

# Drupal as a Social Hub for Personal Learning

Tobias Hölterhof, Axel Nattland, and Michael Kerres

University of Duisburg-Essen, Germany

{tobias.hoelterhof, axel.nattland, michael.kerres}@uni-duisburg-essen.de

**Abstract.** A Personal Learning Environment (PLE) focuses on the personal need of a learner. It refers to informal and self-directed learning and integrates different resources and services in a single environment. But learning can also be considered as a social activity. From the perspective of a formal master program, the article discusses the relation between social and personal aspects of learning and describes the design of a technological platform that connects the different PLEs of the students. Instead of using a traditional Learning Management Systems (LMS) for managing the program, the platform acts as a “social hub” between the PLEs to perform formal learning scenarios and to build a social space.

**Keywords:** Social Learning, Personal Learning Environment (PLE), Drupal, Community, Master Program

## 1 Learning: a Personal and/or Social Activity?

In Education, learning is situated in a social environment. Lectures and courses define social groups where students meet and develop interpersonal relations. These relations often surmount the formal context of the classroom and develop into mutual friendships and social networks. Typically, students use social platforms like Facebook or Twitter to stay in contact and to organize their social life.

Increasingly, learning management systems (LMS) are used in courses and lectures. While these systems most often are used to provide access and to disseminate learning materials to the individual they also provide tools for social interaction, for synchronous and asynchronous communication and collaboration, e.g. in forums, wikis and blogs, in chat and conference rooms. Learning management systems therefore provide an environment for individual learning activities as well as for social activities. Institutional practices typically focus on the process and results of individual learning activities and assessments of learning most often are based on the performance of the single student. The use of traditional learning management systems (LMS) often has neglected the social aspects of learning.

Recently, digital tools for social activities are increasingly being discussed in the context of social constructivist pedagogy (e.g. Lev Vygotsky), a theoretical framework that stresses the social foundation of human learning and development. They provide an environment that focuses on social activities of the learners for communication and the joint production of digital artifacts. Many current projects in E-Learning have focused on these social activities and tools. They demonstrate that learning is an activity

of co-construction, although an individual activity on the surface, always embedded in a cultural context. With this process of enculturation, the individual develops knowledge in the interaction between the learners, teachers and knowledge artifacts, thus participating in the cultural heritage.

Humans are social beings. In order to emphasize the role of sociality for learning and education pedagogy often refers to anthropologists that understand humans as in need for social relations. According to Arnold Gehlen, man alone is deficient by nature; in culture he benefits from the findings of his common activities. In trying to master the contingencies of his experiences in the interaction with his world, culture is a way to interpret experiences to make sense and meaning and to find stability in his interpretations and expectations. Hence, learning takes place by and shared between members of a community that is embedded in a cultural context [1-2]. So even if learning is perceived as a personal process, it implicitly refers to social concepts like culture, community and society. Learning includes access to cultural knowledge and contributes to societal communication [3-5]. The current debate on social learning is closely linked to the new development of social networking tools (like LinkedIn, XING, Facebook) and social media platforms (such as YouTube, SlideShare, Scribd).

This short discussion points out that learning is to be seen as a personal as well as a social activity. Whereas some theories as well as some institutional settings focus individual learning activities, others concentrate on the social side of learning. The technological infrastructure for learning should provide an environment that supports both streams of activities likewise.

Personal Learning Environments (PLE), on the one hand, refer to the environment the individual has setup to organize and execute his/her learning activities. Recently, these PLEs have gained attention especially in the field of informal learning: learning that takes place without the structures of a course or an institutional setting that guides (and restricts) the individual learner. In this context, the learner can deliberately relate to others' or not: It is his or her own choice if or how much s/he wants to exchange with other learners or look for others to support or guide one's learning activities.

However, for (online) learning activities that are organized and supervised in an institutional context the question arises if or how an institution should handle (online) social interactions? In traditional FTF-education, there are many chances for social relations to develop quite naturally. In online education, however, the learning environment the institution provides influences the scope and intensity of social interaction to a certain degree. In the following, we will discuss, how an online environment can be designed that explicitly integrates PLEs with an institutional environment that fosters social interaction, thus acting as a social hub for PLEs.

