Information Communication Educational Technologies in Lifelong Learning of Underprivileged Groups

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Abstract: - The paper describes conditions that influenced the implementation of new technologies in educational organizations for adult learners and presents a project of deployment of ICT assisted learning for underprivileged groups of adults. The aim was to foster quality of teaching and learning and raise digital literacy. Instructional design for adult learners with poor learning skills, collaboration skills and ICT knowledge was formed, and interoperability within different technological conditions, systems and delivery platforms was built. Information communication educational technologies were implemented in three forms: (1) multimedia learning material on a CD-ROM for personal computers without Internet connection, (2) computer supported learning environment for guided self-directed learning, and (3) computer supported collaborative learning environment.

Key-Words: - Educational technology, ICT assisted learning, Constructivism, Computer network, Interoperability, Lifelong learning, Collaborative model

1 Introduction

Introducing Information communication educational technologies (ICT ET) in a learning process of underprivileged groups was a goal of the project named *Intensifying of e-learning introduction for raising educational level and overcoming regional discordance in Slovenia*. The project ran from 2002 to 2005. It involved adult learners enrolled in upper secondary educational programs (ISCED3 according to International Standard classification of Education or ISCED). In the year 2002 58.8% of population aged 25 − 64 in Slovenia had secondary educational qualification. A share of those people which had vocational secondary educational qualification was 52.7% and only 47.3% had technical or general secondary educational qualification which is a condition to enter a tertiary level [10].

2 Development of an ICT learning environment for underprivileged adult learners

2.1 Lifelong learning and e-learning in Slovenia

Percentage of adult population aged from 25 to 64 participating in lifelong learning was in Slovenia in 2003 15.1% while the EU-15 average was 9,7% [6]. Percentage of e-learning usage was

very low. Only 6.6% of labor force in Slovenia was involved in e-learning process while the share in EU was 14%. The low percentage of Slovenian labor force using e-learning can be partially explained by the relative absence of e-learning programs [15].

Involvement of adults in learning processes in Slovenia is strongly related to their attained education: the less educated people are less involved in lifelong learning [2]. Adults with lower educational qualification are also less digitally literate and are less familiar with ICT. Digital literacy in Slovenia is slightly below European average – COQS index in Slovenia is 0.7 vs. 0.8 in European Union [14]. Digital divide index in Slovenia is slightly lower (54%) than in EU-15 (53%), but the gap is dramatic for the educational divide (7.5% Slovenia vs. 27% EU) [15]. A report on ICT usage in households in Slovenia also indicates considerable digital divide. The highest influence has the education (the primary education – 22% of the Internet users, high & higher – 78%), income and differences among Slovene regions [17].

In the first phase of the project we developed a collaborative model of ICT assisted secondary education of adults. Secondary education for adult learners is organized by schools with special units for adult learners, Adult Education Centers (AECs) and private educational organizations. The number of such organizations was 134 in year 2002. Thirty four of them were AECs Share of adult learners enrolled in upper secondary education in 2002 was 21,438 [13]. The model was developed for AECs in the Association of AECs Slovenia. In the first phase of the project 10 AECs were included from the association. The results of the project will be implemented to all 31 AECs in the association.

A survey was carried out to examine potentials for e-learning in all 31 AECs. Main reasons for non-existence of e-learning programs are:

- Lack of ICT infrastructure in some regions;
- Low digital literacy of adult learners with lower educational qualification and inexperience in general ICT use and ICT use in learning;
- Lack of e-learning tutors, organizers and other practitioners.

All mentioned drawbacks thwarted AECs to fully take all advantages of e-learning. This stimulated the beginning of our project. Its main aims were:

- Establish an e-learning infrastructure in all Slovenian regions and consequently provide effective and quality adult learning methods;
- Raise the share of adults involved in e-learning and lifelong learning, raise digital literacy among adult learners with lower educational qualification and stimulate ICT use to increase their employability skills;
- Staff development: teacher and practitioner professional development for educational technology [8].

2.2 AECs and their organizational characteristics

AECs joined in an association are small organizations with 5 to 30 full time employees. In a school year 2000/01 only 271 full time employed, 30 part time employed, while 2223 on a contract basis. Most of employees under contracts were tutors and teachers [5].

