and planning of personal learning. In the self-regulated learning process model proposed by Zimmerman (1989) personal task analysis and self-motivation beliefs are defined as the main elements of the forethought phase. Personal task analysis refers to planning processes such as translating organization's learning objectives into personal learning objectives, choosing appropriate resources to address personal learning objectives and strategic planning by learners. Self-motivational beliefs consist of learner's self-efficacy beliefs, his or her outcome expectations, intrinsic interest and goal orientation.

- **Performing:** as the second phase of the personal learning process observed in both design cases as well as the Zimmerman's self-regulated learning process model, the concept of *Performing* (or learning by constructing or doing) was designated as a core principle of personal learning. The emphasis of this core principle is on nurturing personal development through goal attainment and active learning efforts. Adopting this core principle emphasizes the importance of adopting and supporting learning-by-doing approaches to designing the PLE and allowing learners to become active agents in constructing the learning environment.

- **Reflecting:** as the third phase of the personal learning process observed in both design cases as well as the Zimmerman's self-regulated learning process model, the concept of *Reflecting* was designated as a core principle of personal learning, because of its importance in nurturing personal development through promoting critical thinking and regulating learning objectives, knowledge and strategies. According to Rogers (2001), reflection offers learner opportunities to examine, evaluate and regulate his or her learning and enhances the learner's overall effectiveness by allowing him or her to make "better choices or actions in the future" (p 41). According to Johnson and Liber (2008), critical thinking and reflecting is an inherent aspect of personalizing learning and without them, according to Scardamalia and Bereiter (2006), any activity-based learning experiences can easily decline to a form of shallow constructivism or doing for the sake of doing. Strampel and Oliver (2007) define reflection as a way of thinking and "a form of contemplation that determines how one comes to act on new understandings" being stimulated by new information and choices and leading to conceptual change, knowledge transfer and action.

- **Feeding Back:** as the fourth phase of the personal learning process observed in both design cases, the concept of *Feeding Back* was designated as a core principle of personalizing learning due to the importance of recognizing and considering the learners' behaviours and feedbacks in shaping, evolution, and adaptation of the learning environment. Earlier in this chapter, we referred to personal learning as a cyclic transformation of organization-defined learning objectives, actions and resources and learners-defined learning objectives, actions and resources. This transformation process goes through a long-term and complex process of interaction between the learner's personal agency and the learning environment. According to Johnson and Sherlock (2012), there is a bidirectional and feedback relationship between the learning environment and personal agency in a way that the things that learners do are transformative of the environment within which they operate and vice versa. The importance of feeding back can be seen from the perspective of continuity and rapidity of change which has become a permanent constant and feature in today's learning systems. In this regard, in his path-breaking book, *Beyond the Stable State*, Schön (1971) argues that change is a fundamental feature of modern life and it is necessary to develop learning systems that could learn and adapt. From the PLE perspective, Rahimi et al. (2014a) argued that any attempt for enhancing and sustaining learner's control should recognize, operationalize and corroborate this feedback

relationship to allow and encourage learners to actively participate in constructing, (re)shaping and reseeding (i.e., tooling and de-tooling) of the learning environment, resulting in the establishment of a learner-centric learning environment.

7.3 Answering the Main Research Question

The answer to the main research question is structured in a workplace PLE design framework. As described in chapter 1, a PLE design framework consists of four key elements: core principles of personal learning, design principles, technological components, and implementation guidelines. The development of the PLE design framework goes through a 3-phases process: In the first phase the identified core principles of personal learning are synthesized in an appropriate way. In the second phase a set of design principles are determined to address the designated core principles of personal learning and guide the development of the learning environment. Finally, the identified design principles along with the empirical results from the design cases serve to determine a suit of technological components as well as implementation guidelines to enact these design principles. Figure 7.1 depicts the developed PLE design framework consisting of the aforementioned eight core principles of personal learning (presented in the outer rectangle), fifteen design principles (i.e. D1, D2, ..., D15), and associated technological components (presented in the light grey rectangles) and implementation guidelines (presented in the dark grey rectangles).

To find an appropriate and creative way to synthesize the core principles of personal learning, we take advantage of the main objectives of the PLE concept as described in the literature review chapter. These objectives include: *empowering learners to gain control on their learning process* and, *facilitating continual development of the learning environment as a shared responsibility of learners and organization*. Furthermore, the PLE framework should address the observed orientations between the learner's and organization's views on the design of the learning environment, being: *flexible vs controlled* learning environment, *contextualized vs formal* knowledge, and *socially-oriented vs individually-oriented* learning.

To address these objectives and orientations the core requirements are synthesized along with two dimensions: the first dimension (the horizontal dimension in the outer rectangle in figure 7.1) includes 'learning support', 'forethought', 'performing', 'reflecting', and 'feeding back', while the second dimension (the vertical dimension in the outer rectangle in figure 7.1) consists of 'learner as decision maker', 'learner as knowledge developer', and 'learner as socializer' core requirements.

The horizontal dimension introduces two interconnected development processes, namely, the 'learning development process of learner' and the 'development process of the learning environment'. The former resembles a regulating learning process consisting of forethought, performing, and reflecting phases. Informed by the empirical findings from the

design cases, the learning development process of learners in this framework follows a nonlinear and non-sequential regulating learning process. The nonlinear characteristic of this learning process implies the personal development of learners is achievable by supporting their active role as decision maker, knowledge developer, and socializer. The non-sequential characteristic of this process states that in workplace settings the learning behaviour of learners might be random and emergent by adopting new learning objectives and strategies. Accordingly, there should be backwards and forwards between forethought, performing, and reflecting phases to cope with the complex and emergent nature of learning and working in the workplace settings.

The development process of the learning environment, as shown in figure 7.1, consists of three components: the 'learning support', the 'learning development process of learner', and 'feeding back'. By such embedding, the development process of the learning environment promotes an organization-informed and learner-driven development approach to evolving the learning environment. This approach is in line with those perceptions of PLEs that introduce them as empowering and emancipatory tools and dynamic outcomes rather than static input of the learning process (Drexler, 2010; Attwell, 2007; Rahimi et al., 2013b, c, 2014a). Furthermore, this approach to developing a learning environment aims to build a bidirectional and complementary relationship between designer-generated context (embodied in learning support core requirement) and learner-generated context (embodied in forethought, performing, reflecting, and feeding back core requirements) approaches, identified as a crucial need in both design cases. From the perspective of this development process, providing learners with appropriate top-down learning support is a key requirement to support their personal development aligned with the organization's business and learning objectives and requirements. In return, the outcome of the learner's personal development in terms of explicit and implicit learner-generated feedbacks is beneficial for adapting and evolving the learning environment. This approach to developing and transforming organizational learning environments through a continuous cooperation between designer-generated and learner-generated context recognizes the 'dynamic conservatism' characteristic observed in the majority of today's organizations. In this regard, according to Schön (1971 as cited in Smith (2001)), "A learning system… must be one in which dynamic conservatism operates at such a level and in such a way as to permit change of state without intolerable threat to the essential functions the system fulfils for the self. Our systems need to maintain their identity, and their ability to support the self-identity of those who belong to them, but they must at the same time be capable of transforming themselves"(p. 57).

The vertical dimension consists of the 'learner as decision maker', 'learner as knowledge developer', and 'learner as socializer' core principles of personal learning. This dimension aims at empowering the learners to take control over their learning through facilitating and supporting their active engagement in the learning process.

The second phase of the development of the PLE design framework deals with defining appropriate design principles to address the identified core principles of personal learning. The PLE design framework introduces 15 design principles presented using D1 to D15 indices. As shown in figure 7.1, each design principle has resulted from intersecting a pair of core principles from the horizontal and vertical dimensions. These design principles represent synthesized and abstracted design knowledge derived from our experiences and findings in the design cases and are meant to bridge theory and practice through translating the core principles of personal learning to technological components and organizational support and guidelines required to address these principles.

After the design principles of personal learning have been identified, we have introduced in the third phase of developing the PLE design framework the relevant technological components and implementation guidelines, derived from the design cases, for enacting and implementing each design principle. As detailed in the literature review chapter, one of the perceived challenges for PLEs is the lack of an agreement on what technological mechanisms and strategies can underpin their development (Chatti et al., 2010). As noted by Wilson et al. (2007), several very different strategies may be feasible to develop PLEs: "a single PLE application may be possible, or on the other hand, the coordinated use of a range of specialized tools may achieve a satisfactory result" (p. 33). From a technological perspective, according to Sclater (2008), PLEs can be seen as a single downloadable client software (i.e. PLEX as described by Wilson et al. (2007)) or a made up of several types of externally hosted software that learners can freely choose and make use of them to address their specific learning purposes. In the same direction, Attwell (2007) describe a PLE as a learner-administrated mash-up or collection of loosely coupled web tools and services used for working, learning, and collaboration. The empirical findings from the design cases approve Sclater's and Attwell's view on PLE as a collection of web tools and services. On the basis of these results learners access and take advantage of a collection of web tools and information systems to augment their role as decision maker, socializer, and knowledge developer and address their learning and working requirements. However, as observed in the design cases, unorganized mash-up of tools and information systems and lack of interoperability and integration between them can lead to several problems such as conflict between learners' autonomy and institution control (observed in unit of analysis 1), inability to monitor learners' activities and interactions in different tools required to adapt learning environment, and disseminating inaccurate information (observed in units of analysis 1, 2, 3). Furthermore, generally speaking, configuration and continuous updating of a learning environment consisting of several web tools and services is a confusing activity even for advanced learners (Casquero et al., 2010). Also, as observed in the design case 2, the learners in the workplace settings have limited amount of learning time, which makes it difficult for them to construct their learning environment from scratch. On the basis of these observations we suggest a two-fold approach to develop the technological part of the PLE: (*i*) a PLE, instead of a collection of loosely coupled tools and services, should be envisioned as a collection of interoperable, traceable and integrated tools, content

and services. This argument is in line with the definition of PLE proposed by Siemens (2007) describing a PLE as a collection of web tools and services integrated under the conceptual notion of openness, interoperability, and learner control, (*ii*) a PLE should provide a single front-end interface to connect learners with these tools, content and services and hide back-end complexity and configuration.

In the next sections we will describe the identified design principles. To emphasize the process-driven nature of the PLE development the horizontal dimension in figure 7.1 is used to define five categories of design principles.

7.3.1 "Learning support" design principles

The necessity of providing appropriate learning support in terms of learning choices, aligned with the organizational working and learning objectives, for learners to undertake three roles of decision maker, knowledge developer, and socializer have led us to define the following three design principles (D1, D2, D3 design principles).

D1-Providing personal learning management choices:

This design principle has resulted from intersecting *Learning Support* and *Learner as Decision Maker* core principles. Providing learners with appropriate personal learning management choices, strategies and opportunities plays a key role in nurturing and developing their autonomy and metacognitive skills. As examined in the unit of analysis 1 the broad access of learners to the Internet had provided them with numerous web tools and services, which led them to feel a sense of autonomy and ownership over their learning process. Furthermore, as observed in the unit of analysis 3, the learners used a multi-tool learning environment to support their intertwined working and learning activities. Moreover, it has been observed in the unit of analysis 4 that providing the learners with clear learning objectives and strategies embodied in contextualized and quality content items and flexible delivery of learning helped the learners to tailor the learning content to their personal learning needs and requirements.

Inspired with these observations, the required technological components to enact this design principle in an e-Learning context include:

- A repository of clearly organization-defined learning objectives: considering personal learning and competency development as a process to address the work duties and objectives of the worker/learner, the starting point of this process is to translate the work requirements into relevant competencies to be developed by the learner. The identified competencies for each job position then inform appropriate learning objectives. For example in design case 2 the call agents had to develop two competencies, being: the ability to serve customers and the ability to quickly refresh their insurance knowledge. These competencies then informed several learning objectives including: acquiring communication, listening, questioning and selling skills to develop the first competency and being aware of any changes in different categories of insurance information to develop the

second competency. The identified learning objectives then serve to design and develop appropriate learning content and practices for each job position. Following and achieving all or a part of these organization-defined learning objectives may be compulsory based on the requirements and conditions of the organization for each job.

- A repository of connected and interoperable work and learning supportive tools: as observed in both design cases, the learners in workplace and educational settings take advantage of several tools to support their work and learning. As described in chapters 2 and 4, mash-up and web services provide interesting technological solutions to bring together different tools and services in one single place. A mash-up is a website or application that combines content or functionality from different sources into an integrated service. Mash-up services along with the sophisticated interfaces of Web 2.0 tools support easy development of the drag-and-drop, semantic, widget-based websites by using AJAX, XML, RSS and CSS (Rahimi et al., 2014a). Chapter 4 describes a mash-up PLE consisting of different web tools which are accessible through widgets. In addition to one-stop-place to access several tools and services, the learners, managers, and teachers in the design cases emphasized the importance of easing their access to these tools and also tracing and analyzing learners' interactions within these tools. Easing learners' access to several web tools necessitates implementing an effective single-sign on (SSO) mechanism to enable learners to take advantage of a single username and password for different web services. As elaborated by Casquero et al. (2010), to implement a SSO mechanism, a bunch of web services and protocols are required including OpenId (a decentralized global identity provider that provides a unique digital identity to simplify the access to different web services by bypassing remembering several usernames and passwords), a SSO system such as simpleSAMLphp (an open source implementation of Web SSO and several federation protocols), and OAuth (a web protocol that provides a secure communication between APIs by exchanging user credentials in a secure way).

Implementing this design principle goes beyond merely providing technological facilities and asks for appropriate organizational support. Meeting this design principle requires a holistic organizational plan for continuously tracing the organization's changes and needs, translating them into new learning goals and refining current learning goals and strategies. Also, this holistic plan should address issues of tools' support, security, connectivity, and consistency. Furthermore, enacting this design principle asks for a comprehensive learning's data plan to identify and retrieve data pertain to learners' working/learning activities in different tools and using this data to provide the learners with more meaningful and contextualized learning choices. A part of this holistic organizational plan is about creating a community of practice (CoP) consisting of the PLE designers, experts (or teachers in formal educational settings) and (the representatives of) learners. This CoP is meant to act as a support community for learners, managers, and PLE designers to facilitate "sustained interaction" (Cochrane, 2014) of the learners and their engagement in constructing the learning environment, translate organizational needs and objectives into motivating learning model, and adapt the learning environment by considering the needs

and preferences of the learners. Ensuring "e-learning readiness" of the CoP's members in addition to learners, according to Hutchins and Hutchison (2008), "should be part of an initial assessment to ensure they have the skills necessary to develop authentic and engaging e-learning experiences". These competencies include applying relevant technologies in designing the e-learning system, using creative processes in developing content, "providing continuous assessment of the organizational technology infrastructure, and considering the development and delivery of e-learning process from a return-on-investment (ROI) perspective" (p. 367).

D2-Providing cognitive choices:
This design principle has resulted from intersecting *Learning Support* and *Learner as Knowledge Developer* core principles. Providing learners with appropriate cognitive choices in line with organizational objectives is essential for developing their cognitive skills and assisting them to acquire relevant knowledge.

