# TOWARD A MODEL FOR THE CONCEPTUAL UNDERSTANDING OF PERSONAL LEARNING ENVIRONMENTS:  A CASE STUDY

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## ABSTRACT

The development of Personal Learning Environments (PLEs) is in the scope of research groups and educators aiming to propose suitable mechanisms for the organization of self-controlled and self-directed learning, providing students with tools and services for access to content and human intelligence inside and outside the educational institutions. The students' understanding about the PLE purpose, tools, and applications utilization according to their preferences and learning styles, arrangement of a learning process, social functions empowering is an important phase of the design of personal learning space. In the development and adoption of such environments, it is essential that students' opinion and viewpoints are taken into consideration. This provokes the present exploration of students' preferences, learning styles and needs in the point of view of their preliminary preparation and conceptual understanding of the technical and pedagogical aspects of PLE building. In this article, a model of PLE conceptual understanding is proposed. It is created according to students' perspective during the past year and it is elaborated with new students this year. Several surveys are developed to support students' self-cognition about learning needs, styles, and goals and to construct the vision of PLE organization. The results from preliminary understanding of PLE and opinions after working with the Personal Learning Environment Framework (PLEF), developed at RWTH Aachen University, Germany, are compared and analyzed. A 2-year project was held with bachelor degree students at Technical University–Sofia, College of Energetics and Electronics, Department of Electronics and Computer Science.

## INTRODUCTION

The features of modern learning environments are in scope of exploration by researchers and educators from different perspectives. They wish to know how to design a given learning environment to expect positive effects on students' learning. Furthermore, their ambition is to point an effective way to students for learning environment organization according to personal characteristics and needs. There are several solutions of Personal Learning Environment (PLE) specially created and adopted by Higher education [1-4]. Their functions are based on social software tools and services which allow students to interact and share content and knowledge with other peers and professionals. Blogs, wikis, news readers, social networking websites, and social bookmarking sites are examples of some of the tools that are being used to share and collaborate in educational, social, and personal contexts. One tendency in PLE development is the integration of widgets for improvement of their dynamics and interactivity [5, 6]. Services proposed by Google, Yahoo, and educational sites [7, 8] make a large number of widgets available. In addition, there are sites that offer collections of widgets, such as Widgetbox, Widgipedia, and Clearspring. Under the educational category there are applications such as flashcards, web page translators, dictionaries, news readers, search engines, bookmarks readers, mini HTML editor, and webcams.

PLEs are designed to propose a student-controlled space for the establishment of a model of learning that goes beyond curriculum and characterizes by the convergence of lifelong, informal, and ecological learning [9]. In the development and utilization of such PLEs, it is essential that students' opinion and viewpoints are taken into consideration. Also, students who meet the idea for PLE organization for the first time, always have several questions to understand how in the best way it can support their learning. The students understanding about the PLE purpose, what kind of tools and applications are suitable for them according to their preferences and learning styles, how to arrange a learning process, how social functions can be utilized to assist their learning is an important phase of the design of a personal learning space. This provokes the present exploration of students' preferences, learning styles and needs in the point of view of their preliminary preparation and conceptually understanding of technical and pedagogical aspects of PLE building.

Our hypothesis is that when students are introduced with PLE conceptual understanding as a first phase of PLE building (Figure 1), the next phases can be completed with the needed knowledge and an effective learning process can be performed.

In this article, a model of PLE conceptual understanding is proposed. It is created according to students' perspective during the past year and it is elaborated with new students this year. Several surveys are developed to support students' self-cognition about learning needs, styles, and goals and to construct the vision of PLE organization. The results from preliminary understanding of
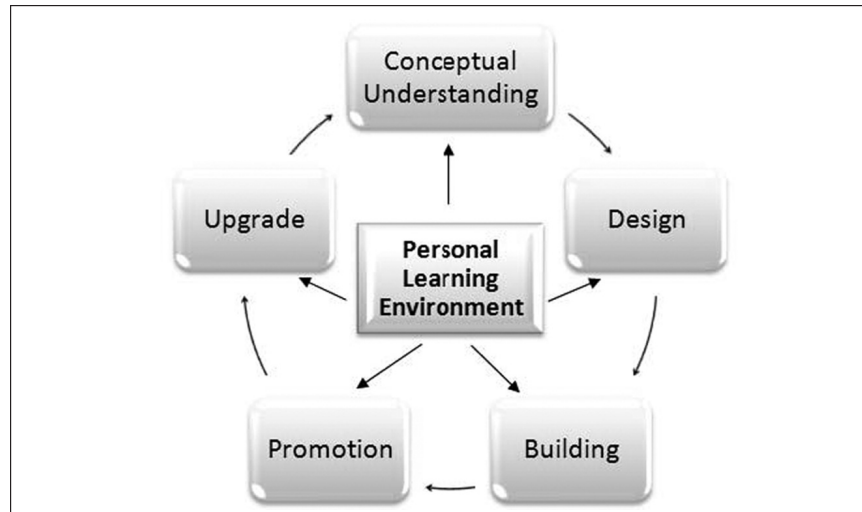
Figure 1. Phases in PLE building.

PLE and opinions after working in a real PLE are compared and analyzed. A 2-year project was held with bachelor degree students in their second year, from Technical University–Sofia, College of Energetics and Electronics, Department of Electronics and Computer Science.

## METHODOLOGY

The methodology for PLE conceptual understanding consists of the following procedures:

1. interviewing students about their PLE conceptual understanding;
2. summarizing the viewpoints and developing a model for conceptual understanding;
3. for self-cognition of learning style, needs, and goals, several tools are designed in form of surveys and they are passed by students; the results from surveys are then summarized and analyzed;
4. a survey about how a virtual personal learning space has to look is designed and students answers are analyzed;
5. the students were involved in a project concerning building a virtual personal learning space using the platform of Personal Learning Environment Framework (PLEF), originally designed and developed at RWTH Aachen University, Germany during the course Computer Graphics;
6. a survey about how preliminary conceptual PLE understanding contributes to PLE effective building and learning process supporting is created.

