1st Workshop on Technology Support for Self-Organized Learners (TSSOL08)

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Self-organised learning in the interactive Web - Changing learning culture?

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Preface

The special track/Workshop on Technology Support for Self-Organized Learners took place in conjunction with the 4th Edumedia Conference “Self-organized learning in the interactive Web – A change in learning culture” on the 2nd and 3rd of June 2008.

The shift from institutionally provided isolated learning environments to learning landscapes that consist of a range of different tools and applications is currently right at the beginning. In addition the internet with its huge offer of different software tools and services has always offered a support-infrastructure for self-organised learning and self-directed learners.

Self-organised learning covers ways of learning, which allow learners -in comparison to traditional educational scenarios-a major dimension of self-determination and self-regulation: self-regulated learning is a self-initiated action that involves goal setting and regulating one’s efforts to reach the goal. Nowadays this way of learning is increasingly supported by interactive learning environments, semantically enhanced content and social software (e.g. Wikis, Weblogs, ePortfolios, Social Bookmarks, Social networks like YouTube, FaceBook, Flickr).

Self-organised learning is pre-requisite for competence based development. This is defined as an activity in which individuals have primary responsibility for the planning, the performance and evaluation of learning activities in order to attain specific learning goals. Although the importance of self-regulated learning has been discussed intensively in the educational field, it has not been an important topic for technology-enhanced learning until today.

The focus of most technological development for learning and competence development was the support of institutions as a provider of learning opportunities. With the widespread acceptance and use of social software this focus is starting to change towards supporting consequently the individual and her/his competencedevelopment throughout life. This change of perspectives has a significant impact on the way learning technologies are envisioned, planned, developed and evaluated. This special track is dedicated to advanced learning technologies supporting the self-directed learner in all phases of competence development.

This special track/workshop was issued under the scientific coordination of the Open University of the Netherlands, the TENCompetence EU Integrated project and Salzburg Research.

We appreciate the work of the contributors to the special track/workshop and we are grateful for the work by the members of the programme committee listed on the next page for their good and accurate reviews.

Salzburg, May 2008

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SELF-DIRECTED ADULT LEARNING IN A UBIQUITOUS LEARNING ENVIRONMENT: A META-REVIEW

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Abstract: In our rapidly changing technological society, formal training alone cannot meet the need for development of working individuals. Self-directed learning is seen as a solution for adult learners to keep up with these changes. Therefore, the aim of this paper is to identify the essential elements of self-directed learning that should be integrated into a ubiquitous learning environment for learning in the workplace. To achieve this, a systematic review on self-directed learning was performed. This produced five elements that support self-directed learning: learner control, self-regulating learning strategies, reflection, interaction with the social world and interaction with the physical world. This study shows that the characteristics of adult learning, as well as those of ubiquitous learning, match with the elements that support self-directed learning. Still, in the development of ubiquitous learning environments some elements of self-directed learning are not used yet. Therefore, the fields of research that focus on learning (e.g. adult learning, self-directed learning) and those that focus on learning technology (e.g. ubiquitous learning) should work towards a more integrated approach in the design of learning environments.

Keywords: technology-enhanced workplace learning, self-directed learning, self-managed learning, self-regulated learning, student centered learning, adult learning, ubiquitous learning

1 Introduction

The world is changing, and it is changing fast. Knowledge is becoming obsolete in this rapidly changing technological society the moment it is learned (Du Bois & Staley, 1997). Apart from the practical issues that accompany formal training, like time away from the job and our rapidly changing society, this is one more reason to support adult learning in the work-situation. In their workplace, working adults face new challenges every day, challenges they cannot meet if they do not keep on learning and developing on the job continuously. These challenges can be seen in terms of the new knowledge, skills and attitudes they need to act appropriately in new situations and in the way they use these. Beckett, Agashae & Oliver (2002) speak of ‘practical wisdom’ when describing the need for adults to achieve ‘understanding’ and not mere skill-acquisition or technical expertise for its own sake. This ‘practical wisdom’ should be structured in workplace learning, where it requires real worksites, real problems and real peers (Beckett, Agashae, & Oliver, 2002; Percival, 1996; Vann, 1996b). Individuals can learn from experience when they can effectively see what changes are involved and how they can be accomplished (Collins, 2004; Karakowsky & McBey, 1999). To do this, they must put their experiences into perspective. This implies that they do gain experience in the real world (external events) and are able to understand what they can do to improve their own performance in similar situations (internal events). The employees should learn to evaluate their self in the role of performing for the organization and to evaluate the required behaviours in the workplace. Development, therefore, grows out of the interaction of both internal/psychological events and external/social events (Karakowsky et al., 1999) and is based on change rather than on stability.

Beckett carefully proposes that technology can be used to support workplace learning. He does fear, however, that the learner may ‘end up alone with the computer’ when using technology. This would not match with his earlier statement that adult learning should take place within a social and physical environment. Looking at articles on ubiquitous learning environments (Hwang, 2006; Liao, Yang, Sun & Chen, 2005) he does seem to have a point: the approach is mainly technological. Looking at the average working place today, it becomes clear that technology is very much part of everyday life and work. Information and knowledge is nowadays handled and shared by using ubiquitous technology; modern information and communication technology that makes it possible to access information ‘anytime, anywhere’ (Adkins, Kruse, & Younger, 2002). A learning environment that makes use of the ubiquitous technology that is already available, would support the learning process that is needed to keep up with new developments (Dieterle, 2005). Working and learning become intertwined, set in the social and physical work-situation.

The technological approach of ubiquitous learning environments assumes that learners are able to learn and will develop themselves in a well-designed learning environment. Exposing learners to meaningful experiences would in this view be enough to stimulate development. As such, this approach only takes one element into account that leads to development: external/social events (Karakowsky et al., 1999). At the same time it ignores the internal/psychological events. A learner can only learn from experience if he can compare these events to his/her experience, see what changes are involved and how they can be accomplished. Some individuals may not need to be stimulated in this internal process, but others may; some people are learners for life on their own accord. They could be supported in their learning by a ubiquitous learning environment, but they would keep on developing even if it was not there. Others do not initiate learning automatically themselves. It might be too ambitious to assume they will develop this way of learning spontaneously when presented with a ubiquitous learning environment. The ability to manage one's own learning is becoming increasingly important. Apart from content-based learning goals, one of the goals of education should, therefore, be to create learners for life (Du Bois et al., 1997).

Learners for life can be described as (mostly) adults who have a flexible and pro-active attitude towards learning and developing themselves. In this context the concept of self-directed learning is often mentioned: the learner is in control of his/her own development and education (Collins, 2004). In relation to this, Collins states that the optimal role of the adult learner is that of a self-directed, self-motivated manager of personal learning who collaborates as an active participant in the learning process and who takes responsibility for learning. Self-directed learning is a method of learning that some adults use in some situations, usually work or hobby-related (Collins, 2004). The question remains if this is something that (some) people develop as they grow older, or if self-directedness can be learned by all learners. At school or university, most students are not taught self-regulating strategies explicitly, so the fact that they are not self-directed learners does not mean they cannot learn to become so. Presuming that there are many elements used in relation to self-directed learning, a classification is needed in organizing the analysis and discussion in this meta-review.

To our knowledge, there is no real classification of elements supporting self-directed learning available yet. Therefore, the primary objective of this study is to gain a comprehensive view on these elements. To achieve this, a systematic meta-review on self-directed learning was done to define the elements that stimulate self-directedness. A secondary aim is to identify the essential elements of self-directed learning that should be integrated into a ubiquitous learning environment for adult learners in their workplace. To do so, the elements essential for a ubiquitous learning environment were identified using a literature study. Subsequently, these elements were matched with the elements of self-directed learning.

2 Data collection

For the systematic meta-review on self-directed learning, a computer search was conducted using the internet database Ovid-PsycInfo, for the period of 1967 to 2007. To identify educational studies, search terms like training and education were used. To find studies about self-organization and self-management terms like self-organized, self-structured, self-regulated, self-initiated, self-managed, self-directed and student-centred, student-driven, learner-driven, learner-organized, learner-initiated, learner-regulated and out of classroom were used. The search resulted in 5287 hits in PsycInfo. Because such a large number of references were found, the terms literature review and meta-analysis were used to narrow down the selection. This resulted in 63 hits.

The search hits were imported into the computer database Reference Manager. Three double hits were removed from the database. The following criteria for selecting studies were used: the objective should be self-directedness in relation to education. Therefore, studies about self-management in relation to illnesses (physical illnesses but also learning disabilities or hyperactivity) were excluded. Furthermore, self-management should be a method of learning, studies in which self-management was a result of training were excluded. On the basis of the abstracts of these 63 references only 18 met the selection criteria. Consensus was reached about the final selection of references. They were studied in full in order to conclude whether they fit the selection criteria. Fifteen of these were used in this study (Henderson & Cunningham, 1994; Meece, 1994; Percival, 1996; Schunk & Zimmerman, 1994; Vann, 1996a; Vann, 1996b; Wexley, 1984) (Hannafin & Land, 1997; Kirschenbaum & Perri, 1982; Oddi, 1983) (Hattie, Biggs, & Purdie, 1996; Hughes, Korinek, & Gorman, 1991; Pereira & Winton, 1991; Risemberg & Zimmerman, 1992; Zimmerman, Greenberg, & Weinstein, 1994). The selection did not include any publications after 1997. To ensure that the literature reviews found are in line with more recent literature on self-directed and self-managed learning, two more recent reviews were included that had not been found in the systematic search (Azevedo, 2007; Schraw, 2007). In retrospect, it was not possible to use better search terms when conducting the computer search.

For the literature study on ubiquitous learning, it was not possible to perform a systematic review. At the start of the study (2007) Ovid-PsycInfo did not include publications on this subject. Therefore, a search alert was placed in Scopus using the terms ‘ubiquitous learning’, ‘u-learning’, or the combination of ‘ubiquitous computing’ with ‘education’ or ‘learning’. In this way, 15 publications (mostly proceedings) were found that provided the essential elements of ubiquitous learning environments (Cho & Kim, 2007; Dieterle, 2005; El Bishouty, Ogata, & Yano, 2006; Hwang, 2006; Klopfer, Yoon, & Perry, 2005; Li, Zheng, Ogata, & Yano, 2004; Liao, Yang, Sun, & Chen, 2005; Mitchell & Race, 2005; Nino et al., 2007; Sakamura & Koshizuka, 2005; Verdejo, Celorrio, Lorenzo, & Sastre, 2006; Williamson & Iliopoulos, 2001; Yang, 2006; Yang, Huang, Chen, Tseng, & Shen, 2006; Zhang, Jin, & Lin, 2005)

3 Results

3.1 General characteristics of the reviews on self-directed learning

Table 1 presents an overview of the outcomes obtained in the recent literature on self-directed and self-managed learning. The years of publication of the reviews lie between 1982 and 2007. This means that self-directed or self-managed learning has been a subject of interest for a long time. The average number of studies reviewed was 46. Nine out of the 17 reviews took ‘adults’ as subjects (Henderson et al., 1994; Kirschenbaum et al., 1982; Meece, 1994; Oddi, 1983; Percival, 1996; Schunk et al., 1994; Vann, 1996a; Vann, 1996b; Wexley, 1984). The other eight looked at students: primary school, secondary school or university. (Azevedo, 2007; Hannafin et al., 1997; Hattie et al., 1996; Hughes et al., 1991; Pereira et al., 1991; Risemberg et al., 1992; Schraw, 2007; Zimmerman et al., 1994). The studies were set in formal training situations. Three reviews (Percival, 1996; Vann, 1996a; Vann, 1996b) discussed self-directedness from a theoretical point of view. The other 14 reviews described experiments.

Vann (1996a) states that self-directedness is something that can be learned by imitating and interacting with others. Good mentors are the role models from whom the novice can learn. The learner can then experiment with behaviours and attitudes which are in turn assessed against his/her reaction and reflection (Vann, 1996b). Percival (1996) objects to the term ‘imitate’. As a constructivist she feels that the word ‘imitating’ gives the impression that the learner is passive. In her opinion self-directed learning is a method of learning in which control by the learner is the central theme. A learner, from her point of view, is an active constructor of knowledge by interacting with his/her social and physical environment. Both authors mention the interaction with the social environment and the active role the learner has, either when trying out new behaviours and attitudes or when constructing new knowledge. Furthermore, they both stress the importance of reflection. According to them reflection is needed to assess the new (learned and performed) behaviour, attitude or knowledge to be able to learn from experience.

The experiments described in the other 14 reviews involve training which was given on one or more element(s), described as indicators of self-directed or self-managed learning. All reviews show that performance improved and learners became more active and in control of their own learning process; they became more strategic and effective learners.

Table 1. Systematic meta-review self-directed learning

1th author & publ.year	No. of studies reviewed	Learning concept	Definition	Elements
ADULTS				
Vann 1996b	4	Self-directed learning	The learner's interaction with others sets the stage for many of her/his experimental behaviors and attitudes, which are in turn tested (assessed) against the individual's reaction and reflection.	Learner control Reflection Social environment
Vann 1996a	33	Self-direction	A person’s being open to new learning and develops a love of learning, independence in learning, informed acceptance of responsibility, creativity, an orientation towards the future and the ability to use basic study and problem-solving skills.	Learner control Social environment
Percival 1996	55	Self-directed learning	A method of learning in which control by the learner is the central theme.	Learner control Self-regulating learning strategies Reflection Social environment Physical environment
Schunk 1994	20	Self-regulation	Strategy use, goal setting, help seeking, self-evaluation, experiences in live social settings	Self-regulating learning strategies Reflection Social environment Physical environment
Henderson 1994	54	Self-regulation	Active participation at metacognitive, motivational and behavioral levels, in one’s learning processes.	Social environment
Meece 1994	54	Student-centered: Achievement goal theory	Achievement goal theory emphasizes the active role of the individual in choosing, structuring and interpreting his or her achievement experiences.	Social environment Physical environment

Wexley 1984	150	Self-management	Stimulus and reward management	Learner control Self-regulating learning strategies Physical environment
Oddi 1983	17	Self-directed learning	Self-directed use of teacher designed learning modules	Learner control Self-regulating learning strategies
Kirschen-baum 1982	20	Self control Self-regulatory study skills	Perceived control Planning, problem solving, self-monitoring, self-evaluation	Learner control Self-regulating learning strategies
		STUDENTS		
Schraw 2007	5	Self-regulation	Metacognition: knowledge of oneself as a learner, as well as the conditions that constrain learning (goal setting, planning, implementing strategies, monitoring, evaluating one's learning)	Self-regulating learning strategies Reflection
Azevedo 2007	6	Self-regulation	Set goals, monitor, regulate and control cognition, motivation and behavior; guided and constrained by goals and contextual features in the environment	Self-regulating learning strategies Reflection Physical environment
Hannafin 1997	124	Student-centered learning	Student as designer. Learning environment should stimulate reasoning, problem solving, critical thinking and reflection	Learner control Self-regulating learning strategies Reflection Social environment Physical environment
Hattie 1996	51	Self-management: Learning or study skills	Cognitive study skills (task-related skills) Meta-cognitive study skills (self-management of learning: planning, implementing, monitoring) Affective study skills (motivation, self-concept)	Self-regulating learning strategies Physical environment
Zimmer-man 1994	57	Self-regulation	Student's awareness of and strategic efforts enhance student's personal perceptions of self-efficacy and intrinsic interest (and thus academic motivation).	Learner control Self-regulating learning strategies Social environment Physical environment
Risemberg 1992	18	Self-regulation	The degree to which individuals are metacognitively, motivationally and behaviorally proactive participants in their own learning process.	Learner control Self-regulating learning strategies

Pereira 1991	55	Self-management	Student-initiated procedures: self-instruction, self-verbalizing	Learner control Self-regulating learning strategies
Hughes 1991	69	Self-management	Self-instruction: students provide their own verbal prompts Self-monitoring: individual's systematically observing his/her own behavior and recording in some way the occurrence or non-occurrence of specific responses	Learner control Self-regulating learning strategies Reflection

Note:
Learner control: Control over educational decisions and learning process.
Self-regulating learning strategies: setting goals, planning, self-instruction, self-monitoring, problem solving, strategy use.
Reflection: self-evaluation of performance and learning process.
Social environment (interaction with): cooperation, collaboration, experiment with new behavior and attitudes.
Physical environment (interaction with): explore in real world, authentic problems, manipulate.

3.2 Definitions of self-directed learning

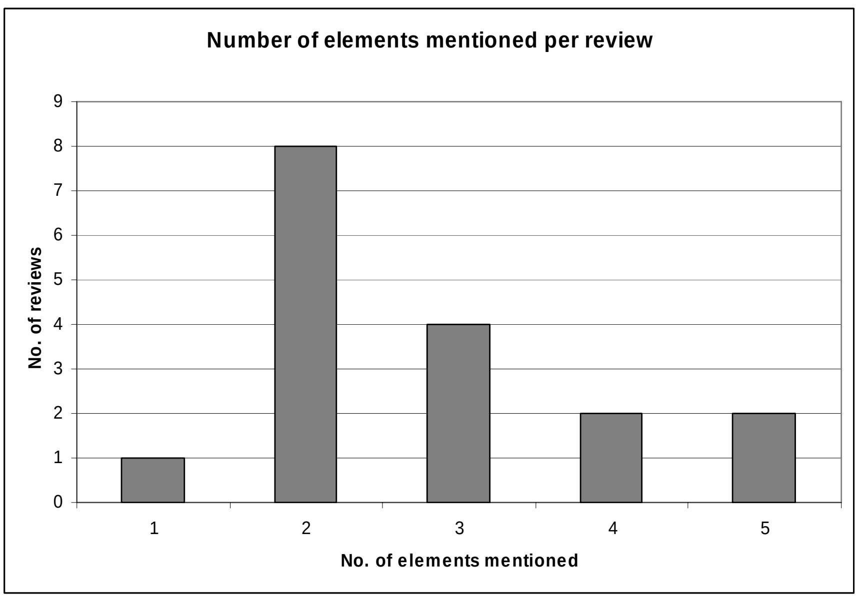
The systematic search was performed on a number of terms. Eleven of the reviews in this study used the term 'self-regulation' or 'self-management' (Azevedo, 2007; Hattie et al., 1996; Henderson et al., 1994; Hughes et al., 1991; Kirschenbaum et al., 1982; Pereira et al., 1991; Risemberg et al., 1992; Schraw, 2007; Schunk et al., 1994; Wexley, 1984; Zimmerman et al., 1994), four used 'self-directed learning' (Oddi, 1983; Percival, 1996; Vann, 1996a; Vann, 1996b) and the last two were 'student-centred' (Hannafin et al., 1997; Meece, 1994). The definitions of self-regulation or self-management, in these reviews, stress the active role of the learner and mention the use of learning strategies, problem solving, goal setting, self-monitoring, self-assessment, self-instruction and, sometimes, reflection. The reviews using these terms all assume that these indicators can be isolated and taught in training. By being able to apply self-managing learning strategies, learners can increase the control over their own learning process. Student-centred approaches emphasize the active role of individuals in choosing, structuring and interpreting their own achievements (Meece, 1994). The learning environment should stimulate reasoning, problem solving, critical thinking and reflection (Hannafin et al., 1997).

In self-directed learning, the heart of all definitions is that the control over all educational decisions is in the hands of the learner (Percival, 1996). In interaction with the environment, social and physical, the learner decides what he needs to learn and how he can achieve this. Not all learners can make these decisions by themselves. To make informed decisions about his/her educational process, the learner needs to develop skills like goal setting, planning, evaluation and reflection. As such, the term self-directed covers both the students-centred approach and self-regulation or self-management and more. Therefore, the term 'self-directed learning' is used throughout this paper.

3.3 Classification of elements of self-directed learning

Five elements of self-directed learning could be identified from the reviews studied: *learner control*, *self-regulating learning strategies*, *reflection*, *interaction with the social environment* and *interaction with the physical environment*. In interaction with each other, these elements stimulate self-directed learning. Only two reviews mentioned all five elements (Hannafin et al., 1997; Percival, 1996), the others limit their study to one or a few of the elements found. This implies that the implementation of self-directed learning can only have been one-sided. Figure 1 shows the number of elements mentioned per reviewed study.

Figure 1: Number of elements that support Self-Directed Learning mentioned in reviews



(1) *Learner control* means that the learner is in control of his/her own learning process. This control works on two levels: on the one hand, the learner has control over all educational decisions; on the other hand the learner can manage his/her own learning.

(2) *Self-regulating learning strategies* are a number of skills that support the learner to manage and monitor his/her own learning process. Examples of these are: setting goals, planning, self-monitoring, self-instruction, self-assessment, problem solving and learning strategies.
(3) *Reflection* is the combination of self-assessment and self-evaluation on both the performance and the learning process that gives the learner insight in his/her own development. By assessing their individual performance, learners can determine if they have reached their own learning goals. This assessment provides input for future learning. Apart from this, the learners can also reflect on the way in which they have achieved their goals. The results of this can also be used when deciding on the direction of future learning. In some studies, reflection is seen as one of the self-managing learning skills, in others it is referred to as an isolated element. The reason for this is that reflection is used at two different levels. On the one hand, students can reflect on cognitive level. On the other hand, they can reflect on meta-cognitive level. Therefore, in this study the choice has been made to identify reflection as an element on its own.
(4) *Interaction with the social environment* can be described as the interaction with others, learners and teacher/coaches, in order to determine what goal should be set, discuss in what way this goal can be achieved, cooperate and collaborate during the learning process and ask for help.
(5) *Interaction with the physical world* is the last element mentioned. This element implies that the learning experience should be set in the 'real world', or a virtual world that is real enough to evoke the real world. The problem, which is the basis for the learning process, should be a 'real-life problem', something the learner could come across in the work situation. Furthermore the learner should be allowed to manipulate the problem and try out possible solutions.

3.4 Classification of elements in relation to reviewed studies

3.4.1 Learner control

Eleven reviews mention the importance of learner control; to develop self-directed learning it is important to activate the learner to make educational decisions and to monitor and manage his/her own learning. Ideally, a self-directed learner has control over all educational decisions (Percival, 1996). This even includes the development of learning activities or the training itself. This is not something that learners are used to: most formal training settings offer little space for learners to be in control; most so-called self-directed training is still ‘*directed*-self-directed training’ (Percival, 1996). It is only in the informal learning situations that learners, usually adults, have control over their own learning process. That might be the reason that self-directed learning is often associated with adults. Gradually, however, the characteristics that were first seen as unique of adult learners are now more viewed as innate tendencies of all human beings that emerge as people mature. The idea behind the experiments described in the reviews is that with the right support (in the right environment), all learners can become self-directed. By teaching self-managing learning strategies, the learner is supported in his/her control over educational decisions because he can then make informed decisions. There is, however, a contrast in the perception of the concept learner control: Percival (1996) states that the learner needs to be in control to be(come) self-directed where the other reviews argue that a learner needs to develop self-directedness in order to be in control of his/her learning process. Another discrepancy is the assumed level of control: the experiments described in the reviews allow only limited levels of control; they are based on formal training in which the subject of training, the content and the period in which these have to be studied have been decided upon beforehand. Percival (1996) supports an interpretation of the concept control in which the learner can exert real influence on his/her education.