The required components to enact this principle include:

- A repository of contextualized content items associated to the defined learning objectives: to address organization- or learner-defined learning objectives and problems and challenges faced by the learners during their daily activities. These content choices might be derived from the organization's CMS (content/course management system) or being developed through a joint cooperation between content experts and learners. For more detail on the specifications of content choices see chapter 5.
- A repository of lower- and higher-order learning strategies to learn and acquire the provided content items. Learning strategies refer to the ways learners process the subject matter (Loyens et al., 2008). For example PowerApp in chapter 5 has provided three different learning strategies to learn the provided content items including reading content items, answering questions about a subject, and playing duel-learning games. As shown in chapter 3, providing a diverse set of lower-order (i.e. searching, reading, tagging, commenting) and higher-order (i.e. problem solving, evaluating, remixing, creating) cognitive strategies is essential to improve the cognitive capabilities of the learners.

In addition to the provided content choices learners might access and use formal content items residing in other tools to support their working and learning process. An organization-wide plan and support to link relevant content items in different tools might increase the applicability, connectedness, meaningfulness, and enrichment of the provided content choices.

D3-Providing social learning choices:
This design principle has resulted from intersecting *Learning Support* and *Learner as Socializer* core principles. In both design cases it has been observed that the learners have a continuous need to connect to the experts and acquire and develop social learning skills such as giving and receiving feedback and support to address their learning objectives and

keep control over their learning process. The required technological components for implementing this design principle include:

- A repository of experts associated to the defined learning objectives: as observed in the unit of analysis 3 addressing a learning objective in a highly contextualized setting such as the workplace in addition to relevant content resources requires appropriate social resources in terms of experts in a specific domain. The repository of experts attaches a group of more knowledgeable people to a learning objective.

A repository of collaborative strategies: a collaborative strategy is an "instructional strategy that encourages interaction between and among two or more learners to maximize their own and each other's learning … the goal is to share different viewpoints and ideas and to collaborate on problem-solving and knowledge building activities" (Dabbagh, 2005, p. 36). In both design cases several sorts of collaborative strategies were introduced including: online group discussion area, collaborative document creating and storytelling, brain storming, finding and exchanging information, observing peers' learning, apprenticing, and expressing faced problems and solutions, and playing duel-learning games.

Enacting this design principle asks for an organization-wide mechanism to continuously identify experts to address a learning objective.

7.3.2 "Forethought" design principles

The following three design principles are meant to stimulate learners to access, translate, and tailor the provided learning choices to their personal learning needs and objectives and prepare them to undertake their roles as decision maker, knowledge developer, and socializer.

D4-Stimulating personal goal setting and planning:

This design principle has resulted from intersecting *Forethought* and *Learner as Decision Maker* core principles. As observed in the design case 2, the learners to be stimulated to access and use the provided learning choices need to find a relation between these learning objectives and their personal learning needs and objectives. According to Brown and Duguid (2000) people learn in response to a (personal) need and when they cannot see the need for what's being taught or delivered, they simply ignore and reject it, or fail to assimilate it in any meaningful way. Conversely, when they have a need, then, if the resources for learning are available, people learn effectively and quickly. The results of the design cases have suggested the following technological specifications and components to enact this design principle:

- Dynamic learner profile: to capture, contain, and update information about the learner-defined, -followed learning objectives and activities, preferences, level of knowledge, learning progress, expertise, preferred cognitive and collaborative strategies, and relevant indexes to measure and show the learner's level of activeness as decision maker, knowledge developer, and socializer. This dynamic profile serves as a filter for the PLE

system to provide the learner with relevant and personalized learning objectives in line with his/her needs and preferences. As a part of the learner's control, the learner has rights to make decision about the visibility level of his/her profile.

- Customizable personal learning activity space: allows the learner to choose and set learning objectives, choose and access to relevant learning or work supporting tools, access to and work with the content choices, and customize different aspects of the PLE. Providing learners with a personal activity space is useful to feel a sense of control and ownership over their learning environment by the learners, as observed in the design case 1.
- Learner-defined learning objectives: beyond the organization-defined learning objectives for each learner (based on the learner's job), due to the high diversity in knowledge level, experiences, and learning needs of learners in the workplace, each learner might have a different set of personal learning objectives associated to his/her work requirements and challenges. Accordingly, stimulating personal learning goal setting/planning asks for allowing learners to define and choose their personal learning objectives and assisting them to trace and measure the achievement of these objectives in a given performance period using relevant indexes. Furthermore, these learner-defined learning objectives might be analyzed to gain insight into the learning needs of the learners and develop appropriate content items to address these objectives.

As remarked by the results of both design cases, the learners in addition to the provision of appropriate technological components need reasonable technical skills as well as enough learning time to be able to utilize the provided learning choices. Accordingly, a key prerequisite for enacting this design principle is to ensure e-learning readiness of the learners including assessing their hardware/software and searching/retrieving data proficiency, willingness toward learning with technology, and having a preference for more learner-centric and self-directed learning (Hutchins & Hutchison, 2008).

D5-Stimulating learner to choose cognitive choices:

This design principle has resulted from intersecting *Forethought* and *Learner as Knowledge Developer* core principles. As observed in the design cases, content learning and knowledge development in the workplace settings is a complex process mainly driven by work challenges and problems. Accordingly, instead of following a one-size-fits-all approach to delivering similar content items to all learners, the learners' personal needs, objectives, and preferences should lead any content delivery mechanism.

The empirical findings from the design cases have suggested the following technological specifications to stimulate learners to access and choose the provided content items:

- Personalized content delivery mechanism: considers learner's profile to provide her with appropriate content items suiting her preferences, needs, objectives, expertise, and knowledge/cognition state.
- Content quality: as observed in both design cases, content quality is an influencing factor for personal learning and competency development and plays a key role in adopting

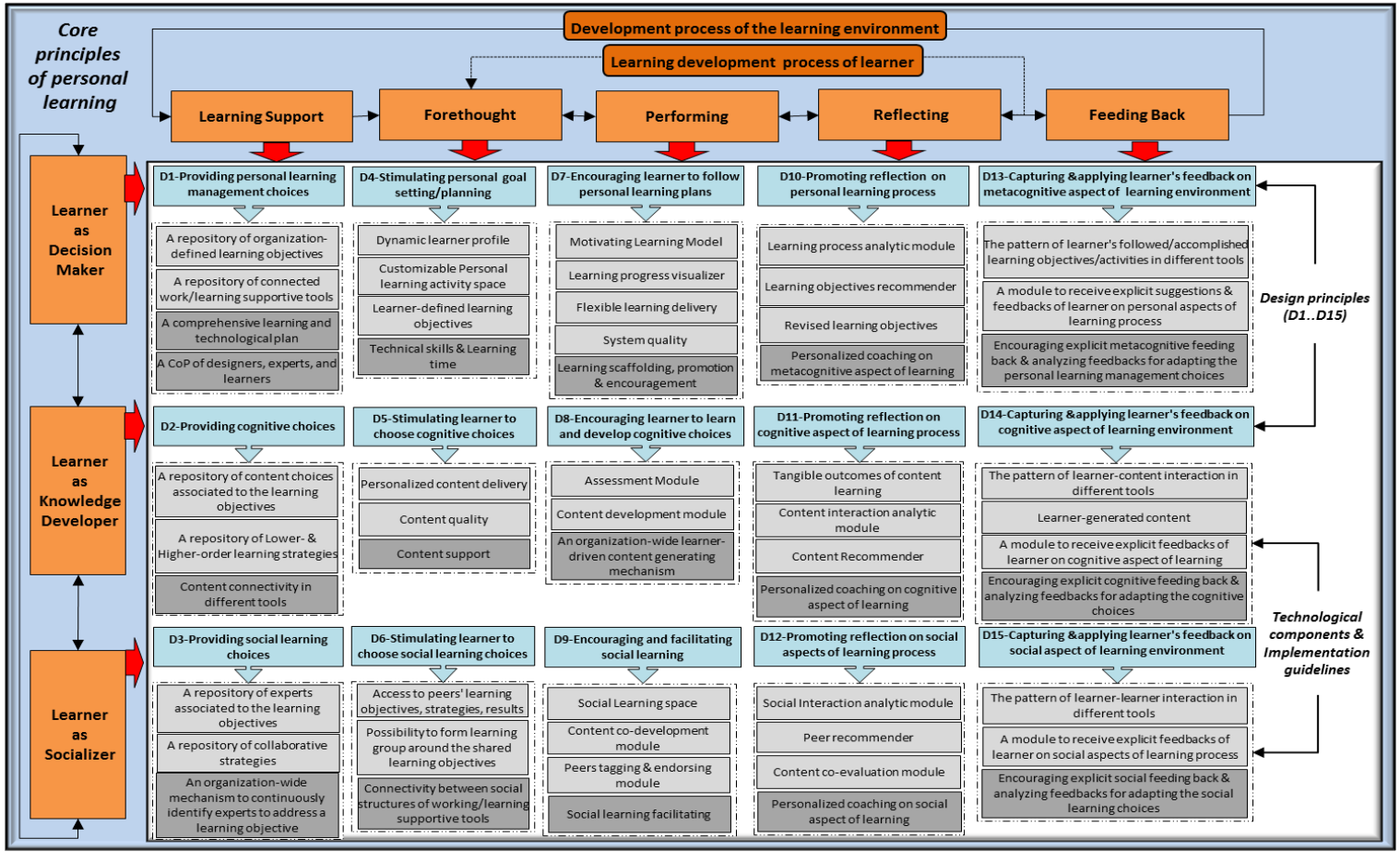


Figure 7.1. The PLE design framework for the workplace

an e-learning system by the learners. Content quality deals with the specifications of appropriate content in terms of relevancy, accuracy, size, applicability, completeness, navigability, understandability, rich format, and remixability.

Stimulating learners to choose content items and tailor them to their personal learning needs goes beyond solely personalized delivering of quality content. Rather, it relies on and asks for continuous support of knowledge experts, coaches, and e-Learning designers to help learners to contextualize and give meaning to the provided content choices and increase their applicability and accuracy.

D6-Stimulating learner to choose social learning choices:
This design principle has resulted from intersecting *Forethought* and *Learner as Socializer* core principles. The results of the design case 2 have revealed the strong influence of peers on motivating learning, regulating and revising one's learning goals and actions. Similarly, according to Littlejohn et al.(2012), in workplace settings learning goals are individually set, with influence from the collective, workplace, or organization and from other people's goals. According to them, "goals may be shared with or related to the goals of other network members. Consequently goals are likely to be emergent rather than predefined" (p. 2).

These findings call for developing appropriate social mechanisms that allow the learner to take advantage of the provided social choices to plan and regulate her learning process. Such mechanisms should support the following functionalities:

- Matching relevant learning peers by considering their needs, objectives, and expertise and allowing peers to access and observe learning goals, expertise, and strategies of each other through their profiles
- Possibility to form learning group consisting of relevant learning peers around shared learning objectives.

Learners may use other social networking platforms to support their work/learning activities. The social structure and interactions in these platforms are mainly shaped around work procedures and requirements (i.e. Yammer in the design case 2). Our observations from the design case 2 state that there is a big overlap between working and learning peers in the workplace. This finding suggests to use the social structures of work supporting tools (i.e. Yammer in the design case 2) to inform the design of the social structure of the workplace PLE.

7.3.3 "Performing" design principles

The following design principles aim at encouraging learners' active involvement and deep learning around the provided learning choices in line with their roles as decision maker, knowledge developer, and socializer.

D7-Encouraging learner to follow their personal learning goals/plans:

This design principle has resulted from intersecting *Performing* and *Learner as Decision Maker* core principles. This design principle seeks to encourage the learner to take advantage of the provided learning choices to carry out his/her learning plan and monitor and manage his/her learning progress. The empirical results from the design cases have suggested the following technological components to implement this design principle:

- A motivating learning model: to systematically organize learning experiences to achieve the learning objectives using provided learning choices. Rooted in the principles of interest-driven learning, implementing inspiring and motivating learning model can attract the attention of the learners and encourage them to use the e-Learning system.
- Flexible learning delivery: to allow the learners learn anywhere, anytime, and with their personal devices and control the sequence and pace of their learning.
- Learning progress visualizer: as described in chapter 6, the learning visualizer mechanism implemented by PowerApp had been perceived influential in triggering the learners to update their insurance knowledge in a daily basis. Accordingly, the learning progress visualizer of the PLE is meant to show the learning progress of the learner in a specific learning objective dynamically and trigger a continuous learning and competency development.
- E-learning system quality: deals with the technical and design characteristics of the e-Learning system that increase its adoption by learners including usability, effective notification mechanism, reliability, accessibility, response time, ease of use, and aesthetic aspects including look and feel and interface design. To emphasize the high influence of the e-Learning system's quality on its adoption by the learners, Ardito et al. (2006) remarked that "we often find that an e-learning application is a mere electronic transposition of traditional material, presented through rigid interaction schemes and awkward interfaces. When learners complain about web-based training or express a preferences for classroom-based instruction, it's often not the training, but rather the confusing menus, unclear buttons, or illogical links that scare them off" (p. 271). Along similar lines, Hutchins and Hutchison (2008) argue that the success of any e-learning system can be predicted by its system quality and usability features including seamless access, relevant and accurate content, and an engaging and motivating learning experience.

In addition to these technological components, encouraging learners to actively adopt and use the e-Learning system calls for providing appropriate level of scaffolding, promotion and organizational support and encouragement.

D8-Encouraging learner to learn and develop content choices:
This design principle has resulted from intersecting *Performing* and *Learner as Knowledge Developer* core principles. This design principle serves to address two requirements: (*i*) encouraging the learner to learn and acquire systematic and formal knowledge informed by the organization's learning objectives through practicing the provided lower- and higher-order cognitive strategies, and (*ii*) encouraging the learner to develop new content choices or enrich and contextualize the current content choices through commenting, tagging,

evaluating, remixing, and creating. The following technological specifications and components have been designated to implement this design principle:

- Assessment module: to evaluate and assess the accuracy of learner's formal knowledge.

The assessment module can be implemented as automated quizzes to be answered by the learners. For more detail about this module please see PowerApp description in the previous chapter.

- Content development module: to allow the learner to create new content item and idea from scratch or enrich and improve current content choices through articulating, bricolaging, contextualizing, rating and remixing. The content item developed by the learners might include a fact, and idea, an experience, a faced challenge or problem, or a solution for a faced problem by the learners. According to Bereiter and Scardamalia (2014) any support for leaner-driven knowledge development process should address two learning requirements: first, it should keep agency in the hands of learners instead of the system. Secondly, it should overcome the "danger of loss of continuity" resulted from scattered and loosely connected knowledge-building discourses across different learning tools such as wikis, blogs, and social networking services "while allowing learners to follow their knowledge building discourses in these tools" (p. 43). To address these requirements Bereiter and Scardamalia (2014) have suggested different technological requirements including: providing "user-selected epistemic markers" to support theory building and other forms of idea-centered discourse, utilizing network and semantic analysis technologies to provide meaningful feedback to people participating in knowledge building process, supporting interaction between learner-learner and learner-ideas, and facilitating self-organization at social and conceptual levels, and receiving inputs from a wide range of tools and combining them into a coherent discourse.

