KNOWLEDGE MANAGEMENT IN COURSE CONTENT DEVELOPMENT AND TEACHING

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Abstract

Many times for an individual student or a knowledge worker in an organization education courses do not provide satisfactory learned education quality growth. Paper shows developing courses and follow-up management system utilizing a knowledge management approach using the potential of modern technologies. The paper represents the model of learning methods development using different Technologies for different type of classroom, which can be used in professor's decision making process to choose the most effective e-learning methods. At this stage of the research a model of personal-knowledge based worker environment is viewed in the perspective of several-form learning methods using technologies and personal knowledge management integration in each special course accordingly to particular student group. A partial introduction of the developed system in the field and its results has been described.

Keywords: knowledge management, technology, course content.

1 INTRODUCTION

In period of several last decades of previous century till now there can be observed a historic change from the industry age to the information age. One of the most important prerequisites in base plan for long-term development of Latvia is high education level in society. However Latvia's rapid economic growth creates danger of increased future self-sustaining poverty which brings insufficient education with it. On the other side economic development is characterized by rapid technological advancement and more and more mobile devices find their way in people everyday life. They create additional possibilities also for educating oneself, but currently there is not enough support to effectively use them. In order to ensure a balanced and long-term growth one of the main tasks is to diminish the arisen disproportion, and to prevent it from developing. As pointed in the government report about development of national economics in 2008, a creation of information society opens up new opportunities to develop society based on intellectual capacious branches, to forward regional development, to form new working places, and to take part in global information and cultural processes.

Similarly workspace equipment and systems are becoming more sophisticated. That calls for extra skills and ways to handle the new work environment and the vast amounts of data that has to be dealt with. This leads to acknowledgment that knowledge has become the most important asset for organizations and for individuals as well. With more high intensity this has been viewed as an active area of research. The increased importance of knowledge has been a reason for appearance of so called "knowledge work".

The increased value and usage of knowledge in everyday life and in business develops a necessity for well educated individuals. That in turn demands for appropriately well developed education system, which points also to the possibilities of using technology for fortifying course contents. The bloom of different new technologies including highly popular mobile technologies and virtual reality might promise to provide some clues from the technological perspective.

The problem is that many times for an individual student or a knowledge worker in an organization education courses do not provide satisfactory learned education quality growth.

The aim of paper is to develop a courses and follow-up management system utilizing a knowledge management (KM) approach using the potential of modern technologies.

At this stage of the research a model of personal-knowledge based worker environment is viewed in the perspective of several-form learning methods using technologies and personal knowledge

management integration in each special course accordingly to student group. A partial introduction of the developed system in the field and its results has been described.

2 THEORETICAL MODEL OF COURSE CONTENT DEVELOPING

2.1 Model of Web-based E-learning Course

The learning theoretical approach is developed on the basis of philosophical understanding of knowledge and learning. Learning theory can be defined as a conception of the individual, the world, the individual's relation to the world, and knowledge. Analytically, learning principles can be divided into the form, content and relations of a learning work environment. The concept of form describes the organization of the students' work; how do the students work with the subject matter? Content describes organization of the subjects matter; what is that the students work with? Finally, the concept of relations describes the relationship between the participants (teachers and students) in the learning environment and their respective roles. Learning principles can be defined as an approach to form, content and relations of the learning environment [1].

The framework for a theoretically grounded model of technology in learning is termed as a pedagogical approach which is characterized by learning theories, learning methods, learning environment and activities using different type of technologies and technological devices. From pedagogical approach the E-learning model is based on cognitivist learning theory with radical constructivism approach and activity theory. Central to a cognitivist learning theory are the human cognitive, mental or intellectual abilities. A cognitivist approach is based on the belief that there is a structure in the way we perceive and understand the world. Principle is based on opinion that information from the world has an objective structure which correlates to the structure of the information processing. The learning process is a training of mental abilities or intelligence which is accomplished by the students' work on predetermined exercises. Therefore students' work should be based on a curriculum divided into predetermined and isolated units which means that it is possible to structure the activities of the learning environment. The activities should be structured on the basis of the inner structure of the subject matter and are controlled by the teacher. The content should be organized in accordance with inner structure of the objective information [1].