## **2 Personal Learning Environments vs. Learning Management Systems**

Personal Learning Environments (PLE) include the digital tools and sources the individual learner has aggregated to satisfy his/her needs for learning. It typically consists not only of a single software or knowledge base but of a collection of tools and sources the individual has assembled over time.

The PLE focuses on the personal needs of a learner and its configuration depends on the kind of learning activities learners are engaged with – independent of demands and infrastructures of an educational institution. Learning Management Systems (LMS) on the other hand typically are platforms institutions use to organize and to manage courses they offer [7-8]. They provide many sources and various tools that increasingly also are configurable to the learners needs. But essentially they most neglect the fact that the environment the learning activities take place in are *not* identical to the environment the institution provide: The PLE is never identical to the LMS. In some cases, students might spend a lot time “on” the LMS, but still will perform several activities apart from the institutional LMS, for example using a preferred tool for processing words or graphics.

To advance this course centered and organizational scope, PLEs increasingly are being considered as a tool to support self-regulated and informal learning. Although a PLE is widely discussed as a technological concept, it should direct the focus of attention from the needs of the educational institution (e.g. to disseminate learning materials) to the activities learners do perform to meet certain learning objectives. By focusing the individual learning activities, PLEs are associated with self-organized learning, lifelong learning and informal learning [9-11].

A PLE, however, typically is not a solitary island. In fact, the concept has many relations to the discussion of social software. It has emerged in close vicinity to developments labeled as “web 2.0” and typically, a PLE consists of a rich toolset that provides mechanisms to aggregate web content from others into the PLE as well as to publish content from the PLE to the net. By integrating external services into a personal environment, the PLE collects and aggregates activities and information from different networks and integrates them into the user interface.

To realize this, the software framework should rely on open standards and use accessible interfaces for the exchange of information. Beside RSS feeds, web applications can use mash ups for implementing this task. Mash ups can combine external information and services into a personal portal and hence build a technological basis for a personal portal and a PLE [12]. Turner considers the individual as the center of the social web similar like the PLE considers it at the center of a learning process [13].

Describing a PLE as an integrating user view to aggregated sources and tools leads to the particular understanding of PLE. According to this, a PLE is a tool like a computer program or a web application collecting information and services. Wilson stresses, that not only collecting but also publishing information belongs to such an application. According to his description of the “VLE of the Future”, which can be considered as an early description of a PLE, the following features characterize a PLE [14]:

- it is not institutional but personal and it offers anyone the possibility to become a learning provider
- it supports formal and informal learning situations as well as social activities
- it collects user activities and also services and materials from learning providers
- it publishes content, invites other to this content and shares it
- it interacts with external devices (e.g. mobile phone, tv, guitar)

An early example of a PLE as a computer program is PLEX [15]. PLEX manages personal profiles and contacts, aggregates feeds and content from different sources and if

offers the possibility to share content through different and expendable conduits (see figure 1).

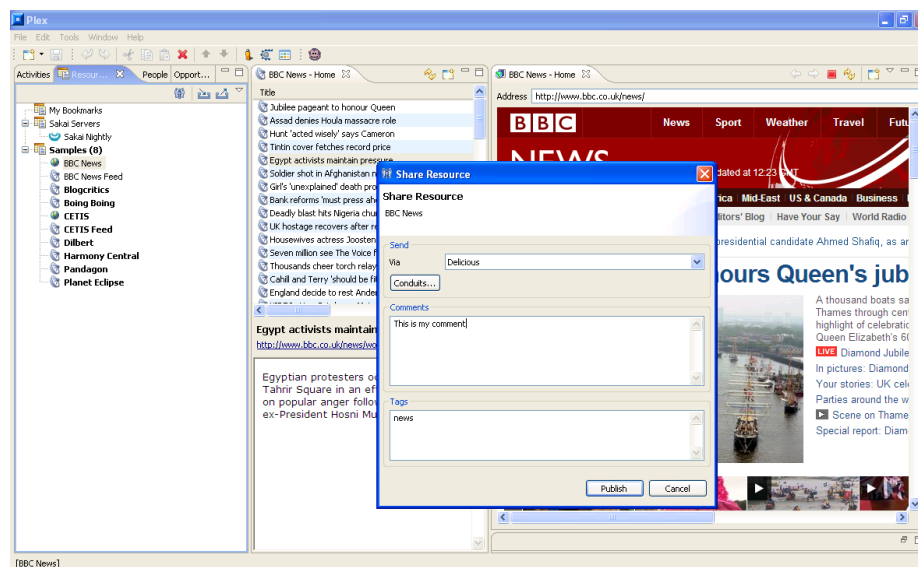


Fig. 1. PLEX Personal Learning Environment.