Another functionality needs to be supported by the content development module is the articulation of knowledge by the learners. According to Dabbagh (2005), as learners "articulate their knowledge to one another, they share multiple perspectives and generalize their understanding and knowledge so that it is applicable in different contexts" (p. 35). Folksonomy is another required functionality for the content development module. Folksonomies are user-generated taxonomies, which are dynamic and socially or collaboratively constructed, in contrast to established, hierarchical taxonomies that are typically created by experts in a discipline or domain of study. As pointed out by Dabbagh & Rick (2011), folksonomy as a context-based mechanism for supporting social tagging and sharing the personal experiences of people can be seen as the "language of a community to form connections" between the members of the community, support "socio-semantic networking" and create learning environment through tagging, annotating and sharing learning resources and experiences.

Encouraging and facilitating learner-driven content development requires an organization-wide encouraging mechanism based on different techniques such as badging and reputation.

This design principle has resulted from intersecting *Performing* and *Learner as Socializer* core principles. This design principle aims at encouraging and facilitating social learning and communication around content items, faced problems, solutions, experiences, and ideas. The following technological components were designated to address this design principle:

- Content co-development module: the content co-development module aims to encourage and facilitate social learning discourse and communication around content as essential activities in developing and maturing organizational knowledge (Scardamalia & Bereiter, 2014). To this end, the content co-development module receives the content items developed and shared by individual learners in the content development module as input and asks the peers to develop and enrich these content items by editing, annotating, criticizing, tagging, rating, contextualizing, and sharing them. From the theoretical perspective, the co-development module is underpinned by the concept of boundary objects associated with Vygotsky useful for nurturing socially mediated learning discourses and communities of practices (Attwell, 2010b). According to Denham (2003, as cited in Attwell (2010b)), "Boundary objects are not necessarily physical artefacts such as a map between two people: they can be a set of information, conversations, interests, rules, plans, contracts, or even persons" (p. 4). According to Leigh Star and R. Griesemer (1989) "Boundary objects are objects which are both plastic enough to adapt to local needs and constraints of the several parties employing them, yet robust enough to maintain a common identity across sites. They are weakly structured in common use, and become strongly structured in individual-site use. They may be abstract or concrete. They have different meanings in different social worlds but their structure is common enough to more than one world to make them recognizable means of translation. The creation and management of boundary objects is key in developing and maintaining coherence across intersecting social worlds" (p. 393). Accordingly, the boundary objects can be envisioned as a place for shared work and a "point of mediation and negotiation around intent and content (Denham, 2003).

Inspired by these descriptions, content items can be considered as boundary objects meant to facilitate social learning discourse and communication around a meaning (such as a fact, problem, idea, solution, challenge) embedded in the content.

- Social learning space: as observed in both design cases, the shared social space triggers the co-regulation of the learning process of the learners by exposing them with their peers' learning objectives and actions. Inspired by these observations, the social learning space aims to allow the learners to observe their peers learning activities and share and communicate around their learning activities, experiences, and progress. Furthermore, the social learning space is meant to foster and nurture a shared sense of ownership among the learners by benefiting from the value of "operational proximity" or the sharing of day-to-day activity and space (Whitworth, 2009). From this perspective, the social space can be envisioned as a means to influence the decision maker role of the learners through their socializer role.

- Peers' tagging and endorsement module: as emphasized by the participants in the second design case, recognizing and valuing learners' expertise and knowledge by their managers, peers, and customers might motivate the learners to keep improving their knowledge and expertise. To this end, this module aims at allowing learners to endorse, value and motivate their peers by recognizing their expertise using appropriate tags and badges. These peer-recognized expertise and endorsements then can be shown in the learners' profiles. Furthermore, the results of this module can be used as an input for the repository of experts explained in the design principle D3.

The results of the design cases have shown that triggering and sustaining effective technology-based social learning mechanisms goes far beyond solely technological provisions and asks for active involvement and facilitation of team managers and coaches.

7.3.4 "Reflecting" design principles

Promoting reflective thinking involves providing learners with opportunities and asking them to review and examine what they have done, analyse their performance and compare it to that of experts and peers (Collins, 1991). The outcomes of "reflecting" design principles serve supporting two developmental processes shown in figure 7.1 include : (*i*) the learner's personal development process by informing the "Forethought" design principles through providing revised learning objectives, content, and social interactions of learners, and (*ii*) the bottom-up and learner-driven shaping and adaptation of the learning environment by informing the "Feeding Back" design principles through providing insight into the learners' learning behaviours, preferences, and needs. The designers/developers of the PLE can use these insights to adapt the PLE and revise and reseed the provided learning choices.

Our observations of the design cases have led us to place *learner analytic module* as the key technological component to support "reflecting" design principles. The learner analytic module is meant to meet the learner-centred objectives of the PLE and facilitate assessment for learning through realizing the learning preferences and orientations of learners and making their learning visible. To this end, this module monitors and keeps track of every learning activity the learners performs in their personal or social learning spaces and renders visible the complex pattern of their personal and social learning experiences. The learner analytic module provides separate but interconnected analytic functions or sub-modules including learning process analytic module (meant to monitor and analyse learners' interactions with different learning objectives, tools and services), content interaction analytic module (meant to monitor and analyse learners' interactions with content items), and social interaction analytic module (meant to monitor and analyse interpersonal relationships between learners) associated with the learner as decision maker, knowledge developer, and socializer roles, respectively. The following design principles aim at promoting learners' reflection and critical thinking on their performance as decision maker, knowledge developer, and socializer.

D10-Promoting reflection on personal learning process:
This design principle has resulted from intersecting *Reflecting* and *Learner as Decision Maker* core principles. Promoting learner's reflection on personal learning process involves asking the learner to review what and how s/he has learned including the defined/achieved learning objectives and the pattern of personal learning process (i.e. learning time pattern and used tools for different learning purposes). To enact this design principle the following technological components and organizational support have been designated:

- Learning process analytic module: to monitor, keep track and analyze their learning performance associated to their learning objectives as well as their learning experiences in different work/learning supportive tools. Our observations have asserted that learners access and use different tools to meet different learning purposes and objectives, and learners' behaviors in each tool form and reveal a part of their personal learning and competency development. Therefore monitoring, recording, and analyzing learners' interactions within different tools provide valuable insight into different aspects of their working as well as learning process including their access pattern and tendency to each tool. These results are stored in the learner's dynamic profile and can be seen by the learner, his/her managers (or teachers) and allowed peers.
- Learning objectives recommender: suggests a set of appropriate learning objectives to the learner taking into account the outcomes of the learning process analytic module, the assessment module, the content interaction analytic module, and the organizational- and learner-defined learning objectives. Also, the learning objective recommender module might receive inputs in terms of suggested learning objectives from the relevant people who have appropriate insight on the learning needs of the learner (i.e. team managers in the design case 2 who are aware of the knowledge gap of their team members).
- Revised learning objectives: refer to the regulated/redefined learning objectives by the learner. These revised learning objectives are placed in the learner's profile for continuing and directing the personal learning process in the next performance period. As observed in design case 2, the process of regulating and revising personal learning objectives in the workplace settings is mainly influenced by three sources: (*i*) the working requirement and faced challenges by the learner, (*ii*) the personal endeavours of the learner in accessing the content choices and exploring the organizational knowledge resources, and (*iii*) the socialization process. While the first source informs this learning objectives' revision process through the "learning objectives recommender" module, the learner's performance as the knowledge developer and socializer provides the second and third inputs, respectively, to this revising process.

Managers/coaches play an essential role in promoting reflection on personal learning process among the learners, and to be effective, the outcomes of these technological components should be supported by the managers/coaches. The managers or coaches might take advantage of these outcomes to realize the learning pattern of each learner and provide him/her with personalized coaching and guidelines such as revising learning objectives,

providing more learning time, and introducing relevant learning tools or strategies. Furthermore, enacting this design principle asks for taking an expansive rather than restrictive approach and providing learning supports including scheduled time for reflection on learning objectives, process and outcomes, and supporting workers' "status as learners" (Tynjälä & Häkkinen, 2005, p. 325).

D11-Promoting reflection on cognitive aspect of learning process:
This design principle has resulted from intersecting *Reflecting* and *Learner as Knowledge Developer* core principles. Promoting learner's reflection on cognitive aspects of learning process involves asking the learner to critically reflect on own knowledge level and review what content s/he has learned and what cognitive skills s/he has practiced and acquired. To enact this design principle we designated the following technological components and organizational support:

- Tangible outcomes of content learning: refer to the outcomes of the assessment module and provide indexes representing the learner's knowledge level in a specific subject. These indexes can be used to promote critical reflection on one's knowledge level and trigger personal learning development through revealing personal lack of knowledge and regulating learning objectives and strategies accordingly.
- Content interaction analytic module: monitors, keeps track, and analyses the learner's interactions with the provided content choices within the PLE. The learners may access and use the content items in other work/learning supportive tools. Due to the importance of these tools in addressing the working requirements as well as developing cognitive skills of learners through informal learning processes, the content interaction analytic module should trace and analyze the learners' activities in these tools to generate a holistic pattern of learner-content interactions. This holistic pattern helps the designers of the PLE and managers to realize the emerged learning behaviours and cognitive needs of the learners and reconfigure and reseed the PLE accordingly. For example, as detailed in design case 2, realizing the personal search pattern in Brein was emphasized by the interviewed managers as a key factor to gain insight on the day-to-day working/learning needs and challenges of the learners which is highly required by the content designer to develop contextualized and relevance content.

Based on the cognitive strategies defined by "Learning support" design principles, the learners may use the provided content choices to practice lower- or higher-order cognitive skills. The content interaction analytic module creates a pattern of cognitive skills practiced by each learner by tracing, analyzing and visualizing different sorts of learner's cognitive activities including: learner's access to content choices and learner's individual/social cognitive activities in content generating/co-development modules. This insight into personal cognitive needs, skills and habits provides several implications for personal development, personalized coaching, and content recommending.

- Content Recommender which takes advantage of the outcomes of the content interaction analytic, assessment, and revised learning objectives modules to recommend appropriate content choices to the learner.

The managers and coaches might take advantage of the assessment and content analytic modules to give learners personalized coaching on cognitive aspect of their learning including introducing complementary content resources and personal development workshops for improving and practicing higher-order cognitive skills.

D12-Promoting reflection on social aspect of learning process:
This design principle has resulted from intersecting *Reflecting* and *Learner as Socializer* core principles.
Promoting learner's reflection on social aspects of learning process involves asking the learner to review with whom s/he has learned, the joint learning activities, content co-development, shared learning objectives, peers' endorsements the pattern of social interactions, and what social skills s/he has learned. To this end, this design principle asks the learner to examine own personal learning network and its resulted social interactions as important elements in enriching personalizing learning. Furthermore, considering the influence of peers and socialization process on the regulation of one's learning objectives, this design principle aims at providing the learner with opportunities to benefit from peers' learning objectives and progress to revise and regulate his/her learning objectives and actions.
To enact this design principle we designated the following technological components and organizational supports:

- Social interaction analytic module: monitors, keeps trace and analyzes the social interactions of learners within the PLE and other work/learning supportive tools and provides a picture of learners' personal learning networks and their social interactions. This picture might serve to address several learning purposes: first, it triggers learners' reflection on the social aspect of their learning by observing their own personal learning networks and comparing it with the which of their peers. Secondly, it assists the managers and designers of PLE to recognize "isolated" learners or communities as the first step to address "isolation", "parochialism", and "cognitive separation" issues suffering communities of practice (CoPs), as observed and detailed in the design case 2. Furthermore, getting a holistic picture of social interaction between learners and their communities might help the managers and PLE designers to find opportunities to spread new idea, content, or innovation within and among communities by recognizing two influential members of CoPs namely strong ties (i.e. learners who are at the centre of a community or network with strong connections with the members of the community), and weak ties (i.e. learners at the edge of a community or network). As recognized by Granovetter (1973) and Whitworth (2009), "strong ties" play a key role in spreading things such as ideas, content, innovations, and diseases within a community or network, while "weak ties" are most helpful in spreading things through communities or networks. From a learning perspective, as asserted

by Whitworth (2009), "if a community is isolated and parochial, something might spread virally between members with great ease, via their strong ties, but it will have few opportunities to leave that community. However, weak ties that connect communities can cause the idea, or disease, to leap across boundaries into different communities. Weak ties are therefore more important than strong ties in spreading learning between different contexts, which have a tendency to be cognitively separate" (p. 36).

- Peer recommender: takes advantage of the outcomes of the learning process, content and social interaction analytic modules in addition to assessment module to identify and introduce like-minded peers (i.e. peers with similar learning objectives, needs, and interaction patterns) or supplementary peers (i.e. peers mastered in those expertise and objectives required by the learner or appropriate weak ties to bridge different communities) to the learner. Access to the learning profile of these peers and observe their learning objectives and outcomes, expertise, and social interaction pattern might trigger learners' reflection and foster their personal development process.
- Content co-evaluation module: allows learners to participate in a joint evaluation of the provided content choices or learner-generated content items resulted from the content development and content co-development modules. Joint evaluation of content involves different learning activities including evaluating and rating the accuracy of content, contextualizing content by examining its applicability within different contexts and giving meaning to it, discussing, debating, negotiating and defending content. Implementing this module asks for defining and promoting an organization-wide content evaluation mechanism.

The managers and coaches might take advantage of the outcomes of the social interaction analytic module to give learners personalized coaching on social aspect of their learning including teaming up learners with supplementing expertise and knowledge and running appropriate professional development program to help the learners to acquire or improve their lacked social learning competencies.

7.3.5 "Feeding Back" design principles

Capturing and applying learner-generated feedbacks on different aspects of the learning process is essential to facilitate bottom-up development and evolution of the learning environment. The learner-generated feedbacks include implicit feedbacks (i.e. the pattern of learning behaviours, progress, preferences, needs, objectives, content, and social interactions) captured using different modules of the PLE system, and explicit feedbacks (i.e. learner-generated content, ideas, suggestions, and faced problems and challenges by the learners) provided by the learners. The designers and developers of the PLE might use these feedbacks to adapt, revise and reseed the learning environment and the provided learning choices. This approach to evolving and adapting the learning environment conceptualizes the development of the learning environment as a shared responsibility of the learners and designers and envisions the learning environment as a dynamic output of

the personal learning and development of the learners. The following design principles aim at capturing learner-generated feedbacks and applying them to the learning environment.

D13-Capturing and applying learner's feedback on the metacognitive aspect of the learning environment:

This design principle has resulted from intersecting *Feeding Back* and *Learner as Decision Maker* core principles. This design principle aims to capture the outcome of the learner's performance as decision maker and utilize it to adapt and evolve the personal learning management aspects of the learning environment. To enact this design principle we designated the following technological components and organizational support and guidelines:

- The pattern of learner's followed/accomplished learning objectives/activities in different tools: resulted from the learning process analytic module. Analyzing the outcomes of the learning process analytic module, in addition to serving to trigger backward learners' reflection on their personal learning process, might be useful for the designers of the PLE to adapt and reseed the PLE by realizing learners' preferences and needs in terms of learning technologies and objectives. The need for this sort of learner-driven adaptation of the learning environment has been remarked by teachers (in case 1) and managers (in case 3).
- A module to receive explicit suggestions and feedbacks of learner on personal aspects of the learning process including learner-defined learning objectives and the discovered learning potential of different working/learning supportive tools. A sample of this module has been presented in chapter 4.