3.4.2 Self-regulating learning strategies

As mentioned above, learners should be stimulated to make educational decisions. But in order to make informed educational decisions, learners should be aware of their own learning process, performance and the related learning goals. This awareness is conditional to being in control. In order to develop this awareness, learners require access to adequate learning resources (Percival, 1996). A study on gifted students shows that they, on the whole, use more and more-advanced self-regulatory strategies and carry them out more effectively (Risemberg et al., 1992). Thirteen studies show that when trained in these skills, learners become even better. This implies that supporting learners in the skills of planning, setting goals, use of learning strategies and problem-solving makes their learning more effective (Azevedo, 2007; Hughes et al., 1991; Pereira et al., 1991; Schraw, 2007; Schunk et al., 1994; Wexley, 1984; Zimmerman et al., 1994). They conclude that instructional interventions that increase awareness and self-regulatory strategy-use, help students to become more strategic and effective learners: they can learn to take control of their own learning process, and thus become self-directed learners. The use of hypermedia stresses the need for students to regulate their learning. It greatly increases task demands and requires the learner to stretch limited processing resources across two major constraints: to-be-learned information and the hypermedia environment (Schraw, 2007). Self-management or self-regulation is something that is acquired in stages. These skills are not developed overnight, but rather become refined through repeated instruction and practice (Schunk et al., 1994).

3.4.3 Reflection

Seven of the reviews state that reflection is a critical component to learn from experience (Azevedo, 2007; Hannafin et al., 1997; Hughes et al., 1991; Percival, 1996; Schraw, 2007; Schunk et al., 1994; Vann, 1996b). In this respect, learning can be described as a dynamic process of 'reflection-in-action' where action is used to extend thinking and reflection is governed by the results of action (Hannafin et al., 1997). According to the reviews, reflection contains two aspects: on the one hand, learners should be able to assess their own performance in relation to their goals. On the other hand they should be able to evaluate the learning process itself: the use of self-regulating learning strategies and the cooperation with others.

3.4.4 Interaction with social environment

Eight reviews (Hannafin et al., 1997; Henderson et al., 1994; Meece, 1994; Percival, 1996; Schunk et al., 1994; Vann, 1996a; Vann, 1996b; Zimmerman et al., 1994) explicitly mention the social environment when describing the learning process. Percival (1996) points out that although the word 'self-directed' seems to indicate that learners are on their own, the actual meaning is that they are in control of their learning process (Percival, 1996). In the process of making informed decisions on their own learning process, learners can and do seek varying degrees of assistance from others (Percival, 1996).

Some reviews mention that working with peers has a positive effect on the motivation of learners. Furthermore, they state that cooperation and collaboration also enhance the learning process itself (Henderson et al., 1994; Meece, 1994; Schunk et al., 1994; Vann, 1996a; Vann, 1996b). From a behaviourist point of view (Vann, 1996a) the learner's interaction with others sets the stage for many of his/her experimental behaviours and attitudes: experiences serve as catalysts for the learning process that leads to self-directedness. Constructivists (Percival, 1996), on the other hand, stress the need for cooperation and collaboration during the learning process. In their view it is the dynamic social interaction with others that makes it possible for higher mental functions, like self-regulation, to develop. Apart from these differences, during the learning process, all learners experiment with new behaviour and attitudes. They need live social settings to do this. Self-directed learning should, therefore, be a social activity in a 'natural setting'.

3.4.5 Interaction with the physical environment

Eight reviews (Hannafin et al., 1997; Meece, 1994; Percival, 1996; Schunk et al., 1994) (Azevedo, 2007; Hattie et al., 1996; Wexley, 1984; Zimmerman et al., 1994) mention the interaction with the physical world when discussing self-directed learning. Two of these reviews (Hannafin et al., 1997; Meece, 1994) focuses on student-centered learning in which the learning environment should stimulate reasoning, problem solving, critical thinking and reflection. Schunk (Schunk et al., 1994) stresses the fact that it should be possible for learners to experiment and gain experiences in live settings. The interaction with the physical world serves as a stimulant and a possibility to practise and experiment. A more theoretical approach is that self-directed learning only occurs when there is a felt discrepancy between the self and the real world (Percival, 1996). In an effort to make sense out of their experiences, self-regulating individuals actively construct meaning and transform their understandings of the world. As such, they are active participants in their own learning processes. If they do not feel a 'sense of urgency' to learn, they will not take action. The 'real world' will give them this sense of urgency. If looked at from this view-point, it is essential to take the interaction with the physical world into account when trying to determine the elements of self-directed learning. A learner cannot become self-directed without becoming engaged in a curriculum that allows it to happen. Scenarios, cases or problems should present the learner with a situation in which he/she feels he/she needs more information, knowledge or communication to solve the problem (sense of urgency). This problem should be realistic enough for him/her to want to solve it (Meece, 1994). The learning environment should, therefore, be meaningful and relevant.

3.5 Elements of ubiquitous learning

As stated in the introduction, information and knowledge in the workplace is handled and shared by using ubiquitous technology; modern technology that makes it possible to access information anytime and anywhere.
Most articles on ubiquitous learning environments approach this subject from a technological point of view (Cho et al., 2007; El Bishouty et al., 2006; Hwang, 2006; Klopfer et al., 2005; Li et al., 2004; Liao et al., 2005; Mitchell et al., 2005; Nino et al., 2007; Sakamura et al., 2005; Verdejo et al., 2006; Williamson et al., 2001). This probably stems from the need for advanced technological know-how to create such an environment. They primarily describe the technical requirements such a system should meet. Thus, most definitions of a content-centred ubiquitous learning environment come down to the fact that learning can take place 'anytime and anywhere'; the learner and the way in which he can learn are not taken

into account. A more learner-centred definition of ubiquitous learning states that it is a learning style in which the learner can completely concentrate on the learning process, irrespective of location and time restrictions, computers, contents, interface and communication and forget that there is a computer (Zhang et al., 2005). The learning-process-centred idea of ubiquitous learning is that a network of devices, people and situation must be created that allows learning experiences to play out (Nino et al., 2007). Yang (2006) combined these views when defining ubiquitous learning as ‘characterized by providing intuitive ways for identifying right learning collaborators, right learning contents and right learning services in the right place at the right time’. In this definition, the embedding of learning in a social and physical environment is recognized as important to learning.

Studying these articles on ubiquitous learning, the following six elements could be identified:
(a) *Permanency* in a u-learning environment implies for instance that the work is recorded continuously and saved until deleted
(b) *Accessibility* implies anytime, anywhere availability of the learning environment
(c) *Immediacy* implies learning environments with immediate access to information
(d) *Interactivity* implies that the learning environment supports both synchronous and a-synchronous interaction with experts, teachers or peers
(e) *Situating of instructional activities* implies that the learning is embedded in real life situations.
(f) *Adaptability* implies access to the right information, at the right time, right place and right way.

4 Discussion and conclusion

4.1 The meta-review

The systematic literature review produced a large number of studies on self-directed learning. This shows that self-directed learning has been discussed intensively for a long period of time. It is, therefore, striking that only two of the reviews were based on all five elements that support self-directed learning. This seems to indicate that the theoretical discussion on self-directed learning has not yet found its way to the practical level Experiments were performed on a selection of elements, thus taking a one-sided view.

The literature shows that self-directed learners are more strategic and effective learners. They take control of their own learning process and make their own educational choices. Knowing this, one would like all learners to be self-directed. Reality shows that this is not the case: some people develop a self-directed attitude towards learning, especially in relation to work or a hobby, others do not. This resulted in the question that was raised in the introduction of this article: Is self-directed learning a skill that can be learned or is it a trait that some adults have. Explicitly offering self-regulating learning strategies or tools for reflection and stimulating (perceived) learner control helps learners to become more self-directed. It must, therefore, be the interaction between the elements of self-directed learning that support the learner to develop this skill. The explicit knowledge of learning strategies gives the learner insight in his/her own performance and learning process. On the basis of this insight it becomes possible for the learner to make educational decisions. In other words, this insight is conditional to benefit from being in control.

4.2 The classification

On the basis of the reviews, five elements of self-directed learning were identified: (1) learner control, (2) self-regulating learning strategies, (3) reflection, (4) interaction with the social environment and (5) interaction with the physical environment. The interaction of the elements described above follows from their descriptions. Learner control and self-regulating learning strategies interact because a learner cannot make informed educational decisions without being able to use these strategies. As learning is not an isolated process, being in control of the learning process means that the learner decides when and how he seeks assistance of others. This shows that there is an interaction between learner control and the social environment. The physical world provides the situations and problems that a learner can choose for practice. Therefore, there is an interaction between learner control and the physical world. As mentioned above, reflection is often seen as one of the self-regulating learning strategies. Obviously, they are strongly connected. Reflection can take the form of self-reflection, but others often play a role in reflection as well. Thus, the social environment and reflection often interact. Both the social and physical environment offer input for reflection as well. In this way they also interact. There is a strong connection between the social environment and the physical environment. Often, when the term ‘real world’ is used, a combination of these two environments is meant.
The theoretical reviews (Percival, 1996; Vann, 1996a; Vann, 1996b) discuss that these elements, in interaction with each other, can support a learner to become a self-directed learner. The other reviews describe

experiments in which one or two of the elements were isolated. The learners were then explicitly trained in relation with this element, mostly self-regulating learning strategies and / or reflection. As a result, the learners improved their performance and became more strategic and effective learners. This proves that the elements described above support self-directed learning. In this way the classification is a useful step in describing learning environments that support self-directed learning.
A learning environment that stimulates self-directed learning should, therefore, give the learner control over all educational decisions, support the learner to make informed decisions by explicitly stimulating self-regulating learning strategies and reflection and provide possibilities for interaction with the social and physical world.

4.3 Self-directed learning in a ubiquitous learning environment

Having determined the requirements a learning environment should meet in order to stimulate self-directed learning, it is possible to assess if ubiquitous learning can be used for this purpose. The question that needs to be answered is: Can a ubiquitous learning environment, based on the ubiquitous technology already present in the workplace, stimulate self-directed learning?

Comparing the characteristics of the elements of self-directed learning to those of ubiquitous learning shows that there are many similarities between the two. In Table 2, the elements of ubiquitous learning are presented next to the elements that support self-directed learning. These ubiquitous learning elements were found in the articles on ubiquitous learning environments mentioned before. Most elements that support self-directed learning are present in ubiquitous learning environments. Only the explicit teaching of self-regulated learning strategies and reflection cannot be found in the described characteristics of ubiquitous learning. Furthermore, the concept learner control is limited to ‘anywhere & anytime’, which has little to do with a learner who can decide what and how he/she wants to learn. Ubiquitous learning environments can be used as learning environment to stimulate self-directed learning with adults, if attention is given to the incorporation of the elements: learner control, self-regulating study skills and reflection.

Table 2. Combination of the characteristics of self-directed learning and Ubiquitous Learning Environment

Characteristics of elements of Self-Directed learning	**Elements of Self-Directed learning**	**Elements of Ubiquitous Learning**	**Characteristics of elements Ubiquitous Learning**
Control over all educational decisions Control over own learning process	Learner control	Permanency Accessibility Immediacy	Work is recorded continuously, saved until deleted Anytime, anywhere Immediate access to information
Setting goals, planning, self-instruction, self-monitoring, problem solving, strategy use	Self-regulating learning strategies	-	-
Self-evaluation of performance and learning process	Reflection	-	-
Cooperation and collaboration with peers	Interaction with social environment	Interactivity	Synchronous and a-synchronous interaction with experts, teachers and peers
Learner should be allowed to explore and manipulate in the real world, authentic problems	Interaction with physical environment	Situating of instructional activities	Learning embedded in real life
-	-	Adaptability	Right information, right time, right place, right way

The control over all educational decisions which lies at the basis of self-directed learning is also the most important characteristic of ubiquitous learning. When learning can be done ‘anytime, anywhere’, it is the learner who decides, so she/he is in control. Sometimes the learner can choose between different ways of training to reach the same learning goal, but this is not very common. Ubiquitous learning does not by definition give the learner the possibility to choose what or how he wants to learn. The concept of self-directedness does explicitly include this choice. A ubiquitous learning environment for working adults reflects the workplace and is preferably part of it. It should, within these boundaries, provide the learner with the possibility to choose what and how he/she wants to learn. This can be achieved by creating an environment in which many, different assignments, databases with information, and possibilities for cooperation help the learner to reach his/her own learning goals. The assignments should differ in their degree of complexity, the learning goal they specifically support, and the kind of activities that follow from them. In this way, the learner is truly in control: he/she can phrase his/her own learning goal(s), decide when he/she wants to do an assignment, what kind of assignments he/she wants to do, and what degree of complexity suits him/her most.

The interaction with the social environment as described in self-directed learning is exactly the same as the characteristic interactivity used in ubiquitous learning. Both state that learning is a social activity: learning with others is a source of motivation, but cooperation during the learning process also improves the performance. The social environment can be incorporated into the ubiquitous learning environment by stimulating learners to do assignments in pairs (or teams) or by facilitating virtual cooperation. Again, ideally, the learner should be able to choose between the two. Virtual cooperation should be supported in two ways: first of all, learners should be able to communicate with other learners, who happen to be on-line at the same moment, through phone, chat or e-mail. Apart from that a database of profiles of learners as well as experts should be provided. These profiles should include background information, expertise, contact details and a picture or photo. On the basis of this database, learners can decide who they would like to contact.

The last element of self-directed learning that is described is the interaction with the physical environment. This element means the same as the situating of instructional activity used in ubiquitous learning. Both characteristics imply that learning should take place in the real (or virtual-real) world, with authentic problems. The learning environment as well as the assignments within it, should be integrated in the work-context or resemble it enough.

The two elements that are not mentioned in ubiquitous learning: self-regulating learning strategies and reflection, should be incorporated into the ubiquitous learning environment (Azevedo, 2007; Schraw, 2007). This could be done within the learning environment: the use of learning strategies and reflection can be stimulated by the (virtual) collaboration and cooperation with peers or by leading questions the learner is confronted with during the learning process (virtual teacher). Apart from that, explicit information on learning strategies and their use should be made available in the learning environment. In the example of learning goals, this means that the learning environment should explain what learning goals are, support the learner to choose of phrase a learning goal, and stimulate the learner to reflect on his/her development regarding the chosen learning goal. The same method can be applied for planning, virtual cooperation, self-monitoring reflection and self-assessment. To stimulate self-assessment learners should be able to compare their own solutions with those of other learners and experts.
Because the learner is assumed to be in control of his/her learning process, he/she should be able to decide for him/herself whether and when he/she wants to use this support.

One characteristic of ubiquitous learning is not mentioned in self-directed learning: adaptability. This characteristic is typical of a context-aware ubiquitous learning environment. For the design of adaptive learning environments it is crucial to understand the characteristics, experiences, attitudes, and needs of the learners (Laak, Veldhuis, & Veerman, 2002; Wang & Newlin, 2000) However, it is unclear how they can be used to engage learners in specific instructional contexts in a ubiquitous learning environment. By indicating his/her own interests and expertise, a learner can structure the information and the contacts that are available to him. The technical environment should also provide supportive information on the location of the learner. In this way a learner has control over the information that reaches him. Future research needs to identify how an adaptive learning environment can contribute to self-directed learning.

The interaction with the physical world is mentioned as one of the five elements that support self-directed learning. In the case of working adults, what better real world can there be than their own work-situation (Beckett et al., 2002; Collins, 2004; Karakowsky et al., 1999). The reviews studied, however, were all set in formal training situations. Furthermore, it was interesting to notice that, although self-directed learning has been an important topic in the educational field for quite some time, no reviews on adult learning in the workplace or technology-enhanced learning for adults could be found. The search was limited to reviews; it is, therefore, unclear whether the reviews were representative for all studies on self-directed learning. Because the focus of the reviews studied is on formal training situations, they do not provide information on the integration of learning and working. Looking at the characteristics of adult learning as described in the introduction: learning should take place in a social and physical environment and learners should be able to assess their own performance as well as the demands made by the organization, it can be concluded that adult learning can be supported by self-directed learning; this should lead to more motivated learners. They will recognize the problems they are asked to solve and will be able to try out solutions. In situations where this would be too dangerous or expensive, a virtual world could be used. The advantage of using a ubiquitous learning environment is that learning can take place anywhere and anytime. It is a more flexible way of learning, and the learner is much more in control. But genuine control follows from the freedom to make educational decisions. So, a ubiquitous learning environment that integrates learning and working and allows for this freedom to choose should have a short-term positive effect on performance and a long-term positive effect on self-directed learning.

4.4 In conclusion

This study shows that the characteristics of adult learning, as well as those of ubiquitous learning, match with the elements that support self-directed learning. It seems, however, that in the development of ubiquitous learning environments only a limited number of the elements that support self-directed learning are incorporated (in various combinations). Especially the element learner control should be exposed. Therefore, the fields of research that focus on learning (e.g. adult learning, self-directed learning) and those that focus on learning technology (e.g. ubiquitous learning) should work towards a more integrated approach in the design of learning environments. Key aspects from both research areas are complimentary and a more complete integration of the two would lead to ubiquitous learning environments that suit (adult) learners better. As we see it, it will be a challenge to try and build a ubiquitous learning environment that really incorporates all the elements that support self-directed learning and the characteristics of adult learning.

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Visualisation of interaction footprints for engagement and motivation in online communities – results of first interviews

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Abstract: Contextualised and ubiquitous learning are relatively new research areas that combine the latest developments in ubiquitous and context aware computing with educational approaches in order to provide structure to more situated and context aware learning. The majority of activities in contextualised and ubiquitous learning focus on mobile scenarios, in order to identify the relation between educational paradigms and new classes of mobile applications and devices. However, the meaning of context aware learner support is not limited to mobile learning scenarios by default. The educational paradigms of situated learning and communities of practice highlight these needs for informal learning and for workplace learning. In this paper we analyse learner participation as a contextual dimension of adapting graphical indicators for engaging and motivating learners in participating and contributing to an open community of practice. For this purpose we analyse six interviews with selected participants of that community. We compared the reactions of the learners who were provided different indicators during their interactions with an online system. The results of these interviews illustrate the impact of small variations in the aggregation and visualisation of interaction footprints on the engagement of learners at different contribution levels.

Keywords: Awareness Support, Context-aware Systems, Evaluation, Informal Learning, Learner Support

1 Introduction

Contextualised and ubiquitous learning are relatively new research areas that combine the latest developments in ubiquitous and context aware computing with educational approaches in order to provide structure to more situated and context aware learning. The majority of activities in contextualised and ubiquitous learning focus on mobile scenarios, in order to identify the relation between educational paradigms and new classes of mobile applications and devices (Naismith, Lonsdale, Vavoula, & Sharples, 2004). However, the meaning of context aware learner support is not limited to mobile learning scenarios by default. The educational paradigms of situated learning and communities of practice (Lave &

Wenger, 1991) highlight the need for contextualisation of informal learning, particularly where the learning activities are related to the workplace or to other social environments. In these scenarios learning processes are often unstructured, unguided, and sometimes even unintended.

In this paper we analyse learner participation as a contextual dimension of adapting graphical indicators for engaging and motivating learners in participating and contributing to an open community of practice. The purpose of the research underlying this paper is to identify variables and conditions for selecting and adapting visualisations of "interaction footprints" (Wexelblat & Maes, 1999) in order to facilitate context sensitive learner support in unstructured learning environments. An unstructured learning environment is best described as an environment in which learners interact at different expertise and activity levels where participants have changing or implicit roles, and interact without guidance of an expert or a pre-defined curricular structure.

For this purpose, we conduced an experimental study, using the team.sPace environment (Glahn, Specht, & Koper, 2007) and interviewed selected learners who participated in this study. In this paper we analyse the results of these interviews. However, before we proceed with the data, the following sections provide an overview of the related research, the underlying research question, a more detailed description of the team.sPace environment, and the hypothesises that were investigated by this study.

2 Background of research

Wexelblat & Maes (1999) showed that interaction footprints of users support peers to navigate through unknown information. Interaction footprints are traces that are left by a user while interacting with a system. In most cases these interaction footprints are stored in server log-files and remain unused. Wexelblat & Maes' idea of utilizing interaction footprints to support navigation and the identification of relevant information, is underlying most approaches to social recommendation in technologically enhanced learning (Drachsler, Hummel, & Koper, in press). Dron, Boyne, & Mitchell (2001) utilize this approach for a system that supports explorative learning on the web, which comes closest to the use of interaction footprints in informal learning. Recently, Frazan & Brusilovsky (2004) captured and analysed different kinds of interaction footprints in order to improve the quality of adaptive annotations.

Dey & Abowd (1999) define context aware systems, as systems that "provide relevant information or services to the user, where the relevancy depends on the user's task”. Zimmermann, Specht, & Lorenz (2005) indicate that interaction footprints are important sources for contextual information. Newer findings of Zimmermann, Lorenz, & Oppermann (2007) identified five dimensions of context information, among which time and activity refer to processes as contexts of users.

Butler & Winne (1995) reported that environmental responses on actions are crucial to learners for controlling and structuring their learning process, and introduced a system model of the cognitive processes that are crucial to self-regulated learning. According to the authors, the result of these cognitive processes is the learner's decision whether and how to proceed with their interactions with an environment. This implies that the responses on the learners' activities affect the quality, pace, and duration of their future learning activities, which includes also the option of dropping out.

Although the model proposed by Butler & Winne model looks as a simple input-output model at the first sight, it is an evolutionary model, because the model includes the self-regulating capabilities of the learners to the responses given by an environment. The actions and reactions of the learners are aligned to their past experiences and are integrated into their “knowledge”. This implies that the learning process is not a constant process, in which each response has always the same effect. Instead, the learner's experiences are evolving, which affects the interpretation of external responses on a learner's actions. This is a well known effect in workplace related competence development (Wenger 1999; Elkjær, Høyrup, & Pedersen, 2007; Chisholm, Spannring, & Mitterhofer, 2007), and has been referenced by Knut Illeris (2003) with the expressive article title “learning changes throughout life”.

Erickson & Kellogg (2003) provide some examples of supportive visualisations of interaction footprints with regard to social information about online spaces, such as discussion forums. Such “social proxies” – as the authors call these visualisations – are “minimalist graphical representations that portray socially salient aspects of an online situation” (Erickson & Kellog, 2003). These indicators present the status of, and the relations between participants in an online environment. While doing so, social proxies are not limited to a general view of these parameters, but also visualises the social dynamics relative to a social space. One effect of presenting social information without recommending learning activities or navigational behaviour has been reported as “waylay”. “Waylay refers to the practice in which a user monitors the Cookie [a social proxy] for signs of another person’s activity […], and then initiate contact.” (Erickson & Kellogg, 2003) The concept of waylay is different to what has been described as stigmergy (Dron, Boyne, & Mitchell, 2001). While stigmergy refers to pathways of activities that emerge through collaborative activities, waylay refers to virtual landmarks which are used by users to structure and plan their social activities themselves.

While “waylay” is related to a user’s observations of public (virtual) spaces, Kreijns (2004) identified a similar effect related to group awareness indicators on distributed activities of peer users. The author calls this effect “social affordance”. Social affordance has been observed with indicators that display the activity of other users within an online environment. Different to social proxies, these indicators provide informations about the activities of users relative to the activities of their peers, without providing information how these activities are interrelated.

Social affordance refers to information that stimulates acitivities that are aligned to the social practice within a collaborative environment. According to the author social affordances create and depend on two relationships between the learner and the environment: the “reciprocal relationship” and the “perception-action coupling”. The reciprocal relationship is based on the social intentions of a learner and on how meaningful an environment can respond to these intentions. The perception-action coupling refers to the connection of the learners' recognitions of their environment, including the actions that they will perform in accordance to it (Kreijns, 2004).

Previous research (Glahn, Specht, & Koper, 2008) has shown that most visualisations of interaction footprints are limited to a single approach for data aggregation and visualisation. Another finding of this research was that these approaches have been evaluated in structured learning environments. However, given to Butler & Winne’s model using static approaches of learner support in competence development appears not sufficient with for the learners’ cognitive self-regulation processes, and to the learners' changing needs for information on their overall learning progress.

