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A study on an empowering e-learning environment for university of applied sciences

Helsinki Metropolia, University of Applied Sciences

Bachelor of Engineering

Information Technology

Thesis

13 May 2014

Author(s) Title Number of Pages Date	Ali Ramz A study on an empowering e-learning environment for university of applied sciences 59 pages 13 May 2014
Degree	Bachelor of Engineering
Degree Program	Information Technology
Specialization option	Programming
Instructor	Sakari Lukkarinen
<p>Providing an empowering environment through e-learning is a wide area. This wide area can be divided into two parts, a pedagogical part and a technological part. The pedagogical part concentrates on the environment, experience, knowledge, situation and learning goals which are set by the teacher and student. The technological part concentrates on the information technology, which can help to generate this environment.</p> <p>This thesis aimed to collect and analyze data for providing an empowering environment through e-learning for students of applied sciences.</p> <p>This study began with interviewing with different lecturers to use their experiences, feedbacks and comments in order to create a base line for empowering environments.</p> <p>Moreover the study defined requirements for an empowering environment and emphasized the user interface of the empowering environment. Also this study work discussed about the Moodle environment as an online environment, the Stack mathematical program for generating random mathematical questions and the Maxima mathematical program for solving mathematical questions.</p> <p>This study can be continued by studying other online environments and other mathematical programs in order to create a better empowering environment.</p>	
Keywords	E-learning, Moodle, Maxima, empowering environment, e-learning environment, online environment

Contents

1	Introduction	11
2	E-learning	12
2.1	Advantages of E-Learning	13
2.2	Disadvantages of e-Learning	14
2.3	An empowering e-learning environment	17
2.4	The architecture of an empowering environment for e-learning	17
2.5	An example of the structure of empowering environment	21
2.5.1	Moodle	22
2.5.2	Stack	24
2.5.3	Maxima	26
3	An empowering environment for a university of applied sciences	28
3.1	Interviewing different lecturers about an empowering environment	28
3.2	Summary about interviewed lecturers and interviews	45
4	The requirement specifications for an empowering environment	49
4.1	Construction plan of the user interface of an empowering environment	52
4.2	Two different user interfaces for an empowering environment	54
4.2.1	The user interface of an empowering environment 1 by lecturer K. S.54	
4.2.2	The user interface of an empowering environment according to research 58	
4.3	Customized search structure	62
5	Discussion	64
6	Conclusion	66

Abbreviations and Terms

Angel	A commercial e-learning platform.
Asynchronous learning (self-paced)	A student-centered teaching method that uses online learning resources to facilitate information sharing outside the constraints of time and place among a network of people.
Blackboard	A commercial e-learning platform.
Blended learning	A formal education program in which a student learns at least in part through on-line delivery of content and instruction with some element of student control over time, place, path, and/or pace.
BSD	Berkeley Software Distribution (BSD, sometimes called Berkeley Unix).
Camstudio	A screen casting program for Microsoft Windows released as free software.
CAS	Computer algebra system; a software program that facilitates symbolic mathematics.
Claroline	A free e-learning platform
Colloquia	A free e-learning platform
CMS	Course management system; a collection of software tools providing an online environment for course interactions.
Cross-Platform	In computing, cross-platform, or multi-platform, an attribute conferred to computer software or computing methods and concepts that are implemented and inter-operate on multiple computer platforms.
Database	An organized collection of data.
DBMS	Database management system; a software system designed to allow the definition, creation, querying, update, and administra-

	tion of databases.
Desire2Learn	A commercial e-learning platform.
DOE Macsyma program	United States Department of Energy imposed on MIT the requirement that they release a copy into the National Energy Software Center (NESC) library in 1982, while allowing MIT to assert restrictions in terms of high price and no redistribution.
Dokeos	A free e-learning platform.
Drupal	A free and open-source content management framework (CMF) written in PHP and distributed under the GNU General Public License.
Edx	An online course system on the Internet
E-learning	Refers to the use of electronic media and information and communication technologies (ICT) in education.
E-learning platform	E-learning platform is a virtual education system which provides classes, class content, tests, homework, grades, assessments and etc.
Finnish virtual campus (Suomen virtuaaliyliopisto)	Finnish virtual campus was virtual university which provided online courses and it doesn't exist anymore.
Flipped classroom	Flip teaching (or flipped classroom) is a form of blended learning in which students watch lectures online and work on problem sets with other students in class.

GNU	General Public License, It is the most widely used free software license, which guarantees end users (individuals, organizations, companies) the freedom to use, study, share (copy), and modify the software. The software that ensures that these rights are retained is called free software.
Geogebra	A mathematical program for dynamic geometry. GeoGebra can manipulate and visualize mathematical objects.
Geoset	Geoset is an acronym for Geometric Structures for Elementary Teachers.
GUI	Graphical User Interface, In computing, a graphical user interface is a type of user interface that allows users to interact with electronic devices using images rather than text commands.
IBT	Internet-Based Training, It is one kind of e-learning training.
Javala	A webpage where everyone can register and practice Java programming.
Khan Academy	A non-profit educational website created in 2006 by educator Salman Khan, a graduate of MIT and Harvard Business School. The stated mission is to provide "a free world-class education for anyone anywhere".
KnowledgePlanet	A commercial e-learning platform.
Mac OS X	A series of Unix-based graphical interface operating systems developed, marketed, and sold by Apple Inc. It is designed to run exclusively on Mac computers, having been pre-loaded on all Macs since 2002.
Maple	A commercial computer algebra system. It was first developed in 1980 by the Symbolic Computation Group at the University of Waterloo in Waterloo, Ontario, Canada. Since 1988, it has been developed and sold commercially by Waterloo Maple Inc.

Mathematica	A computational software program used in scientific, engineering, and mathematical fields and other areas of technical computing.
Matlab	A numerical computing environment and fourth-generation programming language. Developed by MathWorks, Matlab allows matrix manipulations, plotting of functions and data, implementation of algorithms, creation of user interfaces, and interfacing with programs written in other languages, including C, C++, Java, and Fortran.
Maxima	A computer algebra system based on a 1982 version of Macsyma. It is written in Common Lisp and runs on all POSIX platforms such as Mac OS X, Unix, BSD, and GNU/Linux as well as under Microsoft Windows.
Microsoft Access	A well-known database management system.
Microsoft SQL Server	A well-known database management system.
Mind map	A diagram used to visually outline information. A mind map is often created around a single word or text, placed in the center, to which associated ideas, words and concepts are added. Major categories radiate from a central node, and lesser categories are sub-branches of larger branches.
Mind Meister	An online mind mapping software that allows its users to visualize their thinking.
MIT	Massachusetts Institute of Technology, a private research university located in Cambridge, Massachusetts, United States.
MIT Scratch	An educational programming language and multimedia authoring tool that can be used by pupils, teachers, and parents for a range of educational and entertainment projects from math and science projects, including simulations and visualizations of experiments, recording lectures with animated presentations, to social sciences

animated stories, and interactive art and music.

MOOC	A massively-open online course
Moodle	A free e-learning platform
MySQL	A widely used open source relational database management system (RDBMS) that runs as a server providing multi-user access to a number of databases.
OLAT	A free e-learning platform
PHP	A server-side scripting language designed for web development but also used as a general-purpose programming language. PHP is now installed on more than 244 million websites and 2.1 million web servers.
POSIX	Portable Operating System Interface, a family of standards specified by the IEEE for maintaining compatibility between operating systems. POSIX defines the application programming interface (API), along with command line shells and utility interfaces.
PostgreSQL	A well-known database management system.
Python	A popular general-purpose, high-level programming language whose design philosophy emphasizes code readability. Python's syntax allows programmers to express concepts in fewer lines of code than would be possible in languages such as C, and the language provides constructs intended to enable clear programs on both a small and large scale.
Sakai	A free e-learning platform

SAS	An integrated system of software products provided by SAS Institute Inc., which enables programmers to perform.
Stack	An online system which support computer in evaluation of mathematical assignment.
Sum Total System	A commercial e-learning platform.
Synchronous learning (instructor-led)	A learning environment in which everyone takes part at the same time. Lecture is an example of synchronous learning in a face-to-face environment, where learners and teachers are all in the same place at the same time.
TCP/IP	Transmission Control Protocol and Internet Protocol were the first networking protocols defined in this standard
TEL	Technology-Enhanced Learning, an e-learning.
Today'smeet	A virtual room for communication
Unix	A multitasking, multi-user computer operating system originally developed in 1969 by a group of AT&T employees at Bell Labs.
User Interface	A space where interaction between humans and machines occurs. The goal of this interaction is effective operation and control of the machine on the user's end, and feedback from the machine, which aids the operator in making operational decisions.
VilleUtu	An e-learning web platform which provides e-learning courses.

Virtual education	An electronic learning
Virtual education system	An e-learning system
Web platform	A community, convened by W3C that is seeking to create an online reference of Web standards.
WebAlt	An e-learning web platform which provides e-learning courses.
WBT	An one kind of e-learning training.
WebCT	A commercial e-learning platform.
Wolframalpha	A computational knowledge engine or answer engine developed by Wolfram Research. It is an online service that answers factual queries directly by computing the answer from externally sourced "curetted data", rather than providing a list of documents or web pages that might contain the answer as a search engine might.
WxMaxima	A document-based interface for the computer algebra system Maxima. wxMaxima uses wxWidgets and runs natively on Windows, X11 and Mac OS X. wxMaxima provides menus and dialogs for many common maxima commands, auto completion, inline plots and simple animations. wxMaxima is distributed under the GPL license.

1 Introduction

The aim of this study is to collect and analyze information in order to create an empowering environment in an e-learning form for students of an university of applied sciences for supporting them in mathematical and applied sciences. Because the main idea is to create an empowering environment, which is tailored just for students of university of applied sciences, in this study different lecturers are interviewed and every lecturer tells his/her opinion about an empowering environment that prevent students from frustration and help them in their studies.

The purpose of this thesis is to study and collect theory and analyze the theory in order to produce an e-learning tool with high quality through an online study environment specifically for applied sciences. However this kind of empowering environment consists of at least user interface, online study environment, Database and mathematical programs. This research emphasizes more on the user interface of the empowering environment. This user interface includes texts, video clips, leading example and leading assignments in various subject studies. This user interface is a web platform which is very user friendly and easy to use.

One of the most important features of this user interface is that a student can use customized search in order to find the specific lesson that he/she needs to study in any area of any study subject. In addition this research explains structure and architecture of the user interface and the empowering online environment.

2 E-learning

E-learning applies to the use of different kinds of information and communication technologies (ICT) and electronic media in education. It is a wide terminology for educational technologies, which support teaching and learning technologically or electronically. It can be termed as internet-based training (IBT), computer-based training (CBT), web-based training (WBT), technology-enhanced learning (TEL), virtual education or digital educational collaboration depending on the emphasis on a specific aspect, delivery method or component. It contains various types of media that deliver images, animation, audio, text and streaming video and includes technology applications and processes. Communication and information, whether based on either local networks or free-standing or the Internet in networked learning and many e-learning processes.

E-learning can be synchronous learning (instructor-led), asynchronous learning (self-paced) or blended learning (distance learning or in conjunction with face-to-face teaching).

Developments in multimedia and internet technologies provide better possibilities for e-learning and content, consulting, services, technologies and support being identified as the five key sectors of the e-learning industry.

E-Learning is the use of Internet technologies to deliver solutions that enhance performance and knowledge. It is a new way to think about learning.

There are three fundamental criteria, which e-Learning is based on:

- 1) E-Learning is networked, which makes it capable of instant updating, storage/retrieval, distribution and sharing of information. Because of these criteria, CD-ROMs (and DVDs) should not be classified as e-learning.
- 2) With using the standard Internet technology it is delivered to the end-user via a computer. The key characteristic is the use of standard Internet technologies, such as Web browsers and the TCP/IP protocol that create a universal delivery platform.