Enacting this design principle asks for defining appropriate incentives to encourage learners to express their explicit feedbacks on the metacognitive aspects of the learning environment. It also requires active involvement of the PLE's CoP consisting of the PLE designers, experts, and (the representatives of) learners to analyze these feedbacks and adapt and reseed the personal learning management choices accordingly.

D14-Capturing and applying learner's feedback on the cognitive aspect of the learning environment:

This design principle has resulted from intersecting *Feeding Back* and *Learner as Knowledge Developer* core principles. This design principle aims at capturing the outcome of the learner's performance as knowledge developer as a means to adapt and evolve the cognitive and content aspects of the learning environment. To this end, the following technological components and organizational support have been designated:

- The pattern of learner-content interaction in different tools: resulted from the content interaction analytic and assessment modules. Analyzing this pattern can provide insight into learners' cognitive needs and preferences and assist the designers of the PLE to adapt and reseed the provided cognitive choices.
- Learner-generated content: the pedagogically sound learning content resulted from the content development, co-development, co-evaluation modules.

- A module to receive explicit feedbacks and suggestions of learners on the provided cognitive choices.

In the same way as the previous design principle, enacting this design principle asks for defining appropriate promotional mechanisms to encourage learners to generate and evaluate content and express their explicit feedbacks on cognitive aspects of the learning environment. Among other factors, these mechanisms need to clearly define, recognize and address the ownership and intellectual rights of the learner-generated content. After the learners' feedbacks on cognitive aspects of the learning process have been captured, these feedbacks should be analyzed by the PLE's CoP to provide appropriate output for adapting and reseeding the provided cognitive choices.

D15-Capturing &applying learner's feedback on social aspect of the learning environment: This design principle has resulted from intersecting *Feeding Back* and *Learner as Socializer* core principles. This design principle aims at capturing the outcome of the learner's endeavours as socializer to adapt and evolve the social aspect of the learning environment. The following technological components and organizational support have been designated to enact this design principle:

- The pattern of learner-learner interaction in different tools: resulted from the social interaction analytic module. As described earlier, in addition to promoting learner's reflection on social aspects of their learning, analyzing this pattern provides several means useful for adapting the social learning structure and reseeding the social learning choices including recognizing isolated learners and communities, determining strong and weak ties within each community, and identifying like-minded and supplementary peers.
- A module to receive explicit feedbacks of learner on social aspects of learning process.

In the same way as the previous design principles, enacting this design principle asks for defining appropriate promotional mechanisms to encourage learners to evaluate the social aspects of the learning process. These feedbacks then would be analyzed by the PLE's CoP to provide appropriate output for adapting and reseeding the social structure of the learning environment.

Conclusions

In this chapter the theoretical and empirical insights on personal learning and competency development derived from the previous chapters have been synthesized to develop a PLE design framework for workplace settings. The developed PLE design framework encompasses eight core principles, fifteen design principles, and a set of technological components and implementation guidelines associated to each design principle. The developed PLE design framework provides the following functionalities to address the personal learning and competency development in the workplace:

- Facilitating the establishment of a conception of learning among the learners that defines learning as creating rather than consuming knowledge,

- Empowering learners to gain control on their learning process by defining and facilitating the learner's roles as decision maker, knowledge developer, and socializer,
- Promoting a co-regulating learning approach to personal learning and competency development consisting of forethought, performing, and reflecting phases,
- Linking the organizational learning and personal development of the learners by defining continual development of the learning environment as a shared responsibility of learners and organization
- Facilitating bottom-up development and evolution of the learning environment through capturing learner-defined/developed learning objectives and strategies (the outcome of the learner as decision maker role) , content (the outcome of the learner as knowledge developer role), and social learning asset (the outcome of the learner as socializer role).
- Bringing closer together formalization and contextualized and ad-hoc learning by seeding the learning environment with organization-provided formal and evaluated content and allowing and encouraging learner to transfer the provided content into action and generate enriched and contextualized content to be used by other learners,
- Supporting flexible learning for the learners by providing a personal activity space, defining and following personal as well as organizational learnings objectives, allowing to work with different interconnected learning tools
- Defining and facilitating a learning content maturing process (Maier & Schmidt, 2007) consisting of four phases: (i) providing formal learning content by the organization, (ii) allowing learners to develop, contextualize and enrich the content using the content development module, (iii) co-constructing content through sharing and comparing of individually-developed content, discovering any possible inconsistency in the content, and negotiating the meaning and co-construction of content through social negotiation (Gunawardena et al., 1997) using the content co-development module, (iv) evaluating, testing and modification of the co-constructed content using the content co-evaluation mechanism, and (v) creating pedagogically sound formal learning content to seed the learning environment.
- Supporting summative as well as formative assessment using the assessment and learning analytic modules respectively.

8 Contributions of this Research and Recommendations for Further Research

This chapter begins with an elaboration on the contributions and implications of our research. It continuous by enumerating the limitations of the research. Finally, the chapter concludes this research by offering recommendations and future directions for this research.

8.1 Research Contributions and Implications

We conducted a design-based research (DBR) to develop the PLE design framework. As detailed in the first chapter, a DBR should provide at least three sorts of contributions, being: (*i*) practical contributions or situational design knowledge in terms of ideas, suggestions and directions for optimizing the quality of the educational intervention to be developed within the design context, (ii) theoretical contributions or abstracted design knowledge in terms of articulated and tested 'substantive' and 'procedural' design principles to provide theoretical contributions, and (iii) methodological contributions in terms of guidelines and suggestions to improve conducting future design-based studies (Van den Akker, 1999; Goldkuhl & Lind, 2010; Reeves et al., 2005). In this sense this research has provided the following contributions.

8.1.1 Practical Contributions

Our research has provided three sorts of practical contributions and implications as follows:

First, our research has produced different sorts of situational design knowledge which are beneficial for the stakeholders in the design contexts. The Amadeus Lyceum secondary school (the first design case) might utilize the produced situational design knowledge manifested in the specifications of the personal learning process of its students, the PLE prototype and the initial PLE design framework described in chapters 3 and 4 to enrich its teaching and learning processes and improve the pedagogical and technological competencies of its teachers and students. Also, the research has resulted in situational design knowledge in the second design case in terms of the identified factors affecting personal learning and competency development of the call agents as well as improvement suggestions for PowerApp. This situational design knowledge might be beneficial for the Achmea Company to improve their learning and competency development initiatives.

Furthermore, participating in this research stimulated professional development of the participants in these design cases through involving them in different phases of a participatory design/research process including identification and elaboration of a local problem, participating in implementing the proposed solution, involving in the evaluation of the solution, and adjusting the solution.

Secondly, the PLE design framework provides practical implications for e-learning designers. Indeed, the PLE design framework might be used as a theoretical and practical roadmap by e-learning designers including IT, learning, instructional, and content designers and professionals to design, develop and evaluate technology-based learning interventions for both educational and workplace settings. On one hand, grounded in theoretical constructs, this design framework increases the e-learning designers' reflexive "awareness of the theoretical basis underlying the design" (Bednar et al., 1992) by assisting them to understand the utility, synthesize across, and recognize important distinctions among various theoretical approaches and perspectives. On the other hand, grounded in empirical observations and situational knowledge, the design framework provides the designers with relevant learning design paths and instructional prescriptions to conduct the design process of a workplace personal learning environment. In the workplace using this design framework allows developing learning environment that link personal development of learners and organizational learning and development. In the formal education, teachers and instructional designers might use this framework as a roadmap to design appropriate learning scenarios and activities and choose relevant web technologies and integrate them into the educational practices as a means to trigger and enhance students' engagement, reflective thinking and activeness in the educational practices. Furthermore, the PLE design framework might be used as a rubric to evaluate and analyse the quality of e-learning strategies and systems in addressing personal learning and competency development requirements of learners.

Thirdly, given the different contexts of conducted design cases, the results of this research can support cross-fertilization of formal education and workplace learning. On one hand, the formal education can benefits from the insights into the workplace learning as the workplace sets and defines the learning requirements for formal education. In this sense, as explored in the second design case, the nature of learning in the workplace is highly informal driven by the work's dynamics, issues, and challenges. Employees learn by doing, working, socializing, plunging in daily activities, and facing with and solving realistic and authentic challenges and problems, rather than mere studying or working on non-realistic problems. Also, it has been observed that, unlike the fragmented nature of courses in formal education, learning in the workplace is a multi-faceted and multidisciplinary process involving learners in problem finding, recognizing, analysing and solving activities. In contrast, generally speaking, in formal education students are not involved in exploring, finding, and recognizing real world problems. Rather than, as put by Jenkins (2009), our educational system at its best trains students to become individual "problem-solvers". Comparing the learning processes of workplace and formal education from this perspective provides valuable implications for designing e-learning systems for formal education that facilitate the active and collaborative involvement and reflection of students around recognizing, exploring, and solving real world problems.

On the other hand, the workplace can benefit from the planned and structured learning mechanisms of formal education to supplement its informal learning processes. As shown by the results of this study, both informal and formal learning are important elements of learning at workplace although they entail different process and different outcomes. As remarked by Slotte et al. (2004) and shown by our research, there are two reasons explaining why informal learning alone is not enough in the workplace: First, informal learning mainly takes place "without conscious effort" and yields tacit knowledge which may result in outcomes that are not desirable (for instance bad habits and dysfunctional practices that do not necessarily serve the goals of the organization). Second, in today's organizations new knowledge is being produced rapidly so that informal learning alone cannot ensure that the produced knowledge is captured by the organization. Given its planned and structured educational scenarios and assessment mechanisms, formal education provides means to exploit the workplace's informal learning effectively, turn tacit knowledge into explicit knowledge, and integrate and combine conceptual knowledge and practical experience. Further, the workplace might benefit from the experiences and insights from the currently booming educational initiatives such as MOOCs (massive open online courses), educational data mining and learning analytics mainly originated in formal education to scale up its technology-based personal learning and competency development efforts.

8.1.2 Theoretical Contributions

Given its multidisciplinary nature, our research has provided theoretical contributions for both information systems and learning/education domains as follows:

First, as defined in the first chapter, the PLE design framework represents an IT artefact. Gregor (2006) has classified five sorts of theories related to information systems: (i) theory for analysing, (ii) theory for explaining, (iii) theory for predicting, (iv) theory for explaining and predicting, and (v) theory for design and action. Design theories prescribe how to do something by providing explicit prescriptions such as methods, techniques, principles of form and function, guidelines, theorized practical knowledge, and justificatory theoretical knowledge for designing and developing an artefact and providing knowledge support for designers (Goldkuhl & Lind, 2010; Gregor, 2006). In this sense, the abstracted design knowledge manifested in the key elements of the PLE design framework represents a design theory developed through theoretical, empirical, and internal grounding processes. This design theory prescribes how to design and develop a class of IT artefacts (i.e. personal learning environments) within the workplace by giving explicit prescriptions in terms of core principles, design principles, technological components and implementation guidelines and leaping from theory to practice.

Secondly, in this research we developed the learner's control model, see chapter 2, as the essence of personal agency and corner stone of the PLE concept. This model can be seen as a theory-based roadmap to operationalize learner's control and personal agency using technology. As described earlier, the learner's control model defines three roles for the

learners, namely, 'decision maker', 'knowledge developer', and 'socializer'. Then, the PLE design framework translates the learner's control and personal agency notions into a process learners go through when regulating and organizing their learning consisting of 'forethought', 'performing', 'reflecting' and 'feeding back' phases using the provided 'learning support'.

From this perspective, the PLE design framework can be seen as a means to develop and extend self-organized learning environments (SOLE) proposed by Mitra and Dangwal (2010). According to the SOLE concept, to support and facilitate self-organizing learning some requirements should be addressed including: providing appropriate learning choices, minimizing teacher's intervention and replacing teaching with encouraging, facilitating collaboration, designing learning material that can excite learners' curiosity. These requirements are well-addressed by the PLE design framework.

The third theoretical contribution of this research is about adjusting and extending the self-regulating model (Zimmerman, 1989), which is used as the main theoretical framework for developing learner-centric e-learning initiatives in formal education as well as the workplace. Based on the self-regulated learning model learners go through a sequential and linear process consisting of three phases of forethought, performing, and self-reflecting to regulate their learning and achieve control over it. The results of our research, however, have shown that in addition to these phases a feeding back phase is required to capture the learner-generated implicit and explicit feedbacks as the learner's footprint and voice and utilize them to adapt the learning environment. Furthermore, as discussed in chapter 5, the workplace unlike formal education resembles a moving and dynamic curriculum making personal learning a non-linear, non-routine, complex and social process where learning objectives emerge rather than just being defined by the learner. This finding calls for adapting the self-regulated learning model to consider co-regulation, or the influence of the social context in defining and following personal learning strategies, as a complementary aspect for the self-regulating model. Accordingly, the PLE design framework defines the learning regulation as a social process triggered by learner's role as worker, decision maker, knowledge developer, and socializer. Furthermore, from the perspective of the PLE design framework, the main learning material of a learning environment include learning objectives, tools, and strategies (related to the decision maker role), learning content (related to the knowledge developer role), and social asset (related to the socializer role). These materials are initially provided by the organization ('learning support' core principle) in terms of learning choices and matured and adapted through the personal learning process of learners. Given the heterogonous learning needs and requirements of the learners in the workplace a fixed and linear curricula is an inappropriate option to deliver learning. Instead, we agree with Hase (2009) who states the curriculum should be open to change and being negotiable with the learner, provides a minimum level of structure (i.e. mandatory content and competencies). This kind of curriculum then can support the complex, occasioned, and emergent nature of the learning process in the workplace.

8.1.3 Methodological Contributions

Our research has provided the following methodological contributions for improving design-based research:

First, while conducting a single design case is a common scenario in the majority of design studies (Goldkuhl & Lind, 2010; Van den Akker, 1999), in our research we followed a research strategy comprised of multi-design cases, -units of analysis in two different contexts. From this perspective, this research provides insights on the different methodological aspects of multi-design case studies including choosing design cases, choosing appropriate units of analysis, how to compare and analyse the conducted design cases, and how to produce abstracted design knowledge based on the results of the design cases. Secondly, as explained in chapter 1, based on the role and chronological involvement of the researcher in the development, research, and evaluation phases of a DBR, there are two types of DBR: type I and type II. According to Van den Akker (1999), in a DBR of type I the researcher is actively involved in the whole phases of development and evaluation processes (i.e. the first design case in our research). In a DBR of type II the researcher is only involved in the research/evaluation phases (i.e. the second design case in our research). Given this combination of different types of design cases in our research, the strategy of our research has provided appropriate examples and insights for the future multi-case heterogeneous DBR endeavours.