In order to facilitate more adaptive responses based on interaction footprints an architecture for adaptive collecting, aggregating, and visualising interaction footprints has been proposed (Glahn, Specht, & Koper, 2007). This architecture defines a structured way of defining, retrieving and visualising attention meta-data, which are based on aggregations of interaction footprints. Adaptation strategies can get defined on top of the generated data. For testing the effectiveness of this architecture for supporting engagement and reflection in informal learning an the initial scenario has been described. For this scenario several “good” contextual boundaries have been assumed for adapting the visualisation of interaction footprints. However, these assumptions lacked of empirical evidence regrading their effectiveness to structure and to support informal learning processes.

3 Question for Research

Motivating this research were the empirical shortcomings of the solution which has been proposed by Glahn, Specht, & Koper (2007). The authors discuss support for learners in informal learning on two levels, namely “engagement and motivation” and “reflection”. Our research focussed on “engagement and motivation”, by addressing the question, *whether the reception of the visualisation of interaction footprints changes the engagement and motivation in participating in group activities for learners at different participation levels.*

With regard to this research question, we were particularly interested if the effects of “waylay” (Erickson & Kellogg, 2003) and “social affordance” (Kreijns, 2004) are dependent to the participation level of a learner in an online community.

4 team.sPace

In order to get a first idea about structuring and adapting visualisations of interaction footprints to the users' style of contributing to the community, we used a modified version of the originally described team.sPace system (Glahn, Specht, & Koper, 2007). Using this version of team.sPace we conducted a three month experiment within our department. Figure 1 shows a typical view of team.sPace for an authenticated user.

team.sPace is an information portal for online communities of practice, which jointly form a larger learning network (Jochems & Koper, 2005). Each community in team.sPace is founded around the topics and the interests of their users. The participation in team.sPace is open, which means that users can register and set their personal information as they would do, if they were using another social software on the web.

Taking a more technical perspective, team.sPace fetches news feeds about web-log entries and social bookmarks of its registered users, it aggregates the information provided by the feeds, and presents this information to the members of a group. In addition to this basic function, team.sPace embeds features for stimulating the users engagement in the community, and facilitates reflection on the user's contribution and reading interests. These additional features take up the concepts of social proximity (Erickson, 2007) and group awareness (Kreijns, 2004; Kreijns & Kirschner, 2002).

Glahn, Specht, & Koper (2007) described an adaptation strategy for indicators about interaction footprints. This adaptation strategy adapts the aggregation and visualisation of low-level interaction data to a user's contribution level. With regard to engagement and motivation two visualisations of interaction footprints were integrated into the system. These visualisation are sequenced by the adaptation strategy in a way that a team.sPace user would see only one of these indicators at a time.

For testing the contextual conditions for the adaptation strategy we removed the initially implemented adaptation strategy and made each indicator available only to one user group. The assignment of an indicator was static, which means that the users received only one visualisation of their interaction footprints for the entire period of the experiment. Apart from the different indicators about their interaction activity all participants used the team.sPace in the same way. The modified version of team.sPace has two indicators.

Figure 1 Screenshot of team.sPace with authenticated user

The first indicator is an activity counter. This activity counter displays the interaction footprints of a participant. Each action of a participant is counted; and all actions have the same impact on the visualisation. The activity is visualised in a horizontal raster bar-chart (see Fig 2). This bar-chart does not grow homogeneously with each activity. Instead, the user has to “earn” each field of the raster with a pre-defined number of actions. With an increasing number of earned fields more actions are required to earn a new field.

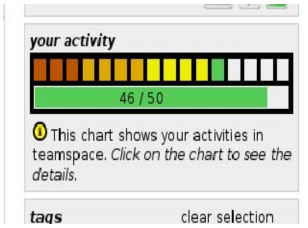

Figure 2 activity counter in use

The second indicator extends the first indicator in three ways. Firstly, it values the different activities with a factor that is multiplied to the user's activity points for that activity. This means that the activities have a different impact on the activity of the participant. For example a blog entry is worth ten points while selecting a link is worth a single point, only. Secondly, the activity is not displayed in absolute terms, but relative to the activity of the most active user in the group. Finally, the indicator integrates a second bar, which charts the same information for the average participant of the community. The performance indicator is shown in Fig. 3.

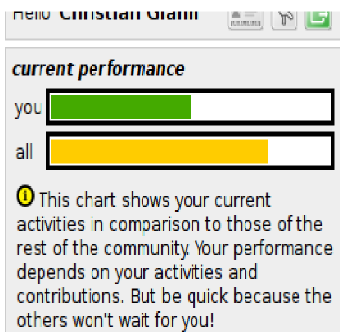

Figure 3 the performance indicator in action.

Both indicators reflect only the actions within the last seven days. This forbids users to pile-up actions and keeping their status while being inactive. Furthermore, if the participants click on an indicator it will open a small overlay window, that shows the sources and the values in detail which were visualised by the indicator.

5 Hypothesises

With the experiment we intended to analyse the relation of visualising interaction footprints and user engagement and motivation at different stages of the learning process. According to our previous considerations on self-regulated learning and context adaptation in the background section of this article, we formulated four hypothesises.

1. The activity counter is stimulating engagement for non-contributing users.
2. The activity counter will be ignored by contributing users after an initial phase of using team.sPace.
3. The performance indicator is stimulating engagement and motivation in participating in the environment for contributing users.
4. The performance indicator is distracting for non-contributing users.

The four hypothesises refer to the adaptation pattern, in which non-contributing team.sPace users receive activity indicators, and contributing users receive a performance indicator. Regarding the interviews we expected to receive answers that will provide a first idea if these hypothesises are supported by the representing users for each subgroup of the experimental group. This provides insights on the quality of the selected adaptation pattern.

6 Method

In order to come as close to the learning processes within a community of practice, the experiment has been conducted with the participation of selected researchers of a research department at the Open University of the Netherlands. The participants have been selected according to the similarity of their research topics, while previously these persons were not collaborating intensively with each other.

30 persons were contacted for participating in the experiment. They were asked to participate voluntarily and use team.sPace for a period of three months, in which they should set team.sPace as the start up page of their web browser. From the persons who have been asked for volunteering, 15 finally registered themselves to team.sPace and participated in the experiment. Each participant has been automatically assigned to use one of the two indicators, in order to guarantee that about the same number of users were assigned to both indicators. For the experiment nine users were assigned to the performance indicator and seven were assigned to the activity indicator.

Once the participants have registered they were asked to fill a questionnaire about their previous experiences with social software, about the way how they use web2.0 tools in their research activities, and about their group awareness. Additionally, to the questionnaire, all interaction footprints of all requests have been stored in a database. These interaction footprints include the reading activities, the contribution activities, information retrieval activities of on-site browsing, and interaction detail retrieval activities. Finally, six users who represent specific user types have been selected for interviews in which they report in a free form about their experiences in using the system.

In this paper we report report about the first responses from the interviews. We selected six participants, who were interviewed individually in a face to face meeting. We interviewed three participants for each indicator, where one has been fully contributing to the community, one has been contributing only social bookmarks, and one did not contribute at all. We selected our interview partners according to the frequency of using the system, according to their user type, and according to the treatment that they have received. All interviews were semi-structured and were between 20 and 30 minutes. During this time frame we asked the participants to reflect about their use of team.sPace, about the parts of the system which they liked and disliked, and about their impression of the indicator that was available to them.

7 Results

As already mentioned, 15 participants contributed to the experiment. Five participants registered their research web-log in team.sPace, nine participants registered their nick name for delicious, and six participants can be considered as team.sPace readers, as they did contribute neither via web-logs nor via social bookmarks. All participants who were contributing their web-log, were also contributing delicious bookmarks. 13 participants filled the questionnaire, of whom nine stated to have prior experiences with various kinds of social software. The contributors have posted 1303 bookmarks and 108 web-log entries over the three month period of the experiment. During this period the team.sPace portal has been visited 926 times by authenticated users. The participants followed 331 times a link to a contribution and used 389 times a tag of the tag could to filter the information for a specific topic. During the experiment the participants checked 137 times the detailed information of their indicator.

This data indicates that team.sPace has been mainly used as a group awareness tool that provides a quick overview about the dynamics in the group. This impression has been confirmed by all participants we interviewed.

All interview partners replied on the first question about their general use of the system, that they frequently visited the portal, but they admitted that quickly after the beginning of the experiment they stopped using it as a start-up page of their browser. Instead they visited the page when it suited their working schedule. In these cases they checked what the other participants were bookmarking or posting on their web-logs. Nevertheless, they followed links only, if its abstract was interesting.

The interviewed participants reported that they liked the content organisation of team.sPace for providing a quick overview of the topics the other group members were dealing with. The participants that were contributing social bookmarks and web-logs reported that through team.sPace they started to estimate features of the external systems that they used prior to the experiment, already. An example of such experiences was the ability to comment bookmarks in del.icio.us. Although adding notes and comments to bookarks is an integral feature of all bookmarking systems, it is rarely used by default. However, in a group context, the comments can be used to highlight special features of a URL that is relevant to the community. Another example was provided by two participants: they reported that they learned about the value of social bookmarking when it is used within a group. Realising this was mentioned as a surprise by one participant, because the participant used del.icio.us for some time before the launch of team.sPace.

With regard to the general use of the system, the participants who received the performance indicator were also focussing more consciously on the quality and quantity of the contributions of the other users. One contributing participant was complaining about link “stealing”, when others bookmarked links that were previously posted by that participant on team.sPace and – from the perspective of that participant – received performance points for that. The other contributing participant was contributing only social bookmarks and mentioned that the “bloggers” were “ruining” the performance by posting three or four postings almost simultaneously.

For the participants from the activity indicator group none of the interviewed contributors mentioned their recognition of such dynamics on team.sPace during the interviews. However, the participants of this group reflected more about their experiences with the usability and the interface functions of team.sPace.

All interviewed participants reported that they disliked the content browsing feature of team.sPace. They found the collaborative tag cloud little helpful to find the contents they were looking for. One participant reported that it was not able to find a contribution via the tag cloud, although the participant remembered that the entry was on team.sPace. The participants would have also liked to see the tags that were related to an entry. Furthermore, the participants were requesting a peer information feature, that provides a link to the user's blog, a link to the bookmarks on del.icio.us, user based content filtering, or the tags that were used by another participant. Finally, the authentication procedure was not well received by the participants.

With regard to the question, how the participants experienced the indicators that were displayed to them, the two groups responded very differently. Those participants who were seeing the activity indicator, responded that they checked their indicator at the beginning of the experiment, and used it for finding out how the indicator responds to which interactions. Two within this group even “admitted” that they “tricked” the system to gain more points. However, for all three participants of this group the indicator lost its attraction after a while and the all three participants used team.sPace mainly as a working group news portal, and in case of the contributors they contributed at their own pace. The participant, who was contributing bookmarks and web-log entries, stated that the indicator was “irrelevant” for visiting the portal.

The user group who received the performance indicator answered differently. At the beginning of the experiment all three participants reported similar to the first group that they were playing around with the system in order to get familiar with the impact of their activities on the indicator. Because the underlying aggregator weights the different activities, it is more challenging for non-contributors to keep their performance up with the group. The non-contributing participant of this group reported this experience as “frustrating”, because the “bloggers” and “taggers” get all the points while the own activity chart hardly takes off. In this particular case this frustration lead to a counter reaction: the participant created a new del.icio.us account and posted a few links in order to see their impact on the performance. After the short reaction phase the participant did not post any new links, but dropped out of the experiment.

The contributing participants perceived the performance indicator more positive and connected it to the challenge of keeping up and out perform the community. In the interview both participants even asked if the indicator was displaying random information, because sometimes they estimated their performance better than what the indicator displayed. Nevertheless, both participants managed to become superior to the group and gain a maximum peek on the chart. According to the participants, this was very satisfying. The participant who contributed only bookmarks via del.icio.us made this even a personal objective, which was reported as “pretty challenging” because of the random “waves” of web-log postings. Both participants reported that they followed the dynamics of the contributions carefully, as they related them to their impact on the performance indicator. Besides this generally positive connotation, both participants also mentioned that while they were “under performing” the indicator was a constant reminder. The participant who contributed both, bookmarks and web-log entries, reported “high pressure” in those cases when the personal performance chart was dropping and there was no time for new contributions due to other obligations.

8 Discussion

Results from interviews always provide weak evidence for validating hypothesises. However, they can provide first impressions about what we can expect from quantitative data. In case of team.sPace the interviews unveiled differences about the emotional affect of the indicators regarding the engagement and motivation in contributing to the portal.

While both groups were initially attracted by understanding the relation between their activities and the visualisation of the indicator, after the initial phase of using the system the participants from the activity counter group were less engaged on an emotional level. Instead their responses focussed more on the general functions and usability of team.sPace. Particularly the responses from the contributing participants support hypothesis 2, whereas hypothesis 1 has weak support, because the participant did not respond negatively on the effect of the indicator but gave no clear statements regarding a positive effect, either.

The responses of participants from the performance indicator group had a greater emphasis on recognising the group dynamics with a strong relation to valuing mechanisms of their activities related to team.sPace. With that regard, the responses of the contributing participants support hypothesis 3. Although the non-contributing participant acted proactive as a reaction to the “bad performance” shown by the indicator, the reported “frustration” supports hypothesis 4.

That the hypothesis 3 and hypothesis 4 are supported has an important implication for the concept of social affordance. The participants at different contribution levels responded differently regarding the indicator that displayed additional social information to the learner. Therefore, it appears that the social affordance of this indicator varies in different contexts. In our specific case, we identified from the reactions of our interview partners that contributing to a community is a contextual variable that affects a participant’s way of interpreting social activity information and reacting to it.

9 Conclusions and further researchs

In this paper we analysed six interviews with selected participants of an experiment of using the visualisation of interaction footprints engagement and participation in an online portal. The goal of the study was to analyse learner participation as a contextual dimension for adapting graphical indicators for engaging and motivating learners in participating and contributing to an open communities on the web. For this purpose we interviewed users who participated in a quasi-experiment in which two user groups received different visualisations about their interaction activity.

We compared the reactions of learners who used an activity counter that visualises only the interaction footprints of the learner who sees the indicator, with those of learners who used a performance indicator that visualises the same information in relation to the rest of the community. Of course, the results of interviews do not provide "hard" evidence of contextual variables, but they illustrate the impact of small variations in the aggregation and visualisation of interaction footprints on the engagement of learners at different contribution levels.

The important finding of this qualitative study is that the concept of social affordance (Kreijns, 2004) appears to be context dependent. However, further analysis of the available data and more focused research into that direction is therefore required for providing more evidence on these preliminary findings.

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Multichannel Self-Organized Learning and Research in Web 2.0 Environment

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Abstract: This paper explores the functionalities of the start pages and considers their usefulness for deployment as learning and research environments for self-organized learners. The start pages' comparative analysis is done according to created criteria, focused on availability of the authoring, syndicated information, communication, collaboration and networking, research, and evaluation tools. The purpose of this evaluation is to propose a solution of a multichannel environment that can support self-organized learners in their learning process and knowledge construction. The importance of the environments for performing a broad set of activities and for producing rich learning experiences is examined from the point of view of learning design. The prototype of a learning and research multichannel environment is provided in Netvibes and Pageflakes.

Keywords: self-organized learning, web 2.0 technologies, multichannel environment, learning design, start pages

1 Introduction

eLearning is a strategy for learning that employs a wide range of technologies, tools and systems that support knowledge increase and skills improvement at times and terms defined by each learner. It has been the first area to benefit from the Web 2.0 principles (O'Reilly, 2005), which have recently been explored by many educators and researchers due to their possibilities for adoption in the learning process (Hinchcliffe 2006, Woodill 2007, Anderson 2007). The new tools and services such as blogs, microblogs, wikis, podcasts, social bookmarking, start pages, mashups, resource sharing, RSS/Atom syndication and social networks enable and encourage informal conversation, collaborative content generation, and the sharing of information, giving the learners access to a vast array of ideas and representations of knowledge (Rosen 2006, Alexander 2006, Kozlowski, 2007).

The second phase of eLearning based on the Web 2.0 technologies is coined by Downes as eLearning 2.0 (Downes 2005) the features of which are summarized after analysis of the Web 2.0 principles in Table 1. This analysis allows making main statements about the implications of eLearning 2.0 for supporting self-organized learners: eLearning 2.0 facilitates the active role of the learner in content, applications and services authoring; assists in knowledge and information capturing, sharing and publishing; Supports the performance of self-organized web-based learning activities and personal creativity; forms a bottom-up and less control-oriented learning culture; gives greater leverage of "collective intelligence" to create learning experiences; facilitates easy starting and building of learning environments; facilitates dynamic learning in multichannel environments, with multiple sensory inputs and many different sources of experience.

Table 1. eLearning 1.0 and eLearning 2.0 main features

eLearning 1.0	eLearning 2.0
Learning in a Web medium – the learner transmits and consumes information	Learning in a Web platform – the learner is an author and co-author - content is created, shared, remixed, repurposed, and passed along
LMS, LCMS – require installation, administration, and maintenance	Free hosted eLearning 2.0 systems, start pages, blogs, wikis, Social networks
The course is designed for the main mass of learners	Long tail and snowflakes effects are related to personalization
The main part of LMS and LCMS are not service-oriented	Free and easy access to services – stimulate participation. Network effects - increase in value of a service in which there is some form of interaction with others
Taxonomy – subject indexing by expert, the learning resources are created in top-down, one-way methods	Folksonomy (social bookmarking) - collaborative categorization of learning resources - bottom-up, learner-driven, peer learning, many-to-many methods
Personal home pages – static presentation	Social software – wisdom of crowd - contribution is encouraged
Overload information, static web pages	RSS, mashup allows learner dynamic organization of right learning resources, individual creativity
Software as an artifact, only for usage in the final version	Software as a service, the perpetual beta – activate innovations in learning and the learner can be in the role of a software co-developer
Coordination of the component's system	Loosely coupled systems – flexible, personalized, adaptive learning
All rights reserved	Some rights reserved – remixible, reusable resources
CD, Web-based learning content	Bring web content to portable devices, podcasting
Web-based applications with "thin" client, desktop applications	Web-based applications with rich user interfaces and PC-equivalent

In this paper the possibilities of start pages for supporting self-organized learners through tools, services, and applications is explored. The comparative analysis of fourteen start pages is performed according to a proposed methodology. The aim of this evaluation is to define a solution for multichannel learning and research environment. The importance of such environments for performing a broad set of activities and for producing rich learning experiences is examined from the point of view of learning design. The gained experience with start pages Netvibes and Pageflakes is provided as one practical example of built learning and research multichannel environments.

2 Used methodology

The comparative analysis of start pages is performed with the goal to select solutions for deployment of learning and research environments for self-organized learners. The methodology comprises: (1) investigation via Internet search engines and using keywords "start pages software" and "learning, education"; to gather blog shared experience, (2) creation of a set of evaluation criteria, (3) experimental practices with the environments and (4) forming the result. The criteria for this review are focused on the availability of the authoring, syndicated information, communication, collaboration and networking, research, and evaluation tools. The point scale is from 0 to 5. The availability of a tool with more functional possibilities is rated at 5, if the tool is missing – 0. The result is formed in two steps: (1) evaluation according to each criterion, (2) count the average value of evaluated weight for all criteria.

3 Start Pages Analysis

According to (Leyden & Jacki2 2006), the autonomous or self-organized learner is being able to "learn how to learn" and possesses a disposition to do so. Such a learner can analyze his/her own learning strategies and outcomes as well as support the learning of others.

For the self-organized learning and research to occur, a framework, learning tools and techniques are needed to assist the learners to identifying, reflecting on and improving their skills as self-organized learners (West-Burnham & Coates 2005, Koper 2005).

The big challenge is how to implement such learning environments which support and facilitate learning process and knowledge construction. One solution proposed in this paper is based on the technical and functional possibilities of start pages. The fourteen start pages are explored and analyzed according to the proposed methodology. Their main characteristics and formed ratings are presented in Table 2.

Table 2. Start pages technical and functional possibilities

Start Page	Characteristics	Rate
24eyes www.24eyes.com	*Authoring*: arrange RSS feeds; *Information*: RSS feeds; *Collaboration and Networking*: share tags, invite friends to dashboard; *Communications*: email tab to friend; *Personalization*: create and arrange RSS dashboard, look and feel	***2,7***
Eskobo www.eskobo.com/default.aspx	*Authoring*: web note ; *Information*: RSS feeds, site addresses; *Research*: search the web; *Personalization*: look and feel	***1,4***
ItsAStart www.itsastart.com	*Authoring*: sticky notes; *Information*: RSS feeds, del.icio.us bookmarks; *Research*: Google search; *Personalization*: look and feel	***1,7***
Favoor http://www.favoor.com	*Authoring*: notes, save links; *Information*: RSS feeds, bookmark import ; *Research*: Google search; *Collaboration*: share links; *Personalization*: look and feel	***1,7***
MyGetGo http://mygetgo.com/index.html	*Authoring*: microblog, notepad; *Information*: RSS feeds, link sites, YouTube videos, bookmarks; *Research*: multiple search; *Collaboration and Networking*: Flickr photos, store and share files; *Personalization*: add modules and widgets, change themes	***3,6***
Personalized Google homepage www.google.com/ig	*Authoring*: via gadgets, notes; *Information*: RSS feeds, YouTube videos, del.icio.us bookmarks, podcast; *Research*: Google search; *Collaboration and Networking*: Flickr photos, share panels and widgets; *Communications*: email; *Personalization*: create or add existing gadgets	***4***
Goowy www.goowy.com	*Authoring*: sticky notes, calendar, file storage; *Information*: RSS feeds, bookmarks; *Research*: search; *Collaboration and Networking:* send invitation via email; *Communications*: email, AIM, ICQ; *Personalization*: look and feel	***2,7***
Jimdo www.jimdo.com	*Authoring*: simple site creation tools, text creation; *Information*: RSS feeds, add links, YouTube videos; *Research*: search engine; *Collaboration and Networking*: guest book, add links to social networks and virtual spaces; *Communications*: email; *Personalization*: add widgets, look and feel templates	***4***
Netvibes www.netvibes.com	*Authoring*: to-do list, notes, calendar, web storage; *Information*: RSS feeds, YouTube videos, del.icio.us bookmarks, podcast; *Research*: multiple searches; *Collaboration and Networking*: Flickr photos, Facebook, Meebo, feeds and modules can be shared with others individually or via the Netvibes Ecosystem; *Communications*: email, Skype; *Personalization*: add user-created widgets	***4,2***
Pageflakes www.pageflakes.com	*Authoring*: to-do list, notes, calendar; *Information*: RSS feeds, YouTube videos, del.icio.us bookmarks; *Research*: web search; *Collaboration and Networking*: share pages, invite friends, collaborate on project, Flickr photos, Facebook, Twitter; *Communications*: email; *Personalization*: add user-created modules	***4,2***
Protopage http://protopage.com	*Authoring*: to-do list, sticky note, blog, comment box, calendar; *Information*: RSS feeds, YouTube videos, bookmarks, images, podcasts; *Research*: web search; *Collaboration and Networking*: share tabs, *Personalization*: add widget, look and feel	***4,2***
Microsoft Personal Start Page www.start.com	*Information*: RSS feeds; *Research*: web search; *Collaboration*: share tabs; *Personalization*: add tabs, look and feel	***3,6***

SuprGlu www.suprglu.com	*Authoring*: add service to existing blog site; *Information*: RSS feeds, bookmarks; *Collaboration and Networking*: add service to existing networks; *Personalization*: look and feel	***3***
SurfNinja www.surfninja.com	*Authoring*: wiki, blog; *Information*: RSS feeds, YouTube videos, del.icio.us bookmarks, podcast; *Research*: multiple searches; *Collaboration and Networking*: Flickr photos, Facebook, other; *Communications*: forum, Skype; *Personalization*: add widgets	***4***

Detailed analysis leads to the following findings: (1) start pages are not specially designed for educational purposes, but they possess flexible functions for configuring the existing components in a learning environment. They can be extended with new created components and it allows connections to other external tools and services. (2) Start pages could be used for supporting and facilitating the self-organized learners in terms of two aspects: (a) learning – learn to exploit the Learning 2.0 advantages such as personal creativity and social interactivity in different situations and in different context. Learn to work with Web 2.0 technologies as aggregate tools and services and create new components; (b) research – exploring the wealth and accessibility of functionality allows the assembling off complex prototypes of a learning environment in a small amount of time. More of the start pages propose tools for data gathering, analysis and visualization. (3) Start pages are suitable for building multichannel learning environments, where learning and knowledge capturing can be provided and mechanisms for coordinating and delivering a wide range of information resources and educational experiences can easily be used. One model for designing the multichannel environment in a start page application is shown in Figure 1.