There are some web–based e-learning course models scientifically worked out by different scientists what can be used for supporting each course also for full time studies. One of the most popular and effective model of web-based e-learning course is developed by Kaschek [2],[3]. He develops the framework for the design of e-learning system. This framework is based on an Abstract Layer Model. Model is worked out like a cycle what goes through several pyramid layer. Classical Kaschek model is one from top to bottom identifying a definition layer, a didactic layer, a tutorial layer, a presentation layer, and an implementation layer. There are also other technologies which can be used in learning process. Therefore authors develop this model and join another layer – technology layer [4].

2.2 Learning models' technological layer

Using technologies in the learning process is recognized as one of the most effective tools for accelerating the transition process to information society. It is important to make qualitative course modeling.

To achieve the main aim of this research – to work out a qualitative technology based learning model, illustrated on Fig. 1 Kascheks' Abstract Layer Model is taken as a base and to this model an extra layer "Technological" is added. The principal assignment of the technological layer is, on the ground of student profile and course outline; to choose technical solution for learning realization. As shown in Fig. 1 Technological layer is between Definition and Didactic Layers. That means that Technological layer depends on Definition layer, but Didactic layer is affected from Technological layer. Definition layer's main purpose is to identify course goals. As we already establish in previously sections different learning course purposes, learner's profiles, personal knowledge management and pedagogical methods ask for a different technical solution because it is very important to clearly define them. Confusing or wrong appointed aim can make learning course ineffective, hinder development and even decrease student's motivation and fidelity for learning methods. The transitions from technological layer to the Didactic layer concretize the course goal, specify technological solutions and choose suitable methodology. As technological layer is one of the top layers it is consequential to exclude gaps and un-sharpness because it makes negative chain reaction to all learning course process.

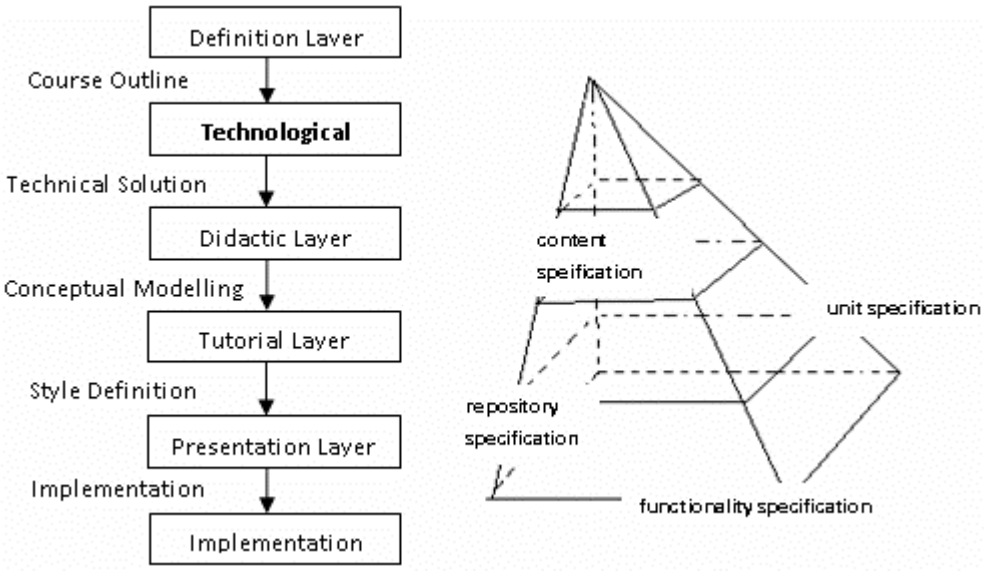

Fig. 1 Abstraction layers of qualitative technology based learning model

Learning course whose goal is to give not only things learned in lectures but also possibility to add knowledge on the base already known things in any-time/any-where needs to be supported by mobile technology. Used devices need to be easy to carry and usable, course material must be easy displayed on a small screen and access must be provided any-time/any-where. To make this course effective it is very important to take into account all of these aspects.