We identified main obstacles of ICT introduction within the progress of our project:

- Small number of fully employed personnel. AECs have difficulties investing in professional development of their employees because most of organizers, teachers and tutors work under a contract;
- Most of learners come from underprivileged groups and a lot of them are unemployed. Their digital literacy is low as are competences and experience of ICT usage. They also meet e-learning for the first time;
- Financial sources in AECs earmarked for educational process improvement and for innovations are very limited. They do not cover development and deployment of e-learning costs.

ICT supported learning offers improvements in domains where education of adult learners is weak: teaching and learning approaches which would increase individualization in teaching and support active learners' role in a learning process. For a sustainable implementation of e-learning a collaboration model was developed. The collaboration included sharing knowledge and experiences and sharing the design cost and technologies. Collaborative model for ICT supported secondary education of adult learners helped us to achieve quality of teaching and learning with ICT support.
Activities in the first phase of a project:

- Modeling networks of e-learning promoters and authors for e-learning material;

- Analyzing e-learning conditions and feasibility;
- Analyzing e-learning development and deployment cost effectiveness;
- Forming staff development system;
- Introducing initiatives for e-learning standards on a national level in Slovenia.

2.3 The instructional design

Instructional design was directed toward characteristics of adult learners, teaching and learning methods and assessment that support realization of educational goals on higher levels from Bloom's taxonomy [3]. Analysis of adult learners characteristics showed that learners with lower educational qualification or with it are not used to active learning methods, they act reactively and not proactively and their learning methods are reproductive. Learners do not have well developed metacognitive skills and collaboration skills. Most importantly they do not have any skills in working with a rich informational educational environment and are mostly digitally illiterate.

Table 1: Student-centered ICT assisted instruction

	TRADITIONAL	ICT ASSISTED
LEARNING ENVIRONMENT	Lecture room.	Combination of lecture room with 3 forms of ICT assisted learning.
LEARNING RESOURCES	School text-books for youth.	Multimedia learning material for adults.
LEARNERS ACTIVITIES	Passive attending lectures. Reproductive learning. Learning before exam.	Simultaneous active learning. Developing metacognitive skills. Self-regulation of learning. Pear and group learning. Simultaneous knowledge assessment.
TEACHERS ACTIVITIES	Lecturing supporting learning transmission. No or little active methods. Exam based assessment.	Facilitative teaching. Active methods. Instruction customised and personalized to meet individual needs.

To support learners by managing activities and track their progress with ET usage we provided 3 educational technology forms that organizations use depending on their technological conditions. This forms are:

- Multimedia teaching material on a CD for personal computers without Internet connection;
- Online learning environment for self-directed learning;
- Online learning environment for collaborative learning.

All participants were given multimedia material based on their needs and technological conditions. The multimedia CDs were given to those without Internet access and those who didn't want to be guided by tutors.

Online learning environment for self-directed learning is intended to increase individualization at the beginning of the learning process and during the course. This was necessary to accommodate the learning process for participants with different knowledge levels and different entering points in the learning process. This last is important for those who, for example, return to education after a long period of time and have some obligations completed but do not have a solid knowledge base that would support their successful blending into the process. In this environment teachers have possibility to diagnose participants' knowledge and their progress at the beginning, during and after the learning process with simultaneous knowledge assessments.

Last ET form is online learning environment for collaborative learning (e.g. a virtual classroom) for the purpose of group work. Most of the participants did not work in groups before. With this work form they were given optimal learning grounding for learning in a group of learners [18].

3 Technological conditions and system requirements

3.1 Encountered Problems

Building an environment for an unprivileged adult learners is very challenging [11]. There are numerous possibilities, but a proper choice mostly depends on the functional requirements and on maintainability of the environment. On one extreme is completely self-contained environment running at a learners own machine without accessibility for the maintainer, while on the other extreme is a learning environment which is under a complete control of the system maintainer. Orthogonally to such division is a division based on the functional requirements (or possibilities). Again, one extreme is an isolated machine which has no possibility of forming a virtual learning environment, while on the other side is a well connected machine which easily becomes part of a virtual learning environment (e.g. a virtual classroom). This is particularly important when we want to use collaborative learning model.

