Computer Labs:Training Undergraduate Students on An online lab by using Asynchronous Discussion Forum as An online learning Tool

Ahmed Omer Ahmed Ismail, Ahmad Kamil Mahmood, Ammar Elyas Babiker

Abstract— This paper focuses on an online computer lab attempting to improve the students' attendance. It also explores the differences in the students' degree of participation in an online computer lab compared to students' participation in traditional computer lab. Hence it will reduce students' excuses and help students perform their assignments and exercises anytime and anywhere. The method used was a lab experiment with participants using online learning tools on asynchronous communication mode. The instructor created discussion forum and gave specific guidelines on what is supposed to happen in the discussion board and students post their work in discussion forums. The results have shown that there are significant differences between the two classes in an online lab compared to traditional lab.

Index Terms— Asynchronous communication , Discussion forums, Participation, Online lab, Synchronous communication ,traditional lab, Training

—————————— ◆ ——————————

1 INTRODUCTION

An online computer lab is a challenging issue to the trainees, students and instructors as it needs new methods, approaches and techniques for combining the software programs to an online teaching environment [10]. It offers greater flexibility and allows access to more students within a given time frame while reducing the total acquisition, operating and maintenance cost [4].

One of the advantages of an online computer lab is the time management and location constrains in teaching and learning. Both students and instructors are free from the restricted lab hours carried out in a single location [2]. The online labs can help in the distance learning setting where learners execute a lab oriented course or exercise from their homes. The collaboration among the learners with various educational institutions executing their lab exercises as if the lab is brought online to the classroom [4].

In addition to that students are able to submit their posts to the instructors via course mail or discussion forums. This flexibility is useful for the learners especially for disabled students who cannot physically attend the traditional lab [2].

An online lab can be conducted under asynchronous communication mode. It is a non-real time interaction of students participation in which information is exchanged with many tools namely, e-mail, mailing lists, discussion forums, course mail and newsgroups [1]. These tools have no time and location constrains since the participants do not have to be in an online at the same time allowing more flexibility for the students.

The benefits of an online lab compared to traditional lab are many namely. For example the instructor could design assignments, exercises and manage by software to be shared among instructors and students. Furthermore as there is no attendance taken students can choose the preferred time to do their works and to complete their assignments [1]. Additionally, the development made for an online lab will allow worldwide students to gain practical experience and obtain all knowledge similar to a traditional lab through internet technology [6].

Finally, from an economic point of view online lab can solve the problem of space that could accommodate the simultaneous presence of many students. It will save the undesirable overhead costs associated with logistics planning and instructor time. All these issues are important and must be considered in both online and traditional labs [5]. As the numbers of distant learners and distant programs increases the demand for an online lab experiences will also increase [4].

On the other hand, in traditional lab the instructor has to consider different practical styles in designing and managing assignments as well as preparing the assignment on sheets or board. Attendance will have to be taken and students should complete their lab assignments/exercises in specified time [2]. In many situations the lab session may not be able to help instructor to manage all students effectively.

In this paper two classes of undergraduate students were conducted for studying an online lab versus traditional lab using an online application links at the Department of Information System, King Khalid University [10].

The objectives of an online application links are:

1. To provide new learning environment for learners to get knowledge.

————————————————

- *Ahmed O. A. Ismail in Universiti Teknologi PETRONAS, 31750 Tronoh, Perak, Malaysia, E-mail: ibn_omer@hotmail.com*
- *AP Dr. Ahmad K. Mahmood in Universiti Teknologi PETRONAS, Malysia, E-mail: kamilmhpet@gmail.com*
- *Ammar E. Babiker in Al-Baha University, Saudi Arabia, E-mail ammaralyas@gmail.com*

2. To consolidate the basic programming concepts via C++ language.

3. To use interactive learning which enables learner to give and take in learning situations?

4. To raise learners motivation via attractive learning environment.

5. To develop learners self-directed learning.

6. To draw attention of teachers and developers to the huge potentials and creative skills that they can be accessed in e-learning system.

The learning outcomes of an online application links are:

1. Students gain experience by using different methods to perform their practical work in an online lab and traditional lab.

2. Students develop their skills by participating in discussion forums and course mail.

3. Students improve their relationship by exchanging comments in discussion board.

The main objectives of this contribution are
1. To improve student attendance.