Also virtual technology can be used for deeper understanding different processes. Using a virtual world for training needs is modern and effective approach to reach good results in short time. The use of augmented reality's (AR) visual sense is typical for overlapping the real work environment by the generated images of the worn computer. AR uses display technologies to combine computer graphics with a user's view of the real world. Unfortunately building the virtual reality's (VR) environment isn't a simple task by itself. The training material must be easy and quickly adaptable in conformity with the professional skills and perceptivity of the trainee, and portable as well. The gap related with the joint standardization and compatibility of VR/AR products and technologies bother achieving the objectives mentioned above. However, hopefully alike to the history of RFID technologies, VR/AR development will succeed the analogous trends promoting to the introduction of low-cost, but in the same time functional and adaptable solutions, increasing the potentialities of VR/AR use in the training systems designing.

The model developed by authors performs course formation through a definition layer, a technological layer, a didactic layer, a tutorial layer, a presentation layer and implementation layer. Implementation layer is not viewed in detail and is left to the technical staff competence.

3 KONOWLEDGE MANAGEMENT SYSTEM AND IMPACT ON COURSE CONTENT

3.1 Knowledge in today's perspective

Today's organizations are experiencing competitive business environment. It has become evident that in order to achieve a better quality service or product, shorter time circles to market, and customers with a higher level of satisfaction it is important not just to find best ways how to manage well capital and labor, but also to realize the importance of effective management of employee's knowledge. As follows a more increasing role is played by knowledgeable employees and the skill level they do posses. Thus knowledge has become an extremely valuable asset. From an individual's perspective knowledge relates to his or her memories. Here comes in person's characteristics such as psychological traits, motivation, volition and intelligence as they play eminent role in that how knowledge is handled in a personal level. As per Davenport knowledge is a mix of ones experience, contextual information, values, and an expertise that serves as a base for evaluation and absorption of new information and experiences. In addition knowledge in organizations often becomes embedded not only in documents or repositories but also in organizational routines, processes, practices, and

norms [5]. Knowledge management (KM) usually is viewed in business context in an organization. KM also represents a mix of different areas, practices, tools, and strategies combined under one umbrella. Some of these are rather new. Others are already well known and used by people centuries ago. Learning by doing and master and apprentice mentoring relationship are examples of widely used forms of interaction and knowledge transfer.

If to focus on an individual's knowledge then the term personal knowledge management (PKM) comes up. PKM encompasses processes that an individual needs to carry out in order to gather, classify, store, search and retrieve knowledge in one's daily activities. Activities are not confined to business/work-related tasks but also include personal interests, hobbies, home, family and leisure activities [6]. Within core of this is the cultural and collaborative aspect of PKM which means hat PKM is not just geared towards an individual, but it is more focusing on culture and collaboration between knowledge workers. Thus PKM facilitates a development of communities of practice (CoPs). They are as a fertile ground for further knowledge sharing, acquisition and creation. Within CoPs PKM fosters the development of CoP focused skills, common language, enhances and supports networking and collaboration between community members, and conduces peer-to-peer skills and knowledge transfer. These are vital components of the proposed system.

3.2 Knowledge worker and knowledge management system

In the information age the term "knowledge worker" has become central to knowledge intensive organizations. For the first time this term is mentioned in a book by Peter Drucker [7]. But it has not been closely looked at until lately in last two decades. Davenport defines knowledge worker as one having high degree of expertise, education, or experience, and the primary purpose for his or her job involves the creation, distribution, or application of knowledge [8]. In addition knowledge worker is influenced by technical know-how and above mentioned personal characteristics. Not less important role is played by his or her cultural and political environment, and personal views. These factors affect knowledge worker's own knowledge management and enhancement. All this is a birth point for innovations be it a business organization, research institute or university environment. Innovation and breakthrough in knowledge worker's level has potential to happen at all places and all times within his or her daily routine, and it is not necessarily just at work place or at university – it may take place in most unpredictable environment.

