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Network of Schools as a Framework to Support E-Learning within Educational Communities

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1. Introduction

The further expansion of ICT in e-learning at schools enables not only to enhance learning possibilities practically at all levels (e.g., learners, teachers, administrators, etc.) but also to address challenges such as creating socio-technology-based networks. The mission of the Chapter is: 1) to discuss some aspects of creating *networks of schools (NoS)* to enhance e-learning; 2) to analyze the characteristics of the real NoS, i.e., the UNITE NoS (UNITE, 2006-2008); and 3) to show in which way the NoS can contribute in creating social value within education communities. To achieve these goals, we first analyze and evaluate the available examples of the communities at school level aiming to find out relevant information for creating a model of NoS. The model we introduce in the Chapter helps us to motivate a systematic approach to dealing with the challenges of e-learning/m-learning paradigm at the school level, to model the e-learning processes (e.g., integration, interaction and exploration of different components, i.e., technology, platform, e-learning scenarios, pedagogy and social-related aspects into one framework), to reason about quality of learning to validation of new concepts, such as e-learning/m-learning scenarios, and finally evaluate the impact of NoS for the community.

Though we describe the model as a case study of the European FP6 IST-26964 project (UNITE, 2006-2008), the model reflects the generic aspects of the problem too. The UNITE network is a group of 14 schools, the UNITE users from the project partner countries with different languages, specialization, age of pupils and cultures. The study presents an implementation of e-learning scenarios in the European-wide school network.

As a result, we have identified and described an *added value of the network of schools*. It includes: *creation of social added value* through e-learning quality of enduring value for teachers and learners of the UNITE schools in the enlarged Europe; *changing the role of teachers* (as content creator, as scenarios developer, as trainer); *novel teacher's knowledge* in modern IT; *better individual learner's support* (e.g., customization and personalization); *better interaction* (e.g., learner-learner, learner-teacher); *better collaboration* (e.g., sharing of learning resources); *broadening learning possibilities*; *international experience and knowledge sharing*. All these are explicitly or implicitly described in our case study.

Our observation is that NoS, such as the one introduced in UNITE, provides social changes and it is also seen as an environmental basis within educational communities for the investigation and validation of the e-learning framework, i.e., technological platform, the pedagogical models, and the e-learning scenarios that were created, integrated, populated and used in the schools. We conclude that e-learning in schools is indeed the challenge for the administrative staff, teachers, and learners because many aspects of the paradigm are still poorly understood and further investigations are needed.

This chapter is organized as follows. Section 2 analyzes related work. Section 3 describes the introduced approach and the model of NoS with the emphasis on the estimation of measurable characteristics to quantitatively estimate the model. Section 3 presents a case study and basic results of the UNITE network of schools. Finally, Section 4 provides a summary of the results and conclusions.

2. Related work

In Section 2 we analyze the related work by categorizing it into two streams as follows: (1) analysis of state-of-the-art in creating network of schools within the learning communities; (2) best practice examples of the network of schools.

2.1 Network of schools in e-learning: state-of-the-art analysis

Schools and universities are social institutions, where educators carry the responsibility of building the foundations of a new social contract that elicits education, knowledge and learning in the learning society. To empower the learning society with new capabilities there is a big need for investment in e-learning in schools, including investment in ICT infrastructure, the development of e-skills of teachers and learners, the possibility to improve and enrich learning experiences, e.g., through the use of mobile, game-based and other new IT-based learning paradigms.

Carneiro describes three scenarios of a learning society, focusing on the interactions of three key variables: paradigm shifts, delivery modes and driving forces which should give the way to empowered communities (Carneiro, 2007). The primary reason for the emergence of relationships within the community as a social network is that individuals interact through social discourse in order to perform their work, asking for and sharing knowledge with each other. *Networks of practice* incorporate a range of informal, emergent networks, from communities of practice to *electronic networks* of practice. Brown & Duguid identify communities of practice as a localised and specialised subset of networks of practice, typically consisting of strong ties linking individuals engaged in a shared practice who typically interact in face-to-face manner; virtual communities interact electronically but their ties are weak (Brown & Duguid, 2001).

Schools involved in networks (NCSL, 2005) have seen that networks: a) broaden the teacher expertise and learning opportunities available to pupils, b) provide a direct mechanism for sharing expert teacher practice, c) provide the diversity, flexibility and range of opportunities that no single school can offer, d) nurture creativity, risk-taking and innovation to improve learning and teaching, e) lead to improvement in pupils' attainment, f) lead to improved teaching.