Based on such classification of environment, also depends the technology of deployment of learning objects, or, in general, of learning software. The simplest case is a CD with self-installing environment. This technique is particularly suitable for isolated machines with no maintenance access. The installed software is then used, mostly, as a reading material with a limited possibility of assessment utility. There are two very big deficiencies of such approach: no possibility of joining and forming of virtual classrooms and lack of support for portfolio handling. The good side is the simplicity of the use. Examples of such productions are so called "live CDs" [1].

Slightly more advanced technology is a learning environment for guided learning. In this case the installed software becomes more advanced and must support some kind of proto-portfolio, since its use provides the necessary means for a guided learning. Mostly there exists an Internet connection to some (http) server which also usually provides the necessary software. Such environment is suitable for home use of learners. The deficiency is when we want to use inside learning objects non-standard material in general, or material which format does not have support provided on the learner's machine. The learner would have to install, in such a case, additional software and in case of underprivileged groups this is particularly challenging task [9]. In general, we encounter a problem of interoperability of learning software under various computer environments. The portfolio handling and virtual classroom support is provided when the learning material (i.e. learning software) is provided not only through a simple http server, but through the LMS [12].

The most advanced is the environment with a complete computer supported collaborative learning environment and a complete maintenance access. The later is particularly important when dealing with underprivileged groups of learners with a limited maintenance skills. An additional benefit from a maintenance access is simplicity of support for interoperability. In the rest of the section we will describe how interoperability on level of operating system in the classrooms was ensured. This permits the use in learning environment simultaneously software designed and implemented under different operating systems. We did not found any similar approach in a literature and hence represents a novel approach to solving operating system interoperability problem.

There are three groups of people somehow connected with ICT supported classroom: administrators, tutors and users. Each of these groups have their own demands from the same system. Let's take a closer look at these demands.

A vision of ICT educational environment is a classroom full of personal computers with an operating system and few services these computers employ (like Internet connection, printer server, DCHP server etc.). As we mentioned there are two extreme setups of such environment:

- a classroom of thin clients that use services remotely [7]; and
- a classroom of personal computers where all services are available locally.

The first option makes it easy to administrate while the second one is a nightmare for administrators. Computers in the first option are useless if services they use are not available while in the second option if one of computers is down others work normally. We will try to pick out the optimal options of both extremes.

ICT tutors work with different types of educational software running under different operating systems [16]. To meet their needs every computer in the classroom should have access to more than one operating system and belonging software. The questions were how to provide all this software at the same time and how to reduce the amount of skills needed to switch between different operating systems. Again we have two extremes:

- Every computer has two or more operating systems installed (e.g. dual boot).
- No operating system is installed on local computer. Operating systems are accessed remotely (thin clients).

Which one of these options is better? It depends on circumstances. Main drawback of the first option is time consuming switching between operating systems or resource consuming virtual operating systems. With the second option no computer in a classroom won't run an operating system if server providing remote access to it fails.

As we already said adult learners, in our case, have no or little knowledge of ICT usage. The question is how to build a proper environment to face a challenge of teaching usability of ICT. In our opinion a proper ICT environment has to render possible successful completion of any task learners have to perform. Environment must support different ways and methods to complete these tasks so learners should be faced with a competition of

offered applications and their operating systems and thus develop creativity and ingenuity using ICT. Additionally every operating system should support same services. For example if a user has a printer available in one operating system it should be available in the other available operating systems as well.

3.2 Building an ICT learning environment

With these three groups (learners, tutors and administrators) and their necessities in mind we built a classroom with three main thoughts:

- Offer heterogeneous instructional and other software which needs different operating systems.
- Same access to all services disregarding operating system in use.
- Simple administration.

Typical computer network is built by clients and servers where servers offer services which clients use for tasks they have to perform. One server can offer an Internet connection as a service another can offer printing services to clients that don't have printers and so on. When a server offers a service, clients do not need this service locally installed. More services clients use remotely less administration is needed but clients become more and more dependent and can not perform one or more tasks by themselves. Proper number of services depends on users', tutors' and administrators' needs. Some of basic services that would be reasonable to offer are:

- Authentication (LDAP, DB, SMB, NIS).
- File server (SMB, NFS).
- Domain name server (DNS).
- Printer server (SMB, LPR).
- Dynamic client configuration (DHCP).
- Internet connection server (routing, NAT).
- Email server (POP3, IMAP, SMTP).
- Terminal connection (SSH, Telnet).
- Web server (HTTP).
- Firewall.
- Anti virus protection.
- Anti spam protection.
- Screen (X server, Rdesktop).
- Operating system (Linux, Windows MS).