In a general understanding, a Personal Learning Environment cannot be considered as a single application or specific piece of software. The most general understanding of PLE includes all technical (and even not technical) tools and applications a person uses for its learning progress [11]. Ranging from a word processor for writing papers, an email client and a web browser to a private weblog and further, a PLE denotes the heterogeneity of tools, the aggregation of different services and the integration in an environment for the personal learning purpose. The personal computer of a learning person, its desktop, files, mails and programs are an example for this understanding of PLE as well as the personal weblog, mobile devices and even the books beside the laptop.

The relation between the general and the particular understanding of PLEs can be characterized as a vision and the realization of a vision. While the general meaning articulates the idea, a particular piece of software that denotes itself as a PLE is an interpretation of that idea and an approach of realizing it. For being part of that vision, a PLE has to be understood as more than a piece of software. A number of different approaches to and forms of PLE show heterogeneity in how PLE look like.

For designing a learning platform for a particular study program in higher education, the following discussion considers a PLE to be the multiplicity of tools and devices a student might use in his / her own learning environment. This understanding is rooted in the assumption that the development of technology and “web 2.0” offers a set of tools, programs and services on a high level of access that serves the needs of the *personal learning environment*. This requires the interoperability of different tools and devices. The study program presented here does not aim to design an all-encompassing PLE, instead it focused on connecting different pre-structured PLEs of

various learners with each other; the goal being to enable formal and informal learning processes between students and provide a social hub for these various PLEs.

### **3 Technology Enhanced Learning in the Masters Program “Educational Media”**

The master program “Educational Media” is a two-year online program offered by Learning Lab of University Duisburg-Essen since 2003. On average around 100 students study together each semester in several courses. In addition to required courses students can select study modules to suit their interests. Each study module (course) is a formalized learning opportunity in which learning units have to be completed at certain times. An academic tutor accompanies learning activities. The semester schedule is divided into six units each of them offering learning materials like texts, videos or podcasts and an assignment that has to be submitted until the next unit starts. Each module ends in a formal exam which has to be taken local in Duisburg (Germany) where students meet face to face one time a semester.

Central element of the instructional design are assignments for groups of learners that are incorporated in all learning units. The environment must therefore allow the formation of groups and offer support to these groups as they work on the tasks. For communication and collaboration several suggested tools are provided, while on the same time students are given freedom to select tools they prefer on themselves. New students typically need more suggestions on how to collaborate together on the internet. As the study advances, students get acquainted with technology enhanced learning, they try different tools and configure a personal learning environment suiting to their needs. Asynchronous communication can be accomplished directly via the platform. For groups working on text documents an etherpad server is provided. For synchronous communication a virtual classroom is included. Other external tools, such as Skype or Google Apps, can also be used alternatively by the learner.

The management of the masters program requires the full range of traditional learning management capabilities. Providing content, managing access permissions, displaying the status of learning progress and managing grades are essential functions of a technical platform supporting the learning process. All these functions are, in principle, covered by learning management systems. However, with respect to the concept of PLE, the design of one basic, all-encompassing platform of the institution seems to be unfavorable. Instead the system should be designed as connecting different PLEs of students to a social environment while permitting formal learning scenarios. The demands for such a sophisticated learning platform can be recapitulated as follows: The environment should:

- implement courses for formal learning in the form of study modules, scheduled learning units and assignments,
- support social interaction and the formation of groups,
- provide a set of suggested standard tools for communication and collaboration,
- assure interoperability with external services as well as the integration of external tools,
- connect to the diversity of hardware devices, students use to access to their PLE.

The resulting platform is called “Online Campus NG” (OCNG). It is used in live operation since march 2011 in the online study programs of Duisburg Learning Lab.