## INTERVIEW

The interview is the primary technique for information gathering at each level of a research project [10]. Talking with participants in a project is a good way to get information that is not publicly available, or that is too new to be found in the literature. We apply this technique: (a) to gather information by students related to their knowledge about PLE conceptual understanding; (b) to conduct a needs determination for PLE development; (c) to uncover problems in students' realization about PLE building and utilization; and (d) to gather opinions and viewpoints for PLE effective usage.

In this 2-year project, one group of 12 students (they are selected at random) from the past year and three groups of 20 students (total 60 students) from this year were involved to discover the possibilities of PLE organization to support their learning during the course Computer Graphics. The performed personal interviews with students at the beginning of the classes reveal problems in their conceptual understanding of PLE, PLE building, and usage of suitable learning strategies. Their answers are summarized in Table 1. Only 25% of the students from the past year and 44% of the students from this year understand the PLE concept. Many of them suppose that there is a need of PLE building, 43% of the students from the past year and 36% of the students from this year imagine the main PLE functions, many of them are not sure how to support their learning effectively. These results point out that different tools have to be developed to facilitate understanding of such "bottom-up" and self-controlled approach to learning.

## A MODEL FOR PLE CONCEPTUAL UNDERSTANDING

When the PLE is examined as a "bottom-up approach," the students interact with processes such as: self-cognition, self-organization, self-planning of personal development, self-competence realization (Figure 2):

*Self-cognition*. Self-answering of questions about learning needs and goals, about preferred media content format for learning, about preferred communication channels, and so on lead to the clarification of the methods for information and knowledge absorbing and remembering.

*Self-organization*. Self-organized learning leads to increased individual control over learning self-management through a process that involves the choice of the learning scenario, the selection of learning resources, reflection, engaging in learning conversations with peers.

*Self-planning of personal development*. Personal change and progress are the main features of the personal development of everybody. To be successful with it, the students need to have a self-improvement plan (strategy) based on understanding of their current and future professional positions, readiness for actions, and awareness of potentials for realization.

Table 1. Interview Answers about PLE Conceptual Understanding

| | Do you understand the PLE concept? | | | Are there needs for PLE building? | | | Do you figure the main PLE functions? | | | Do you figure some learning strategies? | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Yes | Not sure | No | Yes | Not sure | No | Yes | Not sure | No | Yes | Not sure | No |
| Past year | 25% | 50% | 25% | 50% | 40% | 10% | 43% | 31% | 26% | 18% | 56% | 26% |
| This year | 44% | 36% | 20% | 63% | 27% | 10% | 36% | 44% | 20% | 20% | 72% | 8% |
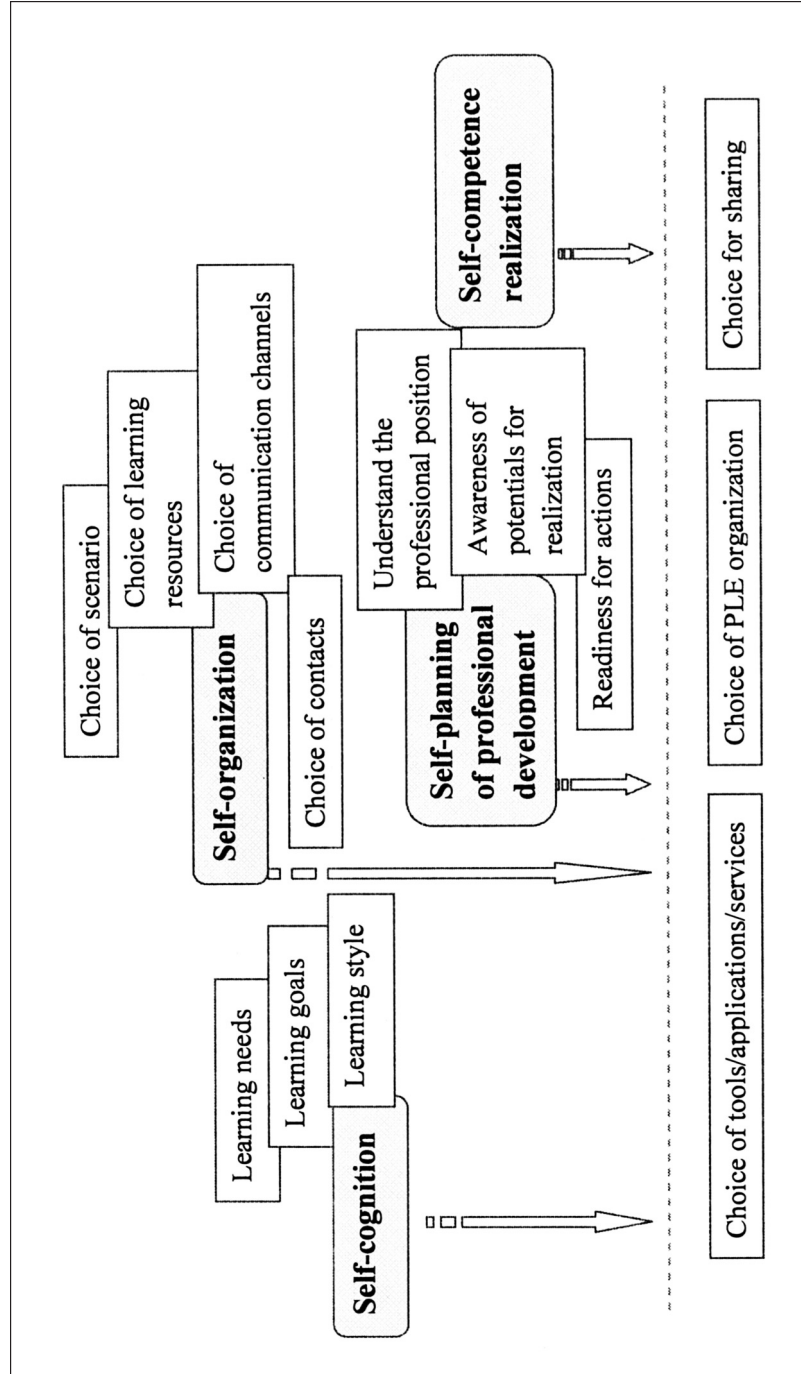
Figure 2. A model for PLE conceptual understanding.