Screen and operating system (OS) services were up to our knowledge so far never considered as services. However, the novelty to define them as services permitted us to make various software, otherwise available on different platforms, available simultaneously on a single platform in a clear and simple way [4].

Every server offering a service can be also a client if it uses another server and its service for normal functioning. An example is email server that needs authentication to authenticate user and assign a proper mailbox. A client that uses services is also a server as it offers a screen to a user. Relationships between clients and servers can be described as an oriented graph where clients and servers are nodes and links are requests between them.

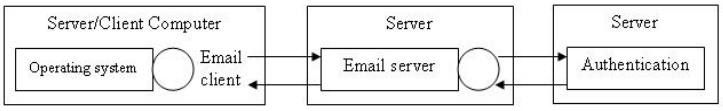
Figure 1: An example of a server

We will describe a server as a rectangle with another rectangle in it which indicates a service. If a service uses another server for functioning we mark it with a circle which describes a client part. A Figure 1 shows an example of a server. A request comes to a service and another request goes out to another server and its service. An answer comes back and service sends its answer to a client that requested it. Let's take a look at few examples and then try to wrap up everything in one system .

3.2.1 Authentication server

Clients and servers can use authentication for their functioning. As we mentioned mail server uses authentication, web server can use authentication for showing restricted websites, OS needs authentication to provide unique environment for each user and so on.

Figure 2: Email server communication



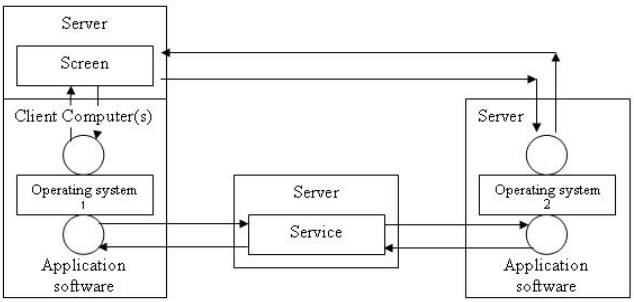
We have three servers on a Figure 2. The first one is an OS which offers its services to a client application – email client. Email client makes a query to an email server which makes another query to authentication server. Authentication server gives back a response to email server and email server answers email client either authentication was successful or not. If it was it provides its services to the email client, otherwise a procedure has to be repeated.

3.2.2 Screen server

Since we want to make our client computers to be as little dependent on service failure as possible, we assume that all our client computers have installed same OS. Screen offers its services to this OS. However defining its service, it can also offer the service to remote OS.

As we can see on a Figure 3 Operating system 1 is installed locally on a client computer. It uses a screen as a service and provides a service to software called Application Software. Screen is also used by Operating system 2 which is not installed locally but it offers its desktop on a screen. Operating system 2 also provides service to software called Application Software. Both applications use the same instance of service screen. Besides application software OS have requests towards other services like authentication server, file system server, DHCP server, printer server and so on. It is very important that each OS uses same resources. We might add as many operating systems as we want and each one of them will use and offer same resources to a user.

