COLLABORATIVE E-LEARNING MATERIAL DEVELOPMENT TOOLS FOR THE KNOWLEDGE SOCIETY

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Abstract. The educational community's demands for e-learning resources are analyzed in the paper. The intentions to individualize the learning material by modelling, developing and renewing the existing e-learning resources are emphasized. A successfully operating environment of e-material collaborative development, designed for knowledge community users with different competences, is examined. Various means and tools, necessary for the quality e-material development, are discussed. The architecture of the designed system is introduced. Various system components and implemented solutions are discussed.

1. Indroduction

More and more attention is being paid to distance learning in Lithuania and through the whole world: the infrastructure is under developing; distance learning methodologies are being analyzed; standards for the distributed usage of e-learning material are being developed. A large work (various issues discussed in [1]) related with distance learning technologies development and implementation is being performed. On the other hand a successful use of distance learning technologies in the learning process depends mostly on the prepared learning material quality.

Currently the e-learning material in Lithuania is mainly being prepared by separate experts or expert groups. Its quality depends on experts' IT knowledge, their collaboration skills. Still, even the expert groups often prepare the material in a "chaotic" way without regarding e-material development as a process and the probability of preparing the quality material mostly depends on individual efforts. When preparing the material experts quite often just divide up the themes and prepare them individually without the use of material development management tools. Consequently the result is the learning material with low coherence, which does not exploit many possibilities of e-material's presentation (various aspects of presenting the e-material are discussed in [2]).

One of the main challenges for the knowledge society is that the knowledge society could not just use the existing e-learning resources, but as well to create them, to develop and to adjust for various use cases. The knowledge society consists of persons from different areas with different IT knowledge levels. So it goes without saying that individual efforts – as in the experts' case – are not enough for preparing the quality learning material and valuable resources are created very rarely. The knowledge society has to prepare the material by combining its members' knowledge, skills and experiences. As the world wide experience shows (Open Source, Open Documentation and other movements) – there always exist people who want to combine their experience, knowledge and initiative, however this is not enough for creating e-resources effectively – one has to know the way to organize the collaboration for quality material development. Collaborative material development performed by different people with different competences and motivations (motivation and responsibility of information society's members are not defined by financial relationships) has to become a defined process of a particular level; i.e. collaborative material development frameworks have to exist and to be used; such frameworks are the work activities (descriptions) and tools sets that would ensure the process quality and as well the product (e-material) quality.

It goes without saying that for an effective work, e-learning development environment has to be integrated with material development support tools (including collaborative development tools). Unfortunately, such material development environments are not yet created and/or implemented in Lithuania. Therefore we can assume that currently the Lithuanian knowledge society have no tool for developing the collaborative e-learning material, for its usage and individualization.

This paper is organized in such a way: the analysis of information society's needs is presented in Section

2; it partly reveals how people imagine the role of the information society in learning material development and the importance of various tools/services. The material development process is discussed in Section 3; various aspects related with the process application for the knowledge society are presented here; the advantages and disadvantages of Wikipedia – a successfully operating project of collaborative material development project – are analyzed, tools that should be used for mature material development are presented. The architecture of the collaborative material development system under development is presented in Section 4; various technological solutions are analyzed. The concluding remarks are presented in Section 6.

2. Knowledge society's needs

In order to clarify the needs of knowledge society the concrete information on Lithuanian educational system was collected [3]. 60 teachers from 17 Lithuanian towns and districts took part in this survey. The surveyed and questionnaired teachers work in all types of secondary education institutions: gymnasiums, secondary schools, vocational schools, even

elementary schools in Lithuanian cities, towns and small towns. The representatives of such government institutions as municipalities and the chiefs of educational institutions from 4 Lithuanian districts, also experts (IT specialists, educators from Lithuanian high schools and universities) and other users (the 2nd and the 3rd level university students, parents) from 7 Lithuanian districts were surveyed too. Both the representatives of government institutions and the teachers think that there is quite a lot of information concerning Lithuanian education on the Internet, however still there lacks information of some areas, as well the available information is scattered in many separate web pages – for their work Lithuanian teachers use more than 17 distinct portals related with Lithuanian education, consequently it would be useful to develop a new overall educational portal (88 % of teachers have such a request).