#### **4 Personal Learning Environments and Social Learning**

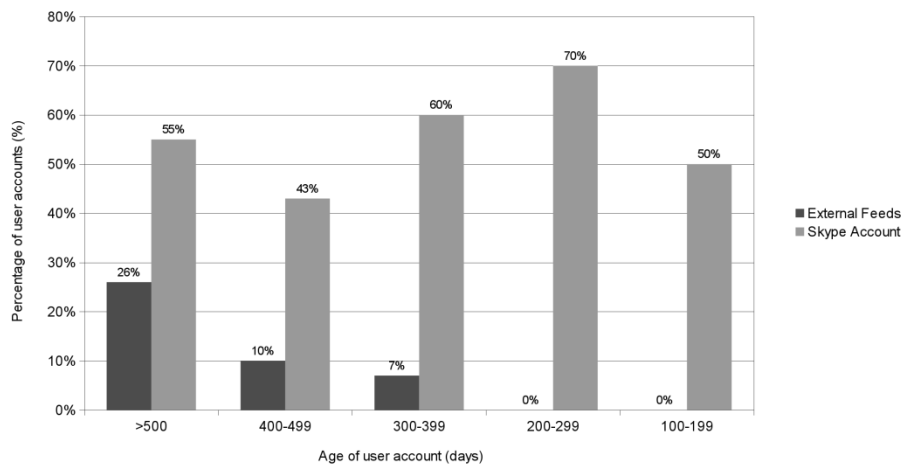
When students join the master program community they can be expected to already have a history of previous learning experiences. They might already be a member of other social networks (eg. Facebook, Twitter), may be reflecting on their learning experiences in a personal weblog, use different tools to communicate with others and to create artifacts including texts. Therefore it can be said that all participants have developed some type of PLE even if the students wouldn't call their environment as a learning environment. Although these PLE needs to be extended to fit the formal learning scenarios of a masters program, a university platform cannot replace these existing PLEs. Therefore the supporting technology platform should act more as a social joint that connects the PLE of the learners, supporting the social activities in the context of the study program.

One can distinguish a diversity of tools used in students PLEs. Some tools like synchronous or asynchronous communication are essential for providing social learning and therefore technology enhanced learning must assure that all PLEs contain these tools. Because the study program takes place mostly online, the usual social meeting places are not available to the students. A study group cannot meet in the library, nor can they exchange ideas in informal gatherings at the cafeteria. It is necessary to support these processes online. Some other tools are useful but not as essential as the first ones. For example writing a public microblog can be useful for staying in contact and sharing ideas with fellow students but needn't be done in this way even if the development of social ties seems particularly important for the stability of the learning groups. Also the usage of tools in a PLE needs different level of knowledge. Creating a personal account on a social media platform is easier than connecting different social media tools together for sharing information and posts between them. At least some tools are more popular than others and therefore new students usually know them and have experiences in using them. In order to offer technology enhanced social learning as a social hub between different PLEs one has to look closer on the tools used in students PLE and offer standard tools for essential elements. But which tools can be regarded as popular and in use by the students and which tools have to be offered

As an example one can distinguish two significant tools of a PLE for social learning. At first social learning needs some communication tools. For providing direct interaction and group work synchronous communication tools are essential. For this propose the voice and video chat application “Skype” can be expected as a popular example. At second as mentioned earlier PLEs are discussed under terms of interoperability of tools and services. A key feature for exchanging posts and activities between different services is the RSS-feed. With feeds blog and microblog posts can be exchanged and aggregated between different platforms and applications. Both elements, Skype accounts and external feeds, can be included in the personal user account of a student on the OCNG platform. If a Skype user name is given, the platform displays the name within the personal profile so that other students can contact that person. If external feeds are specified in the user profile, the system collects the items offered by

these feeds and displays them on several pages. An external feed can be a personal blog but also a social media platform like “Twitter” or “Facebook”.

For understanding the structure of a student PLE at the beginning of the study and its development during the study it is interesting to have a closer look at the user accounts on the OCNG platform. Currently (17.08.2012) there are 173 active students registered at the OCNG platform. Because the platform is in use since march 2011 and new students join the masters program every semester, the age of the user accounts vary between 554 and 122 days. Figure 2 shows the percentage of user accounts with external feeds or Skype user name specified in relation to the age of the user account.



**Fig. 2.** Students registered at the OCNG platform with external feeds or skype user name specified in their user account

The figure offers two different interpretations of the development of students PLE. At first as expected Skype seems to be a popular tool that is in use by around half of the students from the beginning of their study. Regarding all ages of active student user accounts, 51% of the students specify a skype user name. The variation during the age of the user account can be regarded as less important to that analysis. At second including an external feed to a user account seems to be more complicated. The increase of user accounts with external feeds during the progression of the age of the user account can be analyzed as a learning curve. The knowledge of exchanging information and resources with feeds between different applications is itself subject of the study program.