2. To reduce students' excuses.

3. To explore the students' participations.

4. To practice assignments in an online lab.

In computer science there is often a need to develop practical experiences as a key to becoming an effective student and to be able to transfer theoretical concepts into applicable knowledge. In order to address this need the researcher has used an online application to complement and to enhance the delivery of online courses on topic of C++ programming [5].

The overall goal of this paper is to serve a large number of students distributed in geographical locations and to extend the literature with new approach of applicable knowledge in an online environment [6].

2 LITERATURE REVIEW

The importance of students' participation in an online lab has various benefits for students namely flexibility of doing the assignments, exercises and homework without time and location constraints. In addition to that it offers opportunities to various types of students due to its special characteristics [2]. The increase in class size, higher student-to-instructor ratio and a decrease in student-to-instructor interaction have resulted in decreasing of the motivation and participation of students in the traditional lab.

Laboratories are important elements in science, engineering and technical education. They allow turning the theoretical concepts into applicable ones [3]. There are three types of computer laboratories namely local, virtual and online.

In local lab, students operate real devices and manipulate and measure real objects while being directly co-located with the devices and objects in the same room. Students work in team with practical help from instructor. Local labs are still the best

way to get a first hands-on experience real devices [4].

Virtual lab contains software simulations of physical devices or real live systems, experiments and pre-recorded measurements, pictures and videos. But do not manipulate real objects [4]. This type of lab is very expensive and time consuming.

In an online lab students and devices are at different locations. Students work through a computer that is connected to online applications. The lab is based on internet and tries to combine the fundamentals of traditional lab and flexibility of virtual lab. Moreover, it will develop students' skills in using an online environment [4].

Wolfgang N. and Martin W. (2004) found that active learning by means of an online lab has value for distant education students as they can access labs without need of attending traditional labs. This flexibility is important for students as it allows them to practice learning concepts and change them into applicable terms [11].

High cost of constructing traditional lab, outfitting and maintaining labs have often prevented students from getting access to facilities of high importance to their education. Using an online application links has the potential of removing the obstacles of cost, time, technical support and limited access to laboratories [3].

The European-wide availability of an online labs benefits students in less developed countries where few labs are available. Online labs can support group working over the internet from multiple locations and removing the geographic proximity restriction which has far reaching consequences for education [6].

Some researches pointed out the advantages of using an online lab are that the lab can be shared by students working from distant locations 24/7 [8]. Furthermore, it can increase the efficiency of an online lab operation [1], it reduces the cost per student teaching hour [5] and it makes the lab available to a large pool of students [3] thereby enhances their educational experience. Moreover, it allows teachers in the classroom to illustrate theoretical concepts with real applicable knowledge [9].

Compared to traditional labs an online lab opens the potentiality for flexible practice and access to a large number of students from geographical distributed locations thus reducing cost through an online lab sharing [3]. In addition to that it enables online students to perform practical assignments/ exercises in real application at various geographical locations and it facilitates the interactivity of students with the system [5]. There are number of ways of accessing practical lab which includes students can access assignments/exercises over a long time frame/times preferred by them, it can be shared between universities, it is offering improved access for disabled students and it is facilitating greater access to assignments in distance education [7].

The accessibility of an online lab creates an opportunity for educational institutions to make laboratory work available to students out of normal hours. The online lab can frequently be accessed by students during the night hours. The application links are used to permit student access to the course assign-

ments over internet and can be used by instructor to perform demonstrations in front of a class during lab period [8].

In North America and Europe practical work has been done over the last years in making the online lab accessible to disabled students in a fully participatory way and it offers a possibility of overcoming problems of physical attendance to traditional lab.

One view of the role of an online is that it is important in introducing students to the world of scientists and engineers in practice. Today the reality for many students is that they can work collaboratively through the computer that provides excellent context for developing online collaboration skills which will be important in their future careers [7].

In spite of the advantages and benefits stated for the online lab there are some technical and pedagogical limitations due to the poor connection of internet which made the participants quickly get frustrated and stop working with an online lab as well as the lack of communications with instructor and tutor to solve demanding problem [2]. Furthermore, communication with other online students and trainers were not standardized resulting in some frustration as reported by students in the sessions due to lack of control/delays in feedback from remote tutors. The channels of communication do not have easily predictable responses due to the variability of traffic load [5]. The actual delay will depend on the network configuration, bandwidth, routing and traffic at the time [7].

Some online labs are difficult for students to access, they are not integrated into a common framework [3], some students need more training and background of using online lab since these labs are used only in science and engineering education at universities [3].