- 3) It focuses on the broadest view of learning-learning solutions that go beyond the traditional paradigms of training. There is no particular reason why the goal of e-learning should be simply to emulate what could be done in a classroom. [1] [2] [3] [4]

2.1 Advantages of E-Learning

There are many advantages of e-learning. These advantages refer to the brilliant richness of e-learning which can bring new futures to the educational system in order to teach and study. The advantages include:

a) It creates society

The Web enables people to create an enduring society of practice where they are able to come together to share knowledge after a training program finishes.

b) Subject matter is more current and reliable

E-Learning is Web-enabled and because of that it can be updated directly, making the information more precise and better for a longer time and web has the ability to upgrade e-learning content very fast in order to distribute to the learners.

c) Depending on demand messages are coherent or customized

Everyone gets the same content in the same way at the same time. The program can also be customized for various learning demands or different types/groups of people.

d) It reduces prices

E-learning is often the most cost-effective way to deliver instruction (training) or information. No expenses for traveling, reduces training time and there is no need for instructor/classroom infrastructure.

e) Improving business receptiveness

An unlimited number of people can be reached virtually contemporarily.

f) Learning is twenty-four hours a day and seven days a week

Learners can access e-learning anywhere in the world at any time they want.

g) It exploits the company investment on the web

Executives are increasingly looking for ways to exploit their investment in company intranets. E-Learning is emerging as one of those applications.

h) There is no issue for user access

Millions of people are getting familiar with the Internet technology, so access to e-learning through the Internet technology is not issue anymore.

i) It provides an increasingly valuable customer service

Effective and engaging use of e-learning helps customers derive increased benefit from the site.

j) It is scalable

E-Learning solutions are highly scalable. A few participants or even unlimited participants can participate in training programs with little effort or incrementing costs.

k) It is worldwide

E-Learning is web-enabled. It takes advantage of the worldwide Internet protocols and browsers. Everyone can receive virtually the same material on the web in the same way. [1]
[2]

2.2 Disadvantages of e-Learning

There are many disadvantages of e-Learning. These disadvantages refer to ineligible of e-learning which can bring damages to educational system in order to teach and study. These disadvantages include:

a) Loosing motivation

Learners who are not motivated enough or weak students may lose motivation.

b) Missing of familiar structure

Without the structures such as in a normal class, some students may get perplexed in e-learning courses

c) Missing social interaction and various learning styles

By working alone learners feel lonely or isolated because there are no networking opportunities of a classroom for them and they miss this opportunity to be with classmates physically in the same classroom. After all one of the most important human needs is socializing. Missing of face-to-face contact is very dangerous emotionally for a human.

d) Missing of instructor

The instructor may not always be available at the same time when students are studying and need guidance.

e) Difficulties with the Internet or e-learning software program

It is possible that students with beginner-level computer skills cannot manage with an e-learning software program. On the other hand accessing course materials can be frustrating with a poor Internet connection or old computers

f) Difficulties with lab courses

It can be difficult to simulate lab courses in e-learning courses [1] [2]

Table 1 summarizes the advantage and disadvantages of e-learning.

Table 1. Advantage and disadvantages of e-learning

Advantages of e-learning	Disadvantages of e-learning
Creating a society	Loosing motivation
Current and reliable	Missing of familiar structure
Coherent or customized	Missing the Social interaction and various learning styles
Reducing prices	Missing of instructor
Improving business receptiveness	Difficulties with the Internet or e-learning software program
Learning is twenty-four hours a day and seven days a week	Difficulties with lab courses
Exploiting the company investment in the web	
No issue for user access	
Providing an increasingly valuable customer service	
It is scalability	
It is worldwide	

2.3 An empowering e-learning environment

A safe and empowering e-learning environment for students is the environment where students are permitted to choose the goals, with whom they work, resources, materials and the path they take to reach their academic goals. In this environment students engage in the learning process and reflect on their own personal contributions, connections, knowledge and reflection empowering students to make sense of their learning. An empowering e-learning environment permits students to help other students in learning. With this method students demonstrate, share knowledge and deepen their own understanding.

With the help of an empowering e-learning environment students will be aware of their individual goals, have the ability to assess themselves according to specific criteria and they are able to give effective feedback to others. An e-learning environment asks students' opinions, gives them opportunity to be heard, gives them feedback and their feedback will be honored. In the end the right e-learning environment leads students to the right direction where everyone can find his/her own path. [5]

2.4 The architecture of an empowering environment for e-learning

The architecture of an empowering environment for e-learning the in technical form can be difficult to understand but the architecture of the empowering environment for e-learning in abstract form consists of three various parts:

1. User interface
2. Database
3. E-learning Platform

A user interface of an online study environment can be for example a web browser. Database can be for example MYSQL and e-learning platform can be for example Moodle. These three parts are connected to each other and work together, as illustrated in figure 1.

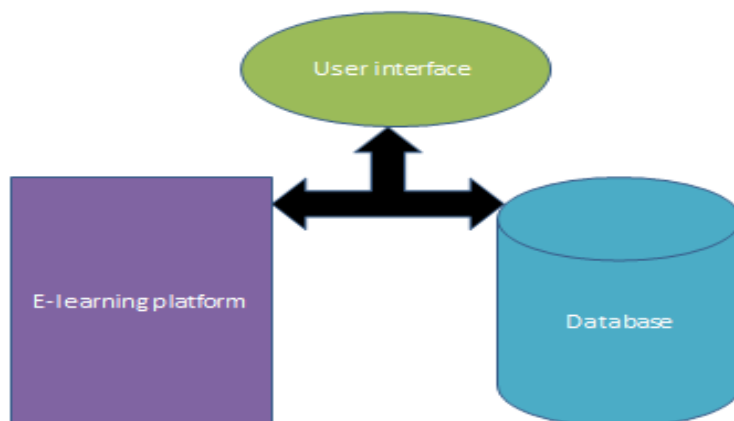


Figure 1. Connection between user interface, e-learning platform and database

The user interface causes interaction between users with a machine and it contains hardware and software components. It allows the user to manipulate a system and allows the system to show the effects of the users' manipulation. It can be for example an application or a web browser.

A database is a collection of organized and structured data. In order to define, create, query, update, and administrate of database, database management system (DBMS) is needed. There are many DBMS such as Microsoft Access, Microsoft SQL Server, MySQL and PostgreSQL. Table 2 summarizes the databases and their DBMS.

Table 2. Databases and DBMS

Databases and DBSM	Address
Microsoft access	Office.microsoft.com/access
Microsoft SQL Server	www.microsoft.com/sqlserver
MySQL	www.mysql.com
PostgreSQL	www.postgresql.com

The e-learning platform is a virtual education system which provides for example classes, class content, tests, homework, grades, assessments for students in anywhere at any time. The e-learning platform is based on the web. There are commercial and free e-learning platforms. Free e-learning platforms are open source. It is difficult to compare commercial and free e-learning platforms. Some commercial e-learning platforms are for example Angel, Blackboard, Desire2Learn, KnowledgePlanet, SumTotalSystem, WebCT. Table 3 summarizes the commercial e-learning platforms and their web addresses.

Table 3. Commercial e-learning platforms and their web addresses

Commercial e-learning platform	Address
Angel	www.anglearning.com
Blackboard	www.blackboard.com
Desire2Learn	https://ocdsb.desire2learn.com/index.asp
KnowledgePlanet	www.knowledgeplanet.com
SumTotalSystem	www.sumtotalsystem.com
WebCT	www.webct.com

Some free e-learning platforms are for example Claroline, Colloquia, Dokeos, Moodle, OLAT, and Sakai. [6]. Table 4 summarizes the free e-learning platforms and their web address.

Table 4. Commercial e-learning platforms and their web addresses

Free e-learning platforms	Address
Claroline	www.claroline.net
Colloquia	www.colloquia.net
Dokeos	www.dokeos.com
Moodle	Moodle.org
OLAT	olat.org
Sakai	www.sakaiproject.org

2.5 An example of the structure of empowering environment

This is one practical example of the structure of e-learning courses which is used in so many universities of applied sciences. One of the simplest and practical examples for Structure of empowering environment can be like the following. It consists of four different parts which are:

- a) User interface
- b) Moodle
- c) Stack mathematical program
- d) Maxima mathematical program

At this moment Stack and Maxima program are integrated in Moodle. Figure 2 illustrates one practical example of the structure of empowering environment where is a user interface, Moodle as the online environment and Stack mathematical program and Maxima mathematical programs which are integrated into Moodle. The Stack mathematical program and Maxima mathematical programs are for solving mathematical assignments.

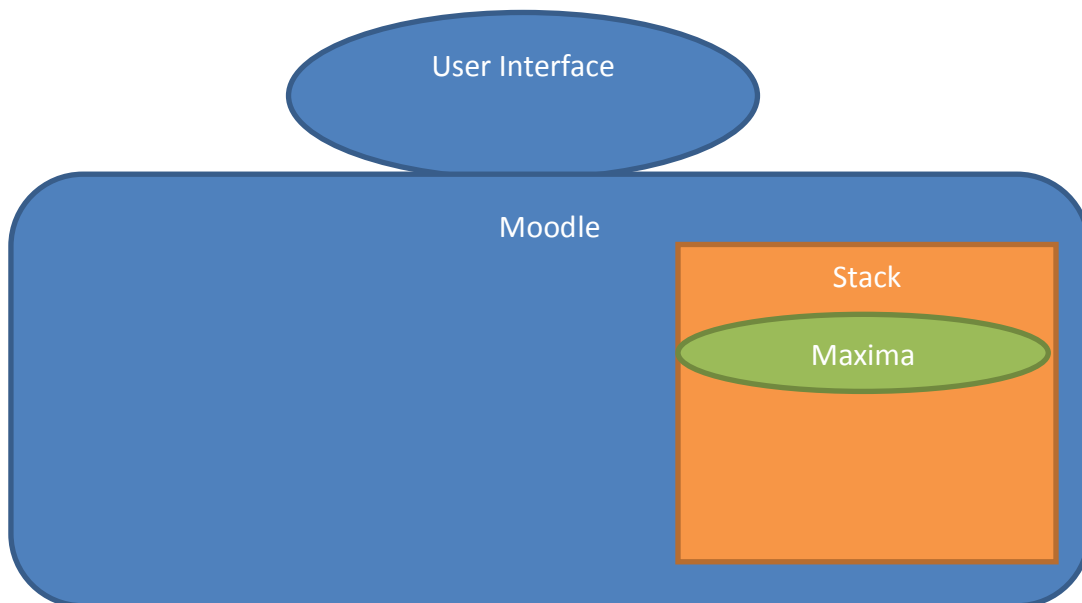


Figure 2. Example of the structure of an empowering environment

2.5.1 Moodle

Moodle is one of the globally used online teaching environments. Moodle stands for Modular Object-Oriented Dynamic Learning Environment and it is written by the PHP program. It is used in many countries with different languages. Moodle is a free open source program. It can be edited or be modified. In figure 3 illustrated the main webpage of Moodle [7].



Figure 3. The main webpage of Moodle

The Moodle program is a Web application and located in <http://download.moodle.org> and anyone can download it for free. Everyone can install Moodle on a Web server and can open it with a web browser. Moodle was created by Martin Dougiamas in Australia. The purpose of creating Moodle was to create a free open source which would have better features for establishing on-line teaching environment comparing with the earlier online teaching environments. Now a days Moodle is used in many environments such as business, development, education and training. The operating system of Moodle is cross-platform.

Martin Dougiamas tried to pay attention to the pedagogical part of Moodle and one of the most important features in Moodle is learning through collaborative knowledge construction. Everyone can register in Moodle in <http://moodle.org> and it is free. The users of Moodle have their own collaborative web services and they discuss about so many useful issues for example developing, using, installing, distributing and editing Moodle according to the GNU General Public License . Table 5. illustrateS some basic information about Moodle [7].

Table 5. Some basic information about Moodle [7]

Information about Moodle	Description
Original author(s)	Martin Dougiamas
Developer(s)	Martin Dougiamas Moodle head quarter Moodle Community
Stable release	March 18,2013
Written in	PHP
Operating system	Cross-platform
Type	Course management system
Website	Moodle.org

2.5.2 Stack

System for Teaching and Assessment using a Computer algebra Kernel (Stack) is an online system which supports computers in evaluation of mathematical assignment. This system functions in this way that first student should deliver the answer. The answer is one mathematical expression which means that it contains differential equations, equations, inequalities, lists, matrices and sets.

The answer which the student sends includes mathematical content. Because of that Stack applies CAS (computer algebra system) which is in this case the Maxima mathematical program in order to establish mathematical features and provide outputs such as feedback which is built on these features. Teachers are permitted to design, write and manage their own questions in Stack. There are some special features in Stack. Here is written four of them. First, Stack can give even a little credit to answer of the student when the answer can fill part of required features. Second, different versions of the question are produced within structured templates randomly. Third, Stack supports even mathematical questions which are Multi-part. Fourth, the feedback of Stack can contain a numerical mark, textual comments and an internal "Answer note".

The above features are responds to evaluative and formative to functions of assignment widely. Students are able to interact with STACK questions in Moodle environment. The code of Stack is reliable and many groups of students, teachers and developers work with it. The first language for Stack was English but later on it was translated into the other languages such as Finnish, Japanese and Portuguese. Stack works in the way that first students submit their answer as a mathematical expression. Then mathematical features of the answer are established by Stack. So the answer of the student is not required to be unique and Stack Stays as an objective testing system but it establishes features of expressions. Figure 4. Illustrates Stack in practice.

Give an example of a function $G(x)$ with a stationary point at $x=6$ and which is continuous but it is not differential at $x=0$

$G(x) =$

Your last answer was interpreted as:

$$x \cdot (x-12)$$

Your answer is partially correct.