The second methodological contribution of our research relates to the integration of different concepts and models of design study in IS and education fields in order to outline the research strategy, illustrated in figure 1.2 in chapter 1. In other words, our research strategy had two pillars: (i) theoretical, empirical, and internal grounding processes adopted from Goldkuhl and Lind (2010) (from the IS domain) and, (ii) design-based research methodology adopted from Reeves et al., (2005) and Van den Akker (1999) (education domain) consisting of four phases: finding a local problem, formulating a theory-based solution to address the problem, implementing and testing the solution, and producing design principles. Furthermore, this research strategy focused on capturing and reconciling both learner's and organization's view on the requirements of personal learning. This research strategy allowed us to outline a systematic and traceable way for leaping from theory to practice and producing robust and relevant design knowledge and principles as the main outcomes of a DBR.

8.2 Limitations of the Research

Apart from the time and cost constraints, there are at least four areas of limitations in our research that require more attention and highlight further research directions.

The first limitation of our research pertains to the results derived from the first design case. As described in chapter 3, a group of students in a geography course had participated in the

resaerch to realize their views on the requirements of personal learning. The main emphasis of the teacher in this class was on enhancing students' engagement in constructing the learning environment and improving their learning process rather than transferring content. Courses that are highly content-based such as mathematics and physics ask for more teacher's control rather than student's control and accordingly the level and pattern of students' engagement in constructing the learning environment might be different from what we have derived in this research.

The second limitation in the first design case is related to the technological facilities and structures provided for the participating students. As explained in chapter 3, in the context of the first design case the students were provided with personal laptops and broadband Internet access. During the research time the access of the participating students to the required hardware, software, and web services had been extended. These enhanced technological possibilities might not be feasible for every school and, as a result, might limit the implication of our research's results for secondary schools.

The third limitation of our research stems from the characteristics of qualitative research and data. Developing a PLE design framework is a multi-faceted design challenge that demands performing qualitative research methods to gain a deep insight into educational, technological, motivational, individual, and social aspects of the learning environment. To this end, we collected and analysed a large amount of qualitative data in both design cases. However, there are some limitations connected to collecting, processing, and analysing qualitative data. The first limitation is associated to the low number of observed cases within a specific time frame. In our research, while the interview was adopted as a main source of collecting qualitative data, the number of the interviewed participants was relatively low in both design cases due to the contextual conditions and constraints. To address this issue and also to triangulate our research's data we used other sorts of data including field observations, blogs, and document analysis.

Language and translation was another limitation of our data collection. When the researcher and research participants do not speak the same language and the research involves translation between languages, the language barriers might arise and affect the research's results. Given the difference between the native language of the principal researcher (Farsi) and the research participants (Dutch) in this research, there were some language and translation issues observed during this research. To address this issue and minimize the effect of language issues, the researcher took advantage of the assistance of other two members of the research team, serving as promotors of this research.

The fourth limitation of our research relates to the confined personal learning experiences of the learners in the design cases. In both design cases we explored and scrutinized the factors affecting learner's control and personal agency within the organization's boundaries. The gained insight has provided us with a deep understanding of factors, discourse, process and dynamics within the organization useful to underpin the PLE design

framework. However, our research has not investigated and considered the factors outside of the organization boundaries that might influence personal learning and competency development of learners.

8.3 Recommendations for Future Research

We conclude this thesis by offering six recommendations and directions for future study around our research.

Recommendation 1: Extend and validate the PLE design framework through more case studies.

Personal learning is highly individual and context-based and each organization has its own diverse and dynamic set of learning needs and competencies linked to its business strategies and objectives. Accordingly, to extend the applicability and relevance of the PLE design framework, it should be examined against the learning and competency development requirements of different organizations. Furthermore, scrutinizing the personal learning endeavours of learners inside and outside of the organization's boundaries might enhance the effectiveness of the PLE design framework. Further research is required to explore and identify different skills learners need to acquire to undertake their roles as decision maker, knowledge developer, and socializer within the learning environment.

Recommendation 2: Identify appropriate motivation and assessment mechanisms to promote personal learning.

Further research is required to identify the factors motivating learners to choose and learn the provided learning choices and participate in enriching and creating new learning choices and evolve the learning environment. Personal learning is a learner-driven process and highly depends on the positive motivation of learners toward learning. The PLE design framework introduced three sorts of mechanisms for increasing learner's motivations: providing personalized learning choices to address the learning needs of the learners, making learning flexible, and using social and game-based learning approaches. Further research should scrutinize and explore the appropriate structure of the organization-provided learning choices and their influence on motivating personal learning. Furthermore, additional research is required to identify different sorts of contextual feedback and support (for example from peers, managers and customers) that might motivate and regulate personal learning and competency development of learners and then adapt the PLE framework accordingly.

Assessment mechanisms play a key role in promoting and directing personal learning and making it visible and tangible. Derived from the empirical evidence, the PLE design framework introduced two assessment mechanisms to (i) assess learning of formal content by the learner and, (ii) the learning process of the learner. These two mechanisms still ask for further evaluation to measure their effectiveness in promoting and directing personal learning and competency development of learners.

Recommendation 3: Research the implementation and technological aspects of the PLE framework.

From a technological perspective, Web 2.0 technologies manifested in concepts such as micro content, the architecture of participation, learner-generated content, and widgets (see section 2.2.4 in chapter 2) have been introduced as the technological grounding of PLEs. Accordingly, we incorporated these concepts in the technological components of the PLE design framework. Also, we described the (partial) implementation of these concepts in chapters 4 (the PLE vision prototype) and 6 (PowerApp). However, further research is needed to identify the technological issues and requirements of implementing a full-fledged version of the PLE framework. This research might cover the following areas: supporting interoperability and integration of different learning supportive tools within the organization, tracing and capturing the information about the working/learning behaviours of learners within different tools, and designing a mechanism to utilize this information for the learning purposes. Also, a research can be defined to incorporate the concepts of semantic web and Web 2.0 to implement the technological aspects of the PLE framework.

Recommendation 4: Explore the changes in definition and meaning of 'knowledge' in the light of new approaches to learning.

Knowledge is the main ingredient of learning and accordingly any new approach to learning should consider redefining the concept of knowledge. Traditionally, learning as well as knowledge have been defined and treated as cognitive products. However, as shown and remarked by our research, learning and knowledge should be considered as cognitive processes rather than just cognitive products. This fact has been echoed by Raelin (1997) stating "knowledge undergoes construction and transformation, that it is as much a dynamic as a static concept. In fact, the relatively new word, 'knowing' has emerged to represent this dynamic process of knowledge" (p. 564). Such knowledge once created, as put by Lindkvist and Bengtsson (2009), "is seen as having something of a life of its own, pregnant with possibilities for further development and use-to be explored collaboratively-in ways which are unimaginable and unfathomable (p. 1).

Addressing these process-based and social-driven approaches to learning and knowledge asks for further research to redefine the concepts of knowledge and redirect knowledge management endeavourers in organizations. In this regard as emphasized by Carter & Scarbrough (2001), "there is a pressing need for a second generation" of knowledge management that puts "people-issues at the centre stage of discussion, theorizing, practice", and collaborative activity of knowledge creation.

Recommendation 5: Improve design-based research for supporting multi-design case studies.

Abstracted design principles are the main outcome of a design-based research and conducting iterative multi-design studies is required to increase the abstraction and

generalization of these design principles (Goldkuhl & Lind, 2010; Van den Akker, 1999). However, given its time consuming a laborious process, the majority of DBR studies and models focus on one-iteration and single-design case studies (Ma & Harmon, 2009). Accordingly, this finding suggests opening a line of research on improving the methodology of DBR. This line of research might cover different methodological aspects of conducting multi-design case studies including: the selection criteria of design cases, formulation of research questions for whole research and each design case, the role of the researcher (s) in each design case, the relationship between produced situational and abstracted design knowledge, prototyping issues, and cross-case comparison and analysis.

Recommendation 6: Develop a theory for describing technology-based personal learning within organizations.

Another line of future research pertains to developing a theory for explaining the nature and characteristics of technology-enhanced personal learning and competency development within organizational settings. To conduct our research we utilized a bunch of theories and theoretical constructs and concept including the community of practice (CoP), self-regulated learning, constructivism, learner's control, and knowledge building theories, see chapter 2. Each of these theories is useful in explaining and analysing specific aspects of personal learning while remains unable to describe and argue about other characteristics of personal learning. For example while self-regulated learning model is useful to describe the motivational aspects of personal learning it is unable to explain the social influence of the learning context on the personal learning and competency development of learners.

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Summary

The purpose of our research was to develop a PLE (personal learning environment) design framework for workplace settings. By doing such, the research has answered this research question, how should a technology-based personal learning environment be designed, aiming at supporting learners to gain control over their learning at the workplace?

We defined a PLE as an activity space encompassing learning objectives, strategies and resources (i.e. tools, content, and people) to support and facilitate personal learning endeavours of learners, see definition 1.1 in chapter 1. In this definition, personal learning refers to the ways the learner pursues to address own learning requirements and gain control over learning taking advantage of the provided learning resources in the learning environment, see definition 1.2 in chapter 1. Accordingly, we defined the PLE design framework as abstracted design knowledge comprised of the core principles of personal learning, design principles, technological components, and implementation guidelines; see definition 1.3 in chapter 1.

By incorporating the design research approaches in information systems (IS) and education domains, we outlined a design-based research strategy comprised of theoretical, empirical, and internal grounding processes to develop the PLE design framework. The theoretical grounding process, as described in chapter 2, is meant to increase the robustness of the PLE design framework by grounding it in theory. To this end, we performed a literature review study to realize the theoretical constructs, characteristics and objectives of the PLE concept. After reviewing and analysing the characteristics of the PLE concept, we have selected two objectives to underpin the PLE design framework, including: empowering learners to gain control on their learning process, and facilitating continuous development of the learning environment as a shared responsibility of learners and organization. Then we utilized these objectives in order to develop a learner's control model defining three roles for a learner within the learning environment, being: the learner as 'decision maker', 'knowledge developer', and 'socializer'. These roles aim to facilitate and promote personal agency of the learner within the learning environment. The learner's control model is based on the assumption that learners, in order to be in control of their learning process, should act as (*i*) knowledge developer to *achieve control* on their learning by acquiring relevant cognitive capabilities, (*ii*) socializer to *keep control* on their learning by acquiring and utilizing social and help seeking/giving skills, and (*iii*) decision maker to *practice control* on their learning by performing personal learning endeavours and managing and tailoring web tools to their personal needs and preferences.

After the theoretical constructs of the PLE concept have been identified, we conducted the empirical grounding process. The purpose of the empirical grounding process was to increase the relevancy of the PLE design framework. Accordingly, in the empirical grounding process we focused on exploring and identifying the factors within the workplace that affect learner's control and personal agency and realizing the requirements

of both learner and organization to support personal learning. To this end, a multi-case design-based research was conducted in two contexts, namely, the Amadeus secondary school and the customer call centre (CCC) of the Achmea Company both in the Netherlands. Regardless of their different contextual conditions, both design cases shared the same characteristics of the workplace where the learning is driven by working. In each design case we chose two units of analysis for examining the learner's as well as organization's views on the requirements of personal learning.

The results of the empirical grounding process have revealed that the personal learning experiences of learners should be aligned with the organization's objectives. It has been realized that the dynamic context of the workplace and participating in unstructured informal and social learning activities within the workplace provide great learning opportunities for learners. However, to keep pace with the rapid production of relevant information and content, this informal learning process should be supplemented by formal and structured learning resources and support.

Furthermore, it has been observed that learners go through a nonlinear co-regulating personal learning process consisting of accessing to the provided learning resources, 'forethought', 'performing', and 'reflecting' phases. Moreover, this study has led us to conclude that when the learners are provided with an appropriate amount of control and support, they participate in constructing and adapting the learning environment by introducing new learning objectives, tools, content, or social asset through the 'feeding back' phase.

After these theoretical and practical insights on the requirements of personal learning have been captured, we compared, analysed and synthesized these insights in the internal grounding process to develop the PLE design framework by identifying its four key components. Derived from the learner's control model, the learner's roles as 'decision maker', 'knowledge developer', and 'socializer' have been designated as three core principles of personal learning. Designating these core principles aims at giving active roles to the learner and placing s/he at the centre of the learning environment. Furthermore, we designated 'providing learning support' as another core principle of personal learning. This core principle is meant to harmonize the personal learning endeavours of the learners with the organization's requirements and objectives through seeding/initiating the learning environment with organization-provided learning resources. Moreover, we chose 'forethought', 'performing', 'reflecting' and 'feeding back' as another set of the core principles of personal learning. These core principles facilitate the first leap from theory to practice in the PLE design framework.

After the core principles of personal learning have been identified, we synthesized and intersected them to designate 15 design principles as the second key components of the PLE design framework. These design principles include:

- *D1-Providing personal learning management choices:* resulted from intersecting '*Learning Support'* and '*Learner as Decision Maker'* core principles. This design principle intends to nurture and develop the autonomy and metacognitive skills of learners by providing them with appropriate personal learning management choices, strategies and opportunities aligned with the organization's objectives and requirements.

- *D2-Providing cognitive choices:* resulted from intersecting '*Learning Support'* and '*Learner as Knowledge Developer'* core principles. This design principle is meant to develop the learners' cognitive skills and assisting them to acquire relevant knowledge by providing them with appropriate cognitive choices.

- *D3-Providing social learning choices:* resulted from intersecting '*Learning Support'* and '*Learner as Socializer'* core principles. This design principle aims at assisting learners to acquire and practice social learning skills by providing appropriate social learning choices including peers and collaborative learning strategies.

- *D4-Stimulating personal goal setting and planning:* resulted from intersecting '*Forethought'* and '*Learner as Decision Maker'* core principles. This design principle intends to stimulate learners to access and use the provided personal learning management choices by helping them to find a relation between these choices and their personal learning needs, preferences and objectives.

- *D5-Stimulating learner to choose cognitive choices:* resulted from intersecting '*Forethought'* and '*Learner as Knowledge Developer'* core principles. This design principle is meant to stimulate learners to choose the provided cognitive choices by considering the learners' personal needs, objectives, and preferences in the delivery of learning content.

- *D6-Stimulating learner to choose social learning choices:* resulted from intersecting '*Forethought'* and '*Learner as Socializer'* core principles. This design principle is meant to develop appropriate social mechanisms that allow learners to take advantage of the provided social choices to plan and regulate her learning process.

- *D7-Encouraging learner to follow their personal learning goals/plans:* resulted from intersecting '*Performing'* and '*Learner as Decision Maker'* core principles. This design principle seeks to encourage the learner to take advantage of the provided learning choices to carry out his/her learning plan and monitor and manage his/her learning progress.
- *D8-Encouraging learner to learn and develop content choices:* resulted from intersecting '*Performing'* and '*Learner as Knowledge Developer'* core principles. This design principle serves to address two requirements: (*i*) encouraging the learner to learn and acquire systematic and formal knowledge informed by the organization's learning objectives through practicing the provided lower- and higher-order cognitive strategies, and

(*ii*) encouraging the learner to develop new content choices or enrich and contextualize the current content choices through commenting, tagging, evaluating, remixing, and creating.