All the teachers pointed the necessity of publication of training materials via internet. (Figure 1). The 46% (in average) of respondents prefer to find full e-lessons online, 41% (in average) - only materials of main subjects, prepared by experts (especially the teachers from the cities).
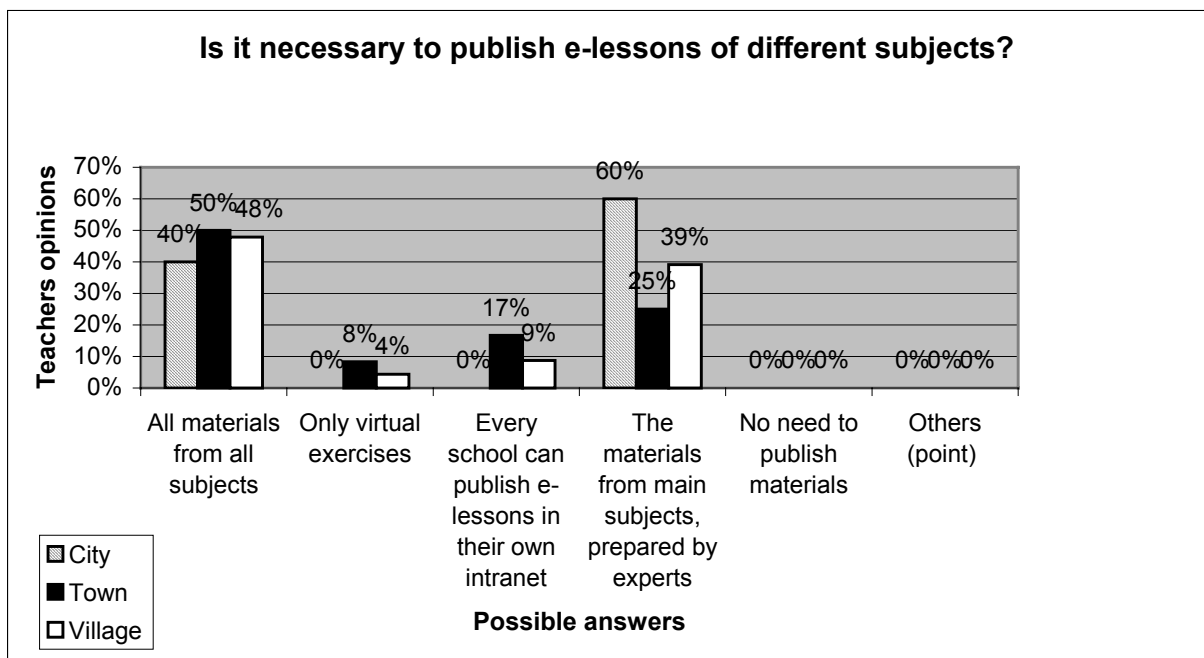

Figure 1. The needs of e-learning material publication

Thus all the teachers desire to find the learning material on the Internet; the differences can be noticed only in volumes. The interesting thing is that the teachers prefer the material prepared by experts. This fact can be explained by:

- the unwillingness to perform the excess work or the lack of motivation;

- the mistrust in their own capabilities and the lack of knowledge;

- the mistrust in the knowledge society and its competence to develop the quality e-learning material.

No specific reason can be excluded, however all of them are natural – people without seeing a successfully operating example and e-learning resources that were developed by the knowledge society and successfully used in practice do not have a full understanding of the existing possibilities.

One of our survey results – the distribution of knowledge society requests for different levels of online services (information publication, downloading, forms processing, transactions and tools) (Figure 2).