Eckel and colleagues suggest a set of common definitions of *institutional learning as transformation* that (1) alters the culture of the institution by changing underlying

assumptions and overt institutional behaviours, processes, and structures; (2) is deep and pervasive, affecting the whole institution; (3) is intentional; and (4) occurs over time (Eckel et al., 1998). Active learning, collaborative learning may lead to different types and degrees of change. It may lead to some modification of the traditional lecture/discussion mode and pedagogy. If it is pursued more deeply and broadly, it can become transformational, challenging existing notions of the roles and behaviours of school and learners, forcing new pedagogies to be developed, creating new applications for technology, calling for new measures of success and mastery, and leading to different thinking about learners' engagement with courses' content and materials.

Denning emphasizes that fostering a change of practice in a community is much more difficult than inventing a new technology. The *practice of innovation* can be learned - once you know what it is. Denning uses innovation to mean the adoption of a new practice in a community. Innovation is therefore a social transformation in a community. Innovation requires attention to other people, what they value and will adopt (Denning, 2004).

McPherson remarks that the *organisational context* is critical to the success of the e-learning settings, in which tutors, learners, courses and ICT are integrated (McPherson, 2002). Rogers and Finlayson describe the main lines of a *teacher preparation* model (Rogers & Finlayson, 2002). They discuss the levels of competence to be achieved by trainee teachers, putting them in relation with the training objectives. They also define innovations to be introduced in ICT training to support teachers in understanding how, and under what conditions, technology can support the emerging pedagogical practices.

Drawing upon the social constructivist theory, Hargreaves (2006, p. 17) suggests that co-construction places less emphasis 'on the teacher having to take account of the learner as a knowledge constructor and more on the need for the teacher to treat the learner as an active partner in the jointly constructed activity of learning and teaching co-construction'. This view focuses on the relationship between teachers and learners and also between teachers - other teachers.

In a wider context, "Europe needs to boost its capacity for *creativity and innovation* for both social and economic reasons" (Europa, 2008). Fischer and Giaccardi extend this view saying that social creativity can be supported by innovative computer systems that allow all users to contribute to framing and solving design problems collaboratively and act as designers (Fischer & Giaccardi, 2004). One of the most well-known innovation paradigms refers to the so-called "diffusion of innovation" theory (Rogers, 1962). According to this paradigm, any innovation in its early stage of development is a disruptive rather than a consensus-building factor. Therefore, it tends to create divides between "early adopters" and "laggards", which shrink over time. However, recent research pinpoints that "the simple invention-innovation-diffusion model does not do justice to the multilevel, non-linear processes that firms, entrepreneurs and users participate in to create successful and sustainable innovations" (Fagerberg & Jan, 2004).

At the heart of professional learning communities is the idea of *co-construction*. The focus is not only on individual teachers' professional learning, but also on the co-construction of knowledge within a community context, within a community of learners. Co-construction and professional learning are also two essential features of D and R networks in England (Harris, 2008). Harris explores the way in which D and R networks have been established and led, as well as the emerging evidence about their potential to create new knowledge.

The National College for School Leadership (NCSL, 2005) refers to three *characteristics* that *effective networks* of schools have in common: 1) design around a compelling idea or aspirational purpose and an appropriate form and structure; 2) create new opportunities for adult learning; 3) plan and have dedicated leadership and management.

When we talk about evaluation, we should recall that the major goal of evaluation is to “judge and improve the ways in which human services policies and programs are conducted, from the earliest stages of defining and designing programs through their development and implementation” (Rossi & Freeman, 1993). Evaluation uses traditional social research methods within a political and organizational context; therefore it requires group skills, management ability, political dexterity and sensitivity to multiple stakeholders. Results of evaluations serve a range of actors (sponsors, donors, clients, administrators, staff, policymakers and decision makers, project managers, evaluators, contextual stakeholders and other constituencies/stakeholders), by providing some “useful feedback”. The provision of empirically-driven feedback is meant to influence the decision-making, policy formulation or further program/ project development.