Your answer is differentiable at $x=0$ but it should not be. Consider using $|x|$, which is entered as $\text{abs}(x)$, somewhere in your answer. Your mark for this attempt is 0.67. With penalties and previous attempts, this gives 0.67 out of 1

Figure 4. Stack in practice [8]

This example may clear Stack more; the instructor may try to show that the answer is equal to the correct answer algebraically. On the other hand the answer does not need to be unique and Stack establishes properties of expressions. However it remains just an objective testing system. The feedback is particular for the answer directly and it related to possible improvement on the task. This kind of feedback is very effective. Stack includes and displays the results of computer algebra calculations within this kind of feedback which can be as detailed as appropriate to the situation.

Stack especially uses the computer algebra system Maxima in order to

- a) Generate problems randomly in a structured mathematical way
- b) Establish the mathematical properties of expressions which are entered by the student
- c) Generate feedback for student if it is necessary and this feedback includes mathematical computations of the student's answer.

Stack can help the instructor to track the progress of every individual student, analyze all responses to a particular item, and so on. The stack system is separated from Moodle and it can be used also through other interfaces. At this moment a new version of Stack is integrated into

the Moodle. In fact it integrates a mathematical question type into the quiz module of the Moodle content management system. [8]

2.5.3 Maxima

Maxima [9] and some other mathematical programs such as Mathematica [10], Matlab [11] and Maple[12] came after the DOE Macsyma program [13]. The DOE Macsyma program was a computer algebra system. It was created in 1968 at MIT (Massachusetts Institute of Technology). William Schelter volunteered to maintain the Macsyma program from 1982 until 2001. The Macsyma program was released as the open source code in 1998. In 2000 Maxima project was started and developed by some user and developers [13].

In fact Maxima is a computer algebra system (CAS). It means that Maxima is a software program that facilitates symbolic mathematics computer algebra, algebraic computation or symbolic computation is scientific area where software and algorithms are studied and developed in order to manipulate mathematical expressions and other mathematical object [9].

Maxima is one of the good systems for the manipulation of symbolic and numerical expressions. These symbolic and numerical expressions can be differentiation, integration, Taylor series, Laplace transforms, ordinary differential equations, systems of linear equations, polynomials, sets, lists, vectors, matrices, and tensors. Maxima provides numerical results with high precision numerical results by using arbitrary precision integers, exact fractions and variable precision floating point numbers [9].

Maxima is able to plot data and functions in three and two dimensions. It was released with the terms of the General Public License (GNU) [14]. It runs on POSIX platforms [15] like BSD, Mac OS X, Unix and Linux/GNU under Microsoft Windows. Maxima has some completed features such as ODE solver, symbolic integration and 3D plotting. On other hand there are some incomplete features such as cleanup, bug fixing and documentation. Maxima is still under development and different graphical user interface (GUI) can be used for it. One of them is wxMaxima which is a trend cross-platform GUI. Some of the Maxima errors can be seen on the page: <http://cadadr.org/maxima/faq.html> [9]

Figure 5 illustrates Xmaxima 5.18 running on Linux (with Tk 8.5) with the embedded plot windows option.

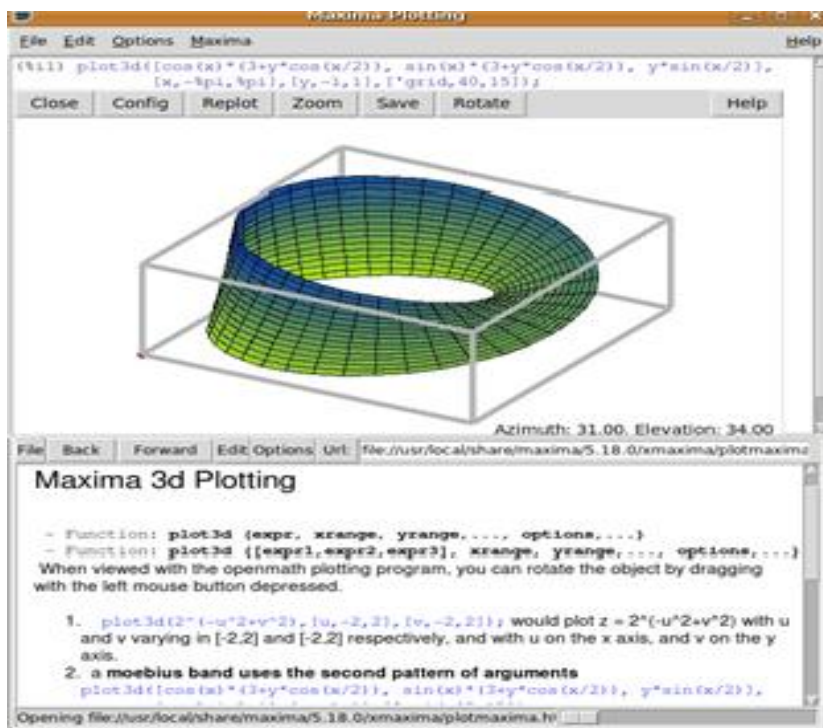


Figure 5. Xmaxima on Linux [9]

3 An empowering environment for a university of applied sciences

Students of universities of applied sciences have different backgrounds of different levels. Some of the students come straight from high school or vocational school. Some come to study after the army. Some work in day time and study in evenings. Some want change their jobs and in order to do that, they should study. Also some are unemployed or retired and want to study more. These students have different levels of knowledge. Some of them have fresh memory and some of them not. Therefore a university of applied sciences wishes to create an empowering environment through e-learning which is specialized in applied sciences in order to help these students in their studies.

3.1 Interviewing different lecturers about an empowering environment

In this study, some of the lecturers of different universities and universities of applied sciences have been interviewed in order to find out what kind of empowering environment is suitable for a university of applied sciences. These interviews were conducted in a qualitative research method. The interviews were face to face and standardized, that is open-ended interview. The questions were explained (what and why) to the interviewed lecturer step by step. The interviewed lecturer explained and answered the questions according to his/her experience, opinion, knowledge, behavior and background freely. Every interview took from one hour to six hours. The environments of interviewing were very peaceful. Interviews with lecturers gives exact information in order to create an empowering environment which is needed for a university of applied sciences.

The interview with lecturer T. S. was done in his office. T. S. teaches in the way that in the first meeting with student (at the beginning of course) he will tell students where they are, where they are going to and what the goal is. Then he splits the course into smaller parts and starts teaching (moving forward). T. S. makes mid-term tests for students and after evaluation he gives the answers to students. The final exam questions are quite similar to mid-term tests. The final exam consists of five questions: The first question is very simple, and all students are able to solve it. Almost %100 of the students gives the right answer. The second question is almost

easy and almost all students are able to solve it. Almost 80-90 % of the students give the right answer.

The third question is a little difficult. Almost 60-70% of the students give the right answer.

The fourth question is part of the medium and the students are able to solve it. Almost 50% of the students give the right answer. The fifth question is challenging, and only a small part of the students are able to solve it. Almost 25% of the students give the right answer. So, in this way, students are reminded that everything is not always ready and an engineer should think in order to solve problems. Table 6 illustrates the questions, their mode and percentages of the right answers to these questions.

Table 6. Test questions, their mode and percentages of right answers to the questions

Question number of test	Question mode of test and percentages of right answers
Question 1	Question is very simple. . Almost 100% of the students give the right answer.
Question 2	Question is almost simple. Almost 90-80 % of the students give the right answer.
Question 3	Question is a little difficult. Almost 70-60 % of the students give the right answer.
Question 4	Question is more difficult. Almost 50 % of the students give the right answer.
Question 5	Question is challenging. Almost 25 % of the students give the right answer.

In this lecturer's opinion instruction books are good but they do not necessarily provide all the required information for students. There are not so much instruction books in the Finnish language. In other hand study materials/notes have a leading role. Notes give students an overall

of the lesson and it should be enough in the way that. It will help the student to understand things more and better.

T. S. says that contact and a bandage between teachers and students is very important and students should not be left alone. The student should tell about his/her feelings and opinions about the course and the teacher should give the student feedback about his/her work.

T. S. believes in the traditional training method. It means that first the student should think by himself/herself then do the tasks with paper and a pencil. After that the student can use the computer and computer programs/web as useful tools. Mathematics is practicing.

According to lecturer T. S. an empowering environment should consist of the following features:

The lesson text, video clips, samples, exercises and assignments should be limited, concise/brief, strong, leading, straight, in order, clear and distinct. In the lesson text should be a certain plot. Explanations should be 5-15% less than the normal lesson text. The video clips could be from 2- 20 minutes. It is better that a human explains the lessons. Of course in some subject like physics animation can be used. The assignments should be one third of the course assignments. The assignments/exercises start from easy to difficult.

The answers of the assignments/exercises should be rounded. In an empowering environment should not be many links so that the students get confused and lost. An empowering environment should be very user-friendly and especially for weak students. It should be designed carefully. Its structure is very important. Everything has to be reasonable. In an empowering environment keywords should be used. Table 7 summarizes the features.

Table 7. Feature of an empowering environment according to lecturer T. S.

Features of empowering environment according to lecturer T. S.
The lesson text, video clips, samples, exercises and assignments should be limited, concise/brief, strong, leading, straight, in order, clear and distinct
In the lesson text should be a certain plot. Explanations Should be % 5-15 less than the normal lesson text
The video clips could be from 2- 20 minutes. It is better that a human explains the lessons. Of course in some subject like physic animation can be used
The assignments should be one third part of course assignments
The assignments/exercises start from easy to difficult
The answer of the assignments/exercises should be rounded
In empowering environment should not be a lot of links so that the students get confused and lost
Empowering environment should be very user friendly
Empowering environment should be for weak students
Empowering environment to be designed carefully. Its structure is very important
Everything has to be reasonable
In empowering environment keywords should be used

Challenges of the features of an empowering environment according to T. S. are as follows: One challenge is in the fact that every year the level of the students and the teaching change. Does that mean that all the time the empowering environment should be updated? The students come to university with the different levels, culture, habits, behavior, points of view and talent. One problem is that there is so much material from the Internet that students get lost. Empowering environment should be designed really well. Not too easy and not too difficult. Empowering environment should be definitely able to encourage students. Table 8 summarizes to challenges of empowering environment according to lecturer T. S.

Table 8. Challenges of empowering environment according to lecturer T. S.

Challenges of empowering environment According to T. S.
One challenge is in the fact that every year the level of the students and the teaching change
Does that mean that all the time to keep updating empowering environment
The students come to university with the different levels, culture, habits, behavior, points of view and talent
One problem is that there is so much material from the Internet that students get lost
Empowering environment should be designed really well. Not too easy and not too difficult
Empowering environment should be definitely able to encourage students

T. S. believes that students need teachers and even in an empowering environment a teacher is needed. For example, medical service cannot be just on the Internet without the real presents of doctors. It is possible that a student does not understand the lesson from video clips or easily

gets confused. In addition, lecturer T. S. explained about Khan Academy [16] during the interview. Khan Academy is an educational website which provides high quality education in general. The website has a free online collection of thousands micro lectures via video tutorials which are in YouTube. According to lecturer T. S. Khan Academy consists of the following features: It is good just for starting not for developing the students and it is good in the sense that it explains the subject studies very easily. Visualization is one of the best features in the Khan Academy.

Lecturer T. S. thinks that there should be an assistant in order to answer students' questions in an empowering environment and it will be need 4-5 students as assistants. Due to the feedback the best way is that first a small platform should be created (a prototype) for experimentation and then the result could be seen.

An other interview was with lecturer O. P. in his office. Teaching method of lecturer O. P. has similarity to empowering environment. His method will be explained in order to get more ideas about empowering environment. Lecturer O. P. has distributed study materials for students and everyone has access to them. These materials consist of video clips and the Lecturer's own book, study material/notes and assignments. All of these materials are short, concise and powerful.

Lecturer O. P. has two experimental groups:

Group 1 is taught in the traditional teaching method, where he teaches in front of the class. A teacher is like a leader and the student should study with the teacher pace and the teacher is unable to help weak students because of the schedule and pace. In this case it is possible that weak students will be left behind and lose motivation.

Group 2 (experimental = Custom Education) with the new method. The students have to study at their own rhythm. Some students are faster and some students are slower. Because students have all the materials, tasks and assignment, they can work in small groups in class. The lecturer walks around the class and when a student has questions, the lecturer goes to him/her and with a pencil and paper explains problems to the student.

The benefit of technology is that technology makes this situation possible in order to save time and effort and everyone learns in his/her own way and pace. In the other hand there is more

time for the teacher so that he can focus more on the weak students. If strong students want more challenges, they will have more challenges. Because already the lecturer O. P. has put more difficult questions for students who want to study more and learn more. The students will gain a greater motivation, enthusiasm, and self-initiative and self-confidence. (Just like lecturer T. S.' theory).