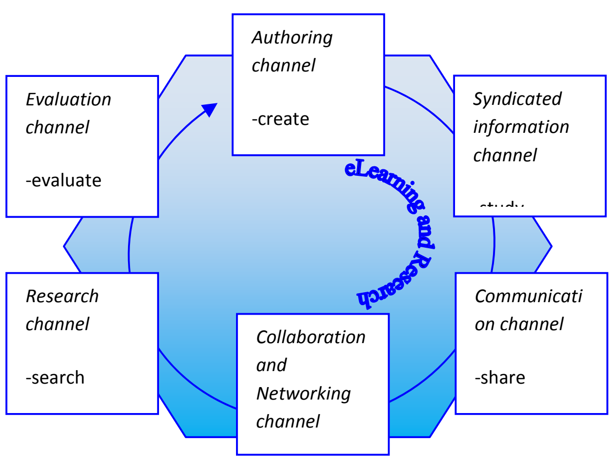

Fig.1. A Model of Multichannel Environment

(4) As mentioned before, the start pages are not typical learning products, but in this paper are treat as learning environments. So, one way for better analyzing their features is comparison with IEEE LTSA (Learning Technology Systems Architecture) component architecture (IEEE 2001). IEEE LTSA presents 4 Processes (learner entity, evaluation, coach, and delivery process) - active system components that transform their inputs into outputs, 2 Stores (learner records and learning resources) - inactive system components used as repositories, 13 Flows (behavioral observations, assessment information, learner information (three times), query, catalog info, locator (twice), learning content, multimedia, interaction context, and learning preferences) - flows that starts, stops, or changes processing. The start page's limitations are commented below. In the start pages the evaluation process is limited –data gathering, tracking and evaluation of learner activities is not possible. Only the test thought widget or html components can be arranged. The role of a coach is limited to a consultant. The coach could be another learner or a group of learners. There are no Learner Records: information, such as learning activity performance and preferences are not stored. The following flows are missing: interaction context, assessment, learner info, and catalog info. Despite these limitations the start pages could be used for supporting self-organized learners in their knowledge capturing.
(5) The start pages Netvibes, Pageflakes and Protopage show the rich possibilities for self-organized learning environments with characteristics for authoring: create a list of activities, use a simple text editor, access to blog and wiki; syndicating information of rich media sources; researching via search engines and using additional widgets, for example polls; collaboration and networking: sharing of information and knowledge, connecting to social networks; personalization of feel and look as well as using widgets, for example for quizzes and surveys. Other start pages can be used for different learning purposes, for example: 24eyses– working with RSS feeds or lists of RSS feeds; Jimdo for site creation and arrangement; SurfNinja: proposes visual arranging of icons and access to favorite websites.

4 Design of Self-Organized Learning in Start Pages

The Web 2.0 technologies have several implications for learning design and its elements: roles, activities, environments and scenarios (Koper & Tattersall 2005). The learners play a wide range of roles: they can be authors, contributors, distributors, searchers, moderators, reviewers, editors, researchers, or evaluators. The role of educators has changed from controlling and managing learning to be consultants and advisers. With so much Web 2.0 artifacts being produced, the learners need guidance on selecting the right learning resources, the right technology, tools and services which are appropriate for their needs. Also, the educators can support the development of the skills required to become a self-organized learner. Self-organized learning can occur in the Web 2.0 platform combining a wide range of applications, tools, services and devices. The learners create, examine, syndicate and search for microcontent objects which encapsulate knowledge created in a collaborative way through social interactions using Web 2.0 tools. The importance for scenarios of self-organized learning is integration of the multichannel environment with simple play and short time acts, where learners perform a wide range of activities and educators support learning resources identification, developing of the skills of self-organized learners, arrangement of technologically rich and social oriented environment. The Learning design conceptual model for self-organized learning is presented in Figure 2.

5 Prototype of Multichannel Learning and Research Environment

The model in Figure 2 is used for the implementation of learning and research environments in Netvibes and Pageflakes. The environments are arranged using embedded start pages components as well as components for customer html code and widgets.

The authoring channel is realized through the following components: to-do list, note, calendar and html component for links to tools, proposed by: www.box.net – store and share documents, http://www.zoho.com/ - create documents, http://www.slideshare.net/ - share presentation, http://animoto.com/ - create and share videos, http://pbwiki.com/ - share information, http://bubbl.us – concept mapping, http://secondlife.com/ - virtual space, http://www.inetword.com/ - social html editor.

The syndication and information channel consists of: embedded component for social bookmarking Del.icio.us, and html component with links to RSS readers – http://www.bloglines.com/, http://www.newsgator.com/, http://technorati.com/. The communication channel includes components for Gmail, Yahoo mail, Hotmail. Networking channel proposes access to Facebook, Ning social networks. Research channel contains components for search – pictures/audio/video/podcast, Google search, Babylon translator, poll/survey, analysis and visualization. The evaluation channel includes link to http://www.polldaddy.com/ - polls/survey.

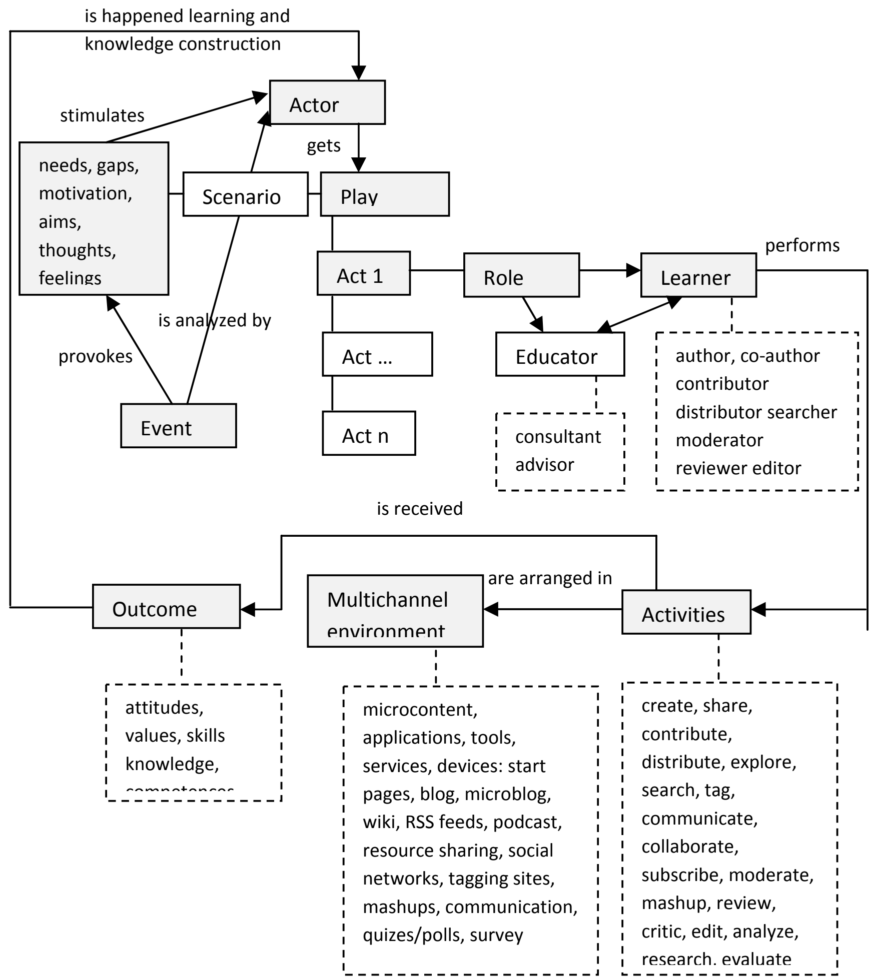

Fig. 2 Self-Organized Learning Design

6 Conclusion

Fourteen start pages are examined with the main point of view being how they can be better used for defining the self-organized learning and research environments. The analysis shows that start pages are suitable for easy and fast unfolding of learning and knowledge construction environment. To describe the complexity and richness of current technological solutions, a model of multichannel learning environment is developed, consisting of authoring channel, syndicated information channel, communication channel, collaboration and networking channel, research channel, and evaluation channel. Self-organized learner has to cope with two main tasks – (1) study technology and functionality of a start page and (2) design environment and learning. The role of the educator is to consult the learner in a pedagogical and technological aspect.

Web 2.0 technologies also impact on defining new learning design approaches by extending and transforming current practices, while keeping learners and the social dimensions of learning at the forefront. The model of self-organized learning is proposed, which presents the new roles of learners, new learning activities, performed in a technologically rich multichannel environment with a social orientation.

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Competence advancement supported by social media

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Abstract: People regularly need to cope with new challenging situations that cannot be mastered by only applying routine procedural skills and knowledge. Independently updating one's set of skills and knowledge base in the context of technologically rich environments is essential to meet the changing life- and workplace requirements. This paper proposes the creation and maintenance of landscapes of networked tools and services as an important area for competence advancement in higher education. It discusses this in the context of self-directing intentional learning projects within personal and distributed learning environments.

Keywords: Competence, Social Media, Personal Learning Environments, Self-Direction

1 Introduction

Many contemporary life and work contexts can be characterised as being increasingly uncertain, ambiguous and unpredictable. We are regularly confronted with situations where we have to deal with rather complex and dynamically changing and often unexpected requirements. We live in a fast-changing world in which individuals leaving formal educational institutions cannot expect to remain in the same career paths or even the same domains of work for their whole work-life. It is not enough to be a knowledgeable and skilled person in one particular area. Once acquired factual knowledge and procedural skills in a certain domain increasingly cannot meet all the requirements emerging in rapidly changing workplaces. People regularly need to cope with new challenging situations that demand continues updating of one's set of skills and knowledge base. Abstract levels of thinking, creativity, and continues decision-making have become crucial dispositions. Transferring existing knowledge and skills to new situational contexts is often not sufficient. Instead, a *competent* person also needs to be able to build up new knowledge and skills while adapting to new situational constraints that require acting under various levels of uncertainty. Herewith, self-directing intentional learning and change projects have become one of the challenging areas in every day life- and work contexts.

Following paragraphs discuss about the theoretical constructs of competences and self-directing intentional learning and change projects within personal and distributed learning environments. This paper challenges the current strategies and methods in higher education for preparing individuals to cope with unpredictability and obscurity in technologically mediated life and work. We propose alternative ways of practicing and advancing the necessary dispositions for self-directing intentional learning through the use of networked tools and services.

2 What do we mean by competence?

Unfortunately, the term competence is often used in a somewhat inflationary, overly broad and very fuzzy manner in the literature, thus inviting a sloppy use of the term. That this lack of coherence and precision is acceptable and quite common in ordinary speech is well documented in any regular dictionary. Webster's dictionary, for example, defines 'competence' as "fitness or ability" with synonyms including 'capability', 'capacity', 'efficiency', 'proficiency', and 'skill'. But even some scientific publications simply attest that "a competency may be comprised of knowledge, a single skill or ability, a personal characteristic, or a cluster of two or more of these attributes" (Marrelli, Tondora, & Hoge, 2005, p.537), or that "competencies are not fundamentally different from traditionally defined KSAOs (i.e., knowledge, skills, abilities, and other characteristics)" (Shippmann, Ash, Battista, Carr, Eyde, Hesketh, Kehoe, Pearlman, Prien, & Sanchez, 2000, p. 704).

Weinert (2001) highlighted the existing range of terminological differences and offered a set of recommendations and orientations for further efforts on the clarification and elaboration of the concept. However, any conceptualization of competence for scientific, analytical purposes cannot simply propose the synonymous use of other concepts such as skill, knowledge, and ability.

Competence is a theoretical construct that refers to a human potentiality for action in a range of challenging situations (Fiedler, 2006). It is thus a concept that foremost indicates a precondition for future problem solving and coping (including the use of adequate tools) in a particular area of action. The more elaborated, contemporary conceptualizations of competence are best understood as a programmatic attempt to expand older notions of what constitutes the necessary dispositions for successful problem solving and coping in a given area of action. In general what used to be emphasized was the role of well trained, standardized, and largely automated procedural skills and of factual knowledge for successful problem solving and coping. Now, this emphasis is increasingly coming under scrutiny, since situational challenges in many work and life contexts cannot be mastered by applying routine procedural skills and knowledge anymore. Instead, the changing conditions for life and work produce situations that can be described as dynamic, complex, open-ended, and ambiguous, and that regularly require novel, creative and sometimes surprising solutions. This is where the old notion of qualification that is based on requirements analysis oriented in the past and on the acquisition and performance of standardized procedural skills and factual knowledge clearly shows its limits. Erpenbeck and Heyse (1999) thus emphasize, for example, the importance of internalized orientations, values and attitudes for coping with dynamic, open ended and complex problem situations where actors cannot exclusively rely on a stock of factual knowledge and procedural skills previously acquired. They argue that factual knowledge and procedural skills can only be viewed as necessary but not as sufficient for the execution of successful ("competent") action in many areas of human activity.

We follow this conceptualisation introduced by Erpenbeck and Heyse (1999). A competent actor is thus understood as an individual who has acquired factual knowledge and a set of procedural skills in a certain area, but in addition also holds orientations, values and attitudes for coping with open-ended and complex problem situations (Fiedler, 2006). Like any other theoretical construct referring to a human potentiality, a competence, understood as a set of dispositions, cannot directly be observed. It has to be inferred from the observation (or self-observation) of a given performance that is considered to be an indicator for the theoretical construct. Based on the conceptualization of competence that we have referenced above, a person needs to perform in a situation that is complex, ambiguous and thus challenging enough to prevent a mere application of routine procedural skills and factual knowledge, when we want to accept her performance as an indicator for an underlying competence in a particular area of challenge.

3 Self-directing intentional learning projects

One of the challenging areas in every day life and work contexts is self-directing intentional learning and change projects (Fiedler, 2006). The concept of self-direction is certainly not a new concept in educational research. An extensive amount of research about self-direction in education exists and has produced rather heterogeneous theoretical understandings and interpretations. Terms like self-planning, self-organising, independent adult learning, autonomous learning, etc. often refer to a variety of notions and different perspectives. Most often self-direction in education is defined as "a process in which individuals take the initiative with or without the help of others, in diagnosing their learning needs, formulating learning goals, identifying human and material resources for learning, choosing and implementing appropriate learning strategies, and evaluating outcomes" (Knowles, 1975).

Based on an extensive meta-analysis of related literature, Candy (1991) offers an overview of the various strands of thought that can be found under the label of „self-direction" in human learning. One prominent strand could be described as activity-oriented. It focuses mainly on activities and strategies of actors who either want to support or execute „self-direction" inside a formal instructional system. On the other hand we can think of the actors who operate outside any formal instructional system to pursue learning opportunities in their natural social setting. Candy (1991) has proposed the term *autodidaxy* to make a necessary distinction here.

The second major perspective can be described as disposition-oriented. This strand of thinking refers to the personal attributes and orientations that influence the readiness and ability of actors to execute self-direction in various contexts. It can be further distinguished into *personal autonomy* referring to the execution of individual freedom in a more general sense, and *self-management* focusing on the willingness and capacity to conduct one's own education (Candy, 1991).

Erpenbeck et al. (1999) propose that, in situations where starting conditions, constraints, and goals are either determined or determinable in a straightforward way, we can speak of "self-direction" in respect to the actions and decisions an individual can execute to reach these goals. In complex, chaotic situations on the other hand, where no optimal outcome can be determined and where people have to act and decide under uncertainty, require action and coping strategies that are more adequately described as attempts of "self-organisation."

There is a growing body of empirical research on adult learning that suggests that the perspective of "self-organisation" might be better suited to describe how adults cope with contemporary challenges in the workplace and other areas of life. However, we would argue that in the context of formal higher education, a focus on self-direction (where starting conditions, constraints, and goals are either determined or determinable) from an activity-oriented perspective seems more appropriate and feasible.

4 Mastering information and communication technologies with social media

Due to the increasing importance of distributed (and often international) work settings, much of our symbolically mediated work- and communication activities have moved to the Web. Communicating, accessing, making sense of and creating informational artefacts have become everyday life and work tasks that rely on the use of personal, networked technologies on the one hand and on the other hand on one's ability to take a control and execute these actions in a self-directed manner.

A growing variety of social media offers a significant potential for networked technologies. Social media represents a class of applications, which support social information retrieval, personalized aggregation and monitoring, easy and joint publishing, sharing and interaction, as well as establishing and maintaining connections. The advantages of social media are mainly seen in openness and free accessibility of web content for everybody, connection building and networks within common interests (MacManus & Porter, 2005). Examples of social media applications are for instance Google Groups, MySpace, YouTube, Flickr, Twitter, Wordpress, Wikispaces, etc.

Social media enables to mix or integrate information via network aggregation platforms allowing the creation of new meaning from mashed information. The combination of various applications offers quite powerful ways of managing and repurposing and remixing information, thus supporting various regulations, coordination and operation processes. Individuals need to handle artefacts, which are predominantly produced and distributed in a wide variety of media modes, genres and forms. They have to be able to recognise different media forms, and to manipulate, transform, and re-distribute informational artefacts. Furthermore, they need to understand how networked, informational artefacts are generated, managed and made available. Only then these means can be fully exploited for personal purposes.

On the other hand, it is not sufficient to only understand how to use certain social media applications. One must also learn how to utilize those diverse and powerful technologies efficiently and effectively for computer-mediated communication, for specific decision-making and problem solving ends (Horton, 2007).

5 Current situation in higher education

It is predicted that dispositions for self-directing intentional learning and change will gain more and more importance for coping with changing life and work demands (Rychen, 2003). Higher education needs to pay more attention to the execution and advancement of competencies in this area. Educational challenges should be created that provide opportunities for self-directing intentional learning and change projects, thus preparing individuals for coping with life and work related problems outside of the boundaries of pre-structured and well supported formal educational settings.

In general there seems to be a widening gap between well structured, pre-defined, and guided settings in higher education on one side, and more and more work contexts moving towards uncertainty and ambiguity on the other side. We would like to stress that this is a rather critical imbalance and that higher educational settings need to provide challenging situations for individuals to practice and advance the necessary dispositions for self-directing intentional learning.

According to the literature on supporting self-direction in education, often an emphasis is put on the individual taking control over one’s activities, goals, strategies, and so forth. Despite of the heterogeneous theoretical understandings, it appears that no special attention has been paid to letting an individual take responsibility for her personal landscape of (networked) tools and services. However, Hiemstra (1994) has proposed that taking personal responsibility refers to individuals assuming ownership for their own thoughts and actions. Knowles (1975) definition indicates among other issues an identification of human and material resources for learning, but this does not state clearly the control over one’s technological means for supporting the fulfilment of her goals. We think it is fair to ask why a landscape of tools and services should be pre-defined and pre-selected for individuals, while at the same time they should be practicing taking control and responsibility of their intentional learning?

Outside of formal education we are witnessing a rapid proliferation of networked technologies that are becoming a significant part of our everyday lives. Being a successful actor in an increasingly networked society includes the selection of appropriate tools and services for supporting the fulfilment of personal goals. Without any idea of how to select and use technology for one's own purposes prohibits the efficient and effective performance of an individual in many every day life and work contexts.

So far approaches to stimulate and advance self-direction in current educational settings mainly emphasise individuals' decisions of what and how to learn in a given educational environment. They are instructed how to apply certain strategies of executing self-direction, such as goal setting, planning, and so forth (see for example Boden, 2004; Song et al., 2007; Fellows, 2002; Lin, 2002; Stolk et al., 2006). Thus leaving aside the opportunity for individuals to decide with what type of technological tools and services they want to mediate their activities. This is mainly due to the fact that individuals at higher educational institutions are frequently provided with a set of pre-determined and centrally controlled landscapes of tools and services.

Institutionalised course management systems are currently in use in most higher educational institutions. Predominantly, they can be characterised as rather closed and centralised systems, mainly structured around content. The rigid structure of these systems does not favour practices that could put an individual's interests, tool preferences and objectives in the centre. The facilitator authoritatively defines the learning objectives, tasks to be carried out, the media to be used, as well as the expected outcomes. These pre-defined and pre-determined technological landscapes simply don't provide the opportunity for individuals to practice the selection of tools and services in order to mediate their self-directed activities.

On the other hand we should not forget about the personal differences of the individuals. Individuals differ widely in terms of their prior knowledge; cultural backgrounds, attitudes, values as well as they have varying degrees of self-direction depending on the situation and subject matter. This all has an effect on their expectations and the level of engagement in an educational experience. Placing everybody in the same situation with the same landscape of tools and services influences subsequent actions within a particular context (Könings, et al., 2006).

6 How to fill in the gap between higher education and work life?

Consequently it is time to rethink what are the educational priorities in the face of the changing characteristics and demands of work and life? We believe that higher education should create challenging situations for individuals to practice the attainment of adequate dispositions for self-directing intentional learning in a technologically mediated work context. At least partial personal control over the technological means that mediate and support work- and study-activities is an important aspect to consider in higher education.

Various social media applications offer a significant potential for dealing with information flows and for supporting knowledge building individually and within groups. The selection and use of appropriate social media can be considered as an educational goal in itself, which presumes a set of skills, knowledge, and orientations in order to make purposeful decisions in respect to mediating technologies.

Nevertheless, many educators claim that social media applications are not stable and structured, and thus not suitable for educational purposes. On the contrary we believe that an individual needs to have a variety of networked tools and services to her disposal in order to enrich her *personal learning environment* with the appropriate technological means to mediate her activities. In a world increasingly dependent upon networked technologies and distributed work settings, successful actors need to make efficient and effective use of information and communication technologies (Horton, 2007) for their own purposes.

7 What do we mean by personal learning environments?

The notion of personal learning environments (PLE) has been under discussion in recent years. Not surprisingly one can find a diversity of interpretations of what a PLE is (see for example Johnson, 2006; Harmelen, 2006; Attwell, 2007; Dron, 2007; Kolas, 2007, Wilson et al., 2006). While this discourse in general rightfully questions the underlying assumptions that still drive the development and implementation of monolithic, all-embracing, applications, it still displays in most parts a very “technology-centric” thinking and reflects strong conceptual ties to the requirements of formal educational systems (Attwell, 2007). Very often a PLE is conceptualised either as a single software application or comprised of all the different tools and services that an individual is using at a given point in time. Thus, the PLE is seen as the conceptual 'glue' embracing all the networked and interoperable tools and services. However, treating a PLE more as subjective, psychological concept, offers a broader, naturalistic view on what comprises a personal environment in which intentional learning is carried out.