As stated by Cronbach, evaluations need to be designed and implemented in ways that recognise the policy and program interests of the sponsors and stakeholders, and that will yield maximally useful information for decision makers given the political circumstances, program constraints, and available resources. Evaluations happen in different social contexts, serve different stakeholders and goals (Cronbach, 1982). In the context of network of schools within the e-learning, evaluation would also serve a range of stakeholders, such as the project management, the involved actors from the schools, potential users of the platform, and policy stakeholders on whom involvement of education depends.

The types of evaluations depend on the object being evaluated and the purpose of the evaluation. For example, formative evaluations strengthen or improve the object being evaluated and summative evaluations examine the effects or outcomes of some object. In a wider evaluation context, Dutta & Jain proposed Network Readiness Index (NRI) which was used in The Global Information Technology Report 2003–2004 funded by World Bank and World Economic Bank to evaluate readiness of countries in use of IT (Dutta & Jain, 2004).

According to Hughes & Attwell, “the evaluation of e-learning, and research into the evaluation of e-learning, has been dominated by descriptive ethnographic studies, rather than interpretation and analyses and there is a predominance of ethnomethodological approaches, in particular, heavily contextualised case studies. The relatively small number of empirical studies has focussed on a limited number of variables. As the databank of research results is built up, particularly as the different variables are ‘weighted’, it becomes easier to identify the irrelevant variables and allow for the impact of others. It also allows predictions to be made which can short circuit the search for an appropriate evaluation methodology” (Hughes & Attwell, 2003).

The European good examples of the networks of practice are provided below.

2.2 Examples of good practice of Network of Schools

European Schoolnet (EUN, 2009) is a framework for the co-operation between the European Ministries of Education on Information and Communication Technology in Education. The EUN also runs several websites for teachers and other educationalists.

European Schools Project Association (2005) is a collaborative open network organization. It builds on the European Schools Project that started in 1988, on the work done in the

Comenius3 thematic networks ECOLE and COMP@CT. There are actually more than 300 participating schools from over 26 countries from all over the world.

The *Nordic Schoolnet* (2008) is a service from the Nordic Council of Ministers aimed at facilitating and stimulating partnership between schools, teachers and learners in the Nordic region, terminated at June of 2008. A vital part of this is the close collaboration between the Nordic Schoolnet and various Nordic organisations and institutions such as the national Schoolnets and the various national programme offices. The Nordic Schoolnet provides a co-operation tool as a service completely free of charge. It is a very simple service, offering a robust platform for work rather than any sophisticated technical solutions. No membership is required in order to access one's own project site.

The Finnish National Board of Education runs the school portal (EDU.fi, 2009), which is primarily aimed at teachers. The portal gathers together services categorised according to the different levels, fields and themes of the Finnish education and training system. The portal is produced in Finnish and in Swedish. On the English site you can find some basic information about the Finnish school system.

Danish Schoolnet is a portal for primary and lower secondary schools and upper secondary schools (EMU, 2009).

The objective of *European Federation for the Education of Travelling Communities* (EFECOT, 2009) is to implement the Resolution of 1989 on school provisions for children of Occupational Travellers: the creation and promotion of educational provisions adapted to the particular needs of the Occupational Travellers and stopping them falling through the educational and social net.

myEUROPE is a project which aims to help teachers raise their pupils' awareness of what it means to be a young citizen in Europe (myEurope, 2009). It is a network of more than 5000 schools that work together, exchange and share information relating to European themes. In this way they bring the diversity of Europe into the classroom via the Internet, proving that the path to living together in Europe starts at school.

The provided analysis shows that though in Europe there are many efforts to create networks of schools, however, they make a little emphasis on new capabilities of technology, such as mobile devices. Furthermore, there are measurable attempts to involve into a wide European network the schools from new East and middle EU countries as the UNITE project did (UNITE, 2006).

3. An approach of Setting-up the Network of Schools

The goal of our work is: 1) to analyse the process and model of creating network of schools (further NoS) to enhance e-learning, 2) to analyze the characteristics of the NoS and 3) to show in which way the model of NoS can contribute in evaluation of social aspects within education communities.

3.1 Model of Network of Schools

We introduce a formalized model called "*evolutionary model of network of schools*" in order to bring the general framework for better understanding of the internal processes and interaction among different schools within the network to be created. Though the model has been built as a result of the UNITE project (UNITE D8.1, D8.2, 2008), the model is general and describes the related problems in a wider context. The approach (model) outlines four

basic items: 1) context of a node (school) of the network (see Figure 1); 2) life-cycle of the network of schools NoS (see Figure 2); 3) measures for the evaluation of the attributes of NoS (see sub-section 3.2); and 4) evolution of attributes of the network within the given life-cycle. Items 1, 2 and 4 are presented in this sub-section, while the item 3 is presented in sub-section 3.2.