The paper question

Is there any significant difference in degree of students' participation in an online lab compared to traditional lab?

The hypotheses of the above question

1. The degree of students' participation in two classes will be the same in traditional computer lab.

2. The degree of students' participation in two classes will not be the same in an online lab compared to traditional lab.

3. The degree of students' participation in two classes will be the same in an online lab.

3 METHODOLOGY

In this part the researcher describes in brief the participations of students, the instructions and rules of the participants group, tool for data collection and the procedures used for lab experiment. The method used for collecting data is a lab experiment using an online lab. The procedure for this method discussed below.

Participants

The lab experiment is conducted in King Khalid University, College of Science and Arts and Community College. The total number of (35) undergraduate students from the Department of information system participated in the current study.

The undergraduate students were divided into two classes. Both classes participated in an online lab and traditional lab. The age of these students ranges between (15:30) years. One of these two classes is bachelor's degree in Faculty of Science and Arts level(2), the course is Computer Science 2(012 AAl-3) with total number of (12) students. While the other is intermediate diploma in community college level (4), the course is Data Structure and Algorithms 2(221 HALL-3) with total number of (23) students. The instructor of two classes is the same.

Thefollowing are instructions and rule:-

1. Student should be trained on an online lab before the actual online lab started.

2. The two classes used the same course materials for their practical work.

3. The two classes are given the same time to complete the online assignment.

4. Only one assignment per week.

5. Both classes attend traditional lab and work in an online lab at their free time.

6. The period of the study is extended for seven weeks in second semester of 2013.

Tool for data collection

The tool which is used to collect the data is a lab experiment carried for two different classes using an online application links.

Procedures used for lab experiment

The online application called Real Time Narrator (RTN) is a quantitative program which is designed for students. It explains how to carryout C++ program step by step.

1. RTN explains basic programming concepts, flow charts, loops, matrix and programming codes.

2. RTN uses simplified examples on the concept of programming as well as it helps in tracking the body of main function.

3. In addition to that students are able to compile and run the program code and get the result in an online environment.

The online application has been synchronously linked between, program statements, output screen, memory status and simplified textual explanation. It aims at making a competent generation in programming language since programming is highly essential in the information technology.

The scope of this application offers simplified explanation for the C++ language such as announcement of variables, rules of priority in the implementation of the operation and control the output.

Technology used is a web-based application implemented by HTML, DHTML, Java script and explanation pages designed by PHP [10]. Fig. 1 shows the structure of an online lab.

Blackboard integrity, an online application RTN is integrated

with e-learning system such as blackboard. It can be used in discussion forums by adding each session in separated link. Students use these links for submitting their assignments, questions and feedback using the same discussion forums or course mail in the blackboard system [10].

The application is connected to the server over TCP/IP protocols. The remote clients are able to interact with an online application by communicating with the server via internet connection. The web serve receive client responses and directed the received responses to the host server. The Hyper Text Transfer Protocol (HTTP) carries the replied responses back to the clients via internet connection [4].
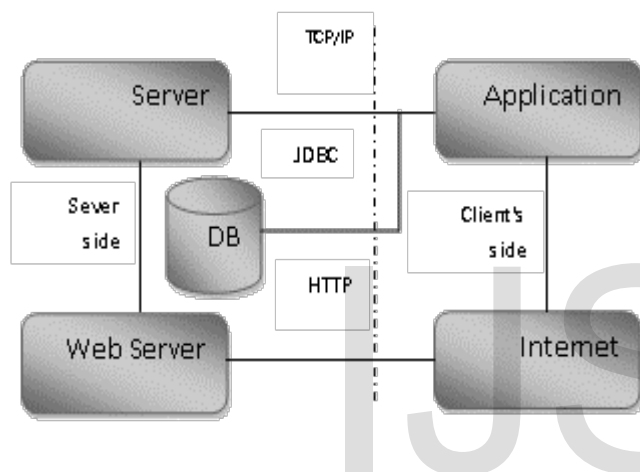

Fig. 1 Structure of an online computer lab

4 ANALYSIS AND COLLECTION

Analysis to answer the question

Is there any significant difference in degree of students' participation in an online lab compared to traditional lab?

To answer this question:

Seven assignments were conducted in both traditional and online labs. The procedures for calculating traditional lab time start from student write program code, compile, correct the errors code, run the program and record the results.