All the services listed in this diagram can be divided into two groups:

1. Services dedicated for e-material use (services of the system publicizing e-publication, search for information, forums, consulting by the Internet, specific software);

2. Services dedicated for e-material development, use and control (document management system, services of managing education be e-system, services of managing projects by e-system, services of test tools development).

Hence a larger need for use can be indicated among teachers, public officials and others. It is good that people understand the value of e-learning resources usage and the usage of other traditional services provided by the Internet technologies. From other view, the survey shows that the IT specialists are the only ones who understand that an effective usage of e-resources can not be achieved without tools dedicated for e-material development and control, i.e. the second group services are the basis for the quality of the first group services.
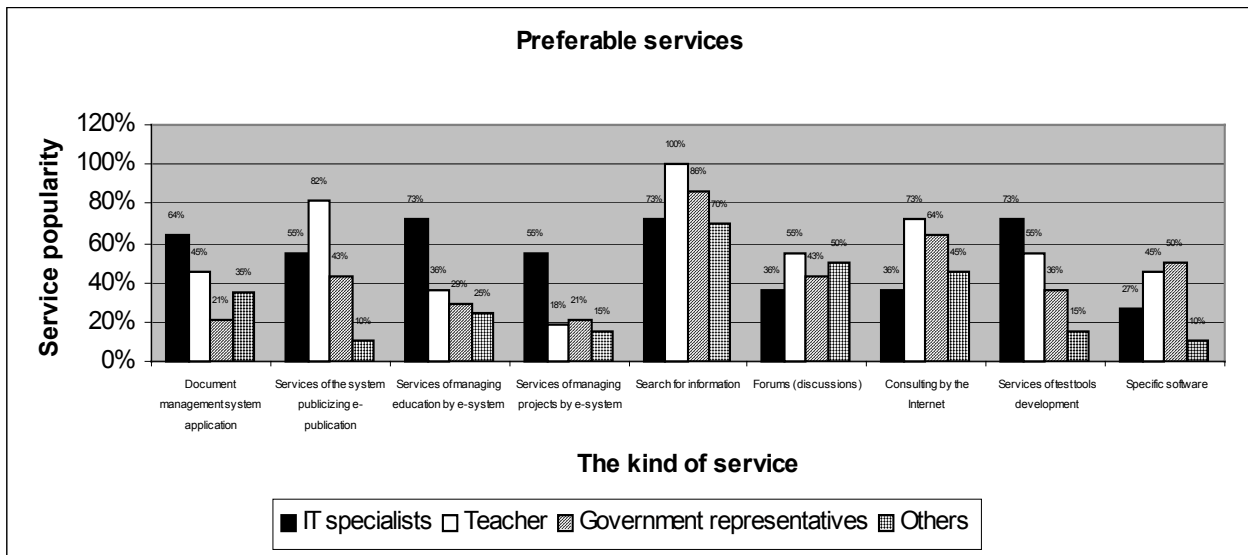

Figure 2. Distribution of requests for online services

Consequently the knowledge society identifies itself as a user but not a creator. The reasons may be the same as the described earlier and the single way to show the people that they can be creators is to create a successfully operating system by displaying the usefulness and the possibilities of the knowledge society in creating quality material resources practically.

3.1. Collaborative e-material development

We have mentioned in the introduction that the main criterion of quality e-learning material development is approaching learning material development as a defined process. A *defined* process means that the material is being developed under certain (described) procedures. In other words, a certain framework for material development is used; this framework has described procedures, activities and tools that support activities determined in descriptions.

It goes without saying that a strictly defined process cannot be adjusted to the members of the knowledge society as to the expert group. On the other hand this indicates that the ways to organize material development environment have to found in order the members of the knowledge society would accept various activities as natural. Consequently, the tools, which support material development activities, have to be closely integrated in one environment to be treated as a natural part of the system. For example, discussions have to be used under the same style both in discussing the material under preparation (material editing tool) and in discussing material development trends (project control tool), and in performing changes tracking and the other activities as well. Tools must support virtual communities to develop abilities of the separate members to work as a team (subjects discussed in [4]).