*Self-competence realization*. Self-competence is related to the sense of a student to be capable, effective, and in self-control. It is the result of the successful management of the learning environment and from the achievement of needs and goals.

## SURVEY AND RESULTS

Before starting building personal learning environments, the students were asked several questions related to their level of ICT knowledge and skills, as well as questions that lead their attention to understanding their main factors for motivation, often used tools and information sources, and methods for learning. The aim of the survey was to clarify the students' self-knowledge about their preferences, learning styles, and needs and to support their conceptual understanding of the PLE concept.

The survey starts with a question about students' self-rating level of computer literacy: excellent, very good, good, average, poor. The students' self-rating (in percentages) is presented in Figure 3.

Summarizing their answers, the result indicates that:

1. The majority of students said that their ICT knowledge and skills are good (69% from the past year, 72% from this year);
2. There was no students' self-rating with average and poor computer literacy level.

The students were also asked to indicate the frequency (several times/day, 1 time/time, several times/week, 1 time/week, several times/month, never) of interacting with applications for document processing, media files creating/editing/sharing,
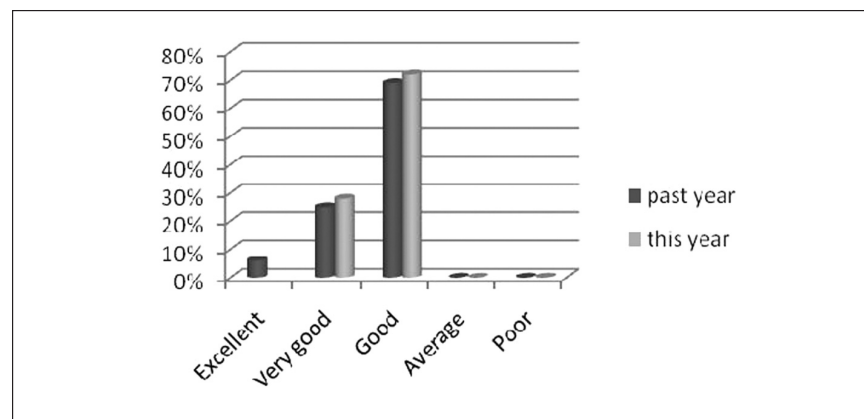


Figure 3. Self-rating of computer literacy.

e-mails composing, news reading, information searching, participation in social networks. The results are summarized in Figure 4a (for students from the past year) and Figure 4b (for students from this year). The conclusions are the following:

1. 74% of the students from the past year and 80% of the students from this year use search engines several times a day;
2. the more used applications by 68% of the students from the past year and 72% of the students from this year (several times/day) are for reading/sending e-mails. Fifty-six percent of the students from the past year and 27% of the students from this year utilize applications for document processing several times/day. Participation in social networks several times/day is increased—this year is 80% versus 38% for past year. News reading is performed by 72% of students this year versus 69% of the students from past year;
3. A small percentage of students (25% for the past year and 10% for this year) have never participated in social networks like Facebook and MySpace.

To the question "What motivates you to use information and computer technologies?," the students' answers were as follows (see Figure 5):

1. The main reason for self-motivation of 56% of the students from the past year and 63% of the students from this year is "to understand the new technology and to study it";
2. For 50% of the students from the past year and 54% of the students from this year, the main driving force is that they "want to advance their ICT skills and knowledge."

Also, 37% of the students from past year and 44% of the students from this year are motivated to use ICT technologies when they "can produce their own artifact."

The students were also asked to sort by frequent usage the communication tools like: GSM, e-mail, skype, social networks, web forums, messengers (Yahoo, MSN), and tools for information gathering: search engines, free accessed websites created by users (Wikipedia, online dictionaries), social bookmarking sites, RSS readers, social networks. The results show that:

1. 68% of the students from the past year and all students from this year use GSM as a main communication tool, at the second place is e-mail preferred by 62% of the students from the past year and 45% of the students from this year;
2. Skype is at third place according to 37% of the students from the past year, 54% of the students from this year placed social networks as third communication tool (Figure 6a and 6b);
3. the search engines are the main applications for information gathering (87% of the students from the past year and 100% of the students from this
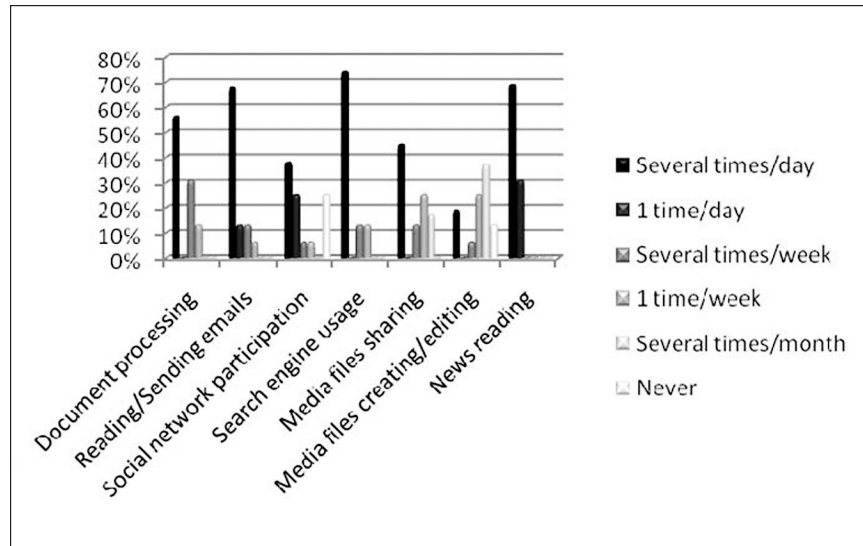
Figure 4a. The frequency of computer and Internet applications usage by students from the past year.
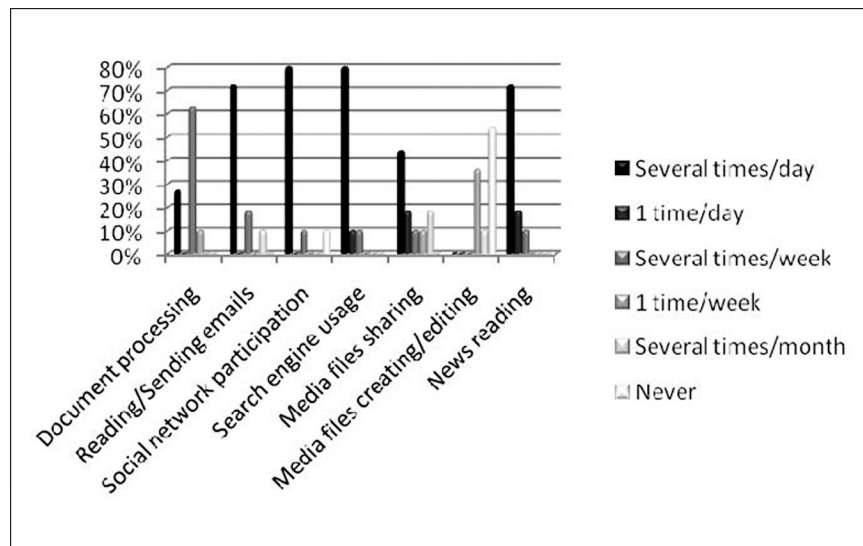