The procedures for calculating an online lab time start from student login in blackboard system, select the course, open discussion board, run the application link, perform the assignment and post the results through discussion forum or course mail.

The collected data tabulated and the difference between classes is examined by using statistical package SPSS version (15.0) for windows operating system. Three types of tests are used namely, independent t-test, Post Hoc tests [ANOVA-Test] and Paired-Test at 0.05 level of significance [12].

5 RESULTS

Three hypotheses generated for this study are stated above in section I (B). The independent t-tests were used for the three hypotheses.

The result of the independent t-tests using 0.05 level of significant against test H1 has shown that there is no significant difference between the two classes in traditional lab. The results obtained in traditional lab indicate that B.dgt (M=39.25, SD=9.845, DF=26, T=0.388, P=0.701>0.05) where B.dgt is bachelor degree class in traditional lab and D.dpt (M=40.69, SD=9.611, DF=26, T=0.386, P=0.703>0.05) where D.dpt is intermediate diploma class in traditional lab.

Based on this result the analysis has suggested there is no significant difference between the two classes in traditional lab. **Thus hypothesis 1 is substantiated**. To test H2 there is significant difference between the two classes in an online lab compared to traditional lab. The results obtained in an online lab indicate that B.dgon (M=7.08, SD=1.564, DF=26, T=4.60, P=0.000<0.05) where B.dgon is bachelor degree class in an online lab and D.dpon (M=4.69, SD=1.195, DF=26, T=4.424, P=0.000<0.05) where D.dpon is intermediate diploma class in an online lab. Table 1 below illustrates the t-test.

Based on the results obtained in both tradition and online the analysis concluded that there is significant difference between the two classes in an online lab compared to traditional lab. **Thus hypothesis 2 is substantiated**. The probability obtained in an online lab for the two classes p=0.000<0.05 level of significant. This means that there is no significant difference between two classes in an online lab. **Thus hypothesis 3 is also substantiated**.

TABLE 1

THE DIFFERENCES BETWEEN THE TWO CLASSES —T-TEST.

Time	T1: Time of traditional lab: T2: Time for Online lab						
	Class	N0.	M	SD	DF	T-V	Sign. 0.05
T1	Degree	12	39.25	9.845	26	0.388	0.701>0.05
	Diploma	16	40.69	9.611	26	0.386	0.703>0.05
T2	Deg.Onl.	12	7.08	1.564	26	4.60	0.000<0.05
	Dip.Onl.	16	4.69	1.195	26	4.424	0.000<0.05

To confirm the above results four tests were examined by using Post Hoc Tests, LSD and Scheffe. The results found in traditional lab indicate that B.dgt (M=23.0, SD=7.640) and D.dpt (M=24.27, SD=5.854) with DF=53, F=45.752>3.0. While the results found in an online lab indicate that B.dgon (M=10.08, SD=3.232) and D.dpon (M=6.07, SD=2.086) with DF=53, F=45.752>3.0). Table 2 below refer to ANOVA Test

Based on this result the analysis suggested that there is significant difference between two classes in an online lab compared to traditional lab. Thus the same results were found to confirm hypotheses H2.

TABLE 2

THE DIFFERENCES BETWEEN THE TWO CLASSES — USING THE ANOVA TEST

Compare	*The mean difference is significant at 0.05 levels.						
	Deg.Onl.	Dip.Onl.	F-V	No.	M	SD	DF
Degree	12.917*	16.933*	45.751	12	23.0	7.640	53
Diploma	14.383*	18.400*		15	24.27	5.854	53
Deg.Onl.	-	4.017*		12	10.08	3.232	53
Dip.Onl.	-	-		15	6.07	2.086	53

For more confirmation two others tests were examined using paired tests compared two dependent variables T1 & T2 in the same class to see whether there is significant difference in an online lab compared to tradition lab.

The results found in degree class indicate that B.dgt (M=22.42, SD=6.882) and B.dgon (M=7.33, SD=1.614); (DF=11, T=7.758, P=0.000<0.05, Correlation=0.207); in intermediate diploma class the results indicate that D.dpt (M=58.78, SD=16.936) and D.dpon (M=6.09, SD=1.564), (DF=22, =16.411, Correlation=0.984). See Table 3 and 4 below using Paired-Test for each class.

Based on the obtained results the analysis confirms there are significant different between two classes.