As mentioned above many times for a student or individual education or training courses do not provide satisfactory learned education quality growth. There are several factors that influence training or education course content development and execution - meaning methods used. And particularly, if to focus on e-learning, can be pointed out such factors as synchronous and asynchronous communication modes; one-to-one, one-to-many, many-to-many interaction modes; types of knowledge involved (tacit and/or explicit); training or teaching approaches (involving experts from a field, mentors, virtual simulations, etc.); knowledge repositories, peer-to-peer networks and technological capabilities (protocols, application architecture viewpoints, tools, infrastructure, service requirements). These are the factors to keep in mind when trying to maintain a well balanced education course from instructor's perspective and to keep up with competition in job market from learner's perspective. Today's rapid economic growth requires frequent enhancement of personal knowledge to adjust to changing conditions and new demands. From perspective of course content creation and execution it is vital to be flexible and to follow up skill and experience requirements for knowledge worker needs in organization or out in job market for needs of current students in university or college. A follow-up on learned material and a feed-back from learners are important steps for proposed system in order to consider previously mentioned education influencing factors enhancement.

A valuable aid for knowledge worker (i.e. for instructor or lecturer for course content creation and execution, and for learner for better acquisition of new knowledge and feed-back possibility) is a personal knowledge management system (PKMS). It is a rather complex system and contains social, psychological, and technological aspects [9]. The performance of PKMS is closely tied with knowledge worker's emotions, perceptions, believes, objectives, surrounding society and environment. Proposed system includes both social and technological aspects. Social aspects of PKMS contain keeping up good relationships with fellow students, colleagues; establishing in lunch time a casual "brown bag" voluntary seminars where students and lecturers from the same or different departments share their knowledge in an open way; and keeping in touch outside education building environment for doing they group assignments. Technological aspects have an important role as well. This level of PKMS employs different of the shelf searching, communication, knowledge storing, groupware, document

management and similar software. In addition custom technologies such as developing automatic rankings for in-house experts of each knowledge area based on student's activities and feedback in communication channels and filtering most accessed knowledge items and accordingly tagging those. A next technological level of PKMS in development by authors is the one defined in [10]. There knowledge worker is supported by PKMS technological platform encompassing three groups of intelligent agents. First one contains agents that enable hardware, software and technologies support. Second group encompasses agents that enable communications. And finally third one encircles personal agents that are most closely tied with individual himself or herself. However the acquisition and evaluation of this PKMS technological level is tied with next step to do and in this context is depicted for purpose to show the final depth of the proposed PKMS. Both social and technological aspects and features of PKMS have to be specifically tailored for each particular course and institution, "one fits all" approach is not applicable in this case. This type of system facilitates completion of simple information management tasks as well as provides a support for much more intellectual activities such as accumulation of information, decision of methods for developing a new course for students or for improvement of already existing education or training course. In the case of using PKMS for creation of training courses it's cultural and communication practices and technological features come very useful in perspective of different abilities and backgrounds of potential students or trainees assuming they also use PKMS or just part of it. Thus an instructor or lecturer can specifically tailor each course for a specific group of trainees. PKMS is valuable also in knowledge worker's (lecturer's, or student's) free time frames for learning new skills like a new algorithm in Java programming class, which might turn handy in student coding competition. In short PKMS turns working and learning time much more productive and an individual's leisure time more rewarding.