Many teachers and schools follow these kind of methods like in Maot [17]. Maot is a Finnish website news about educations and experiments for new education methods. Lecturer O. P. has noticed that the new method of teaching encourages students and students encourage for learning with this new method. Lecturer O. P. thinks that these methods will help the weak, strong and medium students. In this case there are enough challenges and every one finds his or her path. It is delightful opportunity for students who are not sure about themselves and their skill level.

The feedback of students about new method has been the following:

Comparison new method with the traditional classroom (21 persons responded to the questionnaire)

- 100% thought that the studying atmosphere of the new method was better.
- 90% (19/21 persons) wanted to study mathematics rate in the new method.
- 86% (18/21 persons) believed that they learned math better in the new method.
- 10% (2/21 persons) were of the opinion that they learned math better in the traditional method.

In the opinion of lecturer O. P. time is mature to make such an environment like an empowering environment and he believes that very soon someone make an empowering environment. In the future lecturer O. P. wants that in his class, students come and start with the teaching material and then solve the assignment. The environment of the class is relaxed, flexible and everyone can enjoy from that and even students can work in small groups and strong students can help weak students. It is important to have a program that when students confront a problem, the program can explain the theory about this problem and can solve the problem for the student.

Lecturer O. P. believes Opetus.tv [18] (Opetus.tv is a Finnish educational website which provides high quality education for high school students. The website has a free online collection of many micro lectures via video tutorials.) is better than the Academy. He thinks that at this mo-

ment there is no better environment than Khan Academy and students might use Khan Academy because there is still no better format. Khan Academy is a kind interactive program. For example as long as the student cannot solve the first assignment, he cannot move forward to solve the next assignment. Lecturer O. P. says that many teachers think that technology is a threat to their work. That is wrong. Technology is a tool to help teachers in their work. Lecturer O. P. says that the best way to start an empowering environment is that first one small prototype can be made and then it can be developed.

The next interview was with lecturer A. R. in some coffee shop. This interview was in two parts on two different days. Lecturer A. R. started to talk about the e-learning history at Aalto university. The first e-learning project was made in the 90's and it was called HYPE MATH. The project leader was Professor Ismo Kivelä. This project was based on HyperCard application which was commercial software. After that the Iso-M project was made. The web material was similar to books and traditional tasks. It was a static material and Maol organization was also involved in this project. Next was the MOVE project (a math e-learning review) which was similar to the Iso-M project and the Finnish virtual campus (Suomen virtuaaliopisto) [19] was also involved in that.

Then Aalto University and VHB company created together the ABC project (ABC = Approach of Basic Calculus). It was one online material package in English and German. This material is TKK's Moodle. It was kind of high school and college middle ground. It consisted of text, Flash and interactive materials and it had Automatic Repair assignment machine. This project faced financial problems.

The virtual university (Virtuaaliopisto) closed down because the teaching government did not have enough resources for that. German students could use this project. Then Professor Esko Valkeila became the mathematical finance director in Aalto University. At this time lecturers found out that in mathematics and physics only half of the students passed in the first few years, and 75% of the students could pass in the last few years. Then the Pikku-M project was made which was similar to the Iso-M project but it was better. Still Aalto University had the budget problem for making e-learning projects.

Aalto University noticed that such projects will need a big budget. On the other hand it was always noticed that a long-term project worked better than a short-term project. Aalto University

had started an open investigation to determine the personnel and the students were asked about their ideas about study problems. Operation Research was done by the department of Mathematics and Statistical Methodology. Provided ideas were divided into two groups: Pedagogy and Educational Technology. Another important result was that always the cheapest solution is not necessarily the best solutions and even in the future this kind of solutions generate more problems and bigger budget.

The Universities of Technology in Oulu and Tampere in (Alli Huovinen was involved in this project) created a place where students could do their homework and there was an assistant who helped students. The result of this project was very good and the universities even received an honor diploma from the student community. Seppo Pohjolainen did a query/test from students active here.

The following are lecturer A. R. comments about pedagogy and technology related to e-learning. In lecturer A. R.' opinion sometimes a student fails in studies because of his/her ability of organization in study he or she tries too hard in the wrong way. It is important to encourage students not to discourage them. Always teachers should keep on exploring the learning process and monitor students learning.

In his opinion man uses nature to make discoveries. Because human may think that this is a safer way (for example, a bird shape and the shape of the aircraft). However if man does not use nature and thinks a bit differently, then he can invent something new. It should be considered that logic and idea are two different things. Lecturer A. R. wants to mix technology and pedagogy for e-learning. He has about five different views of new e-learning. One of them is a simulator where students could experiment new things in different subjects. In lecturer A. R.' opinion people use e-learning too little and the reasons are:

- a) So much material in in internet
- b) Important parts of the subject in e-learning cannot be marked like in the book
- c) The e-learning material can be deleted but a book is physically in the readers hand and on the bookshelf
- d) The publishers think that the book will be sold more easily than e-material.

- e) An other weak point in e-learning is its material creation; for example making and editing video clips take so much time and even making leading examples and assignments take usually from two hours to a few days.

Lecturer A. R. believes that in primary school and junior high student learn mathematic operators/operands and how to work with those. It continues to high school and the most difficult issue for students is to make a mathematical model from one question. So perceiving usually is difficult for them. For making e-learning organizations should think that why they need e-learning material and it is wrong if organizations think that what e-learning material they need. So the way of thinking should be a little different (Why ---> How ---> What not What ---> How ---> Why) according to lecturer A. R.

Lecturer A. R. says that there are so many software which correct assignments. For example, there are many programming languages such as Mathematica (Wolframalfa [20] uses Mathematica software), SAS [21], Python [22] and Maxima. He gives comments such as Stack is able to take a look at the tasks and solutions in order to fix them. Stack has problems with syntax. On the other hand Moodle is a bit confusing and it has poor usability. At this moment in Moodle is integrated with Stack version 2.0 and some engineers are trying to integrate it with Stack version 3.0. Both versions have benefits and drawbacks. Estimated time for editing Stack is almost 6 months. It is full time work and is needed 2-5 engineers.

The next interview with lecturer H. V. who believes in the traditional method. It means using pen and paper. In her opinion the student should not be left alone and teacher's presence is very important. First the student should do exercises/assignments by a pencil and paper. Then the student can solve again exercises/assignments. Lecturer H. V.'s point of view is that technology should be used as a tool and it is very enriching for students to see and learn the traditional method and the new method of learning.

Technology in teaching and learning are multi-dimensional things. For example, students of media engineering need a computer and different software program for their studies.

Lecturer H. V. believes that technology will save time and effort and is a useful tool for teachers and the students. Sometimes using of computer and programs is more fun, prompt and accurate; for example a computer can change the shape of a circle to an ellipse very easily and accurately. Lecturer H. V. worked with different mathematical software programs and she noticed

that each program has some gaps and always a better program can be done than the previous one. In her opinion Matlab is one of the best mathematical software programs.

Lecturer H. V. has seen WolframAlpha and different programs on the Internet such as Khan Academy and she thinks that there is not yet a suitable program that would be the answer to our universities needs. In her opinion Khan Academy could not encourage all students.

Lecturer H. V. believes that an empowering environment should have a straight body, direct plan and it should be user-friendly. An empowering environment must have a clear logic / patterns / frame (it is good in many ways for example for the users, and the development in the future).

User interface of an empowering environment should be user-friendly (sometimes students do not know how to use programs or computer in order to use program and sometimes students get lost in the middle of the work). If using an empowering environment was difficult for the student, then he/she would get frustrated. The design for an empowering environment must be like a tree. First, a good body; then branches very systematically. So it will be much easier for a student to understand an empowering environment. Lecturer H. V. believes that the teacher must be present, walking in the class, monitoring, assisting and encouraging students. The student is at home alone but in class there are many students and they can tell/share their own opinions with each other.

Another lecturer, M. K., has with another lecturer made support study materials for Metropolia and it is in Moodle. The name of these materials is Expressions and Equations. This material is the high quality and it is highly instructive and always entrance exam questions come from these questions (they are almost 3000 assignment). The intention for this project was to raise students' self-esteem and encourage them. Lecturer K. L. has put this material also in WebALT [23].

Lecturer M. K. says that Moodle is currently in use and it is the best environment for e-learning. He said, according to Harvard university, creating other online environment such as Moodle requires at least 60 000 000 £ budget and still other online environment is almost 5 years behind the Moodle. Grouv Kumar confirms it in his research [24]. In lecturer M. K.'s opinion, Python program is not a good program for Moodle and the Maxima program is good because Maxima is a symbolic software program. Lecturer M. K. thinks that it is good if universities

start to make subject study in Chemistry and Physics on top of Moodle and continue to develop them.

Lecturer M. K. believes that it is very difficult and unusual to construct another environment such as Moodle and it is better if organizations start to build new parts for Moodle or update and upgrade it. Until now people have suspected Moodle because Moodle is not so user-friendly. In lecturer M. K. opinion for programming Metropolia University could use MOOC [25] which is good in relation to programming and is suitable for our needs. GeOSet [26] Internet page is full of videos which can be useful for Metropolia University. GeoSet is an acronym for Geometric Structures for Elementary Teachers.

Lecturer M. K. says that University of applied science in Seinäjoki [27] Also offers many specialization studies in online which are available in English language. In lecturer M. K. opinion Khan Academy says how to solve a task and it does not say why we have this task and where the problem is come from. Lecturer M. K. says also that now teachers start to develop their user interfaces, assignments, videos and teaching methods in e-learning.

Next interview was with Lecturer R. N. who has 2 groups. Group one consists of youths and group two consists of adults. Lecturer R. N. has distributed study materials in Moodle.

1. Group one is taught in the traditional teaching method. That is normal teaching. Lecturer R. N. teaches in front of the class.
2. Group two or adult group / category 2 is taught with new method of teaching which is experimental Customized teaching. The students can study at their own place and in own rhythm. The environment of studying is Moodle which has Videos, Materials, tasks and Assignment.

By reading study material and doing assignments (assignments start from easies to difficult) if student notices that he/she does not need to come to a lecture then he/she can continue in this way and if someone does not understand by study material then he/she goes to lecture.

Lecturer R. N. has made the exam system in the way that by solving assignments and by helping percentage of correct answers in Moodle students understand what will be their grade in exam.

Lecturer R. N. checks students' answers by the help of Maxima program in Moodle and this program gives students feedback based on assignments that they have done. In this way time, effort and energy can be saved and there is more time for weak students. Lecturer R. N. is in contact with students through e-mail and a discussion column and communicates with them and gives them feedback or answers to their questions, so the students are not alone with their problems. Lecturer R. N. hopes that she would make this system also for a group of youths in the future. In lecturer R. N.'s opinion, because in Metropolia students come from two different bases, high school and vocational school, we need a program / environment like an empowering environment.

In lecturer R. N.'s opinion, the e-learning environment of VilleUtu [28] is not so good an environment and the tests work like the CISCO Academy [29] (multiple-choices questions, there is one right answer in four options). On the other hand VilleUtu is more for information technology department. Lecturer R. N. says that WebAlt does not provide very good environment and Metropolia needs a better environment.

In lecturer R. N.'s opinion, the material of an empowering environment should be started from the basics and students gain a good understanding of subjects for example through refresher books. In an empowering environment explanations should be strong and succinct. Some subjects can be forgotten easily, so an empowering environment can refresh students' minds. Video clips/animations must be in order and the collection should be really instructive, concise, strong and clear.

Assignments should have a leading role as well as the references and they lead students to difficult assignments and at the same time give him/her self-confidence and motivation. The program should be able to give feedback to students. An empowering environment can be on top of the Stack program (Stack is made in the University of Birmingham in England for example; Webalt is on top of Stack program. In lecturer R. N.'s opinion, if every teacher puts his/her own study material into Moodle, it will become a bad and confusing environment for students. In lecturer R. N.'s opinion, part of the program would be like WolframAlpha so that the student has any questions, just by writing a question he/she will receive the answer (The program works a bit like a teacher).

Next interview was with lecturer K.L. who said that a new technology can improve Engineering Mathematics and it is a big help for students who study Metropolia. Lecturer K.L. has worked in this area. He started in 1980. First he started to make static e-learning for students of Metropolia. Now with his improved skills he tries to make better online courses and materials for students. In his opinion it would be good if Metropolia will make an environment like an empowering environment for students in order to improve their skills in mathematics and applied sciences.

Students of Metropolia come from two different places, high school and vocational school. This means that these students have different backgrounds. On other hand in the first years of study these students have motivation problem. On other hand they get guidance and feedback very late. The result is that many students fail in mathematics. They get frustrated and some of them interrupt studies and leave university. In order to solve this problem lecturer K. L. did an innovation and made mathematics tests in the Moodle environment using Stack and Maxima mathematics programs. These tests consist of Algebra, Equations, Arithmetic and many other different mathematics subjects. These tests are recommended more to students who have a weak background. By participating in these tests and getting feedback, students can understand their own level and work on their weak points. Another good point of this innovation is that there are many tests in different areas and students can use these tests as samples, exercises and assignments in their own time and place. After solving each test the student gets feedback and the correct answer and he/she can continue solving the tests.