Figure 3: Interoperability between two Operating systems



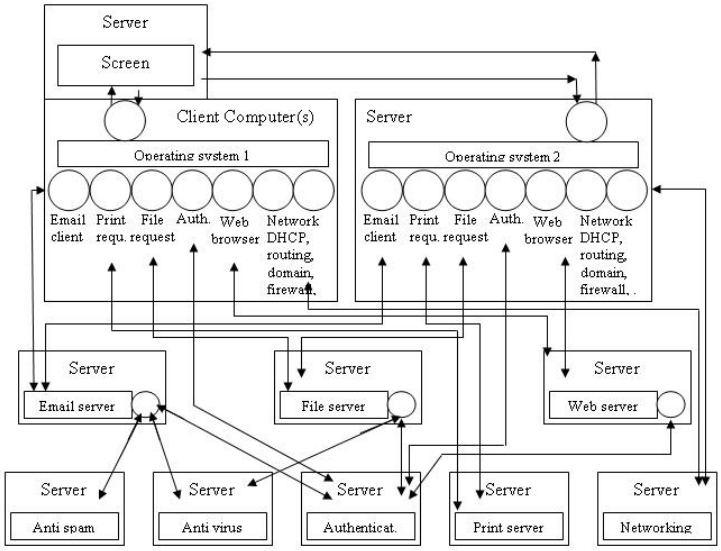
3.2.3 Classroom

After we defined and understood relationships between servers and clients we present the whole system. We have many instances of client computers in a classroom but for the sake of simplicity of this presentation we will consider only one (cf. Figure 3). For the same reason, we will also show only one additional OS, although the complexity of the system can be arbitrarily scaled up.

Every client computer and every additional OS use the same resources as shown in a Figure 4. We have several servers in this figure and each server hosts one service. However, in the real application we might use only a single server hosting several services which makes the system more economically feasible and easier to administer but also less robust.

OSs offer their services to applications and each OS can have immense number of educational and other software installed depending on what is available for that OS. This software can further use services; for example, email clients and web browsers require additional services, while word processors usually do not (although we might have an image gallery on a file server). We did not include such software in a Figure 4.

Figure 4: The whole ICT environment



In this paper we concentrated on a screen service only, although there are other similar services that each OS can use like keyboard, mouse, speakers, web camera and media drives like CD/DVD ROM, floppy disk drive and so on.

3.2.4 Real life example

A Figure 4 led us to a computer network which we use in our computer labs. Each computer in a lab has its own OS installed locally. We chose Linux OS for our client computers. Second OS we use is Microsoft Windows which can be accessed remotely. There is no reason why we should not install Windows OS locally and access X windows on Linux OS remotely. We chose local Linux installation for several reasons. One was that we wanted users to experience something less used; next we use open source software for the research reasons, and at last but not least the computers in a classroom are used as a part of cluster used for scientific computing at the Department.

For the authentication purposes every user has a single user name and password (maintained by the LDAP) and hence they are not burdened with

numerous passwords for every service. They use the same authentication to enter both OSs, to get their files from the server - users can use, edit, listen and create same files and directories in both OSs and use them in available applications. Also, they use the same authentication for checking emails and entering restricted web sites like Learning Management System, etc.

File system is regularly checked for viruses as it is every email that comes to our email server. Emails are checked for spam as well. These are two services users don't directly use. Similar services are firewall, DHCP, routing, NAT and computer domain name services which are essential for network activities and security but not seen by users.

Switching between OSs is easy as a user needs not to re-boot a computer to another OS. Users can connect to Windows OS remotely and use its applications directly – i.e. the remote Windows OS service uses the local Linux screen service. Consequently, learners and tutors are not limited to applications of one OS. Every task they have to teach or perform can be done in several ways and not limited to one application in one OS.

Administration of the classroom is also easy as clients have only one OS. The OS is installed from the network and setting it up takes only a few steps as Linux comes with most of the software we need ready – this was also one of the reasons we choose Linux. Most of the services the computers use are assigned automatically (IP address, gateway, etc.) and hence the administration of all services is easy as it is done at one place only. Each additional operating system (like Windows OS) is administered on a single computer as well.

Moreover, since we collaborate in a Slovenian project that builds a localized distribution of Linux called Pingo, we can add tailor made software to the distribution. Consequently, all our software is readily available to anybody installing the Pingo distribution – also to the prospective learners.

Since all classrooms use the same services, addition of a new OS and a new software is easy. Either we install it with a Linux distribution or install it in a remote OS, in both cases it becomes immediately available to all user. Our computer classrooms and labs turned out a success and most of our users enjoy its heterogeneity and interoperability.

4 Conclusion

The conditions that influenced the implementation of new technologies in adult educational organizations were presented. The basic conditions which tail the practices of teaching and learning of adults in AECs were identified, among them lack of ICT infrastructure in some regions, the characteristics of adult learners with less than upper secondary education: low digital literacy and inexperience in general ICT use and ICT use in learning, and lack of e-learning teachers, tutors and other e-learning practitioners.

The implementation was based on a collaborative model. The collaborative model accelerated introduction of e-learning in organizations with different social, cultural and technological background. The collaboration was a critical success factor for the organizations with poor potentials for ICT assisted education.

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