3.2. Analysis of the Wikipedia project

Some meta-design paradigms are proposed to support flexible development and employment of the information (for example [5]), but we will focus on the analysis of the successfully operating Wikipedia [6] project. Wikipedia is the encyclopedia developed in the Internet by the global knowledge society. More than 500 000 articles in English are stored in it. Lithuanians have their own area [7] in this project as well (more than 3000 articles) and this is the proof that Lithuanian knowledge society is capable of creating and developing the e-material. The Wikipedia project has such features:

- It is a multi-user development environment that has no advanced rights hierarchy (anyone can edit the larger part of the material);
- It has a textual (not visual) environment for fast editing, which uses a specific wiki markup;
- The participants create development templates in the same environment;
- E-material development has a voluntary basis.

The Wikipedia project's existence is successful in using this environment; however system requirements are different so the interception of the development environment just as it is and its direct application to e-learning material development is not enough. We are of the opinion that the main disadvantage of the Wikipedia project is that the development environment is "width" (material amount) oriented but not quality oriented; i.e. there exist a lot of articles that are well prepared but Wikipedia also contains many unfinished articles. This is influenced by this fact that almost anyone can edit the presented material; the material development process is not defined and the groups of material developers use their own methods; the absence of developers hierarchy encumbers the evaluation and validation of the material and frameworks quality (qualified developers sometimes get into useless disputes); the absence of project development tools does not allow developing the material purposefully (material development is performed spontaneously), the progress is not tracked. We assume that the base factors, which enable a successful activity of the Wikipedia project, are the openness both to material development and its usage; the identification of a separate user and its contribution; the existence of tools that ensure material development and their simplicity. Activities in the Wikipedia project are organized so that such activities as changes tracking, their acceptance or rejection, complement become attractive: people demonstrate their knowledge willingly and discuss on the interesting themes. By sharing and communicating of knowledge they transform individual knowledge into society knowledge (noticed in [10]).

3.3. The requirements set for the e-learning resources development environment

In setting the requirements for the e-learning material development environment under design the goal was to include the best features of the Wikipedia environment avoiding the noticed disadvantages and considering the differences between the systems.

The requirements set for the e-learning resources development environment are:

- The development environment has to provide with a model material editor that enables to automate such formatting actions, which are frequently performed;
- The development environment has to provide with a subsystem of visual editing, which enables inexperienced users to present their material without going deep into the fast editing (wiki) syntax;
- The development environment must have an advanced authorization and material control system that enables to define the rights for the material under development;
- The development environment has to provide with a changes tracking subsystem;
- The development environment has to provide with a project control subsystem;
- The development environment has to provide with a template and other subsidiary resources development subsystem;
- The development environment must ensure that created learning recourses must comply with accessibility requirements (i.e. standarts from w3c consorcium [8]). Increasing accessibility is also one aspect of student support in e-learning [9].
- The development environment has to provide with a possibility to describe resources according to learning object description standards (e.g. SCORM).

During the development of the prototype such subsystems were under development revising the requirements for the development environment and for the need for additional subsystems.

4. The architecture of the system under development

The selection of the tool for the architecture was influenced mainly by the requirements of resources usability for the system. Experimenting with the prototype and considering people needs (according to the survey presented in Section 2) the requirements for the system under development were set (not including the requirements for the collaborative development environment). The requirements that influenced the selection of the architecture are presented below:

- The learning objects of the system have to be integrative into the other remote systems so that the integrated learning object would make no harm to the integrity of that system;
- The learning objects of the system have to be reusable in various programming environments (platforms);
- The learning objects of the system have to be apt to individualize, to adapt to corresponding learning needs;
- The adapted material and confidential information has to be unrelated to globally used information and stored in local servers of institutions;

- A search for the open adapted material has to be apt to perform and to use in other systems.