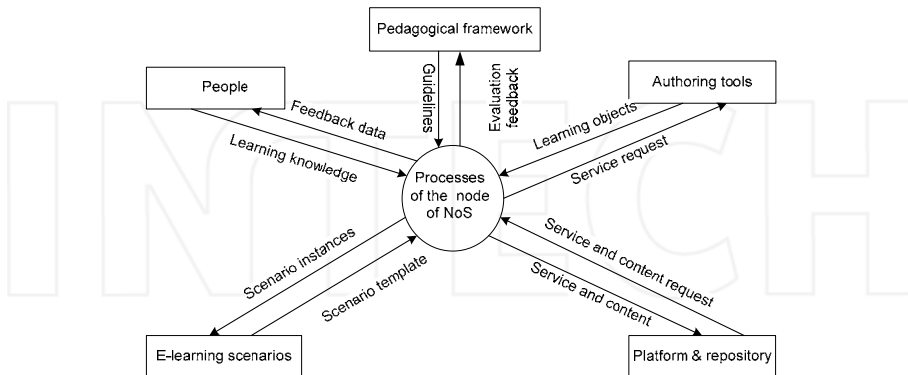


Fig. 1. Context diagram of a node within the NoS in UML-based notation

The primary assumption is that the *node (school)* is influenced by three basic information sources coming from: the platform, the pedagogical framework, and e-learning scenarios for school. The underlying e-learning concept in UNITE is the close collaboration of these components to support the concepts of collaborative and mobile learning (m-learning). The UNITE-platform integrates a portal, a repository, and a m-learning component and, herewith, provides the necessary technical basis. The pedagogical framework, based on this platform, develops guidelines for the creation of collaborative and mobile learning scenarios. The authoring tools are used to implement multilingual content based both on the concepts of the pedagogical framework and using the underlying platform technology. This leads to a new kind of synergy being essential for the European-wide Network of Schools.

The other assumption is that the creation of NoS should be considered within a given period of time and supported by some resources (e.g., introduced through a financed project). The usage, evaluation and feedback by the NoS are continuous processes leading to both an incremental update of the system as well as an improving acceptance of the application partners at schools.

Other sources affecting the node are: people, management, maintenance, internal communication, data of monitoring and evaluation within school, school learning environment (they are not depicted in Figure 1).

The process of the NoS formation is to be harmonized to crucial time slots. We introduce four essential phases as follows: User requirements design for e-learning (phase 1), mock-up design (phase 2) e-learning framework design (phase 3) and e-learning population (phase 4) (see Figure 2). These phases describe the life-cycle of the project. The life-cycle is a framework of the proposed model in the sense that the rest components are considered within the introduced phases.

The primary assumption is that we look at any school as a component, which is usually composed from other smaller components, such as people (e.g., teachers, learners) or e-

learning environment, platform (Figure 1). In a similar way, the NoS is also viewed as a higher-level component. The term “component” is essential in this context. Whereas components in technological disciplines are interacting by sending messages or signals, social components (we treat a school network as a social component) interact between themselves by sending portions of “social information” created within teaching environment. By analogy with technical systems where the structure of component is defined as consisting of two basic elements, interface and functionality, we define a “social component” as consisting of “social interface” and “social functionality”. “*Social interface*” describes how the component interacts with other components or with the external environment (e.g., other schools, governmental authorities, etc.). “*Social functionality*” describes what tasks and activities perform the component and in which way it creates the social information either for the internal use or for transferring the social information to the external environment. The functionality describes also that part of the information created as a result of teaching activities, which is for the internal use only within the school.

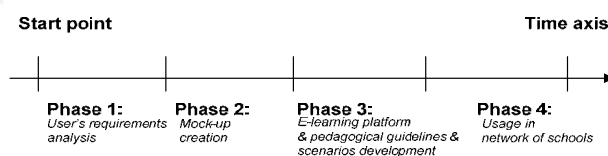


Fig. 2. The life-cycle of the network of schools

The evolution of the e-learning framework within the introduced model is viewed as a result of a combination of the following activities carried out throughout the life-cycle of the NoS:

Phase 1. Definition of users' requirements; main actors are designers, stakeholders, schools, and individuals.