These tests have very good features. They are parametric. It means that there are different tests in each test set. After solving the test the student gets automatically detailed answers and feedback. It is suitable for self-study. The system is online and students can access it very easily.

GeoGebra [30] mathematical program [30] is good for dynamic geometry. GeoGebra can manipulate and visualize mathematical objects but usually Stack exercises are simple and Stack just gives the final answer. In lecturer K.L.'s opinion combining the GeoGebra mathematical program with the Stack mathematical program gives better defined tasks and feedback.

In lecturer K.L.'s opinion the new study plan for students in the future can be in this way that lectures are online and study materials are on the web, students can study online independently, student can do assignments with help of Stack, students are supported by assistants in real time, students can do project works in laboratories using for example GeoGebra and wxMaxima

. Of course there are always basic examples and assignments in Moodle and students can practice there if they forget something about some mathematical subjects.

In lecturer K.L.'s opinion one of the problems of the e-learning courses in Moodle is that students are not so active in chat or discussion room with each other about tasks and assignments. It is strange because in other countries students who study e-learning courses in Moodle are very active in chat or discussion room and talk about tasks, assignments and their solutions.

The next lecturer, called K. S., is a programming teacher and he is excited about using different methods so that students would be inspired. At this moment he practices the Flipped classroom and he thinks that the Flipped classroom and the mind map together will be very good and helpful. Lecturer K. S. thinks that the best programming algorithms are algorithms for normal life. One good example for studying programming is the Javala [31] Internet page. Javala was done at Tampere University of science.

Lecturer K. S.'s vision for the user interface of an empowering environment is based on the mind map. The user interface starts with a core for study subjects. By clicking the core students are able to see components of the core which are subject studies, lessons and so on. If the study subject is for example. embedded System, it can be split to the components by using a mind map (just like the mapping in webpage) and then when students click every part of the mind map, they can see every subject of embedded System and with clicking every subject they can see the video clips, text, example, assignment and tasks of that subject. It is better if the video clips are 5-15 minutes. One example is that the result are much better when students watch video clip which is related to lab work and then start to work in lab.

Lecturer K. S. thinks that one good feature in this project is that each student is able to continue learning in the mind map and make his own mind map by making a copy of the original mind map. Original mind map stays the same. Lecturer K. S. says that some good tools for creating these kind of projects such as an empowering environment are MindMeister [32] and Powerful visual [33] collaboration. There is another tool which is called Todaysmeet [34] and it is similar to the normal blackboard. There are some other helpful programs like Camstudio [35] and Sketch It [36].

Some comments of lecturer K. S. are:

- Discussion forums and blogs are very important tools for making the discussion among students
- Exercises should be a little bit like a puzzle
- Flipping classroom and parallel study is a good way to help weak students
- It is encouraging if a mind map or an empowering environment works just like a game. For example by doing more exercises student position changes to higher position. That gives more motivation to the student.
- Teachers need to understand how a student thinks.
- Lecturer K. S. likes Khan Academy's programming site.

First look at other universities ' frameworks then make a small prototype for an empowering environment and see students ' feedback and in the end start to develop an empowering environment.

The next lecturer, called J. C., said that technology has a valuable part for learning and it is very important to integrate mathematics in subject studies in order to support them more. It is very important to teach to students how they should present data to a computer. It is not necessary that everybody knows about coding or how to use different programming languages for example there is program like MIT Scratch [37] which is very helpful (MIT Scratch is one of the easiest programming language what enables an environment beginners to get results without having any knowledge about syntax). It is important to know the concept of programming. In fact it is important to teach students that it is possible to do many projects with helping of technology. Students should be able to imagine that is possible to do many projects and it is not always necessary follow a specific pattern in order to solve a problem and a problem can be solved in many ways and students can use their talent freely.

This kind of method help students to think more widely and solve problems in a better way in the future and students should remember that principles also are very important.

Using creativity does not mean that students forget basic structures and principles. Teachers should give fewer lectures and give students time and opportunity to learn with their own way

and speed. So students learn that mathematics is not so difficult and is not necessary to give up fast.

In fact when students start to learn mathematics at school, they like mathematics but very soon some students cannot follow with the speed of the class and they fail. They think that they are not good at mathematics. In order to stop this mistake, teachers should tell students about what kind of tasks they should do, how much time they have for solving tasks and what kind of tools they can use. In addition teachers should give students an opportunity and possibility to use their talent and grow with their confidence.

Exams can be divided into two parts. The first one can be in the way that students think and use their creativity and they are allowed just to use a pen and paper, nothing else. The second one can be in the way that students can use anything they want and solve problems. One of the most important keys in success in studies is that students believe that they can succeed, no matter how many times they fail. The belief of students is crucial. Teachers should give opportunity to students to fail in order to try again and succeed. It is one way to make an empowering environment for students.

Of course it is important to learn theories but it should not be an obstacle for students not to use their creativity. Every child has creativity and most important task of the school and teachers is to feed and maintain this creativity. Even many large organizations give free time to their employees for research in peace. The purpose of this free time is that employees can use their creativity without any stress and usually the best results come from this free time.

Lecturer J. C. thinks that one of the good programs for creating a project is Drupal [38] (Drupal is an open-source content management framework and it is free program. It was written with the PHP program and distributed under the General Public License). Drupal is very good when there is many information to show to readers and it is used by professionals.

Lecturer J. C. said that of course Moodle is a very good e-learning environment and there are many ready features but because of the programming architecture of Moodle, it is very difficult to add new features into that or change something in that. On the other hand Drupal is very flexible program and many changes can be done in a radical way, which is not possible in Moodle.

With Drupal a designer can do many difficult projects in short time but the learning of Drupal is not easy.

3.2 Summary about interviewed lecturers and interviews

The interviewed lecturers' age is between 37 and 75 years old, 2 female and 7 male. Interviewed lecturers have experience in lecturing between 10 and 50 years in different areas such as: Mathematics, Physics and Information Technology in high school or university of applied sciences or universities in Finland or even abroad. Their education levels are between Master Sciences and Doctor of Philosophy. Table 9 summarizes general information about interviewed lecturers roughly.

Table 9. General information about interviewed lecturers

Interviewed	Information
Age	37-75 years old
sex	7 male and 2 female
Experience	10-50 years
Education level	Master of Science - PhD
Lecturing area	Mathematics/Physics/Information Technology
Lecturing in	High School/ University of Applied Sciences/ University
Lecturing in Finland or in abroad	Yes

These interviews gave a new perspective for an e-learning empowering environment for a University of Applied Sciences. Almost all interviewed agreed on something such as:

Teaching is very challenging because every class has different students with different levels. Every student is gifted and he/she should study with his/her pace. First students should think and use a pen and paper. Khan Academy has a good format but it is not specialized for University of Applied Sciences needs. Students need instructors in order to get support. An experimental Flipped classroom has given good results. Information Technology and its products are just assets for learning. Almost all of the interviewed persons had started experimental courses. University of Applied sciences needs an e-learning empowering environment which is specialized for its needs. The Internet is full of right and wrong information. Time is mature for making an e-learning empowering environment. However developing of an e-learning empowering environment is very slow. Table 10 summarizes interviewed lecturers' opinions in subjects which they agreed on.

Table 10. Interviewed lecturers' opinions in subjects which they agreed on

All interviewed lecturers were agreed on
Teaching is very challenging. Because every class has different students with different levels
Every student is gifted and he/she should study with own pace
First the students should think by themselves and use a pen and paper
Khan Academy has a good format but it is not specialized for University of Applied Sciences needs
Students need instructors in order to get support
Experimental Flipped classroom has had good results
Information Technology and its products are just assets for learning
All of the interviewed lecturers are working with experimental courses
University of Applied Sciences needs an e-learning empowering environment which is specialized for its needs
Internet is full of right and wrong information
Time is mature for making e-learning empowering environment
Developing of e-learning empowering environment is very slow

All interviewed were disagreed on something such as:

Moodle is the best e-learning empowering environment. There is a need for new e-learning empowering environment/ let's develop a new e-learning empowering environment. Stack is a good Mathematical program. Maxima is the best symbolic Mathematical program. There are some other symbolic Mathematical programs such as Matlab, SAS and Python which can be used

instead of Maxima. Table 11 summarizes the interviewed lecturers' opinions in subjects which they were disagreed on.

Table 11. The interviewed lecturers disagreed on

All interviewed lecturers were disagreed on
Moodle is the best e-learning empowering environment. Let us develop Moodle
There is need for e-learning empowering environment. Let us develop a new e-learning empowering environment
Stack is a good Mathematical program
Maxima is the best symbolic Mathematical program
There are some symbolic Mathematical program such as Matlab, SAS and Python which can be used instead of Maxima

4 The requirement specifications for an empowering environment

Based on the interviews with lecturers, the following requirement specifications can be listed for an empowering environment.

1. The user interface of an empowering environment is a web platform for students of university of applied sciences for supporting them in mathematics and applied science.
2. The goal of an empowering environment is developing the student for his/her life/job, ensuring student that he/she can think alone and even establish his/her own company because he/she can create new ideas and inventions.
3. The policy of an empowering environment is such as giving a good start/environment for weak students and developing them, reminding students of forgotten subjects and practicing, giving opportunity and direction to students and raise their confidence in order to help them to find their real path.
4. The empowering environment should be considered more for weak students and its first prototype should be in English language. It should teach students in a very simple way, not too difficult.
5. The level of the an empowering environment material for the first prototype can be between high school and applied science university. It should be considered that students come from different culture, have different talent and behavior.
6. At this moment pedagogical resources should/can be lecturers of the University of Applied Sciences and Aalto University. There are various options for the technological resources of an empowering environment. For example technological resources

should/can be Moodle as e-learning environment, Stack program for mathematical assignment, Maxima program for mathematical assignments.

7. Developer(s) of an empowering environment should/can be in contact with other University of Applied Sciences and Aalto University and have co-operation. This helps them in order to develop technological resources of an empowering environment and check the other options, for example developing Moodle or checking other mathematical program like Python for empowering environment.
8. Empowering environment should/can have at least one assistant in pedagogy (lecturer with experience) and one assistant in technology and a few students for feedback.
9. Empowering environment should/can have an online assistant that can answer students' questions by e-mail.
10. Empowering environment should be inviting. It should/can start with "Welcome dear student". It should/can show the student that he/she is not alone. It should show the student that he/she can change impossible to possible. It should show the student that he/she will be heard and there is always help for them. It should show the student that he/she can be independent and there is nothing to afraid of but it makes the student to understand that he/she should/can be a team player and technology is for making people closer to each other not vice versa.
11. The user interface of the empowering environment should be welcoming, attractive, logical, user-friendly, with less links (URLs), straightforward and encouraging and it should make the student more curious and empowering. It should be easy to read and give more energy and hope.
12. The study material of empowering environment should be strong, instructive, concise, encouraging, empowering and clear.

13. The user interface of an empowering environment should/can be like a tree. It starts first with the root then with body then with the branches.
14. Empowering environment study material should tell clearly what is the target of the study material plus starting point and final point of the study material. The study material should consist of
 - a) Text: It should be strong, straightforward. It gives a big picture of the subject study in the order of why, how and what. It is 1/3 of the real subject study in the study books.
 - b) Video clips: they should be 2-20 minutes. One example: In the left part in a small screen lecturer is shown and in the middle in a big screen the presentation of lecturer is shown and from time to time teaching will be stopped and there will be questions from students. In video clips can have blackboard and cheerful colors, sense of humor, relaxing voice. It invites/encourages students to see samples and do assignments.
 - c) It should have leading samples, exercises and assignments which consist of explanations, formula, charts and diagrams [39].
15. Empowering environment should/can have Glossary, wiki, blogs, chat room, forum, calendar, feedback (asking feedback from students), assignment corrector/ feedback giver (which has features such as checks students' answers and gives students' answer percentage, gives correct answers). It has a counter which counts time of solving assignment.

In addition to these specifications, empowering environment could have the following specifications:

16. An empowering environment should/can have search machine for empowering environment study material (text, images, video clips), topics, leading samples, exercises and assignments.
17. An empowering environment should/can have exact search (customized search), simulation (in next prototypes), options/download from page/share, an e-mails and messages, have library browse/glossary/help/old exams, input, announcement, news, open account (account for students and save their work if students want to continue their work

from where they interrupted the work), counter (in order to give points to students to encourage them in their study or in solving assignments)

4.1 Construction plan of the user interface of an empowering environment

Construction of the user interface of empowering environment should be as easy as possible. It should be very user friendly, straightforward, attractive, logical, encouraging, strong and clear. It should not have any password or many links. It should start with friendly and supporting words like “welcome”. The structure of empowering environment should be like a tree, first the roots and then the branches. It should make students more cures and give them more energy and hope. It should have search machine in order to go straight to wanted subject.