- *D9-Encouraging and facilitating social learning:* resulted from intersecting '*Performing'* and '*Learner as Socializer'* core principles. This design principle aims at encouraging and facilitating social learning and communication around content items, faced problems, solutions, experiences, and ideas.

- *D10-Promoting reflection on personal learning process:* resulted from intersecting '*Reflecting'* and '*Learner as Decision Maker'* core principles. This design principle intends to promote learners' reflection on their personal learning process by asking learners to review what and how they learn.

- *D11-Promoting reflection on cognitive aspect of learning process:* resulted from intersecting '*Reflecting'* and '*Learner as Knowledge Developer'* core principles. This design principle is meant to promote learners' reflection on the cognitive aspects of their learning process by asking learners to critically reflect on own knowledge level and review what content they have learned and what cognitive skills they have practiced and acquired.

- *D12-Promoting reflection on social aspect of learning process:* resulted from intersecting '*Reflecting'* and '*Learner as Socializer'* core principles. This design principle aims at promoting learners' reflection on social aspects of learning process by asking learners to review with whom they have learned, the joint learning activities, content co-development, shared learning objectives, peers' endorsements the pattern of social interactions, and what social skills they have learned.

- *D13-Capturing and applying learner's feedback on the metacognitive aspect of the learning environment:* resulted from intersecting '*Feeding Back'* and '*Learner as Decision Maker'* core principles. This design principle aims to capture the outcome of the learner's performance as decision maker and utilize it to adapt and evolve the personal learning management aspects of the learning environment.

- *D14-Capturing and applying learner's feedback on the cognitive aspect of the learning environment:* resulted from intersecting '*Feeding Back'* and '*Learner as Knowledge Developer'* core principles. This design principle aims at capturing the outcome of the learner's performance as knowledge developer as a means to adapt and evolve the cognitive and content aspects of the learning environment.

- *D15-Capturing &applying learner's feedback on social aspect of the learning environment:* resulted from intersecting '*Feeding Back'* and '*Learner as Socializer'* core principles. This design principle is meant to capture the outcome of the learner's endeavours as socializer to adapt and evolve the social aspect of the learning environment.

These design principles facilitate the second leap from theory into practice in the PLE design framework. Finally, armed with the observations and evidence from the empirical grounding process, we identified a set of technological components and implementation guidelines to address each design principle. This technological components and implementation guidelines represent the third leap from theory into practice in the PLE design framework. For more detail about the components of the PLE design framework see chapter 7.

The developed PLE design framework conceptualizes personal learning as an interconnected process of decision making, knowledge creation, and socializing directed by the learner and facilitated by the organization. Through the lens of this framework, the learning environment is a dynamic and adaptable entirety consisting of organization-, learner-defined learning objectives, strategies, and learning resources. The development of this learning environment is envisioned per se as an important learning process and the learning environment is considered as a shared dynamic outcome evolved and adapted through cooperation between the learners and organization. To operationalize this vision, the PLE design framework reconciles the learners' and organization's views on the requirements and specifications of personal learning and competency development. On one hand, the PLE design framework aligns and harmonizes the personal learning endeavors of the learners with the learning requirements and objectives of the organization expressed in the organization-provided learning choices. On the other hand, it provides opportunities for the learners to pursue their personal learning needs and interests by exploring and learning the provided learning choices and evolve the learning environment by contextualizing, maturing, and developing new learning choices in terms of learning objectives, tools, content, strategies, and social asset.

Samenvatting (summary in Dutch)

Het doel van dit onderzoek was een ontwerpkader van een PLE (persoonlijke leeromgeving) te ontwikkelen voor werkplekleren. Het onderzoek heeft de volgende onderzoeksvraag beantwoord: hoe moet een op technologie-gebaseerde persoonlijke leeromgeving worden ontworpen, die er op gericht is controle te verschaffen op hun leerproces.

In dit onderzoek, hebben we een PLE gedefinieerd als een activiteitenruimte, die leerdoelen, strategieën en middelen (i.e. technologische middelen, inhoud, en mensen) omvat die leerinspanningen van ondersteunen en faciliteren, zie definitie 1.1 in Hoofdstuk 1. In deze definitie verwijst 'persoonlijk leren' naar de manieren waarop de lerende streeft naar eigen leerdoelen en naar controle op zijn/haar leren, daarbij gebruik makend van de geboden leermiddelen in de leeromgeving, zie definitie 1.2 in hoofdstuk 1. Wij hebben het PLE ontwerpkader gedefinieerd als geabstraheerde ontwerpkennis, bestaande uit de kernprincipes 'persoonlijk leren', 'ontwerpprincipes', 'technologische componenten' en 'implementatie richtlijnen', zie definitie 1.3 in Hoofdstuk 1.

Om het PLE ontwerpkader te ontwikkelen hebben we gekozen voor ontwerpend onderzoek waarbij we de kennisdomeinen van informatiesystemen en onderwijs hebben gecombineerd. Daarbij hebben we theoretische, empirische en interne verankeringsprocessen ingezet. Het theoretisch verankeringsproces, zoals beschreven in Hoofdstuk 2, is bedoeld om de robuustheid van het PLE ontwerpkader te vergroten door dit in de theorie te verankeren. We hebben een literatuurstudie uitgevoerd, waarmee we de theoretische constructen, kenmerken en doelstellingen van het PLE-concept hebben kunnen afbakenen. Na het beoordelen en analyseren van de kenmerken van het PLE concept, hebben we twee doelstellingen geselecteerd die aan het PLE ontwerpkader ten grondslag liggen: ‘empowerment’ van om controle over hun leerproces te krijgen, en het faciliteren van de continue ontwikkeling van de leeromgeving als een gedeelde verantwoordelijkheid van de en de organisatie. Vervolgens hebben we deze doelstellingen gebruikt om het controlemodel van een lerende te ontwikkelen, waarin we drie rollen voor een lerende in de leeromgeving gedefinieerd hebben, te weten: de lerende als ' beslisser', als 'kennisontwikkelaar ' en als 'socializer'.

Deze rollen hebben als doel de personalisering van het leerproces van de lerende te vergemakkelijken en te bevorderen. Het controlemodel van de lerende is gebaseerd op de veronderstelling dat lerenden, moeten fungeren als (*i*) kennisontwikkelaar om controle over hun leerproces te *krijgen* door de nodige cognitieve vermogens te verwerven, (*ii*) socializer om controle over hun leerproces te *houden* door sociale, hulpzoekende- en hulpgevende vaardigheden te verwerven en te gebruiken, en (*iii*) beslisser om controle te *uit te oefenen* op hun leerproces door persoonlijke leerinspanningen uit te voeren en door webtools te beheren en af te stemmen naar hun persoonlijke behoeften en voorkeuren.

Nadat de theoretische constructen van het PLE concept geïdentificeerd zijn, hebben we het empirische verankeringsproces uitgevoerd. Het doel van het empirische verankeringsproces was om de relevantie van het PLE ontwerpkader te vergroten. Daarom hebben we ons in gericht op het verkennen en identificeren van de factoren, die de mate van controle van de lerende op zijn leerproces beïnvloeden en op het identificeren van eisen van zowel de lerende als van de organisatie om persoonlijk leren te kunnen ondersteunen. Om dit te bereiken zijn twee case studies uitgevoerd, een op het Amadeus Lyceum en de andere op het klanten-call-center (CCC) van Achmea Company, beide in Nederland. Ondanks de verschillen in randvoorwaarden, deelden beide casussen dezelfde werkplekkenmerken, waar praktijk gestuurd leren wordt toegepast. In iedere casus hebben we gekozen voor twee analyse-eenheden om zowel het perspectief van de lerende als dat van de organisatie te onderzoeken.

De resultaten van het empirische verankeringsproces lieten zien dat de persoonlijke leerervaringen van de lerenden moeten worden afgestemd op de doelstellingen van de organisatie. De dynamische context van de werkplek en de deelname aan ongestructureerde, informele en sociale leeractiviteiten op de werkplek bieden grote leermogelijkheden voor lerenden. Echter, om gelijke tred te houden met de snelle productie van relevante informatie en inhoud, moet dit informele leerproces worden aangevuld met formele en gestructureerde leermiddelen en ondersteuning.

Verder is geconstateerd dat lerenden een niet-lineair, co-regulerend persoonlijk leerproces doorlopen, dat bestaat uit het verkrijgen van toegang tot de verstrekte leermiddelen, 'voorbereiding', 'uitvoering' en 'reflecteren' fasen. Bovendien heeft dit onderzoek geleid tot de conclusie dat, wanneer de lerenden worden voorzien van een passende mate van controle en ondersteuning, zij deelnemen aan de bouw en aanpassing van de leeromgeving bijvoorbeeld door invoering van nieuwe leerdoelen, gereedschappen, inhoud of sociale kapitaal via 'feedback '.

Nadat de theoretische en praktische inzichten over de vereisten van persoonlijk leren zijn vastgelegd, hebben we deze in het interne verankeringsproces vergeleken, geanalyseerd en gesynthetiseerd om het PLE ontwerpkader te ontwikkelen. We hebben drie componenten gedefinieerd in termen van rollen van de lerende: die van 'beslisser', 'kennisontwikkelaar' en 'socializer'. Deze drie beschouwen we als de basis principes van persoonlijk leren, hebben met deze rollen een actieve rol en stellen hem/haar in het middelpunt van het leerproces. We hebben ook een vierde component geidentificeerd, die van 'ondersteuning bij het leren'. Deze component omvat de afstemming van de persoonlijke leerinspanningen van de met vereisten en doelstellingen van de organisatie. De leeromgeving wordt verrijkt met leermiddelen die door de organisatie worden aangeboden. Daarnaast hebben we 'voorbereiding' 'uitvoering', 'reflectie' en 'feedback' als een andere set kernbeginselen van

persoonlijk leren gekozen. Deze basisbeginselen faciliteren de eerste stap van de theorie naar de praktijk in het PLE ontwerpkader.

Nadat de kernprincipes van persoonlijk leren zijn geïdentificeerd, hebben we deze geconcretiseerd in 15 ontwerpprincipes door de bovenstaande basisprincipes met elkaar te kruisen in termen van activiteiten bedoeld voor ontwerpers van PLE omgevingen. Deze ontwerpprincipes vergemakkelijkten de tweede sprong van theorie naar praktijk in het PLE ontwerpkader. Deze ontwerpprincipes omvatten:

- *D1-Het verstrekken van persoonlijke leermanagement keuzes:* het resultaat van het combineren van de kernprincipes 'leerondersteuning' en 'lerende als beslisser'. Het doel van dit ontwerpprincipe is de autonomie en de meta-cognitieve vaardigheden van lerenden te voeden en te ontwikkelen, door hen te voorzien van de juiste persoonlijke leermanagement keuzes, strategieën en mogelijkheden, die in lijn zijn met de doelstellingen en behoeften van de organisatie.

- *D2-Het verstrekken van cognitieve keuzes:* het resultaat van het combineren van de kernprincipes 'leerondersteuning' en 'lerende als kennisontwikkelaar'. Dit ontwerpprincipe is bedoeld om de cognitieve vaardigheden van de lerende te ontwikkelen en hen te helpen om relevante kennis te verwerven door hen te voorzien van de juiste cognitieve keuzes.

- *D3-Het verstrekken van keuzes in sociaal leren:* dit is het resultaat van het kruisen van de kernprincipes 'Learning Support' en 'Lerende als Socializer'. Dit ontwerpprincipe is gericht op het helpen van lerenden om vaardigheden in sociaal leren te verwerven en te oefenen door middel van passende keuzes in sociale leren, het betrekken van collega's en het gebruiken van samenwerkend leren strategieën.

- *D4-Het stimuleren van persoonlijke doelen en planning:* hierbij zijn de kernprincipes 'Forethought' en 'Lerende als Beslisser' met elkaar gekruist. Dit ontwerpprincipe is bedoeld om lerenden te stimuleren gebruik te maken van de verstrekte management keuzes in persoonlijk leren, door hen te helpen een relatie te vinden tussen deze keuzes en hun persoonlijke leerbehoeften, voorkeuren en doelstellingen.

- *D5-Het stimuleren van de lerende om voor cognitieve keuzes te kiezen:* dit is het gevolg van het kruisen van de kernprincipes 'Forethought' en 'Lerende als Kennisontwikkelaar'. Dit ontwerpprincipe is bedoeld om lerenden te stimuleren om voor de verstrekte cognitieve keuzes te kiezen door te kijken naar de persoonlijke behoeften van de lerenden, de doelstellingen, en voorkeuren voor de levering van de leerinhoud.

- *D6-Het stimuleren van de lerende om te leren keuzes sociale kiezen:* dit is het gevolg van het kruisen van de kernprincipes 'Forethought' en 'Lerende als Socializer'. Dit ontwerpprincipe is bedoeld om passende sociale mechanismen te ontwikkelen, die het

mogelijk maken de voor lerenden om te profiteren van de verstrekte sociale keuzes om te plannen en hun leerproces te reguleren.

- *D7-Het stimuleren van lerenden om hun persoonlijke leerdoelen/plannen te volgen:* dit is het gevolg van het kruisen van de kernprincipes 'Uitvoeren' en 'Lerende als Beslisser'. Dit ontwerpprincipe is bedoeld om de lerende aan te moedigen om te profiteren van de verstrekte keuzes in het leren, voor het uitvoeren van zijn/haar leerplan en het bewaken en beheren van zijn/haar leerproces.

- *D8-Het stimuleren van de lerende om te leren en de inhoudskeuzes te ontwikkelen:* dit is het gevolg van het kruisen van de kernprincipes 'Uitvoeren' en 'lerende als Kennisontwikkelaar'. Dit ontwerpprincipe bevat twee activiteiten: (i) het stimuleren van de lerende om te leren en om systematische en formele kennis te verwerven, en (ii) het stimuleren van de lerende om nieuwe inhoudskeuzes te ontwikkelen of om de huidige inhoudskeuzes te verrijken en te contextualiseren door middel van commentaar, tagging, evalueren, remixen, en creëren.

- *D9-Het stimuleren en faciliteren van sociaal leren:* dit is het gevolg van het kruisen van de kernprincipes 'Uitvoeren' en 'lerende als Socializer'. Dit ontwerpprincipe is gericht op het stimuleren en faciliteren van de communicatie rond de inhoud, de problemen en mogelijke oplossingen, ervaringen en ideeën.

- *D10-Het bevorderen van reflectie op het eigen leerproces:* dit is het gevolg van het kruisen van de kernprincipes 'Reflecting' en 'Lerende als Beslisser'. Dit ontwerpprincipe is bedoeld om de reflectie van lerenden op hun eigen leerproces te bevorderen door lerenden te vragen om te bekijken wat en hoe ze leren.