Phase 2. Design of mock-up of e-learning framework and platform; evaluation and supplement of users' requirements; main actors are designers, schools, and individuals;

Phase 3. Development of e-learning platform/ pedagogical framework (guidelines); validation cycles: validation and improvement of the e-learning platform/framework; training of teachers, e-learning scenarios and content creation, main actors are designers, pedagogical experts, schools, and individuals;

Phase 4. Exploitation of the framework, testing, delivery and evaluation; main actors are schools and individuals (also involvement external experts and decision makers).

What is the benefit of the model? The model is a simplified description of the very complex reality, i.e., a real network, thus the model simplifies analysis. The model emphasizes the most crucial aspects of a real network. Explicit separation of concerns within the model allows focusing on the particular aspects within the school in a time, therefore again simplifying analysis. The model increases understanding, decreases the amount of information for external viewing and transferring, tasks for monitoring and evaluation makes easier to manage. It describes also an evolutionary process identifying changes of attributes of the NoS within the given life-cycle as it is specified below.

Figure 3 describes the item 4 of the approach, i.e., the process of involvement of actors into the NoS through changes of attributes and operations within each phase of the life-cycle. The attributes identify changes of characteristics specified using the so-called network

Readiness Index (details are given in sub-section 3.2) at each phase (from 1 to 4). Attributes 1-4 are evaluated by representatives of individuals, schools and other institutions (teachers, learners, technical staff, principals and experts). Qualitative data need to be gathered from the target groups through the method of structured interviews and direct observation by experts. By qualitative data we mean the information created or elicited (gathered) from the network, which replies to “why” and “how”.

Note that feedback loops within the phases are missed in the Figure 3 for simplicity reasons.

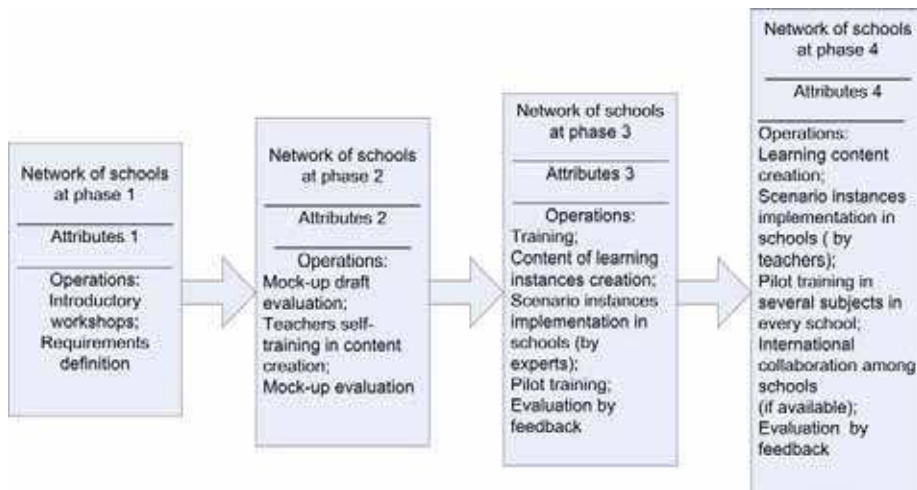


Fig. 3. Evolution of attributes and operations within the life-cycle (UNITE, 2007)

Thus the key action is gathering and analyzing of data from conducted questionnaires with the actors involved in NoS (the schools principals, teachers, technical staff and pupils). The interviews are conducted with all the actors from the schools in all nodes of the network. The questionnaires should be different for each target group and would contain qualitative and quantitative, open and closed questions (UNITE D8.1, 2007).

Now the task is to identify distinctive features and measures of the network of schools as it is described in the next sub-section.

3.2 Network of Schools Readiness framework to implement e-learning

For the analysis and evaluation of *social aspects* of the network of schools, it is necessary to have quantitative measures for the state of the network. To do so, we have adopted the basic concept of *Network Readiness* from (Dutta & Jain, 2004). The framework (see Figure 4) describes characteristics of a school participating in the network and benefiting from e-learning.