The construction plan of the user interface of empowering environment should be like figure 3. Students without any delay; straight enter the user interface of empowering environment where all study subject groups are located such as Mathematics, Applied sciences (Physics and Chemistry) and Programming. By clicking any of these study subject groups, students enter the main subject. By clicking any of these main study subjects, students enter the chapters of different lessons of the study subject. Then students can choose the wanted subject (lesson) from the specific chapter. Of course by writing the wanted subject (lesson) into the search, students can enter that. Figure 6. Illustrates the construction plan of the user interface of empowering environment.

Learning materials in the construction plan

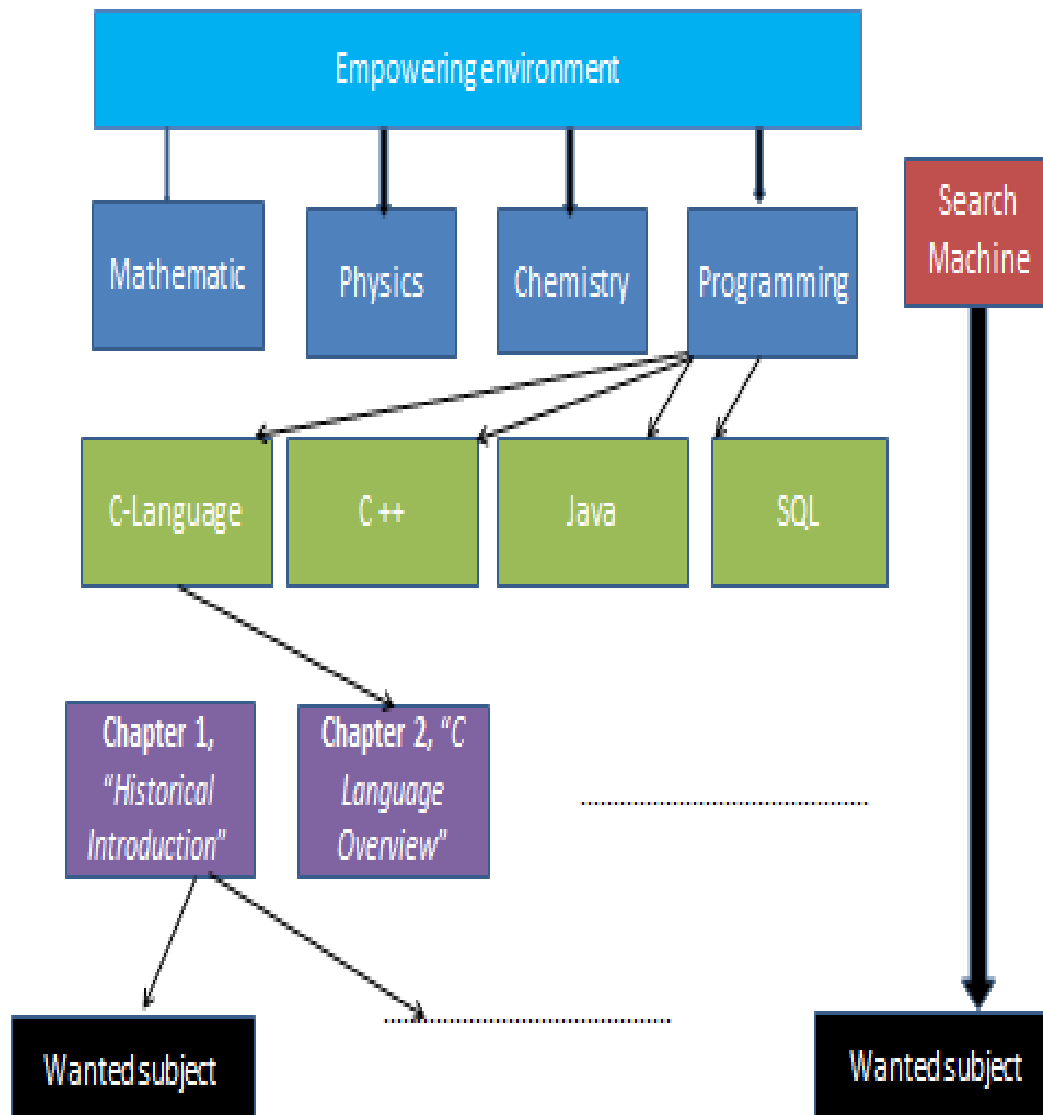


Figure 6. Construction plan of the user interface of empowering environment

4.2 Two different user interfaces for an empowering environment

According to the study and interviews with lecturers, two different user interfaces are recommended for empowering environment. User interface number one is recommended by lecturer K. S. and user interface number two is recommended by study and interviews with other lecturers. Both these user interfaces of empowering environment are easy to understand and use and they are practical.

4.2.1 The user interface of an empowering environment 1 by lecturer K. S.

The user interface of an empowering environment is based on the Mind map. The main idea of the Mind map is that every subject group is a central base for its main study subjects, chapters and lessons. In other hand main study subjects, chapters and lessons are for example branches for this central base. In this user interface the subject groups are located in an elliptical and main study subjects, chapters and lessons are located in different ellipticals. In fact the main study subjects are the first branch, study subjects are the second branch. Chapters are the third branch. Lessons are the fourth branch.

Students enter the user interface of empowering environment where all study subject groups as located such as Mathematics, Physics, Chemistry and Programming in one elliptical (Figure 7). By clicking any of the study subject groups in this elliptical, students enter the main subject group (Figure 8). Every main subject is in a different elliptical (Figure 9). By clicking any of the main study subjects, students enter the chapters of different lessons of study subject. Every main subject is in different elliptical (Figure 10). Then students can choose the wanted subject (lesson) from a specific chapter (Figure 11). In the end students can see the material of that specific lesson (Figure 12). Of course by writing a specific wanted subject name into the search machine can reach material of that specific wanted subject.

In the following figures user chooses Programming as the study subject group (figure 8). Then he/she chooses C-language as the main study subject (figure 9). Next he/she chooses chapter

6 which is the structure (figure 10) and in the end he/she chooses lesson 5 which is the table look up (figure 11). In the end the user enters the wanted subject material (figure 12).

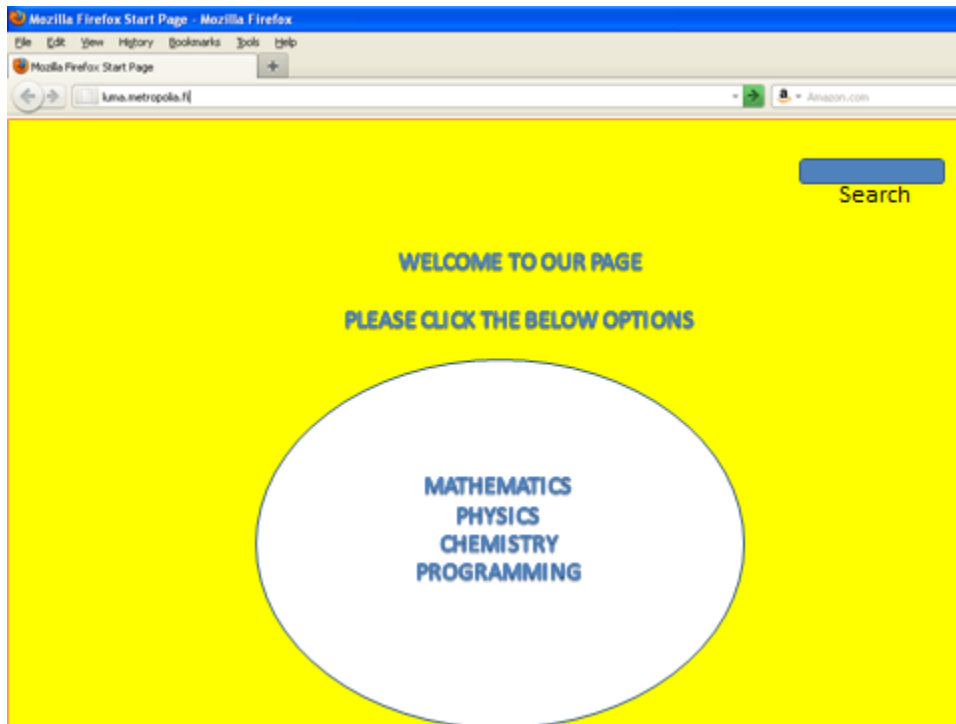


Figure 7. Main page of the user interface of an empowering environment

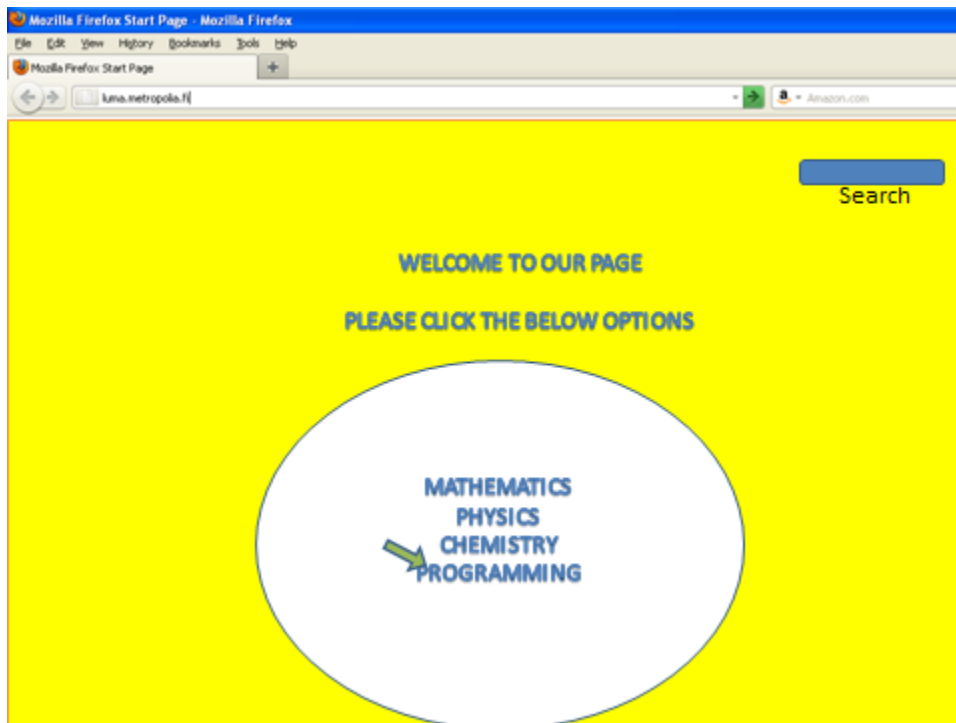


Figure 8. User entering the area of programming by clicking “Programming”

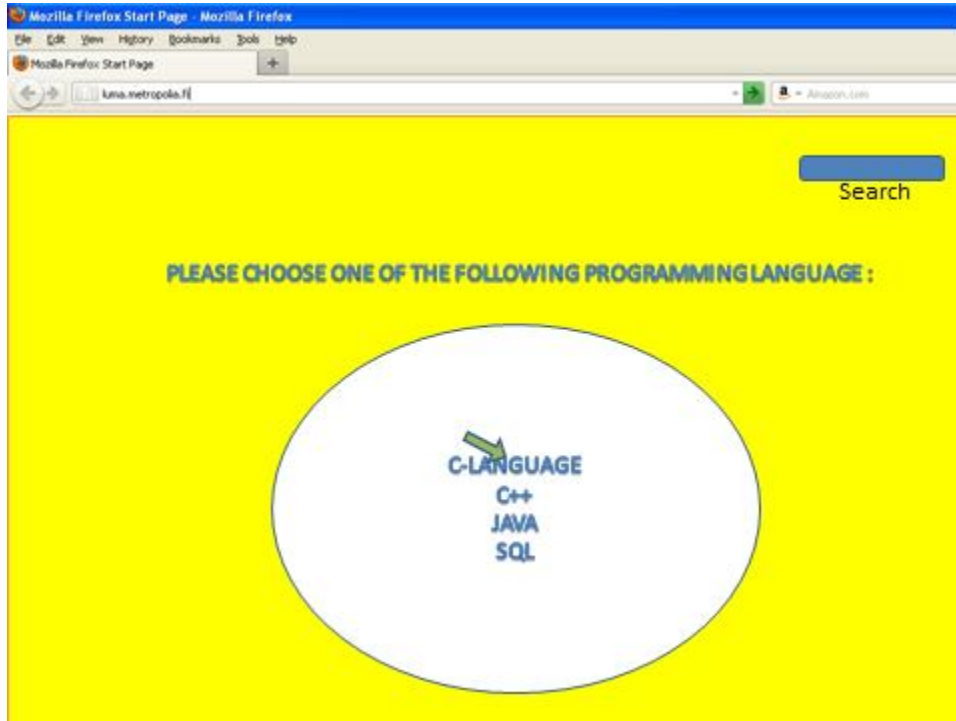


Figure 9. User entering the area of C-language by clicking “C-language”