- *D11-Het bevorderen van reflectie op het cognitieve aspect van het leerproces:* dit is het gevolg van het kruisen van de kernprincipes 'Reflecting' en 'Lerende als Kennisontwikkelaar'. Dit ontwerpprincipe is bedoeld om de reflectie van lerenden op de cognitieve aspecten van hun leerproces te bevorderen door lerenden te vragen om kritisch te reflecteren op hun eigen kennisniveau en te bekijken welke inhoud ze geleerd hebben en welke cognitieve vaardigheden ze hebben geoefend en verworven.

- *D12-Het bevorderen van reflectie op het sociale aspect van het leerproces:* dit is het gevolg van het kruisen van de kernprincipes 'Reflecting' en 'lerende als Socializer'. Dit ontwerpprincipe is gericht op het bevorderen van reflectie van lerenden op de sociale aspecten van het leerproces door de lerenden te vragen te kijken naar met wie zij hebben geleerd, de gezamenlijke leeractiviteiten, de content co-ontwikkeling, gedeelde leerdoelen, de ondersteuning van het patroon van sociale interacties door collega's, en welke sociale vaardigheden ze geleerd hebben.

- *D13-Het vastleggen en toepassen van feedback van de lerende op het metacognitieve aspect van de leeromgeving:* dit is het gevolg van het kruisen van de kernprincipes 'Feeding Back' en 'Lerende als Beslisser'. Dit ontwerpprincipe is gericht op het vastleggen van de uitkomst van de prestaties van de lerende als beslisser en om dit te gebruiken om de aspecten van personalisering van de leeromgeving aan te passen.

- *D14-Het vastleggen en toepassen van feedback van lerende op het cognitieve aspect van de leeromgeving:* dit is het gevolg van het kruisen van de kernprincipes 'Feeding Back' en 'Lerende als Kennisontwikkelaar'. Dit ontwerpprincipe is gericht op het vastleggen van de uitkomst van de prestaties van de lerende als kennisontwikkelaar als een middel om de cognitieve en inhoudelijke aspecten van de leeromgeving aan te passen en te evalueren.

- *D15-Het vastleggen & toepassen van de feedback van de lerende op het sociale aspect van de leeromgeving:* dit is het gevolg van het kruisen van de kernprincipes 'Feeding Back' en 'Lerende als Socializer'. Dit ontwerpprincipe is bedoeld om het resultaat van de inspanningen van de lerende als socializer vast te leggen en het sociale aspect van de leeromgeving aan te passen en te evalueren.

Uiteindelijk hebben we op basis van de observaties en aanwijzingen in de cases een aantal technologische componenten en implementatierichtlijnen kunnen afleiden. Deze technologische componenten en implementatierichtlijnen vertegenwoordigen de derde sprong van theorie naar de praktijk in het PLE ontwerpkader. Voor meer informatie over de onderdelen van het PLE ontwerpkader, zie hoofdstuk 7.

Het ontwikkelde PLE ontwerpkader conceptualiseert het persoonlijk leren als een onderling verbonden proces van besluitvorming, het creëren van kennis en het socialiseren, geregisseerd door de lerende en gefaciliteerd door de organisatie. Door de lens van dit kader, is de leeromgeving een dynamisch en flexibel geheel dat bestaat uit door de organisatie en lerende gedefinieerde leerdoelen, strategieën en leermiddelen. De ontwikkeling van deze leeromgeving is op zichzelf een leerproces en de leeromgeving wordt beschouwd als een gedeelde dynamische uitkomst die is ontwikkeld en aangepast door middel van samenwerking tussen de lerenden en de organisatie. Om deze visie te operationaliseren, verbindt het PLE ontwerpkader de standpunten van de lerenden en die van de organisatie wat betreft de eisen en specificaties van persoonlijk leren en competentieontwikkeling. Aan de ene kant, worden door het PLE ontwerpkader de inspanningen in het persoonlijk leren van de lerenden en de leer-eisen en doelstellingen van de organisatie, uitgedrukt in de door de organisatie verstrekte leerkeuzes, geharmoniseerd. Aan de andere kant biedt het kansen voor de lerenden om hun persoonlijke leerbehoeften en belangen na te streven door het verkennen en het leren van de verstrekte leerkeuzes en door het evolueren van de leeromgeving door te contextualiseren, rijpen en het ontwikkelen van

nieuwe leerkeuzes in termen van leerdoelen, gereedschappen, inhoud, strategieën en sociale netwerken en communities.

Appendices

Appendix A: The Interview Questions for the Students and Teacher Participated in the PLE Project (Unit of Analysis 1)

1. Please explain your previous technology-based learning experiences (apart from this project).

2. What are the tools you would like to use to support your learning activity? Why?

3. Please explain your general perception about the PLE project (including the approach and introduced tools) and the ways they might support/hinder your learning?

4. What are your suggestions for the next implementation of the PLE project?

5. What are the implications of the PLE project for the teaching activities? (The asked question from the participated teachers).

Appendix B: The Personal Learning Environment Construction Survey for the Students Participated in the PLE Project (Unit of Analysis 1)

DIRECTIONS

1-Purpose of the Questionnaire

This questionnaire asks you to describe important aspects of the PLE project which you have participated in it as a part of society and people course.

There is no right or wrong answers. This is not a test and your answers will not affect your assessment. Your opinion is what is wanted. Your answers will enable us to improve your future classes.

2- How to Answer Each Question

On the next pages you will find …… sentences. For each sentence, circle only one number corresponding to your answer. For example:

	Strongly disagree	disagree	Neutral	Agree	Strongly agree
Blog is a useful tool to support my learning.	5	4	3	2	1

- If you found in Blog many interesting opportunities for your learning and school tasks, circle the 5.
- If you think there is not any benefit in Blog for your learning and school tasks , circle the 1.
- Or you can choose the number 2, 3 or 4 if one of these seems like a more accurate answer.

3-How to change your answer

If you want to change your answer, cross it out, and circle a new number.

4- Student Information:

Name:	**How old are you?** ( ) year old
Sex: male ( ) female ( )	

Now turn the page and please answer all questions.

Questions:

1-Do you have personal desktop computer at home?
( ) Yes
( ) No

2-Do you have personal laptop computer at home?
( ) Yes
( ) No

3-Approximately how many hours per week do you spend actively doing Internet activities for school or recreation, in or out of school?
( ) hours for school activities
( ) hours for recreation or other activities

4-Which best describes your preferences about using Internet in your courses? (Select only one option by writing X sign in bracket corresponding to your answer)
A. I prefer courses that use no Internet access and Web tools. ( )
B. I prefer courses that use limited Internet access and web tools. ( )
C. I prefer courses that use a moderate level of Internet access and web tools. ( )
D. I prefer courses that use Internet access and web tools extensively. ( )

5-How often do you do the following activities for your school tasks or recreation? (Please Write down X sign in last column if you've done corresponding activity in PLE project.)

	Not in PLE project						I've done this activity, also in the PLE project
	Never	Once or few times per year	Monthly	Weekly	Several times per week	Daily	
Chat (text, voice, or video by Skype, Gmail, Messenger, etc.)							
Sending and reading Email							
Sending and reading Text message(SMS, etc)							
Search web for information by search engine (Google search, bing, etc.)							
Download music from the web							
Download movie from the web							
Download other file from the web							
Use the school web site							
Use the ELO							
Use Spreadsheets (Excel, etc.)							
Radio: Listen to a radio programme online							
watching TV/Video clips online							
Shopping: buy something online							
Use Presentation software							

(PowerPoint, Prezi etc.)							
Use Word processing software (Word, etc.)							
Use Graphic Software (Photoshop, Flash, etc.)							
Use Video-creation software(MovieMaker, etc)							
Use Social networking (Facebook, Hyves, etc.)							
Use Microblogging websites (Twitter, etc.)							
Online Computer Games, and virtual worlds							
Social bookmarking/tagging(Diigo, del.ici.ous)							
Blogging: creating or writing a blog.							
Uploading to share: music or speech you created							
Uploading to share: a video you took or find							
Uploading to share: a photo you took or find							
Uploading to share: a file you created or find							
Use iGoogle, Symbaloo, or Netvibes							
Group working to create a file or doing a project.							
Use Google reader or any RSS reader							
Wikipedia: looking something up							
Discussion: writing to an discussion board or Forum							
Commenting on someone else's blog post.							
Editing a wiki							
Find a Web site or gadget related to your course topics							
Introduce a new website or gadget to your friends							
Create a website							
Create an online group(in Google, Facebook, Hyves, etc)							
Reading wikis or Blogs							

6-What is your general skill level for the following?

	Not at all skilled (I've not done it yet, and It's very hard for me to do it by myself.)	**Not very skilled** (Although, I've done it sometimes, but still, I need more assistance to do it.)	**Fairly skilled** (I can do it myself, but sometimes I need others' assistance.)	**Very skilled.** (I can do it well, without getting assistance of others.)	**Expert.** (I usually do it well, easily, and also I can assist others to do it.)
Using the school website					
Using ELO					
Using presentation software(PowerPoint, etc.)					
Using Spreadsheets (Excel, etc.)					
Computer maintenance (Software updates, Installing operating system, security, etc.)					
Graphic(Photoshop, Flash, etc.)					
Using the Internet to search for required information.					
Evaluating the quality of online information.					
Understanding the ethical/legal issues surrounding the access and use of digital information.					

7-Have you talked with any of the following people to get information or advice about traveling guide in PLE project?

	No	**Yes**	**Don't know**
Other teachers in school			
My outside-of-school friends			
Other students in other classes			
My family			
Experts or knowledgeable individuals in the corresponding topic, outside of school.			
Any individual that can help me on my courses.			
My friends in Facebook or Hyves			

8-Which of the following best describes you? (Select only one option by writing X in bracket corresponding to your answer)

A. I am sceptical of new Web tools and services and use them only when I have to. ( )
B. I am usually one of the last people I know to use new technologies. ( )
C. I usually use new technology when most people I know do. ( )
D. I like new technologies and use them before most people I know. ( )
E. I love new technologies and am among the first to experiment with and use them. ( )

9-I like to learn through:

	No	**Yes**	**Don't know**
E-mail			
Text chat or voice chat			
Video conference (Skype)			
Educational or online computer games			
Educational websites(Introduced by teacher or students)			
Search engine (Google, yahoo, etc.)			
School's website			
ELO			
Podcasts or movies in web			
Social networking(FaceBook, Hyves)			
Microblogging(Twitter)			
Forums and discussion boards			
Group story telling (by Google Docs)			
Group Brain storming(By Google Docs or Mindmeister)			
Group working around a project(same as PLE project)			
Blogs, Wikis			
Wikipedia			
TV(BBC, National geography, etc.)			

10-What is your opinion about the following statements about Blog?

	Strongly disagree	**Disagree**	**Neutral**	**Agree**	**Strongly agree**
I will use Blog in my future courses.					
Blog is a useful tool to support my learning.					
Creating blog, writing blog's posts, and working with Blog is easy for me.					
I like use blog to publish and share my idea.					
By using blog, teacher can evaluate my activities, better.					
Blog can improve collaboration between I and other students, around course topics.					
I like other students visit my blog and comment on my blog.					
I prefer use blog instead of email to deliver my assignments to teacher.					

I can learn more, when I read other students' blogs.					
I prefer to have separate blogs for personal and school activities.					
I like teacher to comment on my blog's posts.					
I could learn more, when other students comment on my blog's posts.					
I like using blog to write about what I've done and I will do.					
I like to show my blog to my family and my friends.					
I like to comment on other students' blog.					
I like to use Blog as an appropriate tool to exhibit my creativity and intelligence to the world.					
I like use blog to do school activities outside of school time.					
Blog is an interesting and fun tool for my school activities.					
I know how to use blog to support my school activities.					
Writing a blog's post needs more thinking than writing on paper.					
I afraid to make mistake when I work with my blog.					

11-What is your opinion about the following statements?

	Strongly disagree	**Disagree**	**Neutral**	**Agree**	**Strongly agree**
Google Docs is an interesting tool to support my school activities					
I need more training to use Google Docs.					
Google Docs can increase the collaboration between students					
Google Docs can make group work easier.					
Technical problems can decrease my motivation to use PLE.					
Group working improves my learning					
By group working, students can learn more from each other.					
I like to use group story telling technique in my courses.					
I like to use group brain storming technique in my courses.					
Participating in PLE project encourage I to share my knowledge, gadgets, or websites with other students.					
By group working in PLE, I can find more web tool and gadgets that are useful for my school tasks.					
When some students in group don't participate in project, I get unsatisfied.					
Mindmeister is an interesting tool to support my school activities					

Mindmeister can make group work easier.					
I like to use Mind mapping technique in my courses.					
By using Mindmeister we can analyze a problem, better than by pen and paper.					
I like iGoogle, because it is fun.					
I like iGoogle because I can add any useful Gadgets.					
I will use iGoogle in other courses.					
I use IGoogle at home.					
I like to be able to create and share my gadgets.					
I like to be able to show my iGoogle page to others.					
I like to be able to show my PLE tools to others.					
PLE is useful environment to support my school tasks.					
I like PLE project, because I learnt many web tools.					
During PLE project I had freedom to use any useful web tools, found by me or other students.					
During PLE project I had freedom to define and follow what I want to study and learn.					
During PLE project, I learnt how to use Internet and web tools to support my learning.					
I'll get more actively involved in courses that use PLE.					
I can use the web tools I have used in my PLE, in other courses and in the next years.					
The use of PLE in my course improves my learning and my understanding.					
The use of PLE in my course improves my understanding and Web skills.					
I like PLE project, because it supports group working					
I like PLE project, because I have full access to Internet					
In next PLE projects, I'll be able to do project without getting more support from teacher.					
PLE can distract me from my school tasks.					
Having free access to the Internet distracts me from my school tasks.					
I like use web tools that have practical benefits for my school tasks.					
I like use funny web tools in my PLE.					
I need more time to develop my PLE and to use it in my courses.					
I need more training to develop my PLE and to use it in my courses.					
I need more support by teacher to work with my PLE.					
Defined assignments in PLE project were relevant to course topics.					

Defined assignments have improved my understanding about course topics.					
Defined assignments have improved my understanding about web tools.					
Defined assignments have helped me to learn how do a group project by using web tools.					
The goals and purposes of PLE project were clear for me					
In PLE project, the expectations of teacher were clear for me.					
In PLE project, I feel I have more control on my understanding and my tasks.					
By having free access to the Internet, I feel myself more responsible to use the Internet.					
By having free access to the Internet, I can access more websites, relevant to my courses.					
By having free access to the Internet, I might use it more for fun at beginning, but after a while I'll use it for school tasks.					
I prefer to work with Open systems like PLE, rather than closed system, to do my school tasks.					
I like to present my project by creating website to show and share it with others.					
There was a lot of discussion between our group's members during decision making time about structure of traveling guide.					
I've learnt many things from group members' discussions during PLE project.					

12-Have you faced the following problems in PLE project?