The *Environment Component (EC)* is designed to measure the degree of conduciveness of the environment that a community provides for the development and use of the e-learning framework:

- *Learning Environment*: existing pedagogical practice, educational system's conditions, investments, sponsorship of scientific researches, institutions quality, number of educators, international collaboration; school specialization in particular discipline, ICT use in other disciplines.

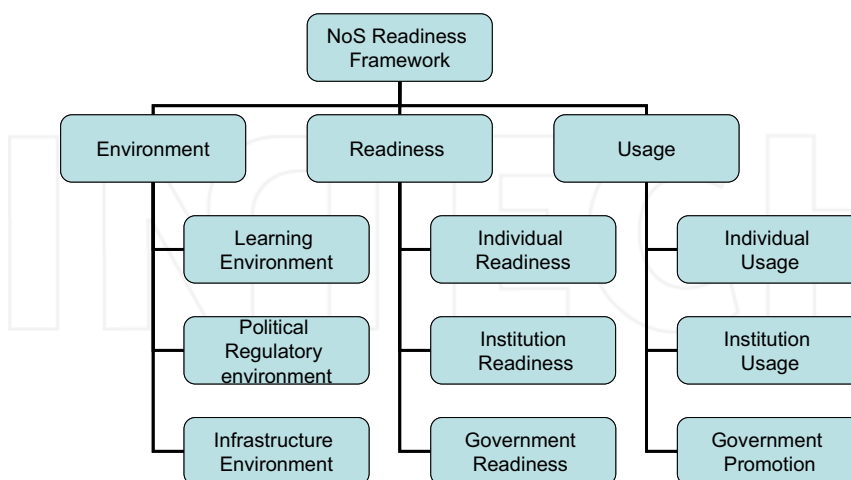


Fig. 4. Network of Schools Readiness framework (adopted from Dutta & Jain, 2004)

- *Learning Environment*: existing pedagogical practice, educational system's conditions, investments, sponsorship of scientific researches, institutions quality, number of educators, international collaboration; school specialization in particular discipline, ICT use in other disciplines.
- *Political And Regulatory Environment*: national curricula and school educational policy plans, the overall weight of management, political system quality, law regulating copyright, efficiency of the tax system.

Every educational system has its specific characteristic (starting from compulsory education and subjects, assessment, preferred pedagogical principles etc). National background for educational policy is rooted in historical, social, cultural, ethical, economic, and other developments. National assessment methodology: traditional assessments (oral exams and written test) are still predominant ways of pupil assessment but there are also efforts to include newer models (problem solving, self-, peer- and formative assessment).

A successful education system requires good administration, effective financing and management mechanisms. Legislation changes and national reforms recently gave more power and independence to most of the schools. School principles will now need to be good decision-makers and effective managers that will make the implementation of educational policies possible. National curriculum and school timetabling can impose a difficulty to the implementation of new pedagogical approaches and the adoption of technology enhanced learning to the daily practice of teachers.

- *Infrastructure Environment*: technology variables of the schools: hardware, software, connectivity, the media, and mode of delivery, type and speed of bandwidth; availability of wireless local area network in school; availability of IT resources: number of PC, laptops, multimedia equipment, data logging equipment, PDA, mobile phones.

The Readiness of a community (network of schools) (RC) measures the capability of the principal agents of a community (individuals, institutions and governments) to leverage the potential of the e-learning framework. This capability is lent to the community by a combination of factors like the presence of relevant skills for using the e-learning environment within individuals, access and affordability of the e-learning environment for schools and government readiness to promote the e-learning in the country:

- *Readiness of individuals*: teachers, learners, parents and foster-parents: the training applied for the needs of ICT institutions, the experience in applying software for preparing of texts and graphical material; individual teacher variables which include: pedagogical history, (negative/positive experience, level of attainment, etc), attitude (positive/negative), motivation (high/low), and familiarity with e-learning methodology, mobile learning (m-learning), and technology in general. Parents' involvement in school management, decision making and controlling processes, fund raising and organization of different mutual activities. Note that quantitative estimations of Readiness of individuals could be obtained from the answers to the following questions at the beginning of the e-learning implementation project: How do you think e-learning can improve collaboration? What do you understand by mobile learner? How do you think moving to a place relevant to the subject being studied can help pupils to better learn key concepts and processes? What has motivated learners/teachers to participate in this project? And others like that.
- *Readiness of learning institutions*: In-house technical competences/skills in school facilities of acquiring telephone lines, subscriber's pay, extent of staff training, educational training quality, the number of qualified teachers.
- *Readiness of the government*: prioritization on ICT and e-learning by the Ministry of Education, ICT supply for the Ministry of Education.