For us a *personal learning environment* entails all the instruments, materials and human resources that an individual is aware of and has access to in the context of an educational project at a given point in time (Fiedler, Pata, 2008). A PLE is entirely "controlled" or constructed by an individual and is adapted according to the individual's needs and current activities. A PLE can be extended, e.g. the components of an environment can be replaced or complemented with additional ones. Some components can also be eliminated or temporarily excluded if they do not serve the purpose anymore. Every personal environment is different, depending on the individual's preferences and expectations, his/her process of personal development and mental processing. Individuals construct their environments so that its components afford them to create the experience they desire and to act according to their purposes. Furthermore, individuals ascribe various roles to themselves according to the situation and context. This is especially important in settings that require collaboration.

8 What happens if study projects are carried out in groups?

If an individual takes part in some collaborative work- and study activities with others, some common goals and objectives for action need to be established and maintained (Fiedler, Pata, 2008). The challenge is to bring personal expectations, experiences, roles and environments together in order to form a functional collaborative setting. In this case parts of a PLE inevitably start to show qualities of a human activity system (Engeström et al., 1999). From an observer's perspective an individual PLE starts to overlap partly with other personal environments and a temporarily functioning *distributed learning environment* emerges. A distributed environment serves as long as the collaboration among these individuals is going on (Fiedler, Pata, 2008).

Naturally, also the notion of distributed learning environments varies a lot (see for example, Converso, 1999). We conceptualise a distributed learning environment as a group managed environment that is a mix of some parts from the individuals' personal environments and some new components that might be needed to carry out particular collaborative tasks. A distributed environment emerges when the collaborative activities such as interaction between individuals, communication and shared activities are executed. Distributed learning environments are also dynamically changing in terms of its components, structure and extension. Changes are defined by the individuals' preferences, negotiation process and the nature of their collaborative activities.

In distributed environments different actions can be distinguished: conversational actions related to subject-matter issues (terminology, concepts) or related to regulative issues (distribution of work, roles, media) and productive actions in which the actual task is executed and objectives are materialised (Fiedler, Pata, 2007). Naturally both types actions are highly intertwined and actors switch rapidly from one to another. In loosely-coupled, networked work-settings, both types of actions need to be mediated by an appropriate selection of tools and services. While making decisions regarding the technological enrichment of a personal learning environment only requires a conversation with oneself (reflection), collaborative settings require the explication, negotiation and mutual acceptance of a selection of technological means in order to form a functional distributed learning environment.

9 Competence acquisition and personal learning environments

It is important to acquire and advance adequate dispositions for dealing with unstructured situations and to utilize existing resources to their greatest potential (Brockett, Hiemstra, 1991). Individuals who need to select the technological means for creating personal or distributed environments in order to support their own work and study activities also need to be competent in terms of managing technology. Thus forming a personal or distributed learning environment including a landscape of mediating tools and services often requires a trial-error approach, which in turn can help to advance the necessary dispositions (knowledge, skills, orientations, etc.) for self-direction in education.

Considering the fact that much of our symbolically mediated work- and communication activities have moved to the Web, practicing the selection and maintenance of a set of networked tools and services to enrich a personal or distributed learning environment seems to provide an interesting and adequate educational challenge.

We believe that taking initiative and responsibility for one’s own learning and change increasingly includes and requires the ability to select adequate mediating technologies to enrich a supportive personal or distributed learning environment. We consider the ability to gain access to, and choose selectively from a full range networked tools and services as an important aspect and expression of self-direction in education.

10 Concluding remarks

Rapid technological developments and changing demands in many work contexts require people to regularly act under various levels of uncertainty while continously updating their knowledge and skill base. An essential requirement of today’s post-modern, technologically rich society is to take control and responsibility for one’s own education, learning, and change. While many work contexts stresses the importance of coping with uncertainty and ambiguous situations, higher education still functions in a highly structured and centralised way, thus prohibiting the expression of self-direction in a broader sense.

We want to argue that educational experiences need to be increasingly constructed in a way that provides opportunities for individuals and groups to organise and manage their mediated activities in the context of technologically rich environments. This is an essential aspect to become increasingly self-directed in today’s world and be in tune with the characteristics and demands of many workplaces.

We propose that taking control and responsibility over one’s personal learning environment and its supporting landscape of networked tools and services is an important expression of self-direction in education. The emerging social media practices seem to be a promising field for mediating and enriching personal and distributed learning environments. Selecting and combining various applications for supporting personal or collaborative learning purposes provide individuals an opportunity to actually execute and advance an important set of dispositions for self-direction.

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Underlying Concepts and Theories of Learning with the Semantic Web

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Abstract: Developers of new learning scenarios – either from technological or educational background – act upon their (implicit) theories and concepts of learning and technology. Especially in the field of learning with the Semantic Web, there is – up to now – no awareness about the differing (and conflicting) underlying concepts. In this contribution, we try to identify and discuss fundamental aspects of implemented or discussed learning scenarios. For that, we screened selected (current) projects concerning learning with the Semantic Web according to their underlying or explicitly pointed out concepts and theories.

Introduction: Semantic Web as a source for educational hopes and fantasies

The Semantic Web is a research endeavour aiming at making Web content accessible to machines in a way that goes beyond mere presentation and rendering of content. Its goal may be briefly described as enriching the existing Web with meta-data and (meta-)data processing so as to provide Web-based systems with advanced (so-called intelligent) capabilities, in particular with context-awareness and decision support, strengthening a person centred, everyday use of the Web.

Semantic Web technologies are likely to significantly enhance future Web applications. On the "Semantic Web", Web applications and services can more easily communicate with each other, and data can be more easily exchanged between different systems. According to Berners-Lee & Miller (2002) the "Web will reach its full potential when it becomes an environment where data can be shared and processed by automated tools as well as by people“.

Semantic Web is often said to have the power to solve current problems in various fields. Especially in the field of e-learning with Semantic Web technology inspires fantasies about intelligent information retrieval, (automated) self adaptation of learning content or a recommendation for the next learning steps. We believe that the use of the Semantic Web – especially when used as the “Holy Grail” to solve all problems in the e-learning context – needs at least a conceptual definition on how to be used in a pedagogical setting.

One of the core challenges for the Semantic Web is the creation of the semantic information. There are two different approaches how meta data can be produced. However both of them are not easy to realise. One the one hand, humans can provide meta data by using a machine interpretable coding scheme, using e.g. XML, RDF, OWL or Topic Maps. But in practice “we can see a lot of practitioners showing resistance when asked to add structured metadata.” (Koper 2004, 17). On the other hand we could also use inductive approaches of tagging and producing structure: Computers can produce meta data automatically, e.g. by natural language processing techniques like text mining (Furdík, Paralič & Smrž 2008) or latent semantic analysis (for texts, based on factor analysis, see Koper, 2004, 17, see also Kalz, Van Bruggen, Giesbers, Waterink, Eshuis & Koper 2007).

According to Koper (2004) the Semantic Web could support learning in the following two areas:

> “1. Staff can be helped to perform some of their tasks in flexible, online educational settings more efficiently and less isolated, this includes online course development tasks, learner support tasks, assessment tasks and course management and administrations tasks (e.g. setting-up new instances of courses)
>
> 2. Persons in different roles (learners, tutors, content providers) can be helped to perform tasks more effectively and efficiently in large, distributed, problem-based, multi-actor, multi-resource learning spaces that are set-up to establish learner-centred, non-linear, self-directed lifelong learning opportunities.” (Koper 2004, p. 5)

The use of semantic technology is at the moment in its infancy. There are several projects and tools, which develop scenarios for the support of knowledge development and/or retrieval, but only few of them with a special focus on learning. Especially semantic Wikis (e.g. IkeWiki[1]) and semantic collaboration tools/technologies (e.g. SIOC[2]) can be used for learning, in learning management systems or personal learning environments.

In this paper we do not discuss concrete projects or ideas how Semantic technologies can enhance Web-based learning environments. The focus of this contribution lies on a conceptual level, namely in the discussion about learning with the Semantic Web and the basic aspects which have to be taken into account. This discussion is related to existing publications and approaches, trying to categorise technology enhanced learning settings. For example one can distinguish between navigability, adaptivity and reactivity, according to Midoro, Olimpo, Persico and Sarti (1991, 181). But from our point of view, these and other existing concepts (e.g. Schulmeister 1997, 50) do not match the discussion sufficiently, because they neither take the learning content and resources, nor the social involvement into account.

In the following paragraphs we try to discuss and illustrate the following basic aspects and their values for a distinct view on learning with the Semantic Web:

- Aspect 1: The Content:
  a) is the content a fixed "canned content", claiming to be objective or b) is it dynamic, permanently "under development" and only shallowly categorised (miscellaneous)?
- Aspect 2: The Learner:
  a) is the learner a consumer, being taught by a teacher/trainer or b) is he/she an active, self-organised creator of his/her own environment?
- Aspect 3: The Social Involvement:
  a) is the learner "isolated", on his/her own or b) does he/she communicate with humans, e.g. in terms of being involved in a learning community?

Coming from a constructivist background and as experts for social software, we believe, that the values b) of the above mentioned three aspects are necessary and important for the effective support of learners and are therefore the foundation for the (ongoing) paradigm shift from

[1] http://ikewiki.salzburgresearch.at
[2] http://sioc-project.org/

(rather static and instructor based) e-learning 1.0 towards (a more user oriented, socially enhanced) e-learning 2.0. This contribution is only a first sketch how the differences and variances of concepts in the field of learning with the Semantic Web could be described.

Based on the descriptions of these three identified aspects, we screened several projects focusing on learning with the Semantic Web. In the following we present our results and try to cluster our main findings according to the underlying concepts and aspects.

Aspect 1: The Content

The first part of this contribution addresses the *learning content* and its two aspects: a) fixed, canned and “objective” versus b) permanently under development and only shallowly categorised.

At first glance, the importance of this part for the practice of e-learning is not immediately apparent, especially in formal learning settings: it is quite usual that curricula or existing learning materials are used. But, as mentioned before, the underlying differences concerning the content are not obvious and need therefore clarification.

By looking on today’s nature of (e-)learning content, we can identify projects that build on fixed and “canned” learning content, which tries to demonstrate/illustrate “reality”. For this, authors (so called “domain experts”) have to develop the materials for a course, which is viable for the target group, the situation and the learning objectives. In recent times, authors tend to develop small, re-usable learning units, which can be easily re-assembled according to different needs. On the contrary, learning content can be seen as something miscellaneous and therefore permanently under development (e.g. content, which is stored in a Wiki). For the realisation and implementation of the content within semantic applications this plays an important role.

At the moment, a majority of activities concerning Semantic Web and learning seems to be about fixed content (as in aspect a). From a technological perspective it means that a fixed ontology – “a specification of a conceptualization” (Gruber 1993) – has to be created by domain experts. A simple notion of a possible ontology may be a controlled vocabulary or a catalogue, more complex ontologies use logical formalisms like first order logics or description logics (e.g. in the Web Ontology Language OWL). Ontologies can be used e.g. for consistency checking, interoperability support, and support validation and verification testing of data and schemas (McGuinness 2003), but also (using "reasoning") for supporting the user in searching and navigating (by "querying") or by adapting the content to personal preferences, user models, or context (e.g. in Semantic Wikis, cf. Krötsch, Schaffert & Vrandecic 2007).

Many publications and research on learning and the Semantic Web are done in the tradition of artificial intelligence and intelligent tutoring systems, where an "expert model" of the knowledge domain is used to draw conclusions and solve problems. Because expert systems only know the difference between declarative knowledge (e.g. definitions) and procedural knowledge (how to initiate an effect), they are limited to domains as science, mathematics, logics, moral and conventional knowledge: knowledge areas like history social or aesthetical knowledge are not represented in such systems due to the intricacies of expressing such knowledge in declarative and procedural ways (see Schulmeister 1997, 205, referring to Ohlsson 1992).

Another important issue is the categorisation of content. Most people tend to categorise things, because they are used to. The concept of categorisation as one approach to giving added value (in terms of metadata) and therefore "truth" to the content to make it more "objective" is a very traditional concept, based in the time, where content was in books and storable in shelves. In modern times, "truth" is not only in the content metadata by having it properly categorised by experts. Also "tags" by other users can give added value to the content, when it is used in different contexts. Here, especially technological experts refer to the discussions in the fields of information science to relativise the objectivism of knowledge and structures. Probably the most prominent promoter is David Weinberger with his book "Everything is Miscellaneous" (2007). In this book he describes the revolution of the classification of information from category-based library systems to folksonomies and tagging of content as a better way of information organisation, e.g. in online environments. As an example, the video of Michael Wesch (2007) illustrates these new ideas and effects of Social Software and semantics for the Web 2.0.

In the case of expert designed and annotated materials ("canned content"), learners (in their role as consumers) are not allowed/able to contribute to learning materials, probably because they lack of expertise. Educational concepts building upon this idea hinder the development of (new or adapted) learning materials. On the other hand, the notion of objective knowledge, distinguishable into categories is always connected to a certain understanding of the teacher's role. Current publications on learning and Semantic Web deal mainly with teaching and instruction from a classical perspective with content that is fixed.

A helpful approach to support this discussion from a theoretical point of view would be e.g. the philosophical discussion of objectivism versus subjectivism. Furthermore, we suggest relying on the idea of constructivism, which is based on the idea that knowledge construction (and acquisition) is a subjective, collaborative, non-objective and dynamic process (e.g. Fosnot 1996), referring to the concept of "viability" of the content in different contexts (cf. Glasersfeld 1995).

Looking at educational practice, it looks as if the fact whether learning content is considered to be "canned" or considered to be "miscellaneous" is directly related to the domain – is it an relatively rigid domain e.g. mathematics (fixed in a school curricula in which it is more likely to be structured, canned content), or is a domain with an dynamic knowledge, e.g. aesthetical knowledge, where correctness of knowledge is not so well defined (in which case it is more likely to find content with a "miscellaneous" structure).

Aspect 2: The role of the learner

In this section, we go on with a more detailed look on the role of the learner. As far as we see, the role of the learner is located between two extremes. On the one hand a consumer of learning materials and a recipient of assignments and interventions or, on the other hand, a pro-active learner, who is aware of his/her learning process. The view on a learner has consequences for the choice of learning concepts, e.g.: are formal and structured instructional settings or open concepts for the self organised learners used?

Self organised learning can be seen as an activity in which the learners have primary responsibility for their planning, their performance and their evaluation of learning activities in order to attain specific learning goals. A related concept is "self directed learning". Malcolm Knowles describes it as a process "in which individuals take the initiative, with or without the help of others, in diagnosing their learning needs, formulating learning goals, identifying human and material resources for learning, choosing and implementing appropriate learning strategies, and evaluating learning outcomes" (1975, p. 18).

Even if a majority will not claim that self organised or self directed learning plays an important role for the development of competencies, a majority of publications, projects and tools focus on formalised learning settings, tending to develop competencies by structured curricula
The classical setting, where learners are in the role of consumers, can be described as follows: Experts usually refer to learning traditions when they make their view of the learner's role explicit. In educational sciences approaches where the learner does not act actively is the behaviourism and related concepts as the Instructional Design: The behaviourism is based on the first scientific observations of learning and describes how the relation between stimulus and responses can be modified. For example, these theories and related experiments show the best way to train a dog that it should not bark when a bell is ringing. The ideas of the behaviourism are the base for Instructional Design (see Schulmeister 1997). Instructional Design follows the idea of the possibility to foster learning in well dosed, sequenced instruction bits. According to learner's differences instruction is adapted automatically, in relation, e.g. to prior learning, learning styles and so on. Particularly in the domain of artificial intelligence the possibility of automatic "personalisation" of the content is considered as an automatic adaptation of the learning content to the learner's model or profile (according to the intelligent reasoning). For example these (pedagogical) ideas were taken to develop so called intelligent tutors: "the server should appear to act as an intelligent tutor with both domain and pedagogical knowledge to conduct a learning session. It should use a presentation planner to select, prepare, and adapt the domain material to show to the student. It also must gradually build the student model during his session, in order to keep track of the student's actions and learning progress, detect and correct his/her errors and misconceptions, and possibly redirect the session accordingly" (Devedižić 2004, p. 32). With these intelligent tutoring systems, the learner's possibilities are usually limited to structure and organise his/her learning steps.

As with any new media technology, there has been a tendency to imitate previous educational paradigms, such as – for instance – the "electronic classroom" (Geser 2007, 37). The disillusion about the missing successes of the e-learning hype and the new requirements on competence development have shown that the development and implementation of new technological supported learning and teaching methods are crucial.

So, the role of a learner as active, self-organised and self-directed learner is also not just discussed but also implemented as core attribute in projects for learning in the Semantic Web.

Especially educational experts often refer to the constructivist learning theory when they favour open educational practices or support learner centred approaches focussing the learner's interests and (informal) activities. Originally a philosophical approach, the constructivism it also used and adapted to the field of learning. The constructive view on learning results in a design of a learning environment facilitating the construction of learner's own constructs: "The ideas underlying constructivism suggest that we shift from designing learning environments that instruct to designing environments that influence the structure of autopoetic unities in ways that conserves organization and adaptation" (Knuth & Cunningham 1993, 167).

Based on these ideas, learning in the Semantic Web focuses for example on the following prototypical implementations, where learners play an active role and the learning process is dominated by the user participation:

- Social Software (especially "semantically enhanced") supports user centered and active learning. Furthermore, it can be seen as a support for informal learning: Weblogs, Wikis, discussion forums, folksonomies etc. need on the one hand an active participation of users, on the other hand, they support user interaction and participation. For instance a Semantic Wiki can be seen/used as a possibility to enhance self-organised learning and open educational practices in terms of collaborative writing (see Schaffert; Bischof, Bürger, Gruber, Hilzensauer & Schaffert 2006).
- Personal learning environments (PLEs) allow a personalised and individual view on individual learning activities. PLEs are currently developed as "mash-up" services of existing Social Software applications. Semantic technologies are needed in the near future in order to further develop the PLEs.

After the discussion of the content's and the learner's role we will discuss the role of the social involvement of the learning process.

Aspect 3: The social involvement

The third important aspect is the amount of social involvement of the learners through collaborating with other humans, e.g. in social communities and networks: The question is, whether other humans – experts, teachers, students, class mates, a community of practice – play an active, important role in the learning process? Is collaboration, communication and the communication within the learning community enabled or supported?

Again, both extremes (the user on his/her own or a learning community as the base of the learning process) of this aspect can be found in technological and pedagogical concepts.

From pedagogical perspective, there are different theories and concepts, some with, some without concrete linkage or notion for a need of an active social environment. For example, the above mentioned behaviourism does not take social aspects into account. In contrary, the social involvement plays an important, even crucial role in constructivist learning concepts: Learning is a recursive, self-referential process and needs the stimulus and challenge through others (Siebert 1998).

From a technological perspective, the social aspects (in terms of the need of humans as teachers or for communication and collaboration) are not overseen but are obviously not in the centre. It is not very challenging (technically) to implement collaboration or communication in a learning environment. Concerning the discussion of semantics and learning, the social communities or teachers are more or less reduced to their provision of learning objects and meta data.

Especially approaches that are developed in the tradition of artificial intelligence forget or oversee the importance of social collaboration for learning and state that a human teacher could (or should) be replaceable by a computer. In this discussion, they totally forget to take the missing social aspects for learning into account. In a way that is surprising, because it is not very challenging to add-on collaboration and communication tools.

But again, there are some technical experts that are not only mentioned, but even concentrate on social aspects of learning: the Social Software experts favour the role of the community and their interaction. Social Software always needs and builds on communities. They are needed for contributors, co-actors, and last, but not least, for someone to provide /recommend (new) learning content and/or metadata to existing content. Current research tries to develop collaboration architectures for the Web to support the new framework characteristics: decentralisation, openness, dynamics and user orientation (e.g. Tapiador, Fumero, Salvachúa & Aguirre´2006). The vast number of tools, supporting collaboration on the Web is an indicator that social networking tools are not only a flash in the pan, but lead to a new notion of learning and a measure for sustainable competence development.

Results of a short exemplary project screening

Additionally, our descriptions of underlying concepts and theories could also be used as an outline how ideas, tools and concepts in the field of learning with the Semantic Web could be compared and assessed.

The goal of the following screening is to illustrate our assertion that a wide variety of concepts are used in the field and application area "learning with the Semantic Web". For that we selected some of the projects published in the last years and are from general interest (e.g. financed by the European Commission).

In the following summaries we tried to illustrate how intense the projects illustrate and/or take these three aspects into account: Is the learning content seen as something miscellaneous and under development? Is the role of learner that of an active, self-organised creator? Does the social involvement, e.g. the learning communities, play a role?

In the following tables, a small black square symbolises a focus on the different aspects, a grey one a moderate discussion or implementation of an aspect. A white square does not mean that the authors do not mention this aspect completely or deny it, but it definitely does not play an important role.

Concerning the following six projects and their developed or planned tools we found very differing approaches and underlying concepts (see Table 1). The classification was not so easy, because our data about the projects was limited to the current publication and self-descriptions at the homepage (because e.g. the full proposals are not published). On the other side, e.g. the APOSDLE project produced a long list of publications that are not easy to analyse (and where it is not easy to decide the tightness to the APOSDLE idea). So our findings are based on the current status of the self descriptions on the homepage, concentrating on the self descriptions and central position papers (end of February 2008)[3].

[3] A reviewer of this paper commented: "I don't think one can easily say whether or not a project addresses a certain dimension – there are shades of grey. Moreover, three out of six projects dealt with have just started within the FP7 framework. I doubt whether the initial self-descriptions can be used as some sort of trend analysis." Nevertheless, the screening is still included in this contribution, because we a) neither found variances of the classification done by two of us independently, nor convincing arguments why we could not use project self descriptions (or which alternatively products we should assess).

	content not fixed or objective	learner as active creator	social interaction and communication
ActiveMath: Web-based, user-adaptive ActiveMath platform for mathematics in school, university, and in life-long learning (developed by the Universität des Saarlandes et al., www.activemath.org):	▨	□	□
LUISA: learning content management system using Semantic Web applications (EC funded FP6 STREP, http://www.luisa-project.eu/www/)	▨	□	□
GRAPPLE: Generic Responsive Adaptive Personalized Learning Environment (EC funded FP7 STREP, 02/2008-02/2011, http://www.grapple-project.org/)	□	□	▨
APOSDLE: Advanced Process-Oriented Self-Directed Learning Environment (EC funded FP6 IP, 03/2006-02/2010, http://www.aposdle.tugraz.at)	■	■	■
MATURE: conceives individual learning processes and knowledge to be interlinked in a knowledge-maturing process (EC funded FP7 IP, http://mature-ip.eu/)	■	■	■
LTfLL project: Language Technology for Lifelong Learning (EC funded FP7 STREP, 03/2008-02/2011, http://ltfll-project.org/)	■	■	■

Table 1: Content analysis of projects and tools in the field of Learning with Semantic technologies

The screened self descriptions of the projects show that a majority is located either on the "left" OR on the "right" part of the scale – we did not find combinations of both aspects (see Figure 1). This illustrates the paradigm shift from (rather static and instructor based) e-learning 1.0 to (a more user oriented, socially enhanced) e-learning 2.0.