Of course the offered technology enhanced learning environment has to be customizable for all students that want to incorporate elements of their own PLE in the environment, while at the same time offering pre-structured elements for those learners that have little experience with at least essential tools for social learning. As this interpretation of user accounts suggests, writing and aggregating posts in a social context within the learning platform should be a pre-structured element offered to new students by the platform. The exchange of posts between different platforms is a demanding task that should be possible but we can expect that new students likely do not use this feature in their PLE. On the other hand, we can expect that new students use tools

for synchronous communication. So concerning this tool for social learning, the platform can refer to external tools.

## **5 Connecting Personal Learning Environments with Drupal**

Building a system to enable distance learning for an online degree program is an issue that faces the aspects of personal learning environment discussed above. It needs to be sufficient open to collect and connect the personal learning environments of the participants but it should not be without a central place, so that it can offer a structure for the degree program. It should support a formal learning scenario but also support opportunities for informal learning. All those demands raise the question which framework to use for realizing a system like that.

In recent years the content management system “Drupal” has attracted attention [16]. It is a software project with close ties to the web 2.0 movement. Unlike other content management systems it does not distinguish between a backend and a frontend with the corresponding user accounts for editing and viewing the site. It only uses one user database table for all accounts with different roles. This circumstance can be considered to represent the shift from users to authors of a website. It also offers a wide range of modules and extensions for integrating external services like other social networks. With the use of this extensions Drupal can be used in formal learning scenarios as a learning management system (e.g. <https://elms.psu.edu/>). So far Drupal has mainly been recognized as a system for editing, managing and delivering learning content that integrates social media features [17]. Beyond formal learning scenarios Drupal is able to export and to import content, applications and services according to open standards like rss-feeds, SCORM and various APIs. It also offers an extension to build personalized The “organic groups” extension allows users to build and manage own groups and to share content within it [18]. These features in combination with its community functions qualifies Drupal for informal and self-regulated learning scenarios and raises the question, in how far Drupal can be used as a framework for personal learning environments. The “Online Campus Next Generation” (OCNG) is our approach to use Drupal in such a way for our degree program.



The screenshot displays the OCNG dashboard for the course 'DIGITALE WERKZEUGE (SOSE 2012)'. At the top, there is a navigation bar with 'Dashboard', 'Studienmodule', 'Gruppen', and 'Projekte'. The main content area is divided into several sections:

- Navigation:** 'Anzeigen', 'By term', 'Bearbeiten', 'Gliederung', 'Revisions', 'Gruppe klonen'.
- DIGITALE WERKZEUGE (SOSE 2012):** A section with a description of the module and a list of learning objectives:
  - Lernplattformen: Funktionen und Auswahl
  - Editoren und Rapid E-Learning
  - Web 2.0 und Social Software
  - Personal Learning Environments (Unpublished)
  - Simulation und Serious Games (Unpublished)
  - Virtuelle Welten (Unpublished)
  - Informationen zur Klausur (Unpublished)
- INHALT:** A sidebar section listing the same learning objectives as above.
- LEHRENDE:** A sidebar section with two profile pictures.
- LEARNAUFGABEN UND EINREICHUNGEN:** A section with two tasks:
  - Lernaufgabe: Wählen Sie eine Lernplattform aus!** (13 Einreichung(en) im Status "Bestanden")
  - Lernaufgabe: Editoren und Rapid E-Learning** (10 Einreichung(en) im Status "Bestanden")
- NEUIGKEITEN:** A section with a 'Trivantis Feedback: Snap! Aufzeichnung Präsentationen INFORMATION E-Learning Lectora Rapid Authoring Tool Lab-Fehler Microsoft PowerPoint Erstellung Lerneinheiten Idee' and a 'Inhalt erstellen...' button.
- External Feed Items:** A list of news items with titles and dates, such as 'Neue Lernangebote bei VETLife', 'VETLife „Antibiogramm“ beim Kalb', 'Educational Media Samp; Friends Kickoff zur Europameisterschaft 2012', etc.