The Usage Component aims at measuring the degree of usage of ICT/ e-learning by the individuals, schools, and governments. In the absence of reliable data about the specific impact of the e-learning on the key stakeholders, the *Usage component* provides an indication of the changes in behaviours, lifestyles, and other economic and non-economic benefits brought about by the adoption of e-learning:

- *E-learning Usage By Individuals*: teachers, schoolchildren, parents and foster-parents: the number of PCs, the number of ISDN subscribers, the number of internet users, the number of e-learning users.
- *E-learning Usage In Learning Institutions*: the number of computers in schools, the usage of the e-learning environment in schools, the spread of software licenses; computer-based courses or lessons, or scenarios implemented in schools; computer-based materials implemented in schools; the level of multimedia used in schools; average number of teachers involved in e-learning per one school; in which networks is the school involved; school policies/traditions in e-learning; cognitive strategies/models being used; hours per week teachers devote to e-learning.
- *Government Promotion/Usage*: government success in e-learning promotion.

To implement the framework and to perform the measurements for each school of the network we introduce a Network Readiness Index (NRI) as follows below.

3.3 Network of Schools Readiness Index

In the context of the framework (see Figure 4) NRI is a composite of three components (equation (1)):

- ECI (Environment Component Index), the e-learning environment offered by a given school,
- RCI (Readiness Component Index) the readiness to e-learning by individuals, schools, and governments,
- UCI (Usage Component Index) finally the use of the e-learning at the school.

$$\text{NRI} = K_1 * \text{ECI} + K_2 * \text{RCI} + K_3 * \text{UCI} \quad (1)$$

We accept that the value of NRI ranges from 0 (the worse case) to 1 (the best case). K_1 , K_2 , K_3 are coefficients evaluating the “weight” of each constituent factor in equations 1 (values of coefficients should be obtained through collecting and evaluating the adequate data known either from literature or obtained from questionnaires). Furthermore, values of K_1 , K_2 , K_3 range from 0 to 1/3. Then values of ECI, RCI and UCI $\in [0,1]$.

The index ECI consists of the following sub-indices: ELS-Learning Environment Sub-index, EPS- Political and Regulatory Environment Sub-index, EIS- Infrastructure Environment Sub-index.

$$\text{ECI} = k_{1,1} * \text{ELS} + k_{1,2} * \text{EPS} + k_{1,3} * \text{EIS} \quad (2)$$

The index RCI consists of the following sub-indices: RIS- Individual Readiness Sub-index, RSS-Institutions Readiness Sub-index, RGS- Government Readiness Sub-index.

$$\text{RCI} = k_{2,1} * \text{RIS} + k_{2,2} * \text{RSS} + k_{2,3} * \text{RGS} \quad (3)$$

UCI- Usage Component Index consists of the following sub-indices: UIS- Individual Usage Sub-index; USS- Institutions Usage Sub-index; UGS- Government Promotion Sub-index.

$$\text{UCI} = k_{3,1} * \text{UIS} + k_{3,2} * \text{USS} + k_{3,3} * \text{UGS} \quad (4)$$

The values of $k_{1,1}$, $k_{1,2}$, $k_{1,3}$, $k_{2,1}$, $k_{2,2}$, $k_{2,3}$, $k_{3,1}$, $k_{3,2}$ and $k_{3,3}$ are in the range $[0, 1/3]$ each. Then values of ECI, RCI, UCI ELS, EPS, EIS, RIS, RSS, RGS, UIS, USS, UGS $\in [0,1]$.

The values of sub-indexes can be obtained by observing the estimations of the variables comprising each sub-index. The quantitative estimations (score) could be used, for example: 5 (perfect), 4 (medium), 3 (poor), 2 (unsatisfactory), 1 (badly), 0 (N/A) to estimate the readiness/usage/environments of individuals, schools and other institutions. Then the estimates should be normalized with respect to the interval $[0: 1]$. The empirical data about the state of the school network collected in each phase of the life-cycle provides data for the evaluation. Contextual (social) schools’ indicators do not depend on e-learning activities:

sources of school funding, urban/rural schools, gender of the learners, age of the learners in school, number of learners in the schools, lesson length.