Figure 4b. The frequency of computer and Internet applications usage by students from this year.
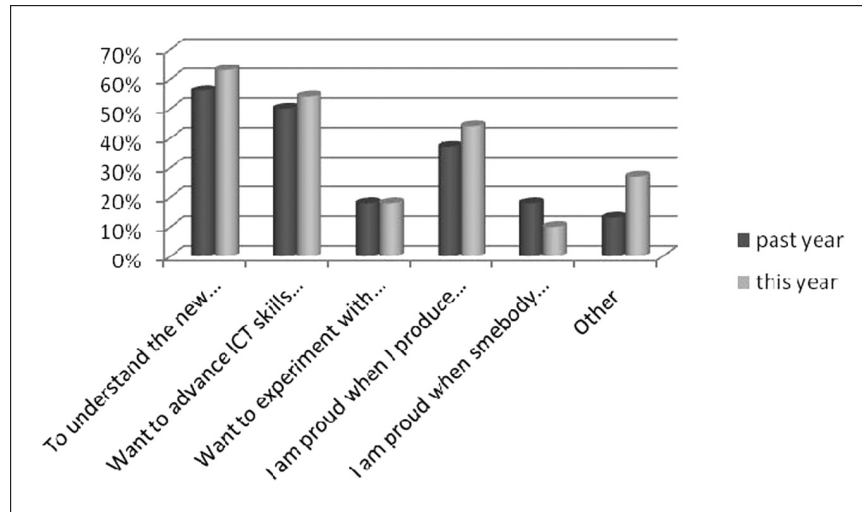
Figure 5. Motivation reasons for ICT usage by students.

year), after this the free accessed websites created by users (Wikipedia, online dictionaries) are used by 50% of the students from the past year and 63% of the students from this year;

4. 56% of the students from the past year rated themselves much better using social bookmarking sites putting them on the third position (Figure 7a), 27% of the students from this year said that their application on third place for information gathering are social networking sites (Figure 7b).

The following three questions are focused on analyzing how students can better understand new information, how they learn better, and how they share interesting information. The findings show that:

1. 81% of the students from the past year understand information better "when it is part of interactive activities" and "when it is presented with graphics," the same percent 81% of the students from this year prefer when "somebody explains it";
2. 75% of the students from past year like to understand new information "when it is presented with video." 36% of the students from this year say that they prefer to receive information in form of graphics and video (Figure 8);
3. the 81% of the students from the past year learn better when they "perform interactive activities," 63% of them point that combination of: "text with many images," "lessons' listening," "explain and discuss," "interactive activities performing," "watch video/multimedia" is a good solution for better learning;
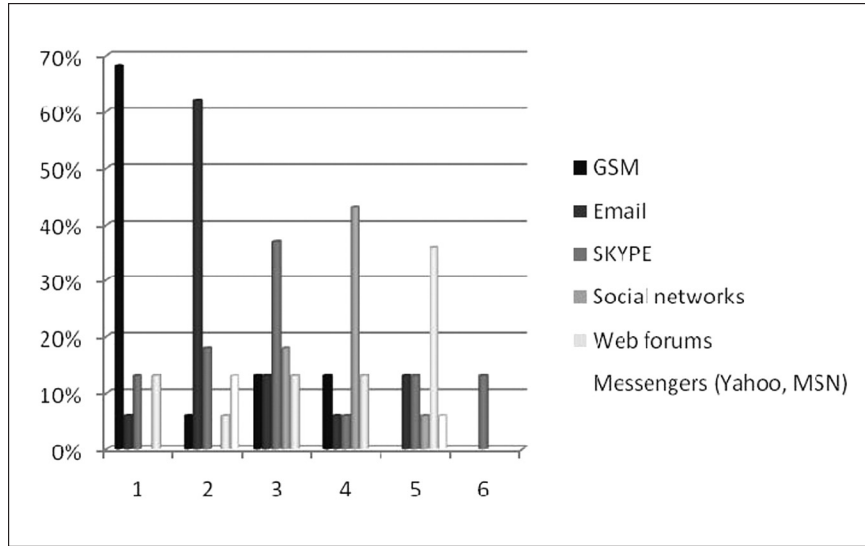
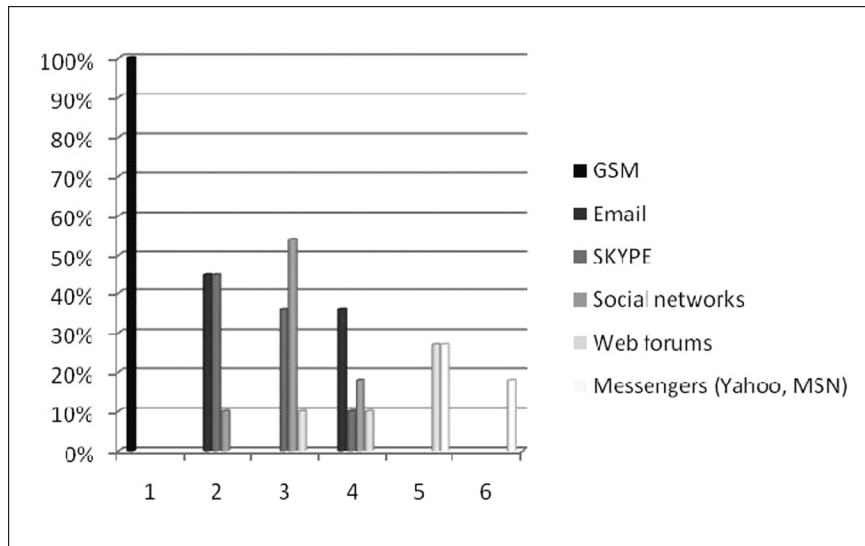Figure 6a. Order of communication tools by students
from the past year.