	No	**Yes**	**Don't know**
Technical problem with Internet Explorer or Google Chrome			
Problem in Creating account for tools(MindMeister, Blog, iGoogle, Google Docs)			
Problem in Working with tools(MindMeister, Blog, iGoogle, Google Docs)			
Difficulty in how and where to find information			
Difficulty in selecting qualitative information from web			
Distraction by other students to help them			
Distraction by some students that were not in working mode or didn't take project seriously			
Not enough time to work out with tools and project			
Difficulty in group working and task sharing			
Disagreement between group members about content and structure of traveling guide			
Difficulty in understanding the objectives of project			
Difficulty in translating information			
Language barriers to connect to other people in different language			

13-Which of the following activities you have done in PLE project?

	No	Yes	Don't know
Comment on other students' blogs			
Receiving feedback from your teacher through your blog			
Receiving feedback from other student through your blog			
See your blog visitors' statistics			
Read other students' blogs			
Follow other students' blogs			
Show your blog to your family and your friends			
Try to make your blog funny and pretty			
Identify new gadgets			
Introduce gadgets to other students			
Share gadgets with other students			
Describe how a gadget work for other students			
Customize your iGoogle pages			
Bookmarking websites in iGoogle			
Show your iGoogle page to your friends or family			
Use iGoogle gadgets for your school tasks			
Use iGoogle gadgets for non-school tasks			
Create file in Google Docs			
Share file in Google Docs with other students			
Participate in group story telling by Google Docs			
Use Google Docs for other courses			
Search web for Information, image, video			
Cutting and pasting			
Create mind map in mindmeister			
Participate in group brain storming by Mindmeister			
Discussing with other students about traveling guide			
Challenging each other's ideas			
Identify new web tools or web sites			
Introduce or share new web sites with other students			
Participate to create web site			
Thinking about structure of traveling guide			
Asking other people outside of school about traveling guide			
Translating information			
Ask teacher or other students to help you in web tools and Internet problem			
Help other students to solve their problem			

14-What is your overall experience about using following tools in other courses?

	Very negative	**Negative**	**Neutral**	**Positive**	**Very positive**
PLE project					
BLOG					
Google Docs					
Mindmeister					
iGoogle					
Prezi					

15-Do you own a handheld device that is capable of accessing the Internet (Whether or not you use that capability)? Examples include iPhone, Tero, BlackBerry, other Internet-capable cell phone, IPod touch, PDA, POCKET pc, etc.

A. No, and I don't plan to purchase one in the next 12 months. ( )
B. No, but and I plan to purchase one in the next 12 months. ( )
C. Yes. ( )
D. Don't know. ( )

16-How often do you use your handheld device to do the following activities?

	Never	Sometimes	Frequently
Send/ Read E-mail			
Send/ read message			
Report what you're doing on Twitter			
Use social networking websites (Facebook, Hyves, MySpace, etc.)			
Check Information (news, weather, sports, specific facts, etc.)			
Read or contribute to blogs			
Use maps			
Conduct personal business (banking, shopping, travelling, etc.)			
Use Internet photo sites			
Watch mobile TV			
Download/stream music			
Download or watch videos online			
Download or play games online			
Conduct school activities			

Appendix C: The Interview Questions for the Teachers Participated in the Evaluation of the PLE Prototype (Unit of Analysis 2)

1. Please explain your previous technology-based teaching experiences.

2. Based on your experiences, please explain your perception about the PLE prototype (including the approach and introduced tools) and the ways it might support/hinder your students learning?

3. What are the requirements to implement the PLE concept and scale up the PLE prototype within the school context?

4. What are your suggestions for improving the next version of the PLE prototype?

Appendix D: The Interview Questions for the Employees and Managers of the Customer Contact Centre (CCC) of the Achmea Company (Unit of Analysis 3)

1. Can you explain your working activities and processes as a call agent?

2. From a learning perspective, what types of learning content, skills, and competencies do you need in order to support your work activities?

3. How do you access, acquire, or develop these content, skills, and competencies?

4. Based on your experiences what are the opportunities/problems to support/against the learning and knowledge development of the call agents in the CCC's context?

5. What sorts of technological tools are available to support your learning and knowledge development processes? And how these tools might support/hinder these processes?

6. Do you think what should be look like a learning technology aiming at supporting learning and knowledge development at the CCC's context?

Appendix E: The Interview Questions for the Employees and Managers of the Customer Contact Centre (CCC) of the Achmea Company participated in the evaluation of PowerApp (Unit of Analysis 4)

1. What is your general perception about PowerApp?
2. How do you evaluate your learning experiences in PowerApp?
3. How do you evaluate the content quality of PowerApp?
4. How do you evaluate the system quality of PowerApp?
5. Do you think how PowerApp can contribute to triggering the employees' motivation for more learning?
6. Do you think what other functionalities should be added to PowerApp?

Appendix F: The survey to measure the learning effectiveness of PowerApp

DIRECTIONS

Purpose of the survey:

This survey aims to collect your opinion about the PowerApp based on your current experience with PowerApp. Also, there are a few questions about Brein and Yammer systems. Your answers will enable us to evaluate the learning effectiveness of PowerApp and improve its next version.

It takes you between 10-15 minutes to complete this survey.

How to answer each question:

On the next pages you will find 81 items. For each item, please circle *only* one number corresponding to your answer.

How to change your answer:

If you want to change your answer, cross it out, and circle a new number.

(i) What is your opinion about the following items regarding your experience with *PowerApp*?

	Agree	Agree somewhat	Not sure	Disagree somewhat	Disagree
PowerApp provides information in different format (i.e. text, picture, and Internet links).					
PowerApp provides me with the most recent information.					
PowerApp provides accurate information.					
PowerApp provides me with a complete set of information.					
PowerApp provides information that is easy to read and understand.					
In general, PowerApp provides me with high-quality information.					
PowerApp makes information easy to access.					
PowerApp operates reliable.					
PowerApp integrates information related to different aspects of my job.					
PowerApp accessibility is high (i.e. in different tools, places and times).					
PowerApp returns answers to my actions quickly.					
Navigation in PowerApp is easy.					
The information provided by PowerApp is clearly categorized and presented on the screen.					
I am notified of the availability of new information in PowerApp easily.					
PowerApp provides a personalized presentation of information.					
Overall, PowerApp is of high quality.					
PowerApp allows the user to select the content he considers appropriate.					
PowerApp allows the user to select the colleague he considers appropriate to do a duel-game.					

Please go to the next page

	Agree	**Agree somewhat**	**Not sure**	**Disagree somewhat**	**Disagree**
PowerApp allows the user to select the way of learning he considers appropriate (reading brain snacks or playing duel-games).					
PowerApp allows the user to control the pace and sequence of their learning.					
Learning by PowerApp is entirely within my control.					
When It was needed, I received satisfactory support about using PowerApp from the responsible people.					
PowerApp allows users to improve their knowledge through competing with each other.					
PowerApp provides different level of learning materials tailored to different learning needs of the users.					
PowerApp allows the user to evaluate and monitor her knowledge level.					
I enjoy PowerApp without feeling bored or anxious.					
The learning objectives of PowerApp are clearly defined.					
PowerApp provides appropriate learning scenarios and functionalities.					
Overall, I am very satisfied with the information I received from PowerApp.					
Overall, my interaction with PowerApp is very satisfying.					
Overall, PowerApp can meet my learning needs, effectively.					
I am happy to take responsibility for creating my learning profile in PowerApp.					
When I think about it, I see a part of myself in PowerApp.					
I have the feeling I could handle questions and challenges provided by PowerApp.					
I feel a high level of ownership toward PowerApp.					
Using PowerApp is fun.					

Please go to the next page

	Agree	**Agree somewhat**	**Not sure**	**Disagree somewhat**	**Disagree**
Using PowerApp awakes my curiosity.					
Using PowerApp will encourage and motivate me to keep the improvement of my learning.					
Using PowerApp would accelerate updating my insurance knowledge.					
Using PowerApp will make my learning easier.					
Using PowerApp would help me to use my time more efficiently to improve my learning.					
Using PowerApp allows me to develop a critical and reflective attitude towards my knowledge and learning.					
Using PowerApp will help me to provide accurate answers to the customers' needs and questions.					
Using PowerApp would help me to speed up my transactions with customers.					
Using PowerApp will improve my job performance.					
Overall, PowerApp would help the organization to save cost.					
I believe the outcomes of using PowerApp are tangible.					
Using PowerApp is easy for me.					
The PowerApp usage is voluntary.					
The frequency of use with PowerApp is high among the employees.					
I think using PowerApp is completely compatible with my work.					
Colleagues who are important to me would think I should use PowerApp					
My superior would think that I should use PowerApp					
My colleagues are using PowerApp in their work.					
My superior thinks it is important I use PowerApp.					

Please go to the next page

	Agree	Agree somewhat	Not sure	Disagree somewhat	Disagree
Using PowerApp would improve my image within the organization.					
Using PowerApp is a good idea.					
Overall, using PowerApp is a pleasant experience.					
I intend to use PowerApp as a routine part of my job.					
I plan to increase my use of PowerApp in future.					

(ii) What is your opinion about the following items?

	Agree	Agree somewhat	Not sure	Disagree somewhat	Disagree
I could easily use computer and Internet to support my work on my own.					
I would feel comfortable using computer and Internet.					

(iii) How frequently do you use the following activities to solve your problems or learn something new at work?

	Always	often	Some times	Rarely	Never
Asking question from knowledge team members and experts					
Collaborating and discussing with colleagues					
Searching the Internet					
Reflecting on your actions					
Sending email					
Looking up Yammer					
Looking up brein					

Please go to the next page

(iv) If you use Yammer what is your opinion about the learning effectiveness of *Yammer*?

	Agree	Agree somewhat	Not sure	Disagree somewhat	Disagree
I could easily use Yammer to support my work on my own.					
Using Yammer will encourage and motivate me to keep the improvement of my learning.					
Overall, I am very satisfied with the information I am receiving from Yammer.					
Overall, my learning experience with Yammer is very satisfying.					
Overall, Yammer can meet my learning needs, effectively.					
I plan to increase my use of Yammer in future.					

(v) If you use Brein what is your opinion about the learning effectiveness of *Brein*?

	Agree	Agree somewhat	Not sure	Disagree somewhat	Disagree
I could easily use Brein to support my work on my own.					
Using Brein will encourage and motivate me to keep the improvement of my learning.					
Overall, I am very satisfied with the information I am receiving from Brein.					
Overall, my learning experience with Brein is very satisfying.					
Overall, Brein can meet my learning needs, effectively.					
I plan to increase my use of Brein in future.					

Please go to the last page

In order to do in depth analysis, we need to use your real performance in PowerApp. Accordingly, we need to know your employee-no to link the information of this survey to your profile in PowerApp. This information will be used *only for the research purposes* accomplished by a non-Achmea research institute and will not be used for any other reason.

(vi) Personal information:

a) Employee no: ----------

b) Age: ----------

c) Sex: Male ☐ Female ☐

d) Organizational position: Manager ☐ Employee ☐

e) Branche: CBA ☐ FBTO ☐ Team:----------

f) Last educational grade: MBO ☐ HBO ☐ WO ☐ Other ☐

g) Duration of Working in Achmea:---------- years

h) Duration of Working anywhere else:---------- years

List of Publications by the Author

Journal Papers

- Rahimi, E., van den Berg, J., & Veen, W. (2015). Facilitating student-driven constructing of learning environments using Web 2.0 personal learning environments. *Computers & Education*, 81, 235-246.

- Rahimi, E., Berg, J., & Veen, W. (2014). A learning model for enhancing the student's control in educational process using Web 2.0 personal learning environments. *British Journal of Educational Technology*, 780-792.

- Rahimi, E., van den Berg, J., & Veen, W. (2013). Investigating teachers' perception about the educational benefits of Web 2.0 personal learning environments. *eLearning Papers*, 35.

- Rahimi, E., Van den Berg, J., & Veen, W. (2014). A Pedagogy-driven Framework for Integrating Web 2.0 tools into Educational Practices and Building Personal Learning Environments. *Journal of Literacy and Technology*, 15 (2), 2014.

Conference Proceedings

- Rahimi, E., Tampinongkol, S., Sedighi, M., Van den Berg, J., & Veen, W. (2014). Investigating relationship between self-and co-regulatory learning processes in a workplace e-learning system. Paper presented at the 14th Annual International Conference of European Distance and E-Learning Network (EDEN), Croatia.

- Rahimi, E., van den Berg, J., & Veen, W. (2013). A roadmap for building Web 2.0-based Personal Learning Environments in educational settings. Paper presented at the 4th International PLE Conference, Germany. **Selected for the special issue of Journal of Literacy and Technology**.

- Rahimi, E., Van den Berg, J., & Veen, W. (2013). A framework for designing enhanced learning activities in Web 2.0-based Personal Learning Environments. Paper presented at the World Conference on Educational Multimedia, Hypermedia and Telecommunications (EdMedia), Canada.

- Rahimi, E., van den Berg, J., & Veen, W. (2013). A Framework to Support the Negotiation of Control between Teachers and Students in PLEs. Paper presented at the 4th International PLE Conference, Germany. **Selected for the special issue of eLearning Papers Journal**.

- Rahimi, E., Van den Berg, J., & Veen, W. (2012). Designing and implementing PLEs in a secondary school using Web 2.0 tools. Paper presented at the 3th International PLE Conference, Portugal.

- Rahimi, E., van den Berg, J., & Veen, W. (2011). Designing a PLE-based learning system in a secondary school. Paper presented at the 2th International PLE Conference, England.

Curriculum Vitae

Ebrahim Rahimi was born in Lordegan, Iran, on January 25, 1976. Ebrahim received his bachelor's degree in Software Engineering from Isfahan University of Technology (Iran) in 1997. After graduation he joined Taban Niroo Company where he worked as a software engineer from 1997 to 1998.

In 1998 Ebrahim started his MSc program in Software Engineering at the Faculty of Computer Engineering at Amirkabir University of Technology (Tehran Polytechnic). As a part of his MSc thesis he participated in a joint research project with the Iran Telecommunication Research Centre (ITRC) to develop a software simulator to analyse and compare the performance of different channel assignment algorithms in the cellular mobile networks. This joint research project resulted in publishing four journal and conference papers. In 2001 he received his master degree.

After graduation, Ebrahim joined Iran Khodro Company (IKCO), a large car manufacturer in the Middle East, where he has been working as a system analyst, data analyst, and software developer from 2001 to 2005. Additionally, in this time period he translated and published two books titled: *Advanced Visual Basic 6.0* and *Access 2000 tutorial*. In 2005 he joined Shahrekord University (Iran) to supervise and teach software engineering and programming courses for the undergraduate students and direct the IT department of the university. In 2010 Ebrahim received a PhD scholarship from the Iranian Ministry of Science, Research, and Technology and accordingly he joined the Faculty of Technology, Policy, and Management (TPM) at Delft University of Technology to start his PhD study in October 2010.

During his PhD, Ebrahim conducted two design case studies in Amadeus Lyceum and Achmea Company to develop a framework for designing technology-based personal learning environments (PLEs). The outcomes of these design studies, in addition to providing practical contributions to the associated design contexts, have resulted in 10 scientific articles published or presented in peer-reviewed top-ranked journals and conferences including Computers & Education, British Journal of Educational Technology, Journal of Literacy and Technology, and eLearning papers.