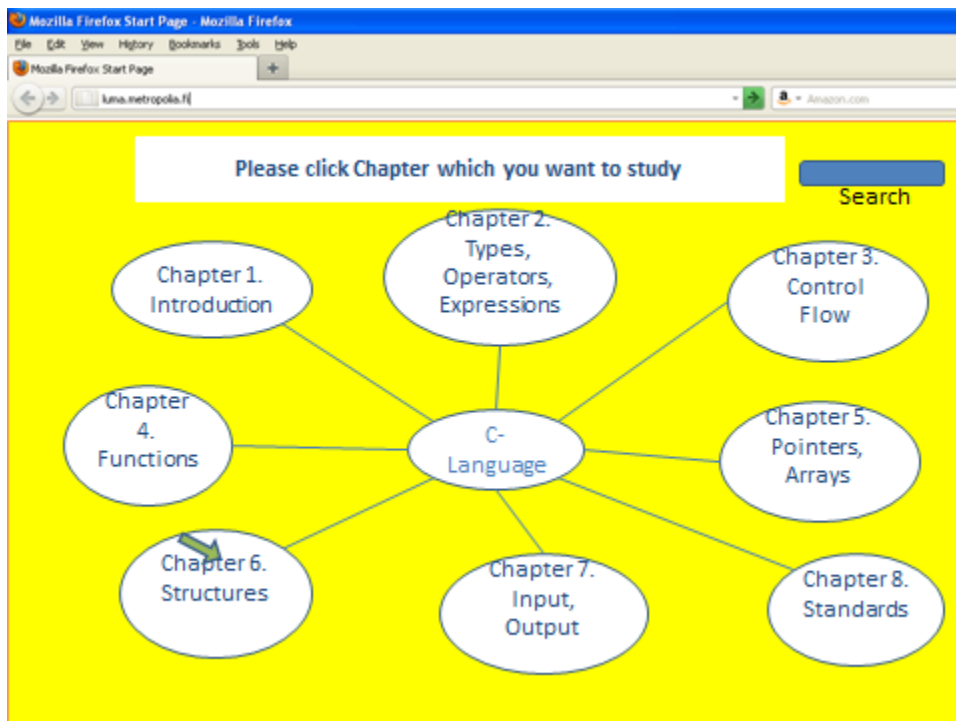


Figure 10. User entering the area of different chapters of C-language by clicking different numbered Chapter of C-language

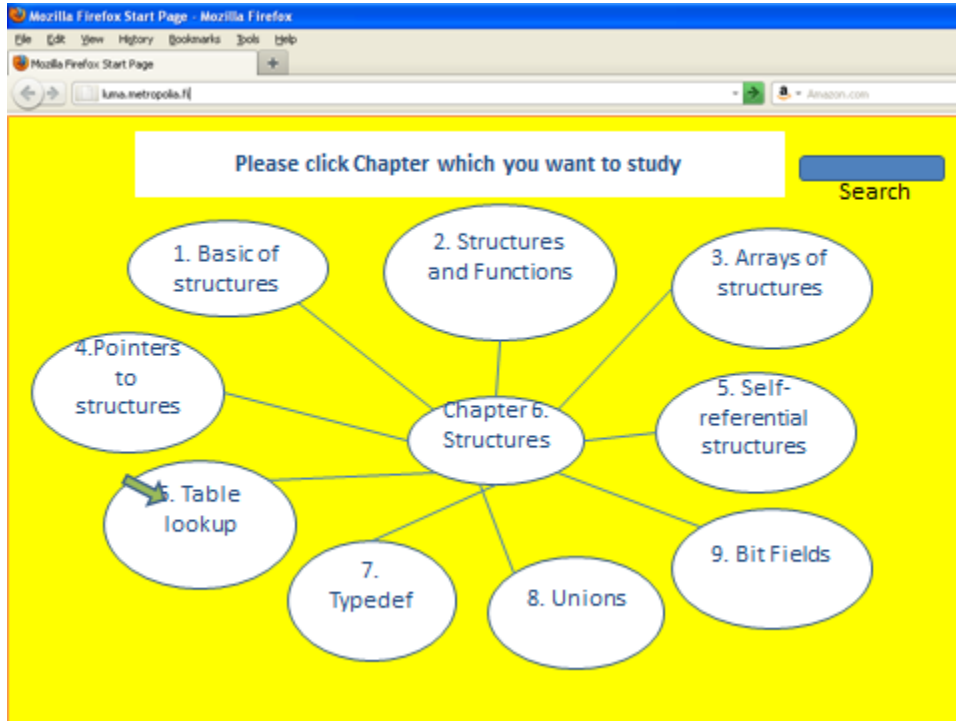


Figure 11. User entering the area of specific chapter of C-language by clicking Specific chapter of C-language

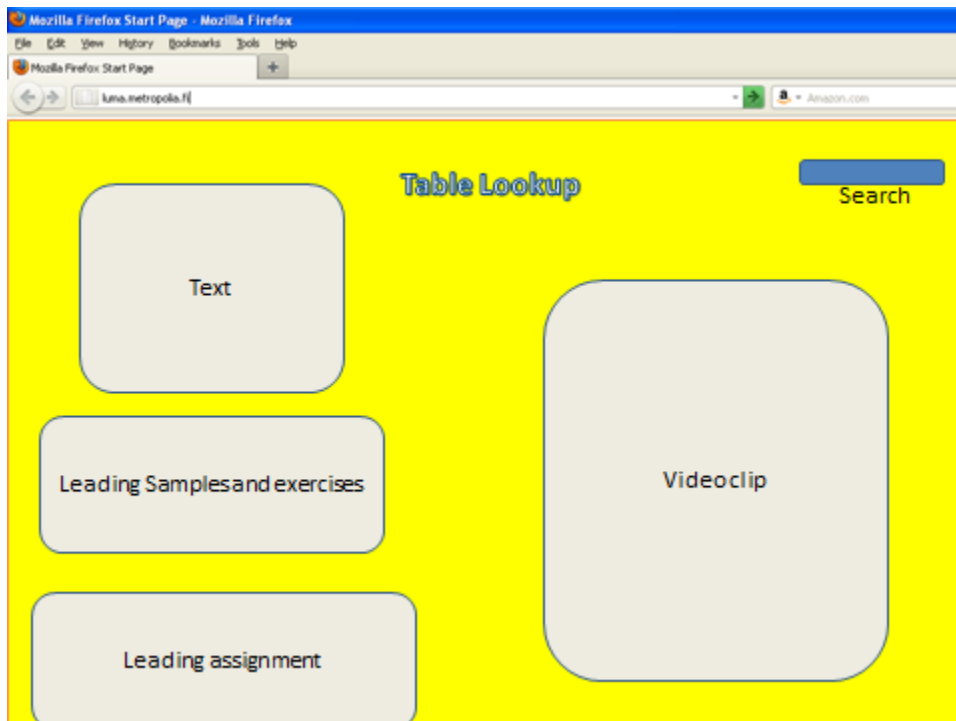


Figure 12. User entering the area of the wanted subject material by clicking specific lesson of C-language

4.2.2 The user interface of an empowering environment according to research

The user interface of an empowering environment is based on this final study. The main idea is to create a very straight and powerful user interface for students of a university of applied sciences. Students enter the user interface of an empowering environment where all study subject groups are located such as Mathematics, Physics, Chemistry and Programming in different items (Figure 13). By clicking any of the study subject groups which are as items, students enter the main subject. Every main subject is in different item (Figure 14). By clicking any of the main study subjects, students enter the chapters of different lessons of the study subject. Every main subject is in the different item (Figure 15). Then students can choose the wanted subject (lesson) from the specific chapter by clicking the specific study subject (Figure 16). In the end students can see material of that specific lesson by clicking the specific chapter (Figure 17). Of course by writing the specific wanted subject name into search machine can reach material of that specific wanted subject.

In the following figures the user chooses Programming as study subject group (figure 13). Then he/she chooses C-language as the main study subject (figure 14). Next he/she chooses chapter 2 which is the C-language overview (figure 15) and in the end he/she chooses lesson 1 which is C-files (figure 16). Next he/she reaches the material of C-Files (figure 17). Of course by writing a specific wanted subject name into search machine or customized search machine can reach the material or specific material of that specific wanted subject.

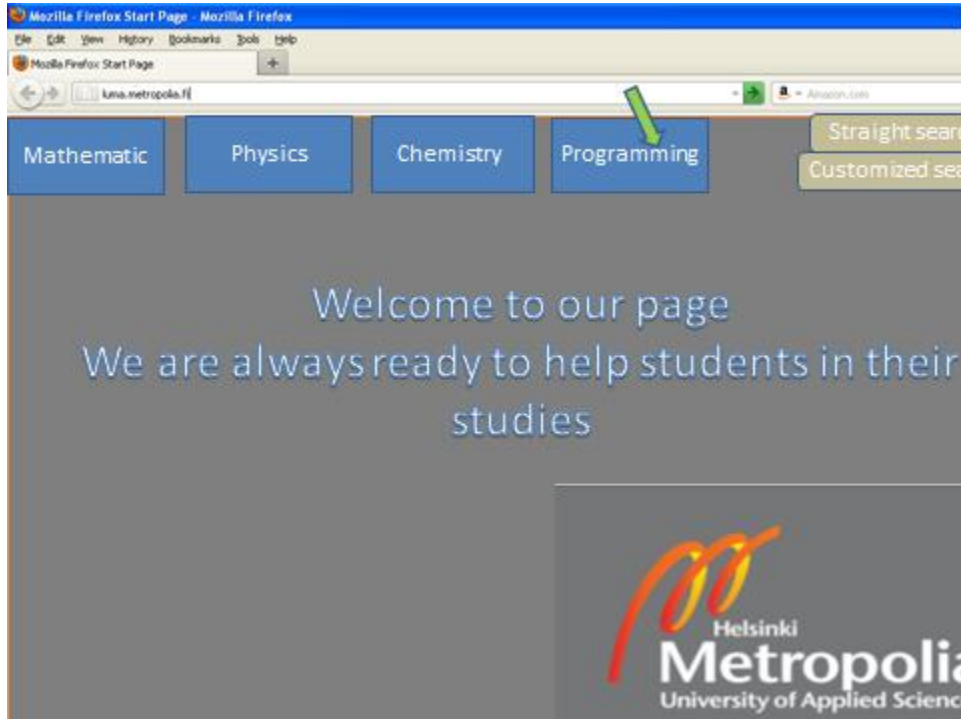


Figure 13. Main page of the user interface of an empowering environment. User entering the area of programming by clicking “Programming”

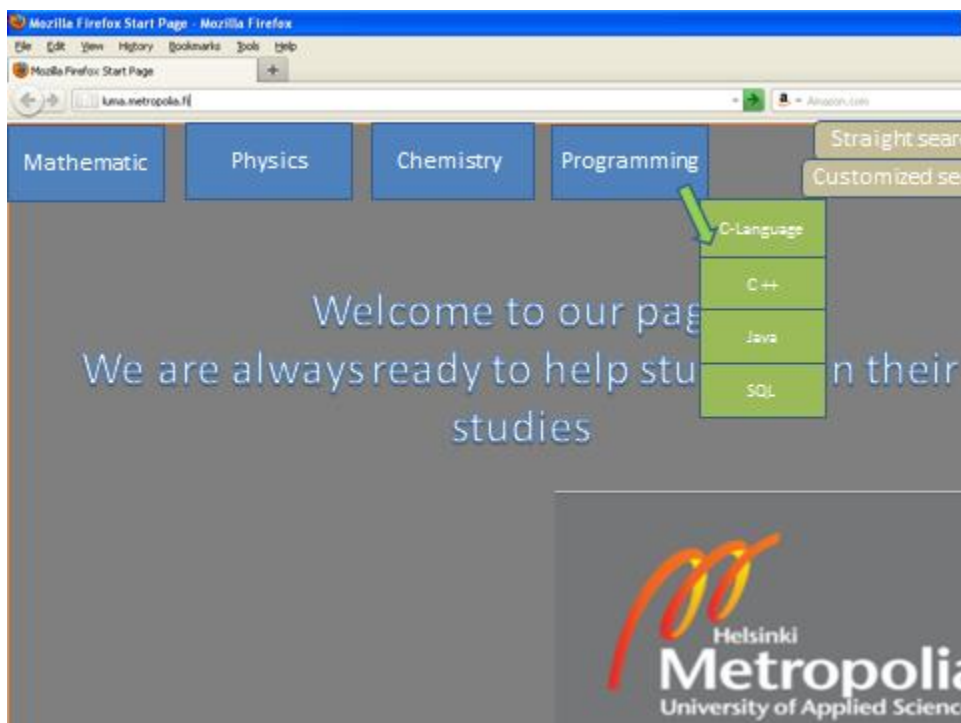


Figure 14. User entering the area of C-language by clicking “C-language”