Fig. 3. Different elements of OCNG: a group (top), a river of news (bottom left) and external feed items rearranged according to a group (bottom right)

In Drupal, content and different content types are represented as “nodes” and “node types”. A simple post to other members of the community is also a node, just like a wiki page that can be edited in cooperation between multiple users. Even external content can be imported into the system as nodes. Custom node types can be modeled and implemented by a “content construction kid” as well as by other external modules. So nodes do not only represent content but also items of cooperative work and even external services integrated by mashups. The following list describes the range of node types we used in OCNG:

- Pages and articles to build the static content of a website to inform the general public about the program and conditions of study.

- Modules and informal learning groups are organic groups that can be freely created by teachers and/or students.
- Blog entries and posts in groups are content created by group members and students for social communication. Wiki pages are posts in a group that can be edited by all members of a group.
- Pads are nodes that integrate an external etherpad server. Pads offer the possibility to edit a text synchronously and cooperatively.
- Activitystream items are nodes imported from external social networks like Twitter, Facebook or Blogs.

An organic group implements a content access system allowing users to create groups and to share content within these groups. This module builds the basis for courses as well as informal learning groups. Groups do not even control the visibility of internal content. External content imported from other social networks can be rearranged according to these groups. As an example, the system can collect the posts of a user in the social network Twitter and display them to the members of the users group in drupal even if they are not followers in the generic social network of the user. In that way Drupal can act as a social hub for connecting and aggregating the activities of different persons on the social internet and rearrange them according to the social structure of a course or a group. Because we regard all tools and networks a student uses for their personal learning process as their personal learning environment, Drupal here connects different PLEs together. Like an ordinary forum, users can also post and comment content in a group within the drupal system. Every group offers a timeline of recent activities as a river of news.

The main difference between informal learning groups and courses, both implemented as organic groups in Drupal, concerns the additional function to distribute learning content and to assess the learning progress of students. Courses can be considered an extended learning group. The distribution of learning materials, videos and podcasts is scheduled by a timetable and content is successively made available to the members of a group. Assignments, including group assignments, appear with the learning materials in the course. As mentioned before Wilson stresses in his “VLE of the future” that the PLE can collect institutional content from different institutions. It is not sufficient for a social hub to collect the activities of the group members, the members must also be able to export the formal learning resources to their own PLEs. Drupal can export posts and comments of a group as RSS-feeds. This personalized RSS-feeds can then be used to trace the resources of the courses back to the PLE of the student, e.g. in a simple reader application on a mobile device (figure 4).



Fig. 4. Reading the latest posts of a course in a feed reader on a mobile device

## 6 Conclusion

The article outlines the design and implementation of the Online Campus NG, a platform for managing online master programs. The instructional design of the study program focuses on personal as well as social aspects of learning. Considering the students to be free to configure their own personal learning environment for supporting self-directed learning processes the platform focuses on connecting these environments for enabling social learning processes. The Drupal based OCNG is a step towards that vision of a social hub of connected learning environment, but does not realize the idea to its full extent yet. It can be critically compared to learning management systems to highlight the differences according to standard platforms. But one can also highlight not yet realized aspects in the concept.

In comparison to typical learning management systems, OCNG is designed more lightly, open and offers a different social structure. “moodle 2.0” is an example for a widely used and established learning management system, that tries to integrate a huge amount of tools for communication, cooperation and learning into a course room by often reimplementing them. In moodle student interactions are arranged by and within courses and building communities outside of courses is difficult.

OCNG, on the other hand, acknowledges the fact that the internet already offers a rich diversity of highly sophisticated tools. According to the instructional design of the master program, students are encouraged to use external tools as part of build-

ing and configuring their own personal learning environment. The system collects the artifacts of students in the internet and aggregates it in a social space. Instead of providing own tools, the focus is to collect activities and resources of external tools by using open standards like RSS-Feeds and APIs. That integration relies on open standards external tools need to be compatible with. If that is not the case, and because of the rich amount of freely chosen tools that case frequently occurs, students need to post a link to the external tools they use. From a pedagogical point of view, these gaps demonstrate the essential structure of the internet to the students and they can be considered to reflect the steps of the development of media competency. From a technological point of view, however, that integration could be more closely and for future releases more options for interfacing with external tools are currently considered. Furthermore, a more tightly mashup of collaboration tools like “Google Docs”, whiteboards, virtual classrooms, instant messaging etc. into the system is being aimed for.