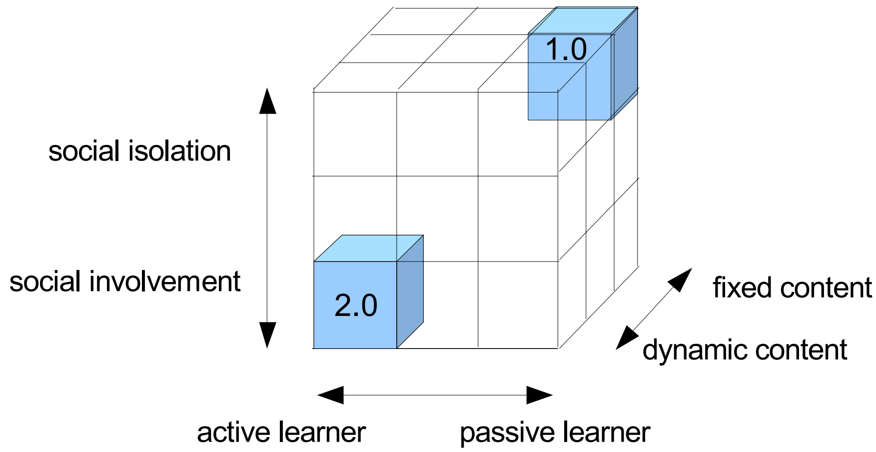

Figure 1: The two dominant types of projects concerning to the three aspects of their underlying concepts in the field of learning with the Semantic Web: Illustrating the paradigm shift from e-learning 1.0 to e-learning 2.0 (just for illustration purpose; the aspects are not orthogonal as depicted in the figure)

So, with this screening we tried to illustrate our assumptions and some critical statements about a wide range of underlying concepts in the field of Semantic Web and learning concerning the identified three aspects.

Summary and Outlook

This paper tried to clarify and illustrate differences and contradictory underlying concepts of learning with the Semantic Web.

To summarise our analysis: We have the impression that self organised and self directed learning is mostly discussed in the educational field and in the field of Social Software (e-learning 2.0), whereas the technological field in general focuses on teaching and instruction (e-learning 1.0). So, interestingly, the differences are not only based on differences between pedagogical and technological perspectives of learning: There are also differences within both disciplines, according to theories, research traditions and philosophies: We find big differences in the use of semantics for learning between technologists coming from the artificial intelligence traditions on the one side and Social Software experts on the other side. Besides this distinction there are also differences between e-learning experts favouring Instructional Design and programmed learning on the one side and others, favouring open educational approaches (see Table 2).

To be fair, neither formal logics nor artificial intelligence actually preclude a constructivist approach to learning. On the contrary, artificial intelligence technologies could result in much better constructivist learning environments by e.g. providing appropriate situations or recommendations. Unfortunately, most e-learning researchers with artificial intelligence background are still primarily focused on instructional design and behaviourism, presumably because these learning approaches are much closer to the formal tradition these researchers are used to.

	E-Learning 1.0	E-Learning 2.0
Pedagogical background	Instructional Design and behaviorism	Constructivism and adapted learning concepts
Technological background	formal logics, artificial intelligence	Social Software, (new) information science
Domains	e.g. mathematics, languages	e.g. psychology, history
Focus of Semantics for Learning	to enhance instruction and teaching	to support personal, collaborative learning settings

Table 2: Features of the two extremes of underlying concepts of learning with the Semantic Web: e-learning 1.0 and 2.0

Beyond the three discussed aspects we assume that the role of the technology itself could be an additional possible aspect that could be used to differ and identify underlying concepts in the field of learning with semantics: is technology seen as an “answer to all” or is it reduced or limited as an additional (nevertheless important) solution to support learning? We do not spread this discussion, because it can easily be seen that in a way we had put the cart before the horse when we describe the role of the Web and technology and different perspectives on it, because this is directly connected with the role of the learner, just the perspective changes.

What we did not do inside this paper is to refer on experiences and evidence with the different theories and technological implementations of and for learning. Nevertheless, with this paper, we hope that we can initiate and contribute to a discussion on a meta level and an appeal for a more profound and theory based construction of ideas and tools.

We hope that we could also clarify and illustrate, that the idea of the support of self-organised learning and self-directed learning does not fit to a lot of papers, ideas, and tools concerning the topic of “Semantic Web and learning”. Supporting self-organised learning means that the learner can be act self-controlled and self-responsible. This might contradict to an adaptive environment arranging all learning objects and learning paths around his learner’s profile.

In the introduction we already emphasised to support self-organised learning and teaching methods which supports the learner. But, such a statement needs some additional remarks: We know a lot of situations and topics where predefined learning paths and "programmed learning", including instructional design could be an appropriate tool, e.g. for young learners, for well defined factual knowledge (e.g. math exercises, learning additional languages). Additionally we are also aware of the fact that self-organised learning abilities could not be assumed for every learner and that open learning practices privilege special groups of learners, e.g. children from middle classes (see Sertl 2007). But besides these specialities and challenges we would like to favour educational settings and teaching methods which encourages and foster the learner and his/her self organised learning abilities in general. Open educational practices and tools which support self-organised learning are the appropriate means facing the requirements of a so-called knowledge society trying to enable and foster life long learning.

Concluding, we want (again) to emphasise our perspective of an adequate usage of the Semantic Web for learning: We follow a competency-focused, collaborative paradigm of learning and knowledge acquisition and favour open educational practices. This means that priority should be given to learning communities instead of teacher-centred education. The development of knowledge requires to tackle and to solve problems instead of subject-centred knowledge transfer. Generally, this will demand an active, constructive engagement with content, tools and services in the learning process (see Geser 2007, 38). Semantics could be an up-and-coming add-on to deal with meta data, which could enhance the collaboration, appropriateness search for learning objects and learning in general. So, especially in the field/area of self organised learning and open educational and technologically enhanced practices, such as Webquests or e-portfolio, and in a clever adaptation and usage of Semantic Social Software we see possibilities to enhance learning (e.g. Schaffert & Geser 2008; Attwell, Chrzaszcz, Hilzensauer, Hornung-Prähauser & Pallister 2007).

For that, a stronger commitment and collaboration between educational and technological experts would be needed, which is not easy. Formal (in the sense of mathematical logics), well defined concepts, wordings, and requirements do not fit with assumptions of educational experts looking at learning as a dialectical, fuzzy and unregulated phenomenon.
We know how hard it is ☺!

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Developing technology-enhanced, work-focussed learning: a Pattern Language approach

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Abstract: This paper identifies issues in developing a three-year duration, work-focussed undergraduate degree programme with a model of inquiry-based learning supported through online communities of inquiry. On the course, students examine their current work-practice to identify issues and then plan, implement and evaluate an improvement strategy. Negotiated learning activities and facilitated networking environments are key to providing students with a highly personalised and relevant learning experience.

Students were surveyed and interviewed through questionnaire, telephone and face-to-face meeting. Staff were asked to produce accounts identifying major issues within their particular role, describing and evaluating steps taken to mitigate them. In both cases, transcripts were examined using interpretive phenomenological analysis and this grounded approach was used to identify key issues.

The findings show that challenges for the improvement of the learning experience included a range of issues unified by concerns regarding diversity of approach and complexity. It is proposed that this was partly due to knowledge held tacitly but unarticulated. To improve practice, a Pattern Language approach is proposed. In order to articulate values and ideas, a Pattern Language category of Online Community of Inquiry is outlined.

These patterns are framed as instructions to inform an approach to new working practices, technologies and systems local to the context in which they were found. It is suggested that this approach helps teaching staff, developers, administrators, and students working together to understand and overcome problems in their own contexts, by adapting these and other patterns.

Keywords: work-based, inquiry-led, e-learning, action research, learning technology

1 Introduction

The four-year Ultraversity project ran between January 2003 and December 2006, it was devised to research new approaches to learning in Higher Education Institutions (HEIs) and to address the government priority for HEIs of widening participation and fair access (Higher Education Funding Council for England (HEFCE) Strategic Plan, 2005) based upon both national economic arguments as well as social justice values. The need to identify new ways for students to access higher education was given further prominence by Leitch (2006) who identified the need to increase opportunities for those in work to be skilled to graduate level and above through work-based routes. The authors would argue that to achieve this outcome, HEIs must explore approaches where technology is central to new models for learning.

The thinking behind the Ultraversity Programme design is briefly outlined. This paper is informed by the reported experiences of course staff and students on the degree programme using interpretive phenomenological analysis as a methodology. The findings show that challenges for the improvement of the learning experience included a range of issues unified by concerns regarding diversity of approach and complexity. The authors sought to develop an approach that made explicit the tacit knowledge and practices to address this issue.

A pattern language was developed to communicate the practices and processes of the online community of inquiry. Conclusions identify possible avenues for future research in both the development of patterns and their validation as a viable approach to progressing research into the use of learning technologies for self-organised learning.The methodology of interpretive phenomenological analysis is briefly explained. Findings are then presented as a Pattern Language. Conclusions identify possible avenues for future research in both the development of patterns and their validation as a viable approach to progressing research into the use of learning technologies for self-organised learning.

2 Ultraversity Programme Design

In the 1990s, Ultralab developed a series of action research projects to investigate online learning including addressing a wide range of constituencies including primary & secondary school pupils, teachers, business people, head teachers and trainee medical officers. The design of these projects was informed by concepts of action research and a common thread was the involvement of participants as co-researchers. The

methodology for reporting outcomes was ethnographic and private, respecting the interests of participants whose detailed individual data was analysed and reported anonymously to the project's sponsors.
The overall effect was to create extensive tacit knowledge amongst Ultralab personnel that was both consensual and coherent (Millwood & Terrell 2005). This knowledge was developed within its own online community of practice through the very medium used in the projects listed. In this way shared values, effective ideas and well-developed debate informed the development of the Ultraversity course. A post-hoc summary of the ideas and values are presented below.

Ultralab’s tacit ideas and values

1. People of a wide range of ages & backgrounds have the **capacity** and can build the **confidence** to operate & appropriate digital creativity tools & online communication environments
2. Online community requires **active facilitation** to develop thriving discourse and effective learning
3. Online community can operate at **large scale**
4. Participants can **co-research** (participants can share and form project goals, and undertake research)
5. The Hawthorn Effect can be used to r**aise self-confidence and achievement** (naming participants as researchers, mutual respect)
6. **Delight in learning** can be achieved through combinations of appreciation, interest, zest, conviviality, recognition and dissent.
7. Online community **learning depth** arises alongside **community strength**
8. Online community can provide a context for **practitioner knowledge** to partner academic knowledge
9. Learner activity in the form of **action research** with the intention to take action for improvements

The Ultraversity project developed a model that was a fully online, three-year-duration, undergraduate, work-place degree with students using inquiry-led approaches to learning. The experience was highly personalised and collaborative in nature, with students learning together as a cohort while studying in their own work context. This supporting network encompassed learners, course staff, as well as guest experts who joined the community for a specific purpose and time. Facilitators helped students to engage in purposeful conversations and share resources with each other. For a full discussion of this project see Millwood, Powell, and Tindal (2008).

3 Pattern Languages

3.1 Introduction to Pattern Languages

The Pattern Language approach has been identified as one that enables discussion between all stakeholder groups with an interest in improving learning with technologies. The 'father' of Pattern Languages is the architect Christopher Alexander. In the 1970's he became concerned about the way in which the design process of living spaces had changed from one whereby those who live and use the buildings, streets, parks, etc. were primarily responsible for their design to one dominated by architects, town planners, and other professionals. He developed the idea of a structured template where

> "Each pattern describes a problem which occurs over and over again in our environment, and then describes the core of the solution to that problem, in such a way that you can use this solution a million times over, without ever doing it the same way twice."
>
> *(Alexander et al., 1977)*

Taken as a whole, the individual patterns describe a Pattern Language of inter-related patterns with different hierarchical relationships to each other.

The Pattern 'formula' developed by Alexander:

a. Picture: showing archetypal example of that pattern
b. Introductory paragraph: sets the pattern in context with other larger patterns
c. Headline: giving the essence of the problem in 1/2 sentences
d. Body of the problem: "describes the empirical background of the pattern, the evidence for its validity, the range of different ways the pattern can be manifested in a building, and so on."

e. The solution: "...the heart of the pattern - which describes the field of physical and social relationships which are required to solve the stated problem, in the stated context. This solution is always stated in the form of an instruction - so that you know exactly what you need to do, to build the pattern".
f. Diagram: "which shows the solution in the form of a diagram, with labels to indicate its main components."
g. Related patterns: a paragraph linking to smaller patterns that complement this pattern

3.2 Why a Pattern Language Approach?

It is important to identify the relevance of pattern languages to the work we are undertaking although a detailed discussion is beyond the scope of this paper.

As observed by Alexander (1999), the element first and most enthusiastically grasped by developers and programmers is that "It allows you to write down good ideas about software design in a way that can be discussed, shared, modified, and so forth. So, it is a really useful vehicle of communication." However, there are other dimensions to a pattern. These include: a moral component; the aim of creating a coherence between things; and thirdly the generativity of the pattern - that is does it enable people who live in the spaces to be the creative force of "morally sound objects".

Patterns are contextual and intended to be adapted and applied by those who use them. Collections of patterns combine to give a pattern language and through a process of following the 'instructions' within the patterns a 'nourishing' living space can be designed.

The patterns will address human behaviours and organisational issues. In our context of online communities of inquiry, stakeholders include programme designers, technical developers, learning facilitators, student researchers, and administrators who all need to be able to engage with the implementation and adaption of the patterns.

> "So, one of the efforts of the pattern language was not merely to try and identify structural features which would make the environment positive or nurturing, but also to do it in a fashion which could be in everybody's hands, so that the whole thing would effectively then generate itself."
>
> *(Alexander, 1999)*

This pattern language should provide enough detail to be useful, but not so much that it becomes too complex for it to be understood and implemented.

3.3 Example Pattern Languages

For Goodyear and McAndrew (2007) the use of Pattern Language is seen as an alternative approach "to capture knowledge from designers and share them with practitioners." This desire to find new ways of describing learning activities is fuelled by the problem of developers engaging with practitioners around the concept of Learning Design, which is an attempt to capture a formal description of learning with technologies that can then be shared and modified by different users using different tools.

From their perspective, "attempts to engage practitioners in the learning design approach have met with only partial success. This is a reflection on learning design being a developing area, but also could be an indication of more fundamental difficulties with the transfer of vocabularies and methods from an expert group to wider use." For Goodyear and McAndrew, a strength of a patterns approach is the ability to co-construct patters collaboratively to create a pattern that "is not intended to supply a complete solution but rather to give enough guidance to support human intervention and variation in each reuse." Their patterns are categorised into tasks to be set for students, ways of organising students or roles of students and the tools required in the networked learning space to enable the interactions to occur. The categories and identified patterns indicate a top down and 'teacher led' approach.

Wilson (2008), in developing Patterns of Personal Learning Environments recognises the need for user lead generative opportunities "people construct the environment for themselves: the tools they choose, the communities they start and join, the resources they assemble, the things they write." Wilson proposes two pattern categories: patterns of personal tools and patterns of the learning networks with which such tools interact in both informal and the formal institutional context.

The e-Len project (2005) that was a large EU funded project has attempted to author design patterns. In this example, special interest groups (SIG) were established around the categories: Learning resources and LMS (9 patterns); Lifelong Learning (24 patterns); Collaborative Learning (5 patterns); and Adaptive Learning (6 patters). In the most part, the patterns are immature, of varying quality and without a clear context for their empirical background of the problem. Arguably, this may be a result of the construction methodology around SIG that required compromise in their construction. None-the-less, they are of use to anyone wishing to understand some of the issues and opportunities that may arise in developing programmes of online learning.

In discussing the development of their pattern language for computer mediated interaction, Schuumer and Lukosch (2007) identify three distinct layers that address different user groups as an attempt to bridge the gap between users and developers. The highest level of abstraction "Community Support" are primarily aimed at end users and their behaviours, the middle level of abstraction "Groups Support" address the design of particular aspects of the human-computer interaction, and the low level abstraction "Base Technology" which addresses the tools and consequently is aimed primarily at developers. Within these layers patterns are clustered into topics and relationships with other topic clusters identified giving a comprehensive set of sevent-one patterns.

Of particular relevance to this paper are the highest and middle levels as they address human behaviours and organisational issues that are of central importance to developing the Ultraversity online communities of inquiry.

4 Methodology

4.1 Approach

The findings in this paper are based upon research using an adapted form of Interpretive Phenomenological Analysis (IPA). IPA was developed in the mid 1990s by Jonathan Smith (Smith 1999) and is itself a hybrid of systematic and naturalistic inquiry. In this approach, data collection and analysis goes through a number of detailed stages in order derive meaning from the text. The approach is informed by the philosophical stance of phenomenology and focuses on how an individual makes sense of experience. Interpretation is the key concept, both by 'subject' and researcher. Smith sums it up as:

> “An attempt to unravel the meanings contained in accounts through a process of interpretative engagement with the text and transcripts.” *(ibid)*

4.2 Data collection

The authors are aware of the issues around taking a top-down approach and the implications this has for validity consequently a wide range of stakeholders were consulted; the authors’ experience, as practitioner researchers directing, developing and facilitating the course, was augmented by data from students and course staff. An online questionnaire presented in July 2006 to students was completed by some 65 of a potential 142 respondents in July. Follow-up semi-structured interviews of 15 students carried out in September 2006 developed a richer understanding. These interviews were conducted using Skype and WireTap Pro software for recording; the recordings were then transcribed. This data was further augmented by semi-structured interviews with 19 graduates of the programme; these were carried out at the graduation ceremony on 26 November 2006 and were recorded on video then transcribed. Except for the initial online questionnaire, in each case, the questions were designed according to IPA methodology to be open-ended and expansive in their opportunity for subjects to comment on the course freely. Course staff, including the authors of this paper, were asked to complete a semi-structured written response; of a potential 21 respondents 10 were completed.

4.3 Analysis

The authors already subscribed to the research strategy for the Ultraversity project and this directed the research assumptions. These centred on the question, ‘Is our model of collaborative learning supported through communities of inquiry an effective interpretation of personalised learning?’ Two assumptions that are focused on here are that we had developed an appropriate technical and organisational infrastructure for undergraduate study and that we had designed the course to enable effective integration with students' work through personalisation. The three authors met and discussed these assumptions in order to ensure these were articulated before analysis.

Discussions were carried out using Skype as the medium for synchronous verbal discussion, Google Docs and Spreadsheets were used collaboratively to discuss and consolidate concepts, analyses and conclusions. The authors transcribed the data pasting each whole conversation into a Google spreadsheet. In this first stage analysis each author individually noted emerging themes. Second stage analysis was carried out using Skype to discuss key titles emerging from our thematic notes in the spreadsheets - such titles were characterised by the team as 'floating to the top', capturing the essence of the transcript's meaning. Our goal was to find titles that were high-level enough to allow theoretical connections, but that were still grounded within the data. Finally the titles were discussed and the authors undertook a process of developing 'super-ordinate concepts' to organise all the themes. These were then re-checked against the raw data in transcripts to ensure they were accurate and grounded.

The super-ordinate concepts allowed the authors to identify pattern titles that were then used as the basis for the construction of a high level Pattern Language.

4.4 Limitations

In undertaking this approach and employing the IPA methods, the authors were conscious of a number of limitations inherent in the approach itself and in this particular exercise as outlined below.

a) The selection of student interviewees was based on volunteer students rather than a random sample; we did not seek students who had dropped out. Some justification for this can be found in our intention to conduct an Appreciative Inquiry, looking for what works rather than uncovering failure.

> “The traditional approach to change is to look for the problem, do a diagnosis, and find a solution. The primary focus is on what is wrong or broken; since we look for

> problems, we find them. By paying attention to problems, we emphasize and amplify them. …Appreciative Inquiry suggests that we look for what works in an organization. The tangible result of the inquiry process is a series of statements that describe where the organization wants to be, based on the high moments of where they have been. Because the statements are grounded in real experience and history, people know how to repeat their success."
>
> *(Hammond, 1998)*

b) The authors maintained a theoretical stance on the language analysed as being fair representation of 'inner states' - this view may be challenged particularly as the students were discussing issues with their tutors, and thus may have been anxious to please.

c) IPA can be critiqued in that the subjects' accounts rely on detailed experiences of participants, which in turn depend on the subjects' memory, ability to communicate and use of language. The students and staff in this study were highly competent and articulate and the authors felt that their accounts were likely to be valid for these reasons.

4.5 Approach to Pattern development

The development of the pattern language was based on both the authors experience gained in over a decade of Ultralab work and from the data gathered from staff reflecting on their recent practice working in the Ultraversity online community of inquiry. The authors were variously involved in the Ultraversity project providing perspectives from a number of roles; director of research, project director, technical development, and learning facilitators.

The methodological approaches for the construction of pattern languages are varied. Either constructed from an empirical base or invented and then tested for validity at a later date. In this case, the approach was that of a 'bricoler', using empirical data that was interpreted by the experience of those working the Ultraversity project in different capacities as well as taking inspiration from other related pattern languages identified in section 3.3 Example Pattern Languages.

5 Findings

In a prior study of student experiences on the same course, Millwood, Powell and Tindal (2008) identified eleven overarching themes from an analysis of student interviews. Analysis of the data in the study based on staff interviews evidenced clear alignment with the earlier study based on student interviews. This alignment was seen both in the issues identified and the reflections on those issues. The predominant issues arose from complexity rather than from failure, i.e. the course was considered to be following an appropriate direction but systems put in place were perceived, by a significant proportion of staff and students, as too complex. There were also significant issues raised relating to the implementation of innovation in the face of institutional restrictions. Many students identified issues relating to complexity as barriers to their learning and staff as barriers to the efficacy of their teaching.

5.1 Evolution in use of Virtual Learning Environments and other software frustrated pedagogical aims

As the course evolved through the use of alternative Virtual Learning Environments (VLEs), the issue of moving from one set of rules, tools and affordances to another was embraced and celebrated but also seen as a source of great frustration for staff and students. The data indicates that as we progressed through VLEs there was some polarisation around favoured systems consequently some felt resentment and others relief when faced with change.

"I believe I am fairly technically competent, but I found it difficult to keep switching platforms, particularly with regard to resource creation and retrieval, and being clear about which tool was most appropriate to each particular purpose......Change is always hard and seems to polarize views - so students became fierce advocates of their chosen platform and closed to the benefits of the alternative system. This is a difficult one to deal with but definitely seemed to stifle thriving communities because the change in medium seem to kill the message."

(Facilitator, 2007)

5.2 Developing a common pedagogy in a team teaching approach was challenging but fruitful

From inception we acknowledged there would be a range of pedagogical approaches favoured by individual team members; we saw this as a potential strength bringing richness and diversity to the student experience. We were aware of the potential weakness as far as parity and a risk of non-parallel student experiences. A coherent team teaching approach was invoked with the intention of reducing the risks and of maximising richness. The data indicates that this approach worked well although there were issues ...

"I had to learn to teach wholly in the textual medium (I never experimented with podcasting which on reflection was short-sighted of me). I was a teacher used to relying on my personality and although this transferred into online contexts also, it was different – I had to be careful of joking or being irreverent about authority. It is easy to do that in a conversation but harder when all you say is recorded in black and white for all to see for all time."

(Facilitator, 2007)

5.3 The flexibility of learning asynchronously conflicts with the inflexibility demanded by fair assessment

On the inflexibility of institutional needs:

"The Quality Assurance procedures in relation to submitting work for assessment were relatively inflexible and for many good reasons, such as the need to be sure that work submitted was done so on time and was not subsequently altered. Clearly, for students wishing to work using Web 2.0 technologies this proved difficult with work either having to be rendered into a format that could be submitted or the extra work of creating zip files of offline web site submissions"

(Facilitator, 2007)

5.4 Students valued 'patchwork' assessment, but this challenged markers

On the patchwork text assessment:

"Many students found value in devising alternate genre pieces and presenting them using rich media. Presentation of sections of work as videos, magazine articles or news bulletins demands precision and required students to reduce complex situations to their key elements. The activities highlighted the value of being concise and precise and of examining situations for alternative perspectives. The issues we faced as

assessors were objectivity and equivalence; how many words is an animation worth?"
(Facilitator, 2007)

5.5 Facilitators recommend measures to increase coherence and consensus

This is a summary of the recommendations made by facilitators from the data collected.