Figure 15. By clicking C-language user enters chapters of C-language

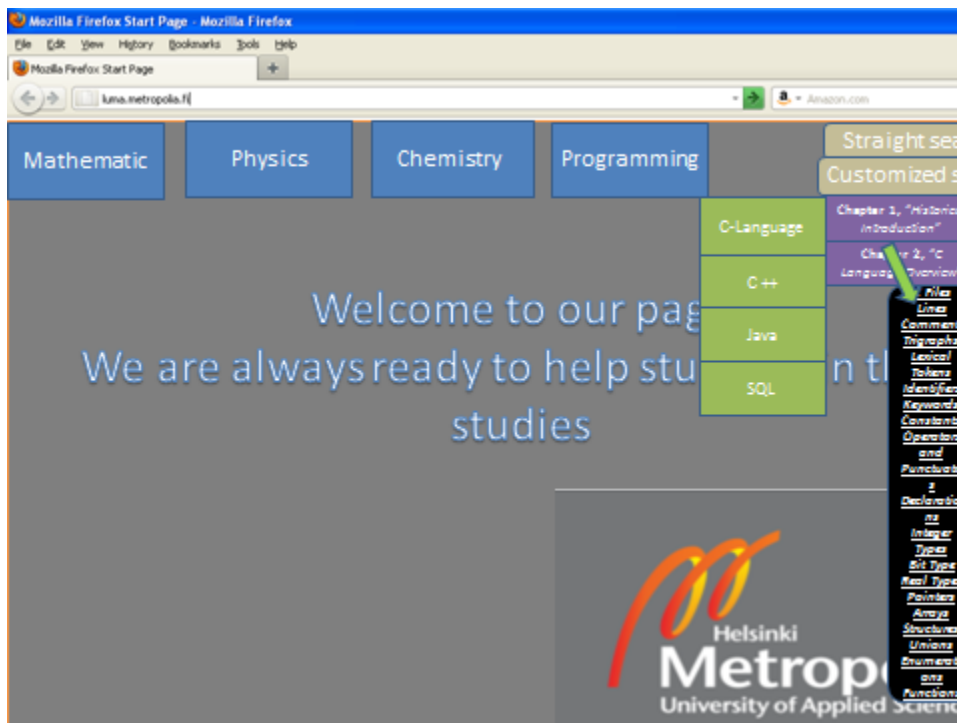


Figure 16. User entering the area of different chapters of C-language by clicking different numbered Chapter of C-language

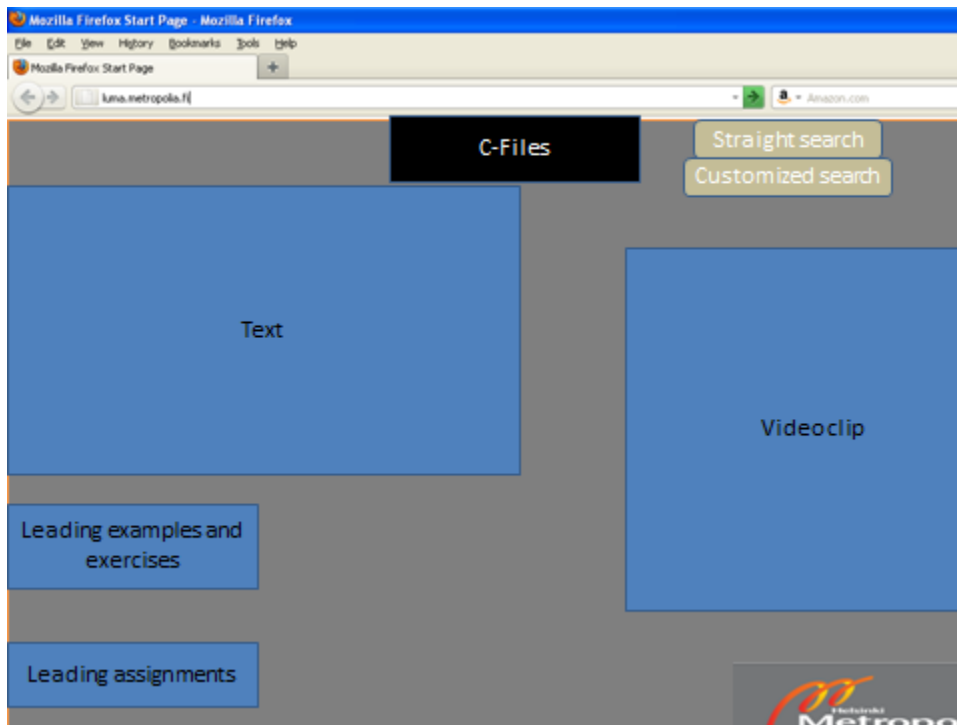


Figure 17. User entering the area of the wanted subject material by clicking specific lesson of C-language

4.3 Customized search structure

Customized search study is fast search which includes many options. These options are subject, text, video, leading samples; leading assignments and solving the wanted assignment .These options help students to reach their wanted subject rapidly. Figure 18 Illustrates a customized search structure where students are able to choose the wanted subject study with following different options:

- And/Or Subject
- And/Or Text
- And/Or Video
- And/Or Leading samples
- And/Or Leading assignments
- And/Or solve this assignment

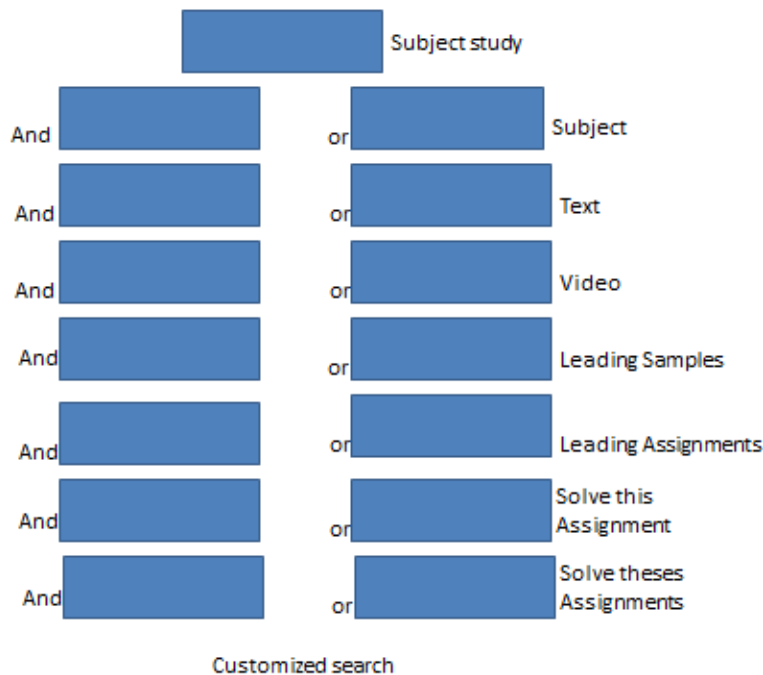


Fig-

ure 18. Illustrates Customized search structure

The advantages of a customized search in the user interface are:

- a) Students are able to select any special part of the study subject
- b) Students are able to get what they need
- c) They do not feel frustration and they feel safe
- d) Customized options save time in searching information

Figure 19 Illustrates a customized search in the user interface where students are able to choose the wanted subject study with following the different options.

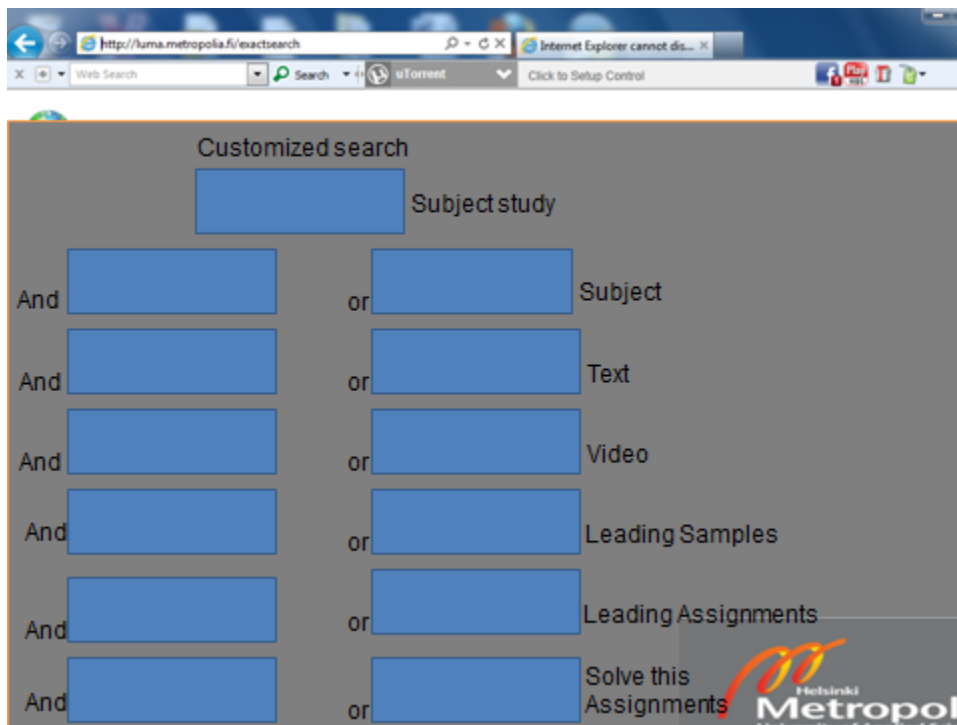


Figure 19. Customized search in the user interface

5 Discussion

Based on many studies in twenty first century, the best method for developing human skills in society, working life and even his own private life is that a human develops his own creativity and does not let external factors kill this creativity. It should always be kept in mind that a human is a creature that can feed and raise his skills and creativity and human is not a machine. Almost from the end of 1980, universities, schools, professors, lecturers and teachers started to experiment e-learning in different places of the world.

After almost 27 years, it has been noticed that e-learning gets more popular in the education system. The most important tool for supporting e-learning is technology which is growing all the time. Today educators notice that there are benefits and drawbacks in e-learning but still e-learning and technology are important factors to feed the creativity of students.

At the moment many lecturers try to teach through e-learning and the results have been good. On the other hand according to interview with lecturer J.C., the students afraid of showing their creativity to the teachers because teachers demand them to do assignments based on specific pattern which the students learn in school. Unfortunately this kind of method destroys creativity in students. Of course theories and principles are very important.

This study is more pedagogical than technological. The aim of this study was that the students would be enabled to feed and raise their creativity, talent and understand that they can be successful in their studies with the help of technology, a good study plan and practicing. Technology is one valuable aid for students in order to success in their studies. For example using technology makes studies easier and more interesting for students. Students can use technology for real-life mathematics such as insurance policy.

The most important point in this study was to create a plan for an empowering environment for students where they would feel safe, raise their own confidence and develop themselves more in the future.

A good empowering environment shows a new direction for lecturers to help students and be more co-operative. According to study and interviews with different lecturers and studying other projects; time is mature to create an empowering environment for university of applied sciences. Creating an empowering environment for university of applied sciences may be difficult. Because collaboration among the e-learning service providers is poor and every lecturer works alone or in small groups in different universities and they do not have good communication among each other.

Empowering environment is just to support students in their studies and it is not an environment where students can make their studies and get credits for their work.

6 Conclusion

Many lecturers individually have done their own study materials and put into the web for students on the Internet. Of course lecturers have the same purpose but until now there is not a common tone in lecturers' work. On the other hand universities do not have a good bondage in order to inform each other about their progress. This study tried to define a good specification for a particular program and web platform for Mathematics and Applied Sciences in order to support students of university of applied sciences. Of course web platform on this program should be implemented and tested. In the other hand there are many tools for implementing this program and the web platform and besides every tool has its own benefit and drawback. Before starting implementation, it should be decided to use the right and useful tools based on university needs in a long-term approach.

At this moment many universities use Moodle as e-learning environment and some mathematics programs are integrated in Moodle such as Stack and Maxima. For example these programs have their own good and poor features. According to study, the e-learning projects are usually shut down or not finished in universities. The reasons for these problems are lack of a well-defined project plan or lack of the necessary resources and budgets. In the other hand the e-learning projects are long-term investments which should be maintained, improved and updated often after implementation. That is the reason why e-learning is developing slowly. Firms provide e-learning environments or special courses for universities even though usually the e-learning projects get started from universities.

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