In other words, these requirements define the so called GRID architecture. Therefore the system was designed from the first in such a way that it would conform to the GRID structure. The centralized model was selected for the prototype; such the model follows the requirement that the material (its quality) has to be controllable. The architecture of the system under development is presented in Figure 3.
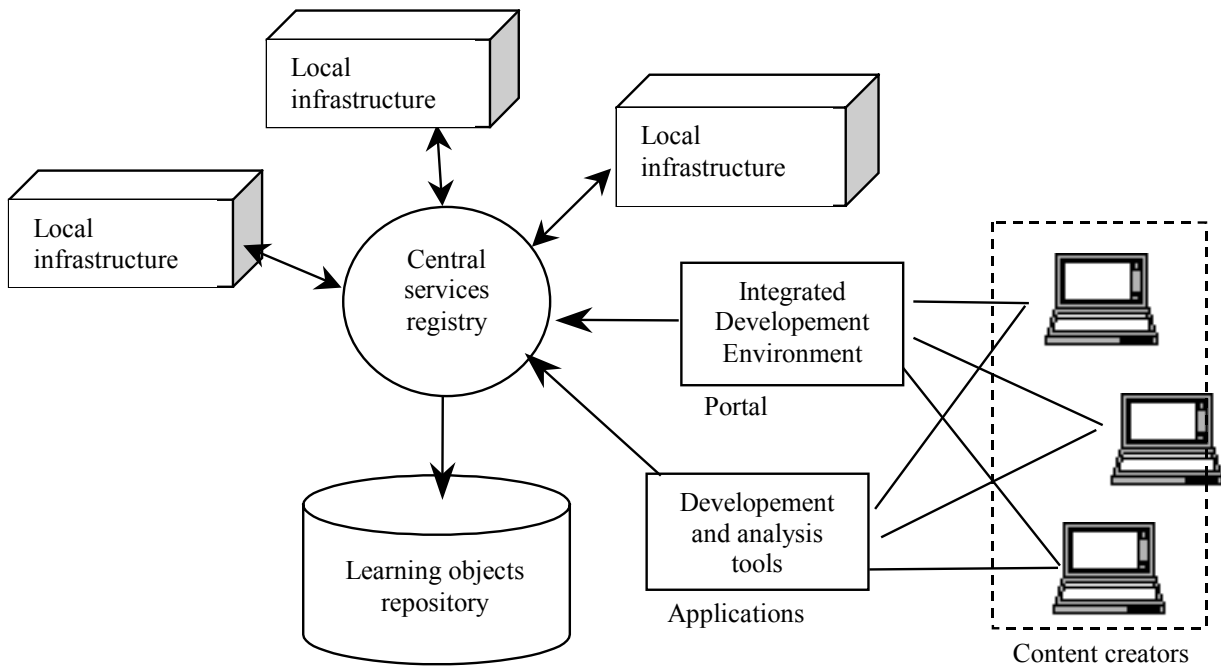

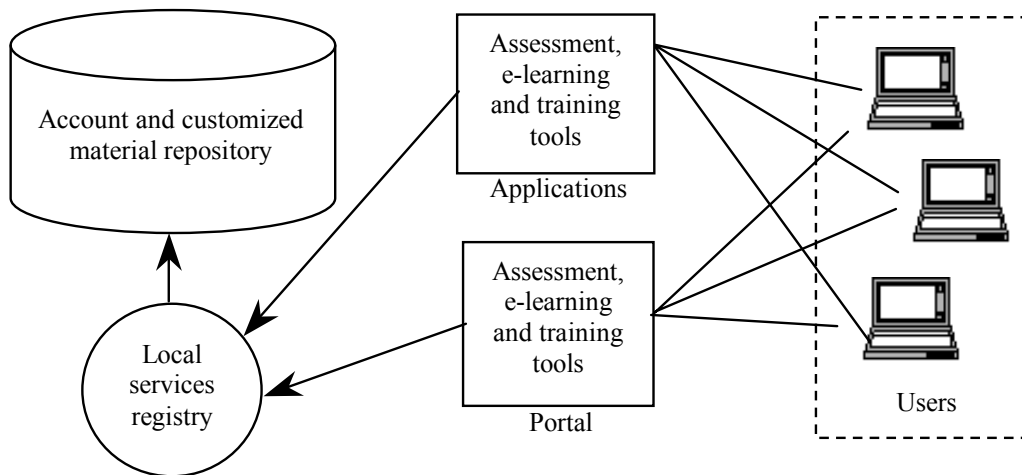**Figure 3.** The distributed architecture