1. Staff induction mechanisms - clarify expected approach, ensure adequate buy-in to new approaches and ensure they are co-owned by the team.
2. Team teaching approach - negotiate agreement of pedagogical approach; leaving room for individual personality/skills to be deployed, carry out parity check through regular monitoring.
3. Put a clear system in place - define parameters of freedom and control, establish clear roles and expectations, team teaching, QA /alignment and monitoring.
4. Organise an aligned team with an adequate scope of skills and specialisms, ensure these are visible, available and effective.
5. Inspire collaboration and trust at the heart of the team to ensure viable team teaching
6. Facilitate community learning through clear and consistent modelling of behaviour, coherent and consistent pedagogy, one to many communications, many to many communications, expertise in VLE technology, protection and support of staff, systematic framework.

6 Conclusions

Most dominant in the findings was the issue of diversity in staff expectations on the themes identified above in the Findings, such as induction, team teaching, assessment, facilitation of online community. The diversity in expectations was clearly also driven by complexity in our approach. Informally, the project could be accused of changing too many variables at once. Although Ultralab had established a coherent set of values and ideas for online learning, these were held tacitly by individuals and needed further clarification and most importantly, articulation. In practice such ideas also required consistent modelling by team leaders and reference to formally articulated procedures. Argyris, Putnam & McLain Smith (1985) explained this phenomena as two different "theories of action": espoused theory as an articulation of the values that they believe their behaviour is based on; and theory-in-use which are the values that their behaviour implies. To the individual, there is no contradiction as discovered in the research reported below. In order to articulate practice these values and ideas more clearly for subsequent development, the idea of patterns has been adopted and a Pattern Language for Online Community was developed. The patterns we propose fall into an identified category of Online Community of Inquiry. They have the specific purpose of informing the organisation of formal collaborative learning within a facilitated and structured online space with clearly defined intentions. The diagram below provides an overview of the pattern 'Nurture Online Community'. Further detail of a selection of the patterns can be found in the appendices.

Nurture Online Community of Inquiry

Deep learning arises alongside strong community

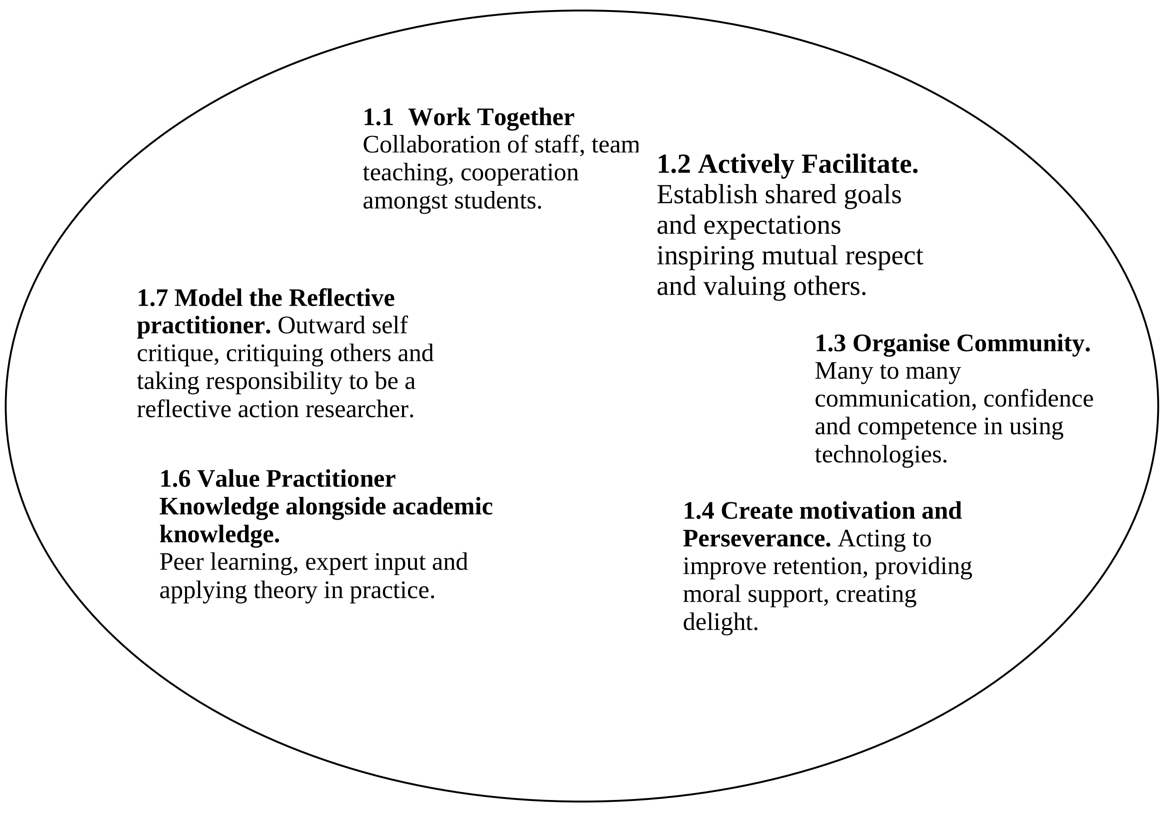

Fig. 2 Diagram of top-level patterns to Nurture Online Community of Inquiry

The first three patterns – ‘1. Nurture Online Community of Inquiry’, ‘1.1 Working Together’ and ‘1.5.1 Learning Sets' are included below together with an overview of the set of patterns.

The next steps in this research are to refine the patterns through evaluation with the Ultraversity staff team as well as students of the online community of inquiry. The refined results should provide a clear set of practices and processes for an approach to online learning in HE. Ongoing work will be to implement the patterns in the communities to assess their effectiveness in attenuating the complexities that arose from the Ultraversity model.

7 Appendix 1: Patterns

	Pattern 1. Nurture Online Community of Inquiry
a. Picture	There is no picture - this an abstract organisational pattern.
b. Introduction	This pattern is located under the Online Communities of Inquiry category. It is the only pattern at this level.
c. The Essence of the Problem	Learning can be ineffective and marginal when it is individual, competitive and isolated. The challenge is to create a social and interpersonal activity of regular dialogue, reflective practice and moral support.
d. The Problem in Detail	Learning organisation is traditionally designed to highlight individual endeavour, define a common curriculum and ensure achievement is assessed reliably through controlled conditions. Schools, colleges and universities achieve this in face-to-face contexts by timetabling, identifying class sets of similar capability and examinations. The problem is that this does not suit all learners' learning style, contextual needs or personal circumstances. This is evidenced in the difficulties faced by learners who are not taking opportunities in statutory or further and higher education. In particular, this pattern addresses the needs and opportunities of higher education, which can address social challenge in a context-based, action-research and online environment. This pattern defines a different view, that learning should be idiosyncratic, tuned to practitioners in context, placing responsibility on learners to negotiate process, content and award to fit their needs.
e. The Solution	This pattern proposes to nurture online community of inquiry. Use online technology to permit rich dialogue and many-to-many discussion and also to free individuals from travel and timetables. Create community to make effective use of peers, both for moral support, cooperation and as sources of experience and expertise. Establish community and learning organisation, which facilitates the negotiation of individual inquiry, the sharing of intermediate activity and the exhibition of results.
f. Diagram	Refer to the diagram that relates all the patterns to this pattern see Fig 2
g. Related patterns	1.1 Work together 1.2 Actively Facilitate 1.3 Organise Community

	1.4 Create Motivation and Perseverance 1.5 Organise learning 1.6 Value Practitioner knowledge alongside academic knowledge 1.7 Model the reflective practitioner

	Pattern 1.1 Working together
a. Picture	There is no picture - this an abstract organisational pattern.
b. Introduction	This pattern is a sub-pattern of the Nurture Online Communities of Inquiry pattern. Other patterns at this level include: 1.2 Actively Facilitate 1.3 Organise Community 1.4 Create Motivation and Perseverance 1.5 Organise learning 1.6 Value Practitioner knowledge alongside academic knowledge 1.7 Model the reflective practitioner
c. The Essence of the Problem	Cooperation between students and collaboration between staff is not normally achieved and is reported to be particularly difficult in online learning contexts.
d. The Problem in Detail	Teaching is usually organised to meet the needs of timetabling, to deliver lectures or lessons and to offer limited personal support in individual tutorials. Preparation and marking is also undertaken individually and this can be difficult. Learners are normally expected to work as individuals, but on the same content at the same time - this can lead to temptation to plagiarise and disaffection through irrelevance to individual interest. Workers in the field of online learning report cooperation and collaboration to be difficult to achieve in asynchronous remote learning.
e. The Solution	This pattern proposes that staff should collaborate closely. This entails treating teaching acts as joint objectives that require ongoing monitoring together in a team. Such acts include admissions, planning, preparation of materials, facilitation, organising, formative assessment, and marking. Responsibility should also be placed on students to cooperate in their learning acts. These include moral support, critical dialogue, sharing resources and ideas and celebration of success. Learners should be required to evidence their cooperation and

	participation as part of the learning outcomes of the course. Staff performance review should include specific criteria related to teamwork.
f. Diagram	Refer to the diagram that relates all the patterns to this pattern see Fig 2 above
g. Related patterns	There are no smaller patterns defined in relation to this category.

	1.5.1 Learning Sets
a. Picture	There is no picture - this is an abstract organisational pattern.
b. Introduction	This pattern is a sub-pattern of 1.5 Organise learning
c. The Essence of the Problem	High quality, constructive, critical feedback is essential for an online community of inquiry. Without challenge from different perspectives the work produced will be of a lower standard.
d. The Problem in Detail	There are many facets to undertaking an inquiry, and at each stage critically reflective evaluation is an essential component. Feedback from several perspectives, from community members with different expertise and experience, is the most valuable. Both giving and receiving of feedback are valuable mechanisms for developing criticality in students. Audience size and trust are factors that impact on learner's willingness to feedback. If the feedback process is to be effective critique must be given in a safe environment; one where those giving and receiving trust each other to be supportive; consequently locating the feedback in a community space with a large membership is likely to lead to selective and possibly limited engagement with the process.
e. The Solution	Establish learning sets with 5 members. Contract the members to support each other for a defined minimum level of commitment and with a group ethos of critical friendship. This should include offering as well as receiving critically constructive feedback. This activity should initially ? be supported by someone with expertise in the process who can model the behavior required as well as explain the process and why it is valuable. Feedback should be targeted on particular aspects of the work as required by module tasks or as identified by those receiving the feedback. All feedback must have the aim of creating the maximum possible positive impact. In giving support: - identify strong aspects of work - suggest alternative approaches based on experience - identify inconsistencies - challenge unfounded assumptions - offer supportive critique rather than aggressive criticism In receiving support: Accept that feedback is offered in the spirit of critical friendship, it is what is said that is being criticized rather than who said it.

f. Diagram	Refer to the diagram that relates all the patterns to this pattern see Fig XX
g. Related patterns	1.3.1 The 'Hotseat' expert guest 1.3.2 Asynchronous Conversations 1.3.3 Online Identity 1.5.2 Workplace advocate 1.5.3 Module design 1.5.4 Summative Assessment 1.5.5 Awards and Recognition

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Effects of the ISIS Recommender System for navigation support in self-organised Learning Networks

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Abstract: The need to support users of the Internet with the selection of information is becoming more important. Learners in complex, self-organising Learning Networks have similar problems and need guidance to find and select most suitable learning activities, in order to attain their lifelong learning goals in the most efficient way. Several research questions regarding efficiency and effectiveness deal with adequate navigation support through recommender systems. To answer some of these questions an experiment was set up within an Introduction Psychology course of the Open University of the Netherlands. Around 250 students participated in this study and were monitored over an experimental period of four months. All were provided the same course materials, but only half of them were supported with a personalised recommender system. This study examined the effects of the navigation support on the completion of learning activities (effectiveness), needed time to comply them (efficiency), actual use of and satisfaction with the system, and the variety of learning paths. The recommender system positively influenced all measures, by having significant effects on efficiency, satisfaction and variety.

Keywords: technology-enhanced learning, self-organised learning, informal learning, learning networks, recommender systems, navigation support, ontology, collaborative filtering, learner profiling

1 Introduction

Learning Networks (LN) strongly differ from traditional virtual learning environments because they are driven by the contribution of their members (Koper & Tattersall, 2004). Traditional approaches are designed top-down, because their structure, learning resources, and learning plans are predefined by an educational institution or domain professionals (e.g., teachers). In LNs, also the learners are able to publish their own learning activities (learning resources), or share, rate, and adjust learning activities (LA) from other learners. Thus, LNs explicitly address informal learning but are also capable to integrate formal learning offers. As a consequence of this more informal character, LNs have several functionalities in common with Web 2.0 technologies nowadays. One effect of Web 2.0 technologies is the dramatically increasing amount of available information, which also applies to LNs. It is a common problem for users of the Internet to select or discover information they are interested in. The need to support users with the selection of information or giving reference to relevant information in order to improve their self-organisation is becoming more important.

This is where navigation plays a major role. Navigation has been defined as “the process of determining a path to be travelled by any object through any environment” (Darken & Sibert, 1993) to attain a certain goal. Therefore, the object requires a position, feedback about the environment, and an idea about its goal. The learners in dynamic and informal LNs are in need of supportive information in order to self-determine their position, to self-regulate their learning path, and to adjust their competence development to their learning goal. Considering this definition, navigation support in informal LNs has major influences for the self-organisation of the learners. Information about other learners’ behavior is beneficial for the individual learner in the self-determination and self-regulation of the learning process.

We have carried out an experimental study with personalised navigation support within the ISIS project, and this article presents the setup and results from that study. Members in complex, self-organising, informal LNs need guidance in finding and composing their most suitable LA (route guidance), in order to attain their learning goals in the most efficient way (Prins, Nadolski, Drachsler, Berlanga, Hummel, & Koper, in press). The innovation of the research is the implementation of existing recommender system technologies into self-organised, informal LNs to support lifelong learners. Therefore, our focus is more on the evaluation of the learning outcomes through personal navigation support systems like recommender systems and less on measures like algorithm performance of the machine-learning field (Sarwar, Karypis, Konstan, & Riedl, 2000; Huang, Zeng, & Chen, 2007) which heavily influence the recommender system research.

The main purpose of recommender systems on the Internet is to filter information a user might be interested in. For instance, the company Amazon.com (Linden, Smith, & York, 2003) is using a recommender system to direct the attention of their users to other products in their collection. Existing ‘navigation services’ help to design and develop specific solutions for lifelong learners. Personal recommenders systems (Adomavicius, Sankaranarayanan, Sen, & Tuzhilin, 2005) are becoming increasingly popular for suggesting tailored information to individual users. In this article we discuss the effects of the ISIS experiment with a personal recommender systems (PRS) for LNs. Section two will describe our approach to navigation support in technology-enhanced learning, and presents our hypotheses for the experimental study. In the method section (third section) we describe the experimental design and the used recommendation strategy. In the results section (fourth section) we will describe measured observations and effects in response to the hypotheses. Finally, the fifth section discusses the effects and limitations of the study, and gives an outlook on future research.

2 Our approach to navigational support in technology-enhanced learning

In technology-enhanced learning navigational support is needed when learners fall short of answers to questions like: *How do I find learning activities that best match my situational circumstances, prior knowledge, or preferences?* PRS are promising tools for a better alignment of learner needs and available LAs. The motivation for PRS in self-organised LNs is enabling more personalised learning paths, while at the same time taking into account pedagogical issues and available resources. One way to implement pedagogical decisions into a PRS is to use a variety of recommendation techniques in a recommendation strategy (Setten, 2005).

Recommendation strategies are a combination of different recommendation techniques to improve the overall accuracy of any recommender system, and to overcome disadvantages of one singular recommendation technique. Such recommendation strategies are implemented into hybrid recommendation systems, because they combine different recommendation techniques in one recommender system (Hummel, Van den Berg, Berlanga, Drachsler, Janssen, Nadolski, & Koper, 2007). Recommendation strategies can be used in technology-enhanced learning to apply specific recommendation techniques in particular learning situations. The decision to change from one recommendation technique to another can be done according to pedagogical reasons, derived from specific demands of lifelong learning (reference deleted to ensure blind review).

The PRS that we used in ISIS combined a top-down, ontology-based recommendation technique (Middleton, Shadbolt, & De Roure, 2004) with a bottom-up, stereotype filtering technique (Sollenborn & Funk, 2002). Both techniques were combined in a recommendation strategy that decided which of the techniques were most suitable for the current situation a learner was in. If stereotype filtering was used to create a recommendation the next best LA was based on the most popular LA of a specific learner group using Collaborative Filtering. In case the ontology was used to create the recommendation, learner preferences (taken from their user profiles) were matched to the domain ontology to recommend the most suitable next best LA.

The following 4 hypotheses were tested in the ISIS experiment, where the control group was provided with the Moodle learning environment and a text book; whereas the experimental group was additionally provided with a PRS that recommended best next LA based on successful choices of other learners with similar profiles.

1. The experimental group will be able to complete more LAs than the control group (Effectiveness).
2. The experimental group will complete LAs in less time, because alignment of learner and LA characteristics will increase the efficiency of the learning process (Efficiency).
3. The experimental group has a broader variety of learning paths than the control group because the PRS supports more personalised navigation (Variety).
4. The experimental group will be satisfied with the navigational support of the PRS (Satisfaction).

In the next section (method section) we will describe the experimental design and the used recommendation strategy in more detail. In section four results and statistical effects will be presented.

3 Method

To test our hypotheses in an authentic learning situation, we carried out an experimental study within the regular "Introduction Psychology" course as offered by the Psychology faculty of the Open University of the Netherlands (OUNL). This new course was offered as alternative next to the existing, old version of the course. The LAs and the PRS were implemented in the Moodle LMS (Dougiamas, 2007).

3.1 Participants

No prior knowledge was required from the participants to attend the Introduction Psychology course. A total of 244 participants subscribed to this pilot. Both the experimental and control group contained an equal amount of learners (122 learners per group) because the learners were randomly allocated. 24 participants (19.7%) in the experimental group and 30 participants (24.5%) in the control group never logged into the Moodle environment. This group of non-starters was not included in our analyses. This leaves a group of 190 learners who did enter the Moodle environment; 98 in the experimental and 92 in the control group.

From the 98 participants in the experimental group 60% of them were women, within an average age of 38,5 years, and 70% of the participants had a higher professional education or university level. In the control group 65% of them were woman, within an average age of 34,7 years, and 62% of the participants had a higher educational level.

The group of actual starters had to be further differentiated into active and passive learners, because not all of the learners actually used or made progress in the Moodle environment. From the 98 participants in the experimental group 72 learners completed LAs; from the control group 60 learners completed LAs. Thus, in total a group of 132 were active learners during the experiment. We used this total amount of active learners to analyse hypotheses 1 (Effectiveness), hypotheses 2 (Efficiency), and hypotheses 3 (Variety). The group of participants was further characterised by an average age of 36.5 years, 62.5% being female students, and 66% having a higher education level.

3.2 Materials

The Learning Network. Moodle was adjusted to the experimental setup. Figure 1 shows the overview screen of LAs for a learner in the experimental group. The overview is divided into three columns. The right column shows the LAs the learner still has to study. The middle column presents the courses the learner is already enrolled for. Finally, in the left column all completed courses are listed. Below an explanation of the recommendation is given. In this screen, the PRS has recommended 'Thinking' as next best course. Next to the recommendation there are additional options to get further information about the recommendation and to adjust the preferences set in the learner profile.

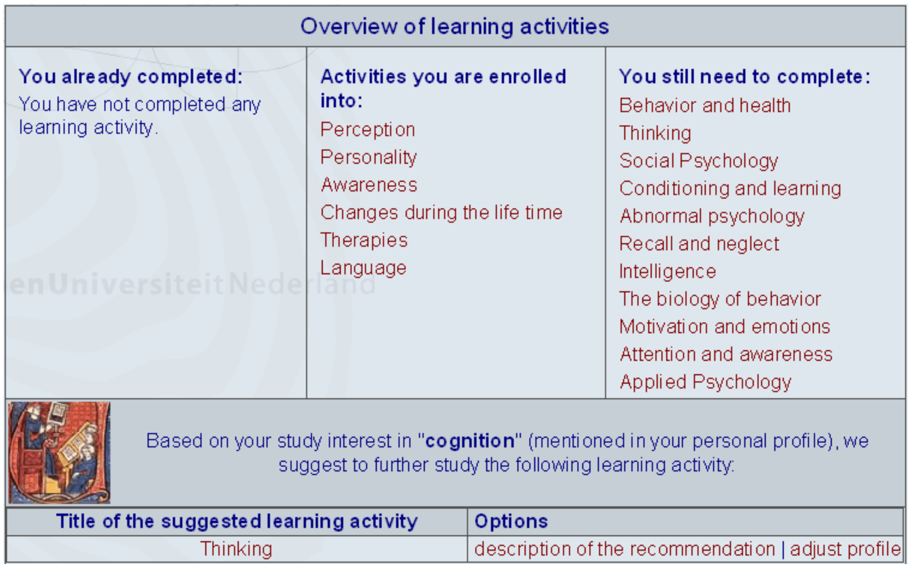

Figure 1: Overview page of the experimental group with a recommendation

The LN contained 17 LAs with an average study load of 12 hours. Formal completion of each LA was assessed by multiple-choice tests consisting of seven equally weighted questions. A score of 60% or more was considered as a successful completion of the LA. With the Moodle environment the learners received an Introduction to Psychology handbook that contained additional information to the 17 LAs. All LAs were separate entities in Moodle, setup according to the same didactical structure. The Moodle environment contained all further learning materials, including support and guidance, task assignments, progress tests, additional pictures and links, summarizations, and other attractive learning tasks.

The Personal Recommender System. The PRS with a combined recommendation strategy provide more accurate recommendations when compared to single techniques PRSs (Melville, Mooney, & Nagarajan, 2002; Pazzani, 1999; Soboro & Nicholas, 2000). The implemented PRS combined an ontology-based recommendation technique with a stereotype filtering technique. The ontology used personal information of the learner (e.g., interest) and compared that with the domain knowledge to recommend the most suitable LA. Stereotype filtering used profile attributes of the learners (e.g., interest, motivation, study time) to create learner groups and recommend LAs preferred by similar learners.

The PRS advices the next best LA to follow based on the interest of learners (ontology-based recommendation), and on the behaviour of the peers (stereotype filtering). If only information about the interest of a learner was available, then ontology-based recommendation technique was used, else the stereotype filtering technique was applied. The underlying recommendation strategy is presented in Figure 2.

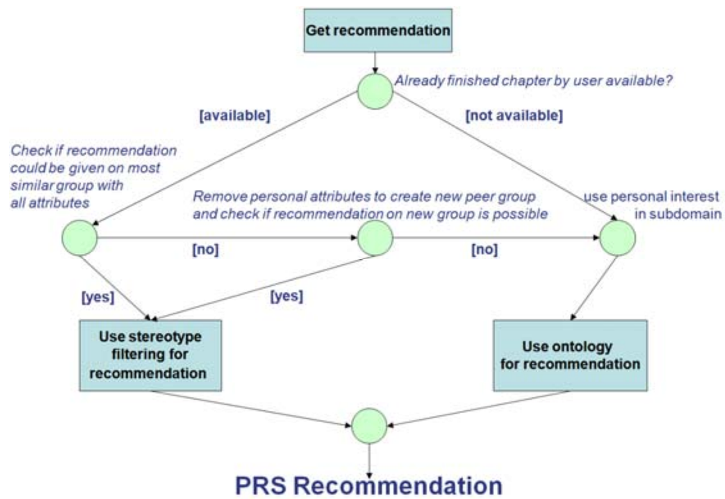

Figure 2: Recommendation strategy for the implemented PRS

The use of the stereotype filtering was prioritized and the ontology approach was used mainly to cover the ‘cold-start problem’ (Herlocker, Konstan, & Riedl, 2000) of the stereotype filtering technique. The stereotype filtering technique was personalised through attributes of the personal profile of the learners. If it was not possible to give any advice it disabled one of the personal attributes and tried to make a recommendation based on larger peer group with less common attributes (Figure 2).