Figure 6b. Order of communication tools by students
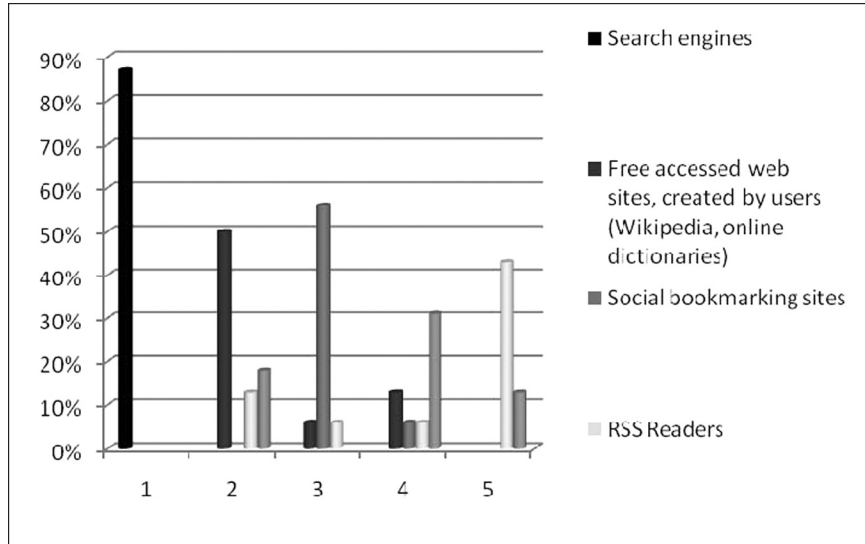from this year.

Figure 7a.  Order of information gathering tools by students
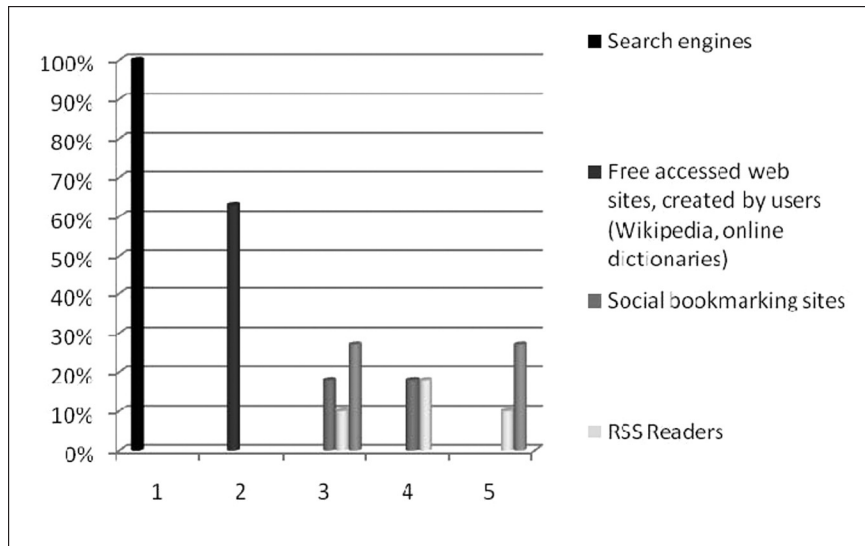from the past year.



Figure 7b.  Order of information gathering tools by students
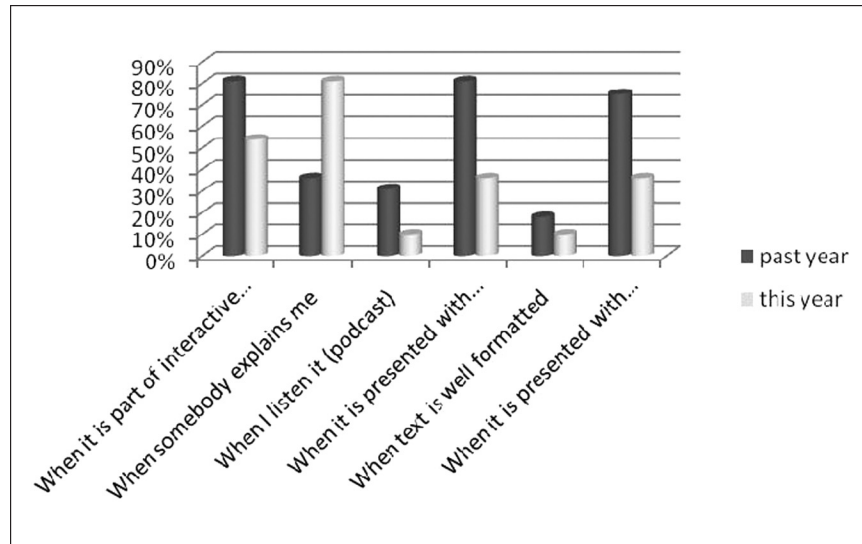from this year.