Figure 4. The local infrastructure

As the e-learning material and programs are being developed by several organizations (all the members of the knowledge society have to be able to create various applications using learning objects), so the

interface for data exchange has to be provided. This interface can be realized on the basis of the web-service. Both portal software and client executables that support the web-service interface can connect to it. "Central services registry" presented in figure 3 is a package that contains the web-services (functions) dedicated for the search for learning objects and data exchange. "Local services registry" presented in figure 4 is a package that contains the web-services (functions) dedicated for operations with client data (e.g. with schoolchildren list control) and data exchange with „Central services registry". "Assessment, e-learning and training tools (application)" is the client software dedicated for presenting learning objects, using them for tasks or learners testing. It is used in case the environment provided by the executable is more convenient for users than the web-page. "Assessment, e-learning and training tools (portal)" is the web-page dedicated for presenting learning objects, using them for tasks or learners testing. Integrated Development Environment" is a tool for e-learning material development. "Development and analysis tools" are subsidiary client program for the analysis of the material under development.

5. The adaptation of e-learning resources

One of the main factors that enable to attract the knowledge society for resources development is the openness of the material under development, the possibility to use it for individual purposes. Therefore one must ensure that the knowledge society could perform this in a convenient, non-excess way. The simplest way to perform this is a direct copy of information from the web-page. On the other hand, this way has some disadvantages:

- The copied information has to be formatted by adjusting it to the system under usage (e.g. for a personal web-page);
- The tracking for changes in the information of the global resource, the repeated copy and adjustments have to be done.

This implies that in order to avoid such a situation the resource under usage has to be related to the global source so that the current information would be sent every time using it. Another aspect is that people have to be able to adapt resources to the context (e.g. teachers must be able to present the explanations together with the learning resources, to include additional tasks, etc.); i.e. they must be able to form the learning material without restraint by including their own material, using the edited global e-learning resources and constantly renewing e-learning resources.

Another aspect is that the developed adapted e-learning material can be approached as a separate learning object that the members of the knowledge society may wish to allow others to use. Due to this reason the interconnection between the central and the local servers has to be established in order the search

for the adapted resources and their transmission could be performed.

6. Conclusions

There is no Lithuanian internet resource where the knowledge society could develop e-learning material collaboratively and use them for their needs. Due to this fact people do not imagine the usefulness of collaborative resources development and perceive themselves more like users (the material for them should be prepared by experts) but not creators. Therefore a successfully operating resource of collaborative e-learning material development is urgent for the evidence of the practical benefit.

Quality material development must have a defined process. As the adjustment of the strictly defined process for the members of the knowledge society is impossible, so the material development environment has to be organized so that the members of the knowledge society would accept various activities as natural and such activities should be attractive for the people. A close integration of tools is of great importance here. After implementing the system surveys will have to be done; such surveys will have to cover the acceptance or rejection of various activities and tools by the people.

The system under development is based on the GRID structure, where the interface is realized through web-services. E-learning material editing is unrelated to a concrete design. This enables to integrate the learning material into various environments so that the integrity of those environments were not violated and the possibility to use e-learning objects in programs on various platforms were provided.

The possibility to adapt the e-learning material is not only practical, but as well important for the motivation of the knowledge society; i.e. the knowledge society will see that the resources developed collaboratively can be effectively adapted to individual needs.

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