4 PERSONAL KNOWLEDGE MANAGEMENT SYSTEM AND TECHNOLOGY

Current age besides processing of large amount of information and data also encompasses the use of modern technological devices such as notebooks, netbooks, mobile phones or global position systems (GPS). Many knowledge workers including students deploy one or another type of technological device in their daily work or study activities which makes them much more productive. Over last decade there can be observed a shift towards technologies with more mobile nature as per survey at [11]. There clearly is showed that mobile phone, the Internet and smart phone pick up more popularity among people. Modern advanced technologies enable and facilitate processing of large amounts of information in reasonable time. Regular workstations (personal computers and large enough screen size notebooks) are being used for such knowledge worker everyday tasks as regular office assignments, accounting procedures, for 3D building designing. Not all such tasks can be done using mobile type of device. However mobile technologies become each day more popular. Wide spectrum of mobile devices such as regular mobile phones, personal digital assistants, camera phones, smart phones, portable media players, or gaming consoles are being frequently used. All of these devices can process some type of media, data, or information.

Rugged mobile scanners are used in warehouses. Smart phones among other applications are used for having a conference call while on the go. Such technologies as communication enablers (chat rooms, voice and video communications, e-mail, electronic message boards, and the new phenomena - twitter), different simulation technologies, smart boards and so on have a substantial influence in education as well. In context of proposed PKMS a course content development, teaching and learning can be supported by number of different above mentioned technologies depending on requirements and needs for each particular case. Thus a training course development and teaching quality is enhanced by support of technological solutions. Above described PKM practices and proposed PKMS go in parallel with just mentioned advanced devices and technologies. An instructor deploying PKM approaches and using mobile device and/or personal computer based technologies can create an effective further follow-up system particularly tailored for specific group of students and geared towards concrete education institution department's study program. PKMS area utilizing further follow-up approach supports students or trainees in their self-studies or work duties after they have left the learning environment (a regular or electronic classroom environment). Thus it is facilitating for recently obtained new skills and knowledge to mature in their minds. Also this particular PKMS area fosters a course content enhancement by including, excluding or changing of particular course content based on current student feedback, study difficulties or vice versa for the benefit of next similar group of students. In short, modern technologies coupled with proposed PKMS provide new ways and means to work on course content development, enhancement, teaching and learning.

5 COMPUTER MODEL OF LEARNING METHODS DEVELOPMENT

To ensure that the model of learning methods development using different technologies for different type of classroom is as closely as possible to real life situation, authors chose to create it using a system dynamics simulation environment STELLA.

The model of e-learning method development realizes simulation of following processes - modeling of:

- availability of technology;
- perceptions distribution;
- learning methods technological practicability;
- students stored knowledge using each learning method;
- enjoyment using each learning method.

Most important part of this model is students' stored knowledge. The other processes of modeling supply the necessary data, or improve it. Modeling of availability of technology imitates the existence of each technology for each student, based on probabilities, which are subordinated to the model [12].

Modeling (Fig. 2 and Fig. 3) of perceptions distribution imitates existence of each student's perception and count the number of each type of students in course. As a default values for perception distribution possibility is used data from "VARK", which is based on almost 60 000 people questionnaire results: distribution of aural perception – 61,4%, distribution of visual perception – 48,2%, distribution of read/write perception – 66,5%, distribution of kinesthetic perception – 69,9%.