TABLE 3
COMPARE DEGREE CLASS IN BOTH TRADITION & ONLINE LAB

Pair 1	T1: Time of traditional lab: T2: Time for Online lab						
	No.	M	SD	DF	T-V	Sign. 0.05	Correlation
T1	12	22.42	6.882	11			0.207
T2	12	7.33	1.614	11			
Pair 1 T1-T2	12	15.083	6.735		7.758	0.000<0.05	

TABLE 4
COMPARE DIPLOMA CLASS IN BOTH TRADITION & ONLINE LAB

Pair 1	T1: Time of traditional lab: T2: Time for Online lab						
	No.	M	SD	DF	T-V	Sign. 0.05	Correlation
T1	23	58.78	16.936	22			0.984
T2	23	6.09	1.564	22			
Pair 1 T1-T2	23	52.696	15.399		16.411	0.000<0.05	

To compare the means of dependent variables time for both traditional and an online Lab. Fig. 2 below show the means of an online lab time vary from 4.7 to 11.7; on other hand the means of traditional lab time vary from 19.7 to 53.3. This indicates that the variation in means of the two dependent times leads to significant difference in the two classes. The regression equation for traditional lab time➜ y=0.299x+33.19 and Square root➜ R²=0.081. The regression equation for online lab time➜ y=0.055x+6.759 and Square root➜ R²=0.057
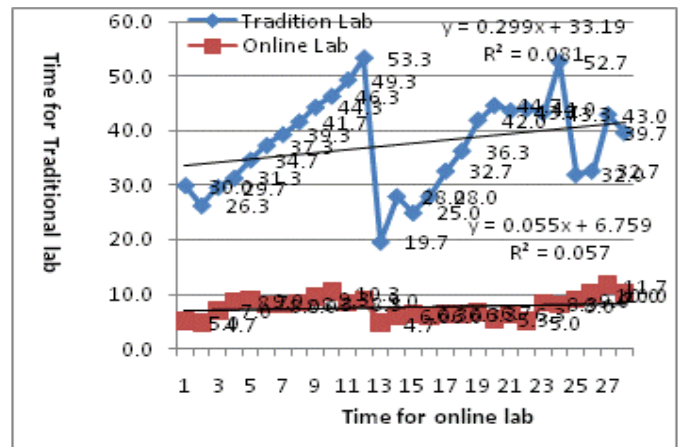

Fig. 2 Illustrate time for both tradition and online computer lab

6 EVALUATION

The process of evaluation includes an evaluation in both traditional and online computer lab. The suitable way of evaluating the participants are based on lab situation [4].

- Entities in both labs.

- The process to be controlled.

- Technology used in both labs.

- Results to be obtained.

The entities in the two labs are the same except that the computer devices in tradition lab are at one location. While application links in an online lab are at different locations. The process that is to be controlled in traditional lab is situated in only one room. While the process to be controlled in an online lab is via internet connection. Both entities contribute in the evaluation which is intended to provide participants with controlled skills in the learning environment.

The activities in traditional lab are managed by instructor. While the activities in an online lab are managed by the software. The technologies used in traditional lab are Local Area Network and intranet. While the technologies used in an online lab are Wide Area Network, internet and online learning tools such as email, course mail, discussion forums and the likes. This evaluation is also intended to provide participants with more experience in how to manage and use learning tools.

The obtained results in traditional lab can be seen through computer screens. While the obtained results in an online lab can be seen via output screens and memory status. This evaluation is intended to provide participants with the skill of how to visualize the memory status when the output is stored in computer memory. Also, when variable is declared the participants will see how variable is stored in memory status. In this approach the two ways for evaluating the participants are shown in Table 5 below illustrating the lab situations.

The learning outcomes that students' gain from using an online application links includes that Students get experience

by performing their practical work in an online lab. Students develop their skills in discussion forums and course mail. Students improve their relationship by collaborating in discussion board. Furthermore, the application links are used to permit student access to the course assignments over internet and can be used by instructor to perform demonstrations in front of a class during lab period.

TABLE 5

EXPLAINS THE TWO WAYS OF EVALUATION

Situation	Computer labs evaluation	
	Traditional lab	Online lab
Entities	Instructor, learners and computer devices in one location	Instructor, learners and application links in different locations
The Process to be controlled	one room, attended learners	Via internet connection
The activity	Assignment, quiz managed by instructor	Assignment, quiz managed by software
Technology	LAN, Intranet	WAN, internet and online learning tools such as email, IM, discussion forums and the likes.
The obtained Results	The learners can see the results through computer screens	Learners can see the results of their action in front of them

7 CONCLUSION

In this study the researcher investigates the difference in the degree of students' participation in an online computer lab compared to students' participation in traditional computer lab. The researcher also explored the practical work over an online environment using online learning tools such as course mail and discussion forums.