Figure 8.  Ways for better understanding the
new information.

4. 63% of the students from this year prefer to learn via combination of methods, 44% of them prefer to "read text with many images" (Figure 9);
5. more preferred method for information sharing by 68% from the past year students and 63% from this year students is when they "comment with friends and colleagues offline or online," 31% of the students from the past year just "think about this information" and "send the link somebody," unlike 36% of the students from this year that share information via social networks (Figure 10).

Then, the students were asked two questions to describe how they imagine their virtual personal space. According to the students from the past year, the most important functions of PLE are as follows: 81%—information gathering, 56%—to show information in a different media format, 50%—to advise him/her about interesting information related to learning goals, 43%—authoring text and media, 37%—mashup information and services. The vote of this year students is for functions like: 63%—information gathering and show information in different media format, 54%—to be able to learn from others, to be able to disseminate my knowledge to others, to save resources, activities, and contacts (Figure 11).

As depicted in Figure 12, the students preferred functions like easy navigation and graphical user interface, possibility for choosing suitable tools, and interactivity.
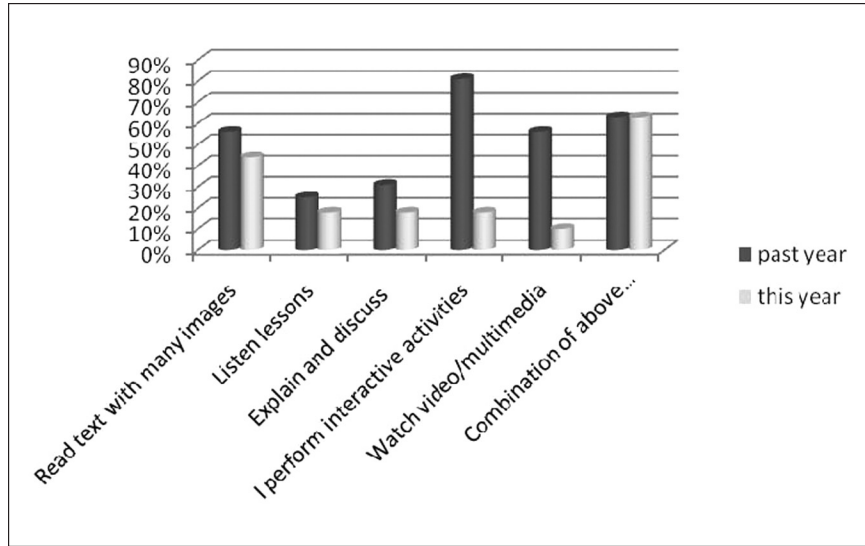
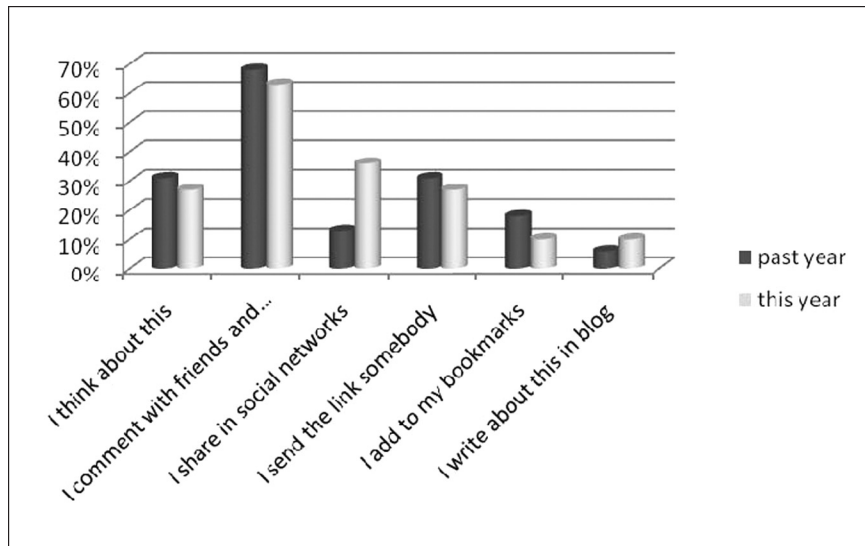Figure 9.  Preferred methods for learning.



Figure 10.  What you do when you find
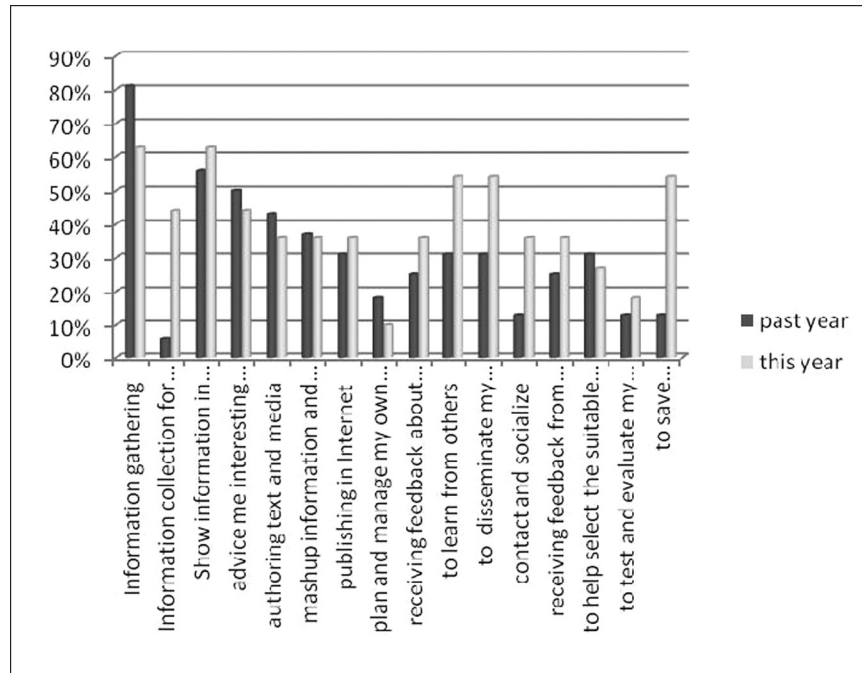interesting information?