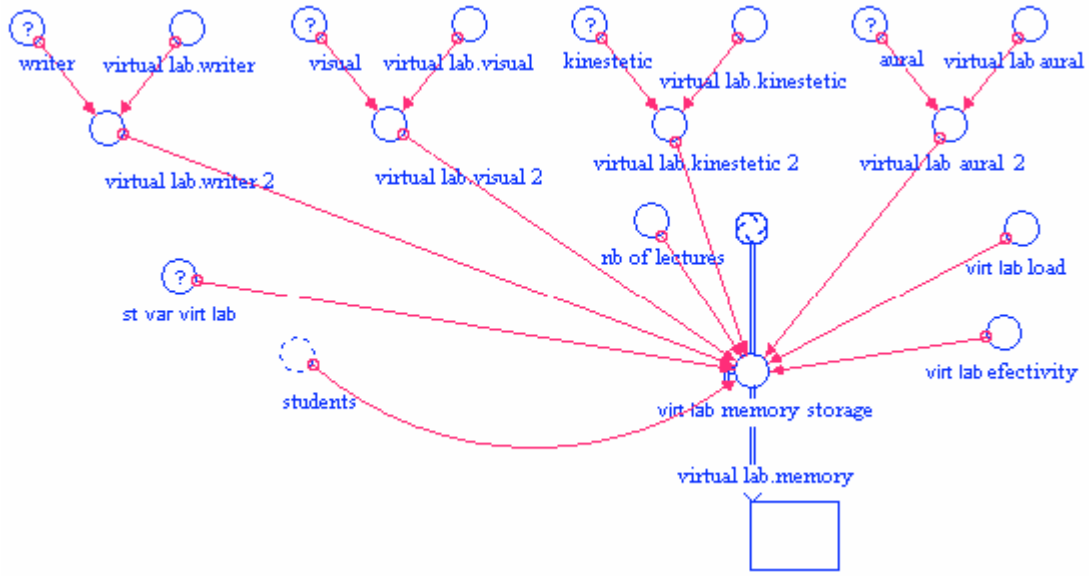

Fig. 2 Modeling of students stored knowledge using virtual laboratory

More than half (approximately 60%) of people have more than one perceptual type [13]. Modeling of learning methods technological practicability is one of the most important sub-models. Modeling for each of learning methods is a little bit different, because of different technologies and input data. This part of model determines possibility to realize a certain learning method using available technologies. As input data are taken:

- The list of required technologies on which it is possible to realize this learning method and availability of this technology (1 or 0). Converters: student has a mobile with mp3, student has an mp3 player, student has a PDA with mp3, and student has a personal computer (PC);
- Percentage of required technology equipped students. Constant: need mp3 % - this constant is established by professor;
- The number of students in course. Constant: students.

After the model execution the time is equal to the number of students. The percentage of accumulated students in stock is equal or bigger than constant "need mp3" in tested model. The Outcome is stored in converter "mp3 can" and is 1 or 0.

The sub-model “modeling of student’s stored knowledge using each learning method” establishes effectiveness for each of the learning method, simulating stored knowledge of one student and all groups together. Fig. 2 illustrates effectiveness of learning method “Virtual laboratories” where as Fig. 3 demonstrates learning from text material. Fig. 2 is based on the above by calculating effectiveness of method, student’s perception style, method intensity and the number of lectures.

The aim of this sub-model is to make possible a comparison of the efficiency of different methods in framework of one learning subject. Because of that this restriction is that the different courses develop a number of different skills.