## References

1. Gehlen, A.: Anthropologische Forschung: Zur Selbstbegegnung und Selbstentdeckung des Menschen. Rowohlt, Reinbeck (1961)
2. Grune, C., de Witt, C.: Pädagogische und didaktische Grundlagen. In: Haake, J., Schwabe, G., Wessner, M.: CSCL-Kompodium: Lehr- und Handbuch zum computerunterstützten kooperativen Lernen, pp. 27-41. Wissenschaftsverlag, Oldenburg (2004)
3. Nuissl, E.: Ordnungsgrundsätze der Erwachsenenbildung in Deutschland. In: Tippelt, R., Hippel, A.: Handbuch Erwachsenenbildung/Weiterbildung, pp. 329–346. VS Verlag für Sozialwissenschaften, Wiesbaden. Retrieved from: <http://www.springerlink.com/content/jn59l56460uh4807/> (2010)
4. Prenzel, M., Mandl, H., Reinmann-Rothmeier, G.: Ziele und Aufgaben der Erwachsenenbildung. In: Weinert, F. E., Mandl, H.: Enzyklopädie der Psychologie: Psychologie der Erwachsenenbildung, pp. 1–44. Hogrefe, Göttingen (1997)
5. Tippelt, R.: Institutionenforschung in der Erwachsenenbildung/Weiterbildung. In: Tippelt, R., Hippel, A.: Handbuch Erwachsenenbildung/Weiterbildung, pp. 453–471. VS Verlag für Sozialwissenschaften, Wiesbaden. Retrieved from: <http://www.springerlink.com/content/m62405kq6128p7j5/> (2010)
6. Marotzki, W.: Entwurf einer strukturalen Bildungstheorie: Biographietheoretische Auslegung von Bildungsprozessen in hochkomplexen Gesellschaften. Deutscher Studien Verlag, Weinheim (1990)
7. Chatti, M. A.: PLE vs. LMS. Retrieved from: <http://mohamedaminechatti.blogspot.de/2007/03/lms-vs-ple.html> (2007)
8. Wilson, S., Liber, O., Johnson, M., Beauvoir, P., Sharples, P., Milligan, C.: Personal Learning Environments: Challenging the dominant design of educational systems. *Journal of e-Learning and Knowledge Society* 3 (2), 27-38 (2007)
9. Schaffert, S., Kalz, M.: Persönliche Lernumgebungen: Grundlagen, Möglichkeiten und Herausforderungen eines neuen Konzepts. In: Wilbers, K., Hohenstein, A.: Handbuch E-Learning 5 (5.16). Deutscher Wirtschaftsdienst, Köln. Retrieved from: <http://dspace.ou.nl/handle/1820/1573> (2009)
10. Olivier, B., Liber, O.: Lifelong Learning: The Need for Portable Personal Learning Environments and Supporting Interoperability Standards. JISC Centre for Educational Technology Interoperability Standards, Bolton Institute, Bristol. Retrieved from: <http://wiki.cetis.ac.uk/images/6/67/Olivierandliber2001.doc> (2001)

11. Attwell, G.: Personal Learning Environments - the future of eLearning ? Lifelong Learning, 2, pp.1-8 (2007)
12. Wild, F., Moedritscher, F., Sigurdarson, S.: Designing for change: mash-up personal learning environments. eLearning Papers 9 (2008)
13. Turner, R.: A Conceptual Map of the Social Web. Retrieved from: <http://blogs.zaaz.com/zaaz/2008/06/a-conceptual-ma.html> (2008)
14. Wilson, S.: The VLE of the Future. Retrieved from: <http://zope.cetis.ac.uk/members/scott/blogview/index-entry=20050117150356.html> (2012)
15. PLEX, <http://www.reload.ac.uk/plex/>
16. Kerres, M.: Potenziale von Web 2.0 nutzen. In: Wilbers, K., Hohenstein, A.: Handbuch E-Learning. DWD-Verlag, München (2006)
17. Chatti, M.A., Dahl, D., Jarke, M., Vossen, G.: Towards Web 2.0-Driven Learning Environments. In: Proc. 4th International Conference on Web Information Systems and Technologies (WEBIST 2008), pp. 370-375 (2008)
18. Fitzgerald, B.: Drupal for Education and E-Learning: Teaching and learning in the classroom using the Drupal CMS. Packt Publishing, Birmingham (2008)