Figure 11. Preferable functions of a personal
learning environment.

The analysis of this survey indicates that the students possess good computer knowledge and skills and that they have affinity to new technologies; they are self-motivated to advance their skills and knowledge. Many of them perceive information in a visual way and others prefer a combination of methods for a better understanding of the new information. Before starting PLE building, the students have thus built a conceptual understanding of the PLE concept.

## INTRODUCTION TO PLEF AND
## EXPERIMENTATION

In the next step of our study, the students who contributed to the PLE conceptual understanding outlined above were introduced with the different functionalities of PLEF as a potential tool for PLE development. PLEF was originally designed and developed at RWTH Aachen University, Germany. It consists of a back-end, consisting of persistence for PLE components and a front-end representing the PLEF interface.
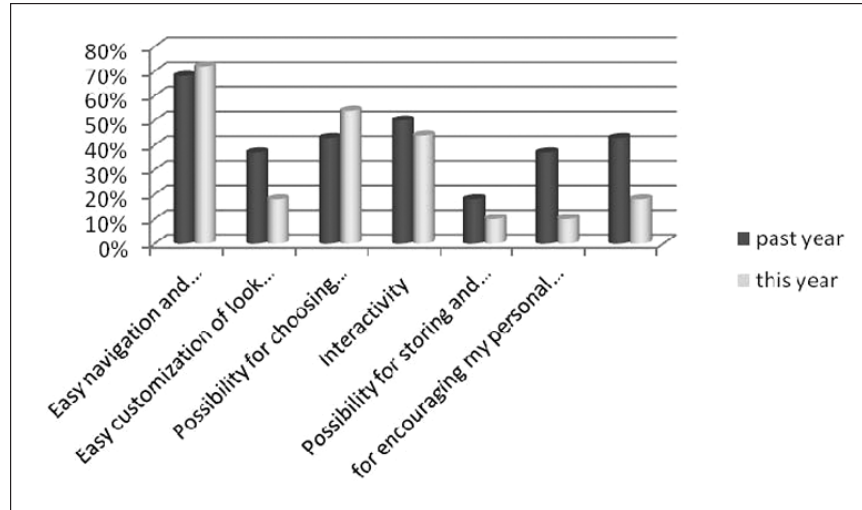
Figure 12.  Other functions of a personal learning environment.

## Back-End Implementation

The PLEF database schema is defined as follows. A learner has one PLE identified by her OpenID and the PLE might have a title. Each PLE consists of one or more pages and each page might consist of zero or more elements. The elements can be specialized into feed, opml, text, image, linklist, and widget. Every element can have zero or more tags while one tag might appear on one or more elements. Each element can also have zero or more comments. A comment has an author, content, and date of creation.

A feed element has feed url. A learner can also determine how many feed entries to be shown for each feed. An opml element consists of one or more feeds. Each of these feeds might have title and feed url. A text element has content only. An image element might have url, width, and height of the image. A linklist element consists of one or more url links and each url link has a title and a url address. A widget element has widget code.

## Front-End Implementation

- Interface: The PLEF interface consists of north, west, east, and center panels. The north panel enables the learner to login/logout, add new PLE pages, and show the element insertion panel in the west panel, which is used to insert new elements into a PLE. The east panel is used for viewing and searching of PLE elements. The center panel shows the elements either organized in pages or grouped based on tags. Drag-and-drop action is

supported in both center and east panels. In the center panel, it enables the learner to change the position of elements within pages. In the east panel, it enables to move elements between pages and to change the order of the pages within a PLE.

- Authentication: PLEF uses OpenID for authentication. The learner is requested to enter her OpenID either to access/create her PLE or comment on a specific PLE element. PLEF verifies the given OpenID by sending a request to the associated OpenID provider and enables the required action if the OpenID is valid.
- Pages and Elements: PLEF enables a learner to organize her learning resources into pages. A page panel in PLEF consists of three parts: tab, toolbar, and body. The page tab contains the page title and icon. The page toolbar includes a page settings menu, a share page button, a private/public button, and a delete page button. The page settings menu contains four items: title, number of columns, background color, and icon of the page. A page in PLEF encompasses several elements. Currently, PLEF supports the following element types: feed, OPML, text, image, linklist, and widget. An element panel in PLEF consists of three parts: header, body, and footer. The element header contains the element title and icon and the collapse-expand button. A different element icon is associated with each element type. The element footer consists of several buttons, which are edit, tag, share, private/public, comment, and delete buttons. The element body differs according to the type of the element it shows.
- Social Tagging, Commenting and Sharing: Social features supported by PLEF include social tagging, commenting, and sharing of PLE pages and elements. Each element in PLEF can be associated with different tags. And, learners are able to give comments to each element. Thereby, they can login as anonymous or via their OpenIDs. PLE pages and elements can be shared via e-mail. If a learner receives and opens a link to a shared page or element, she will be redirected into PLEF. Once logged in, she will receive a panel showing the shared content that can then be added automatically into her PLE.
- Views: Besides a traditional page view, PLEF provides a tag view of all elements in a PLE. Once a tag view is preferred, all tags will appear as nodes of a tree in the east panel. A tag can then be selected and its associated elements will be shown in the center panel.
- Search: PLEF enables full-text and tag-based search of all elements in a PLE. Search is performed in the page/tag view of the east panel. If a sequence of characters is detected by the search field's listener, deep first search will be performed on the tree in the page/tag view to find all pages and elements which contains the exact string. The title of the nodes containing the exact string will then be shown as bold.
- Access Control: PLEF enables access control at both PLE page and element levels. Newly inserted elements or pages are automatically set as private and

can then be made as public by clicking the private/public button which is located at the element footer or the page toolbar.