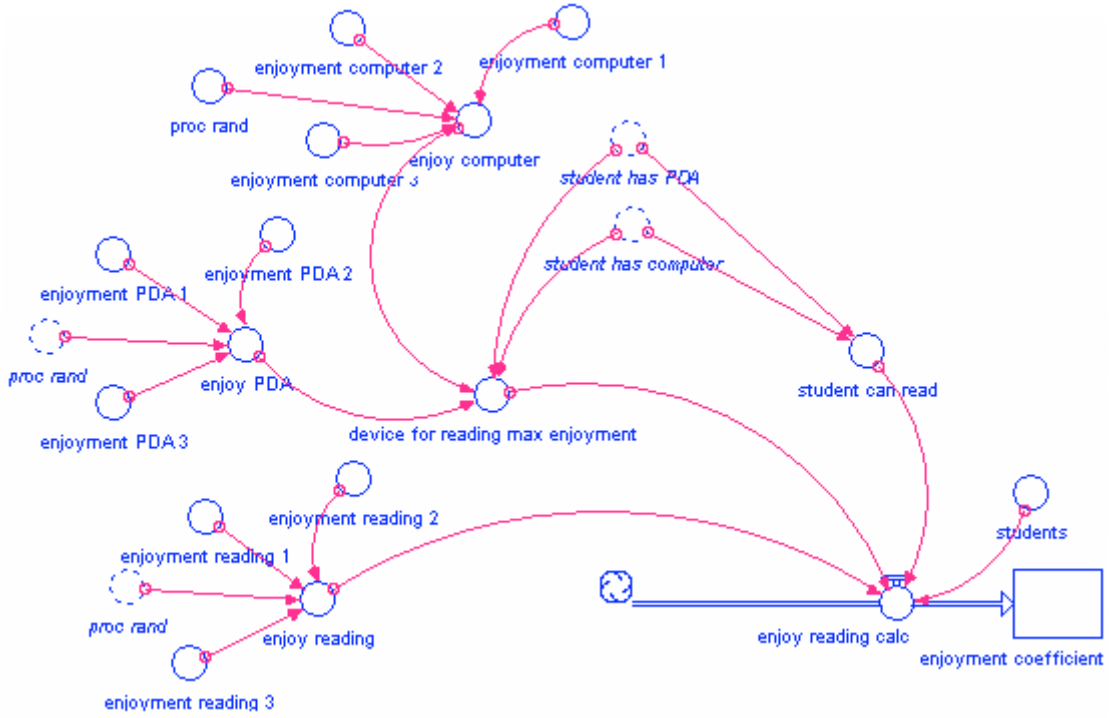

Fig. 3 Modeling of students’ enjoyment using each text material

For convenience, the efficiency is expressed in numerical form, which is also called as basic effectiveness. The basic effectiveness is multiplied by the coefficient of the overall perception, the number of lectures and the load of method. Perceptual coefficient is calculated for each student and method separately to build on:

- The existence of each perception is stored in converters: kinesthetic, visual, aural, read/write – and contains the value 1 or 0;
- A coefficient describes the impact of perception to specific learning method. This constant is stored in converters: virt lab read, virt lab visual, virt lab kinesthetic, virt lab aural – and contain the value 0, 1.5 and 2.5;
- Coefficient of 2.5 means that people with this perception can learn very easy using this specific method. Zero (0) on the contrary means that the perception does not further the positive impact of training and even hampered, as it makes the method impoverish. These coefficients obtained based on the recommendations of which type of learning method should be used for each type of perception and expert interviews. If the student proper perception is not explicit or not at all then model takes coefficient 1. The coefficient of the overall perception is calculated as the average of the individual perceptual factors.

Modeling of students’ enjoyment using each learning method simulates “enjoyment” accumulation rate in course using one or another learning method. Input data of Fig. 3 sub-model is based on questionnaire of students about enjoyment using specific methods and devices. As a result of simulation of e-learning methods development model are obtained information units accumulated in the course through various learning methods.

6 RESEARCH METHOD

An experiment and simulation on computer model was on two courses of information technology bachelor program in Vidzeme University of Applied Sciences: Programming C++ and Professional Communication. Theses courses was chosen as very different and also focused on very different knowledge and skills.

Expert interviews was chosen for defining methods what support all types of perception and give possibility to use modern technology, for evaluating effectiveness of each method. Experts were from University La Coruna (Spain), National University of Distance Education (UNED) (Spain), University of Wisconsin (USA), Riga Technical University (Latvia), Vidzeme University of Applied Sciences (Latvia). Also questionnaire gives data from 100 students as respondents from Latvia and Spain.

Output data from computer model are suspended information units for each student using each learning method. For verifying effectiveness of each method authors use Mann-Whitney non-parametric statistical tests. Results of these tests shows that methods computer games, micro learning, essays and video conferences are the same effectiveness (Table 1) for both courses – Programming C++ and also Professional Communication but methods chat, virtual laboratory, video materials, internet tests and competitions, text home works and other gives different results for each course. Independent statistical t-tests have been used for testing mean of suspended information units using each method are equal in each course.