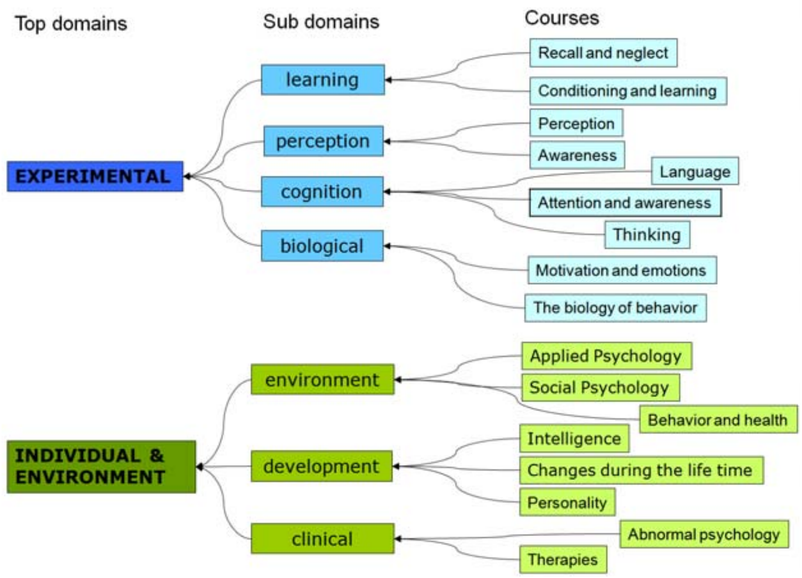

Figure 3: Structure for ontology based recommendations

Only in the case that the stereotype filtering was not able to provide any recommendation, the PRS created ontology-based recommendations. The ontology visualized in Figure 3 consists of two top domains (e.g., ‘Environmental Psychology’) that contain several sub domains (e.g., ‘learning’), each containing two or three courses (or LA) (e.g., ‘recall and neglect’). The learners had to select a special interest (one of the sub domains of the ontology) in their profile. If the learners had chosen a sub domain (e.g., ‘clinical’), they received recommendations on courses located in that particular sub domain. If none of these courses had been completed by others so far, the PRS randomly recommended one of them. If one course had already been completed by the learner the other course(s) was/were recommended. If all courses of the sub domain (e.g., ‘clinical’) were completed the ontology recommended a course that was part of the top domain ‘Environmental Psychology’.

3.3 Procedure

The participants could voluntarily register for the new version of the course, and were informed that they were taking part in an experiment with a new learning environment. They were not informed that only half of the students would receive additional navigation support. The participants were randomly assigned either to the experimental group or the control group. Both groups received the same treatment (course materials); all were able to ask questions to a tutor in a forum. In order to draw conclusions to self-organised informal LNs both groups got a maximum of freedom for their studies. Both groups were informed that they did not have to follow the LAs in a certain order or pace. In principle they were able to study the course over years.

As a consequence not all students started their study in October; some of them started later, (dynamic starting point). Furthermore, they were allowed to complete LAs at their own pace. Students could register for a final exam whenever they wanted, even without completing any of the multiple choice online progress tests available. The experiment ran for four months, from early October 2006 until late January 2007. During this period no further information about the experiment was given to the participants. In the experimental period of four months, measures were taken every two weeks.

3.4 Analysis of Effectiveness and Efficiency

In order to deal with a selection problem in our experiment we defined a goal attainment of 5 completed LAs out of 17 in total. Our aim was to support as much learners as possible to complete these 5 LAs as fast as possible. To measure the effectiveness and efficiency of the PRS learners were taken into account that applied to the following rule; completed more than 5 LAs, or successfully completed the final exam, or were still studying at the measure point. This rule leaves a number of 101 students at the end of the experiment (n=52 in the experimental group and n=49 in the control group). Regarding the individual dynamic starting points of the students the recorded measure in Table 1 contained 0 values in case students started later (see Table 1). In order to ran a MANOVA analysis all individual starting points of the students were moved in one ‘starting’ column through deleting the 0 values. Therefore, Table 1 was transformed into a study progress table (see Table 2). Table 2 differentiate from Table 1 through moving the individual starting points into one ‘starting’ column (first column), and the duplication of the study results towards the end of the Table 2 if the students applied to the above mentioned rule.

Table 1

Example table of biweekly recorded measures.

Learner	Biweekly measure points						
	Oct	**Oct 2**	**Nov**	**Nov 2**	**Dec**	**Dec 2**	**Jan**
1	1	2	4	7	7	7	8
2	0	0	0	1	3	5	9
3	0	0	0	0	0	1	1
4	1	2	3	4	4	4	4

Table 1: This table represents the 'raw' recorded measures of the biweekly measure points. The 0 values are related to the individual starting point of the participants.

Table 2

Example table of prepared biweekly measures for MANOVA analysis.

Learner	Study progress per learner per measure point						
	1	**2**	**3**	**4**	**5**	**6**	**7**
1	1	2	4	7	7	7	8
2	1	3	5	9	9	9	9
3	1	1					
4	1	2	3	4	4	4	4

Table 2: This table shows the actual study progress of all active learners. Therefore, all 0 values from Table 1 are deleted and the individual starting points were moved into one 'starting' column (first column).

To test hypothesis 1 and 2, we analyzed the measures taken using SPSS 12. To avoid inflated Type I error due to multiple tests, a priori tests of specific contrast scores were used. The effectiveness and efficiency was analyzed by means of linear and quadratic trend analysis. Averaged completion scores and averaged completion time during the two experimental periods were transformed into linear and quadratic trend contrast scores by means of computation of orthogonal polynomials. We applied multivariate analysis of variance (MANOVA) for repeated measures on these a priori chosen contrast scores with Group as between subjects factor and Time (or Progress) as within subjects factor. A significant interaction of contrast scores with Group was followed by testing of simple contrast effects. Due to the a priori character of these tests, they were performed with the conventional Type I error of .05 (Tabachnick & Fidell, 2001).

3.5 Analysis of variety of learning paths

To test hypotheses 3, the variety of learning paths, we analyzed the behaviour of the learners with a Graph Theory approach (Gross & Yellen, 2006). Therefore, we modelled the LN in Netlogo 4 (Tisue & Wilensky, 2004), and observed the completion of LAs by the learners. If a learner completed for instance first LA 1 and second LA 7 it was counted as traffic between LA 1 and LA 7. A line was drawn between both LAs in the graph when the traffic became larger than 3. If the learning path was used even more frequently, the traffic line got thicker and changed its colour. Consequently, the thickest path was used most often and the thinnest path was used only three times.

3.6 Analysis of satisfaction with the PRS

To test hypothesis 4, the general satisfaction of the PRS, we conducted an online recall questionnaire. This questionnaire was sent to all 190 participants in both groups at the end of the experiment. We received answers from 52 people in total, thus we had a response rate of 27%. From the control group 24 out of 92 learners responded and from the experimental group 28 out of 98 learners. The response rate of the control group was 22% and the response rate of the experimental group was 27%.

4 Results

4.1 Effectiveness

The amount of progress made by learners in both groups as indicated by the number of LAs completed after four months (half-way) of the experiment is represented in Figure 4. The overall completed LAs (the overall progress of both groups) over time was denoted by a significant positive linear trend ($F(1,99) = 203.22$ $p < .001$) and a significant positive quadratic trend ($F(1,99) = 40,31$, $p < .001$). There was no significant effect of Group for effectiveness on the linear and quadratic trend.

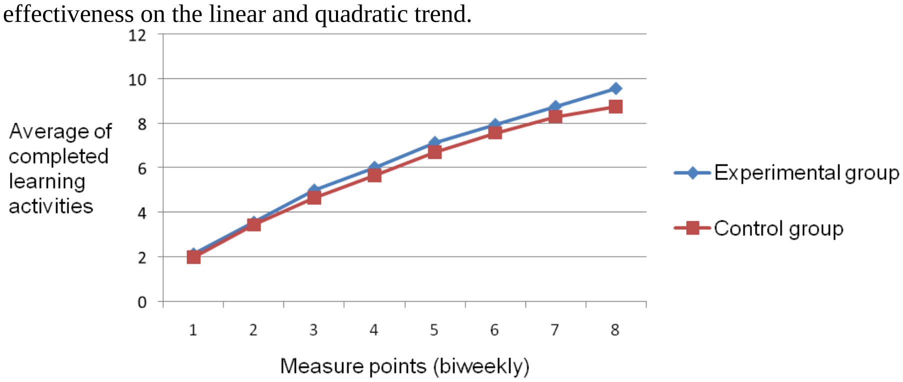

Figure 4: Progress of learners on completion of courses during the experimental period

4.2 Efficiency

The time learners spend after four months is represented in Figure 5. The overall effect of time was denoted by a significant positive linear trend ($F(1,99) = 101.32$, $p < .001$) and a significant positive quadratic trend ($F(1,99) = 4.3$, $p < .05$). The experimental group, needed constantly less time to complete equal amounts of LAs. This result was also confirmed by SPSS with a significant effect of Group on the quadratic trend ($F(1,99) = 5.14$, $p = .026$). No significant effect of Group was found on the linear trend. Simple effects analysis showed that for the control group the curve got a declining trend at the end, whereas the experimental group behaved increasingly linear.

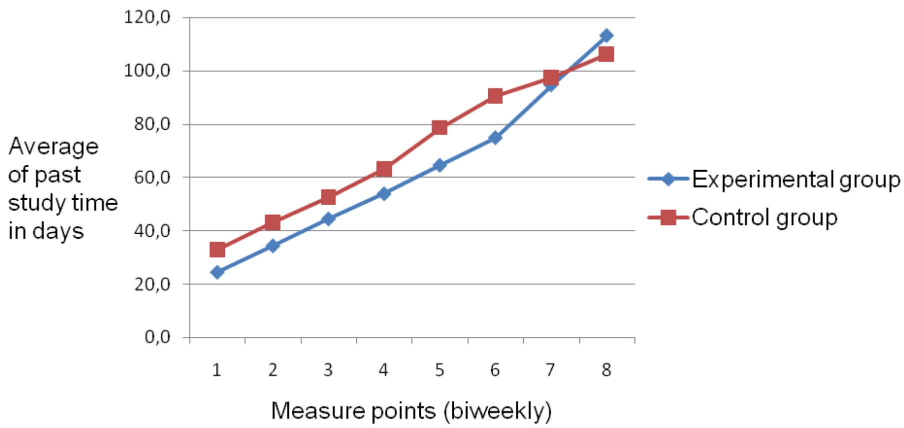

Figure 5: Average study time during the experimental period

Figure 6 shows how often the recommendations techniques were used during the experiment in the distributed and cumulated values. During the first month the cold-start problem of the PRS occurred, because there was no data available for stereotype filtering. Nearly all recommendations in this period were covered by ontology-based recommendations. But starting from the second month, stereotype filtering has been used more often and became equally used, when we consider distributed numbers at the end of the experiment.

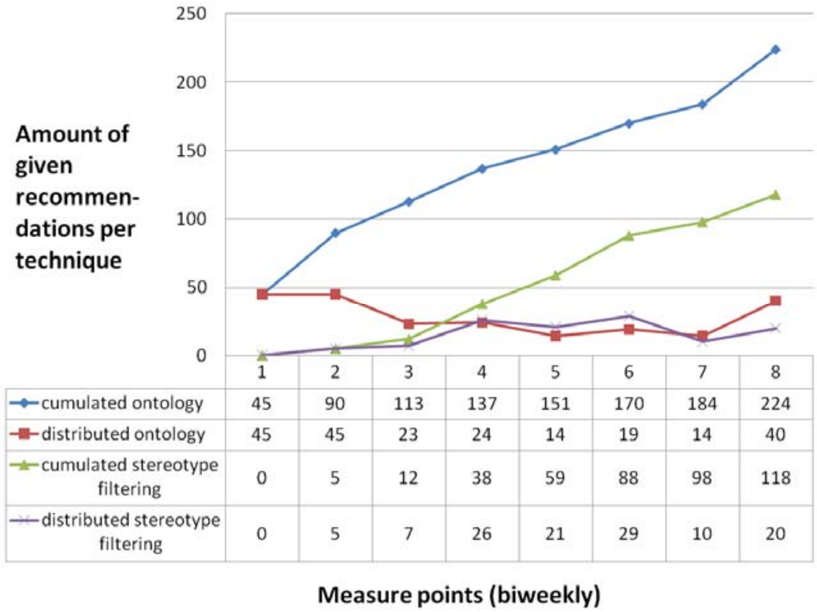

Figure 6: Usage of recommendation techniques during the experiment

4.3 Variety of learning path

To compare the emerged learning paths of both groups we placed all LAs in Netlogo 4 in a circle. LA 1 is the starting chapter of the additional given book labelled as the 'biology of psychology'. The numbers attached to the nodes in the graph mark the chapter number from the additional given psychology book. Figure 7 presents the emerged learning paths of the control group, and Figure 8 presents the emerged learning paths of the experimental group. Both Figures were drawn with the recorded user behaviour at the end of the experiment.

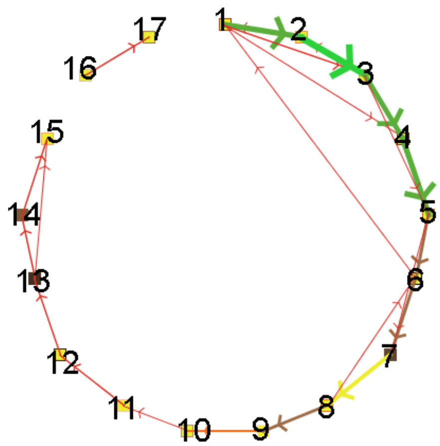

Figure 7: Emerged learning path of the control group at the end of the experiment

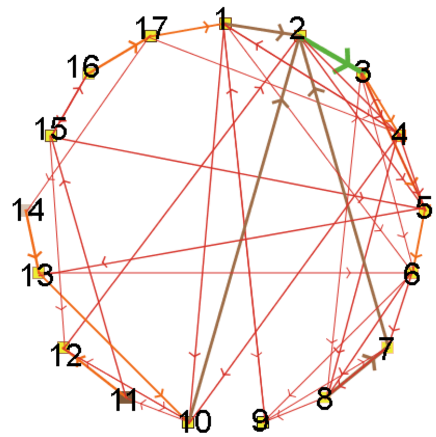

Figure 8: Emerged learning path of the experimental group at the end of the experiment

For the control group we see (Figure 7) that most of the participants followed the order of the textbook that was given to the Moodle environment. For the experimental group (Figure 8) many more thin and medium size lines reflect the influence of the PRS. The participants in the experimental group have taken more personalised learning paths than the control group. They hardly followed the chapter order of the textbook.

4.4 Satisfaction of the PRS

In this section we present the most relevant answers from the online recall questionnaire of the experimental group regarding the satisfaction of the PRS. We also asked for the general usage of the PRS as an indicator for satisfaction. The results of the questions about the general use can be found in Table 3. The more detailed questions about the satisfaction are shown in Table 4.

Table 3

General question about the usage of the PRS from the experimental group (n = 28).

Question	Values				
	Yes	No, because of technical problems	No, because the description of the recommendations were not transparent to me		No, because I also wanted to follow the book
Did you use the recommender system during the whole period of the course?	64% (n=18)	0% (n=0)	4% (n=1)		32% (n=9)
	Yes	No			
Do you think the PRS helped you to structure the learning activities in a more personalised way?	46% (n=13)	54% (n=15)			
	Very often	Often	Neutral	Seldom	Very seldom
How often did you follow the recommendation that was given to you?	32% (n=9)	29% (n=8)	11% (n=3)	11% (n=3)	17% (n=5)

In Table 3, Question 1 it is shown that 64% (n=18) of the participants used the PRS during the whole period, 4% (n=1) did not use it the whole time because the explanation of the recommendation was not clear enough for them, and 32% (n=9) answered that they did not use the PRS the whole period because they also wanted to follow the book.

For question 2 46% (n=13) answered that the PRS helped them to organise the study in a more personalised way, whereas 54% (n=15) of the learners answered that the PRS did not help them to organise their study in a more personalised way.

Finally, the learners were asked about their ‘obedience’ to the system, i.e., how often they follow up on the advice that was given to them (Table 3, question 3). 32% (n=9) answered they had followed the advice very often, and 29% (n=8) answered they had followed the advice often. 11% (n=3) were neutral to this question and around 29% (n=8) answered that they seldom / or very seldom had followed the advice.

We were also interested if the PRS followed the expectation of the learners (Table 4, Question 1). 14% (n=4) / 21% (n=6) of the learners answered that the recommendations followed their expectations (i.e., what they themselves wanted to do next) very good / good. 61% (n=17) were neutral about the PRS and only 4% (n=1) answered that the PRS was less in line with their expectations.

Table 4

Detailed responses about the benefit of the PRS from the experimental group (n = 28).

Question	Values				
	Very good	Good	Neutral	Less	Very less
Did the recommendation of the recommendation system follow your expectations for studying the next learning activity?	14% (n=4)	21% (n=6)	61% (n=17)	4% (n=1)	0% (n=0)
How satisfied have you been with the recommendation given by the recommendation system during the first two month of your studies?	7% (n=2)	18% (n=5)	71% (n=20)	4% (n=1)	0% (n=0)
How satisfied have you been with the recommendations given by the PRS during the last two month of your studies?	7% (n=2)	39% (n=11)	46% (n=13)	7% (n=2)	0% (n=0)

To further analyse the impact of our recommendation strategy, we asked the learners if they were more satisfied with the recommendation given in the beginning or at the end of the experiment (Table 4, questions 2 and 3). We wanted to know if the learners noticed any differences in the given recommendation over time, since the ontology recommendation was mainly used in the beginning of the learning progress and the stereotype filtering technique was used mainly at the end of the learning progress. Surprisingly, the learners rated their satisfaction for both periods quite different. 7% (n=2) and 18% (n=5) were positive about the recommendations during the first two month (ontology). But 7% (n=2) and 39% (n=11) rated the last two month more satisfying. It seems that they are more satisfied with recommendations based on the stereotype filtering. A minor percentage 4% (n=1) and 7% (n=2) were less satisfied with the recommendations. Nevertheless, nobody was unsatisfied with the recommendations.

5 Conclusions and Discussion

Based on the results of the experiment we can draw several conclusions for our research on navigational support in self-organised, informal LNs for lifelong learners. According to our 4 hypothesis, we can now conclude the following.

5.1 Effectiveness

The experimental group was consistently found to be more effective in completing LAs than the control group during the experimental period. Even with these promising observations, we have not found a significant difference; therefore, hypothesis 1 cannot be confirmed. It might be that this is due to the fact that the experimental period was to short and further observations might be more successful.

5.2 Efficiency

The experimental group consistently needed less time to complete equal amounts of LAs, which effect was found to reach significance after 4 months. Therefore, hypothesis 2 could be confirmed. This result shows that our approach to navigational support and our recommendation strategy enhance the efficiency of learners in self-organised, informal LNs.

5.3 Variety of learning paths

The variety of personalised learning paths increased by the PRS. The experimental group from the beginning onward created more personalised learning paths. Some of these personalised learning paths also caused (by emergence) successful learning paths taken by other learners. Considering this results in combination with the positive effect on efficiency and satisfaction it appears that the personalisation and the support of self-organisation in informal LNs were beneficial for the learners. The experimental group outperformed the control group and used the PRS. Based on this result we also confirm hypothesis 3.

5.4 Satisfaction

The qualitative data about satisfaction from the recall questionnaire underlined the quantitative results about the actual use of the PRS. The learners accepted the PRS for supporting them in their self-organised navigation through the LAs. 64% of the participants used the PRS over the whole experimental period very often or often. 46% have the impression that the PRS helped them to organise their learning progress in a more personalised way. The experimental group was more satisfied with the recommendations based on stereotype filtering. This is an interesting finding and will have influence on our future research. Regarding the informal characteristic of LNs, we want to use more bottom-up techniques like collaborative filtering instead of top-down ontologies. In future research we are planning to combine these bottom-up techniques with learner ratings and tags, which have been proven to be appropriate for self-organisation in informal environments like LNs. However, because of the positive responses from the learners and actual usage data we can confirm hypothesis 4.

5.5 Limitations and future research

We have reported positive outcomes to our study. However, we have to point the reader to some serious limitations as well. Besides the limitations already mentioned in the previous result section, there are some more general limitations to this study, regarding the experimental design we applied.

First, although our research addresses lifelong learners in self-organised and informal LNs, the practical character of the experiment, embedded in a formal course with real students that wanted to be accredited, excluded some of the navigational and motivational problems faced by lifelong learners. For the future research of LNs we envision more informal learning activities without a formal assessment, therefore we are planning to have an additional experimental pilot where open educational resources (OER) and their communities are used. An experimental pilot with OER is more similar to LNs, thus a LN could exists out of different mixed OER, formal learning offers, or separated learner contributions in once.

Second, the experimental setup did not force learners to actually take the recommended next step, and we do not know to what extent learners actually followed up the advice. The problem is the definition of what constitutes a 'followed recommendation'. Did learners follow a recommendation when they navigated to a recommended LA? Or did learners follow a recommendation when they stayed longer than 5 minutes in the recommended LA? As a result, the improved efficiency cannot be unambiguously ascribed to the PRS itself. The mere presence of a navigation support tool may have stimulated the experimental group. An additional experiment involving a control group receiving random recommendations would help clarify this point. We were not able to provide faked recommendation to the control group because of ethical reasons. It would have been not fair to confuse the control group with random recommendations, because they also were real students that paid the same amount of money for the course.

Third, we have to mention one limitation for effect on efficiency. There is a difference between the measured 'elapsed time' that students took to complete a LA and the actual 'study time' they needed to successfully complete a LA. Elapsed time as measured through the Moodle environment is an assistant indicator for real study time.

Finally, we decide to show only the 'best next LA', based on our recommendation strategy to the learners. We did that for experimental reasons, otherwise the analysis would have been even more complex. Alternatively, we could have given both groups the same user interface with all the LAs listed, the only difference being that in the experimental group the LAs are reordered according to the recommender system's priorities while the control group gets a standardised ordering. This would have provided a more similar environment for both groups, but also might force the learners to select always the first LA on the list. Nevertheless, in real life a list or a sequence with suitable recommendations on different characteristics might be more valuable for the learners than a single recommendation.

Further research is needed to address these limitations and to reveal whether alternative recommendations would have a greater impact on effectiveness, efficiency, variety, and satisfaction for lifelong learners in self-organised LNs. Additional information given to the recommendation of a LA could be success rates, required competence levels, average amount of study time, subjective ratings, or tagging information given by other learners.

Currently we are running a series of simulations in Netlogo where we test the impact of different other recommendation techniques and their combination in recommendation strategies for different sizes of LNs. Despite the limitations of the presented study, we believe it (at least partially) proofs that the use of navigation support based on a personalised recommendation strategy offers a promising way to advise learners on their self-organisation in LNs.

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