The comparison between students' expectations from a PLE and PLEF functional specification is presented in Table 2. Some screenshots from the students' experimentation with PLEF are shown in Figure 13. The results show that most students have a well-formed vision about their PLEs in operational, functional and management aspects. They opined that the proposed surveys by the authors of this paper greatly support the understanding of PLE usage for learning during the proposed course and for self-organized learning in general. Moreover, the students mentioned several problems related to their comprehension about metadata usage, social tagging, and what is the effective way for network forming.

Their opinion about PLEF functionality after experimentation was quite positive. Most of the students were satisfied with the friendly user interface of

Table 2.  Comparison between Students' Expectations and PLEF Specification

| Criteria | Conceptual PLE view from the past year students | Conceptual PLE view from this year students | PLEF specification |
|---|---|---|---|
| Operational | | | |
|   OpenID authorization | | | Yes |
|   Social tagging | | Yes | Yes |
|   Authoring | Yes | | |
|   Commenting | Yes | | Yes |
|   Sharing | Yes | Yes | Yes |
|   Interface customization | Yes | Yes | Yes |
|   Searching | Yes | Yes | Yes |
|   Networking | | Yes | Yes |
| | | | |
| Functional | | | |
|   Add page | Yes | Yes | Yes |
|   Add components | Yes | Yes | Yes |
|   Add learning objects | Yes | Yes | Yes |
|   Add metadata | | | Yes |
|   Drag and drop | Yes | Yes | Yes |
|   Add widgets | Yes | Yes | Yes |
| | | | |
| Management | | | |
|   Elements | Yes | Yes | Yes |
|   Folders | | | Yes |
|   Views | | | Yes |
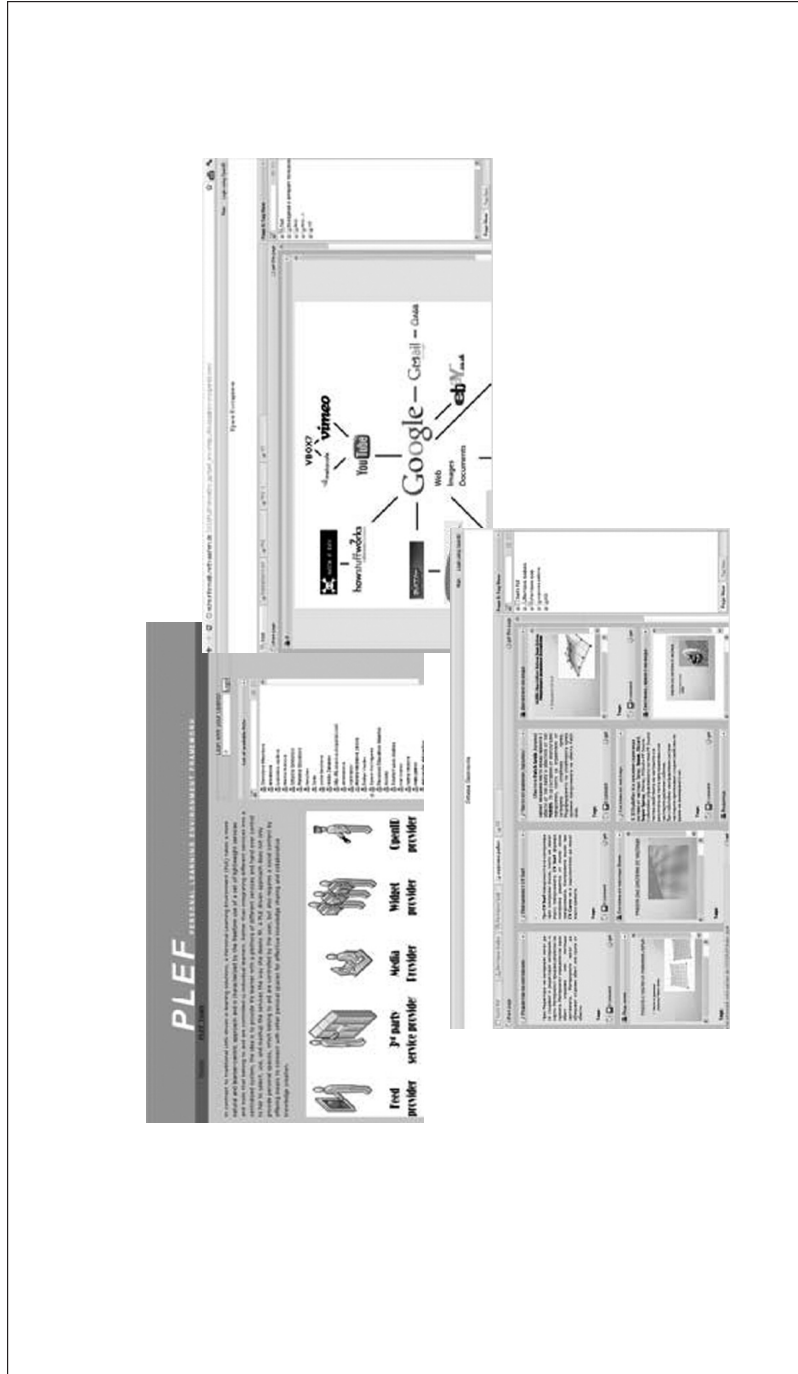
Figure 13.  Experimentation with PLEF.

PLEF, the proposed way for content searching, the media content visualization (pages/components), as well as the possibility for adding widgets, and sharing content with peers.

## CONCLUSION

The created model for conceptual PLE understanding and students' opinion exploration is an important step for the successful PLE usage in different learning scenarios. Our hypothesis was that introducing the students with the PLE concept impacts the effectiveness of a self-organized learning experience driven by PLEs. This has been achieved through the different evaluations conducted in this work. The model of PLE conceptual understanding is evaluated by three new student groups this year during the course Computer Graphics. Applying the model supports students in their orientation, arrangement, and building of their PLEs, using different tools according to their individual learning needs and styles. It could be applied to any functional and technical solution of PLE, because it gives the possibilities for self-cognition of the preferred learning style, learning objectives, needs from competence development by students and for understanding the conceptual base of PLE.

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