Table 1. Suspended information units in the course

	Suspended information units	
	Programming C++	**Professional Communication**
Chat	38148	31635
Computer games	20064	21150
Internet competition	34686	27324
Internet tests	16422	12225
Text material	12480	10695
Micro learning	9177	9780
Audio materials	7923	9260
Home works on computer	33750	17928
Presentations	26829	23772
Essays	14703	15750
Sms tests	12183	8496
Text home works	15717	13500
Video conferences	17577	17835
Video materials	20412	16605
Virtual laboratory	25080	10575
wiki	34020	30132

Table 1 shows that there is different effectiveness of each method in each course. For course programming C++ there are methods from more effective like chat, internet competitions, wiki and home works on computer to ineffective like audio materials, micro learning, sms tests and text materials. A little different situation is in professional Communication course from more effective like chat, wiki, internet competitions and presentations to ineffective methods like sms tests, audio materials, micro learning and virtual laboratory.

Results using independent t-tests show that there are some equal effectiveness methods in course programming C++ like:

- Chat and internet competition;
- Internet tests and text materials;
- Home works on computer and wiki;
- Home works on computer and internet competition;
- Internet tests and video conferences;
- SMS tests and text materials;
- Computer games and video materials;
- Virtual laboratory and presentations.

Results for professional Communications course are equal effectiveness for methods:

- Internet competition and wiki;
- SMS tests and text materials;
- Internet tests and text materials;
- Video materials and text materials;
- Video materials and essays;
- Video materials and computer games;
- Audio materials and text home works.

Results shows that there are methods with the same effectiveness in different courses and also methods what are better in one course but not in others. It means that for qualitative course teacher should analyze methods depending from course content. The computer model made by authors could be useful for such aim. Different methods in the same course could be with the same effectiveness therefore teacher should concentrate on methods what are more interesting and gives better motivation for students, supports more types of perception and can use mobile technology.

7 CONSLUSION AND FUTURE WORK

The important role of education more and more has been emphasized as what means multiple returning in education system. There are some different ways to motivate students for deeper studying process and evaluating student's personal knowledge management system and one of them is to create more interesting courses using modern technologies and supporting student's types of perception.

As a result of this paper has been created a dynamic model of learning methods development created in Vidzeme University of Applied Sciences Faculty of Engineering which carries out Programming C++ and Professional Communication courses in Professional Bachelor Studies in Information Technology. A theoretical learning course evolution model has been developed, factors of qualitative learning method development have been researched, experts have been interviewed and student polls have been made to achieve this result. Theoretical model has been translated into STELLA 9.0.3 modeling environment. An Access database has been created to store all input data.

The model allows a simulation of the effectiveness and students' satisfaction of different learning methods based on many parameters. Created model and analysis of results using statistical data processing methods allow to arrive at important conclusions, which marketed in life, can give significant learning quality enhancement. Choosing learning methods within framework of one course is very important to ascertain whether there are any other methods with the same average efficiency. This is necessary to known because if one of the method requires a large financial or a time consuming investment it is possible to use another method and not to lose learning quality. If there is a situation where two methods get the same average efficiency, then professor choosing learning method needs to concentrate on methods which:

- are more interesting for students and better can motivate students to finish an ongoing course;
- are possible to realize using modern technologies;
- support more of perception types.

The largest amount of accumulated information units are collected in the online synchronous methods: chat, computer games, Internet competition and wiki. There are some methods which in totally different courses achieve equally effective results, but there are also methods which effectiveness in various courses is different. In order to clarify this is necessary to make statistical tests which compare the effectiveness of two methods for one course.

Model, data base and recommendations developed in paper could be used for teacher weekday work by choosing more effective methods for learning course development. Surveys about student group perception and technological possibilities have been recommended before choosing learning methods. Special questioners had been developed for such aim. Only by developing qualitative learning courses is possible to get confidence of society to this relevant new form of learning.

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