Based on the results obtained from lab experiment the current study have shown that the online lab is better than traditional lab since there is no constrains of time and location. In addition to that many advantages and benefits those students have gained from using the online lab.

The impact of using an online lab on the degree of students' participation is higher than traditional lab. As a summary, the results of this study have shown that there is significant difference between the online lab and traditional lab. Technology used in the current study are a web-based application, course mail, discussion forums and asynchronous.

The researcher discusses in the current study the technical and pedagogical limitations of an online lab.

8 REFERENCES

[1]   KF Hew and WS Cheung, (2012) "Students' use of asynchronous voice dis- cussion in a blended-learning environment: A study of two undergraduate classes" The Electronic Journal of e-Learning Volume 10 Issue 4, 2012, (pp360-367), available online at www.ejel.org

[2]   A. Sagun, H. Dermirkan and M. Goktepe, (2001) "A Framework for the De- sign Studio in Web-Based Education" JADE 20.3 @NSEAD 2001,(pp332-342)

[3]   W. Nejdl and M. Wolpers, (2003) "European E-Learning: Important Research Issues and Application Scenarios" L3S Research Center and University of Hannover Expo Plaza 1, 30539 Hannover, Germany, available at www.l3s.de and www.prolearn-project.org{nejdl, wolpers}@l3s.de

[4]   J. Tuttas, (2001) University of Hannover, Learning Lab Lower Saxony (L3S), Appelstr. 4, 30167 Hannover, Germany, tuttas@learninglab.de and B. Wag- ner, University of Hannover, Learning Lab Lower Saxony (L3S), Appelstr. 4, 30167Hannover, Germany, wagner@learninglb.de International Conference on Engineering Education August 6-10, 2001 Oslo, Norway 8DI-7 -8DI-11

[5]   C. Salzmann, D. Gillet, A. Haniph Latchman and D. Oscar Crisalle (1999) "On-line Engineering Laboratories: Real-Time Control Over the Internet" Swiss Federal Institute of Technology, Lausanne, Swizerland/University of Florida, Gainesville, Folorida

[6]   N. Faltin, (2003) Learning Lab Lower Saxony (L3S), Hannover, Germany, faltin@learninglab.de International Conference on Engineering Education July 21-25, 2003 Valencia, Spain

[7]   Cooper, Martyn (2005), "Remote laboratories in teaching and learning – issues impinging on widespread adoption in science and engineering education" Available   at   http://www.i- joe.org/ojs/viewarticle.php?id=11&layout=abstract

[8]   I. Gustavsson, J. Zackrisson, L. Hakansson, I. Claesson and T. Lago, (2007) "The VISIR project – Open Source Software Initiative for Distributed Online Laboratories" Blekinge Institute of Technology/Department of Signal Pro- cessing, Ronneby, Sweden Acticut International AB, Falkenberg, Sweden Rev 2007- www.rev-conference.org

[9]   J. Zackrisson, I. Gustavsson, L. Hakansson, (2007) "An Overview of the VISIR Open Source Software Distribution 2007" Blekinge Institute of Technolo- gy/Department of Signal Processing, Ronneby, Sweden, Sweden Rev 2007- www.rev-conference.org

[10]   A. Mekki Ahmeddi (2013), Designer of RTN:"Real Time Narrator " Applica- tion links, Lecturer in King Khalid University, community college, Bisha, Saudi Arabia, mekki_ahmedi@hotmail.com, the RTN URL available at http://eschoolsudan.com/newkkurtn/

[11]   N. Wolfgang and W. Martin(2004), Important Research issues and applica- tion scenario, L3S Research Center and University of Hannover, Expo Plaza 1, 30539 Hannover, Germany, www.l3s.de and www.prolearn-project.org,{ nejdl, wolpers}@l3

[12] Uma Sekaran, John, W. (2003). Research methods for business. A skill- Building Approach four edition. South- ern Illinois University at Carbondale. Garamond by Her- mitage Publishing Services and printed by Malloy Litho- graphing, Inc. ISBN 0-471-20366-1, ISBN 0-471-38448-8 (WIE)