4. Case study: the UNITE network of schools

4.1 Framework

The EU project UNITE (FP6 IST-26964, 2006-2008) aims to create the unified e-learning environment for European schools (UNITE, 2008) consists of the following basic components: technological platform, pedagogical methodology guidelines, and e-learning scenarios (all together - the UNITE framework). The UNITE platform is an e-learning environment based on three technologies: Microcosmos, MTS-Infopool and m-learning (UNITE, 2007). As such, the UNITE platform provides a seamless integration of those technologies in a user friendly environment in order to offer the following functionality to the end user: e-learning management, content management, communication / collaboration, m-learning. To carry out the design, implementation and validation of the UNITE framework each partner involves one or two schools, thus creating a network of schools (NoS). Quantitative (e.g., structural, social, etc.) characteristics of the UNITE NoS are provided in Table 1.

Country	Name of school	No of schools	Number of teachers	Number of pupils
Bulgaria (BG)	134 Hebrew and English Language School, Sofia & National HS of Mathematics	2	7	130
Cyprus (CY)	The English School	1	1	10
Croatia (HR)	Elementary School 'Spinut'	1	2	15
Germany (DE)	Berufliche Schule Elektrotechnik/Elektronik & Erasmus-Gymnasium Rostock	2	4	70
Greece (GR)	Ellinogermaniki Agogi School	1	3	35
Latvia (LV)	Riga 3. secondary school	1	3	35
Lithuania (LT)	Kaunas University of Technology Gymnasium	1	5	16
Malta (ML)	Stella Maris College, Gzira & Margaret Mortimer Girls' Junior Lyceum, Sta. Lucia	2	12	160
Slovenia (SLO)	Gimnazija in ekonomska srednja šola Trbovlje	1	3	17
United Kingdom (UK)	King Edward VI School & Lynn Grove VA High School	2	6	24
Total		14	46	512

Table 1. Quantitative characteristics of the UNITE network of schools

Figure 5 and 6 provide the geography of the UNITE NoS and learners' ages within the network, respectively.



Fig. 5. UNITE NoS geography (www.unite-ist.org)

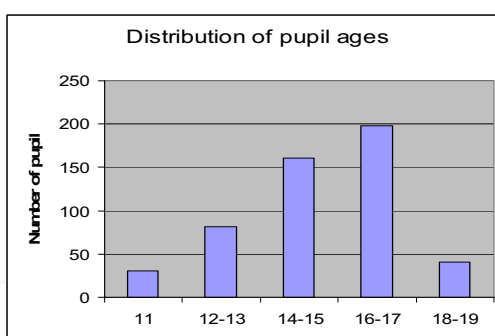


Fig. 6. Distribution of learners ages in UNITE NoS

4.2 Characteristics of Environment Component index

For the analysis and evaluation of social aspects of the UNITE network of schools we measured NRI in different phases of the project. The values of the UNITE NRI (see eq. (1)) components were obtained from estimations of the variables comprising each sub-index. For example, Indicators comprising UNITE ECI - *Environment Component index* (see eq. (2)) are provided in Tables 2 and 3.

Country of school	Computers	Laptops	Multimedia equip.	Data loading equip.	El-whiteboards	Other ICT resources	Wireless local area network	Type of bandwidth	Bandwidth Speed (Mbps)
BG	124	1	4	2	1		No		1
GR	22	2	1			1	Yes	ADSL	1
LT	25	3	2			1	Yes	Optics cable	10
DE	340	40	25		5	3	Yes	2x DSL	3
LV	80	3	5				Yes	Radio link	10
CY	100	3	10	1	1		No	DSL	2
SLO	56	10	7	3			Yes	Optics cable	
HR	40	3	4				No	Optics cable	100
ML	35	3	1			1	Yes	Optics cable	

Table 2. Indicators of the UNITE Infrastructure Environment (EIS)

Country of school	Biology	Chemistry	English language	Geography	History	Computer science	Math	Language	Physics
BG	x	x	x		x	x	x	x	x
GR	x				x				
LT			x			x	x		
DE	x					x	x		x
LV						x	x	x	
CY			x			x			
SLO			x	x		x			x
HR				x		x	x		x
ML						x		x	
UK						x			

Table 3. Indicators of Learning environment (ELS)- subjects of the UNITE NoS

UNITE arranged own analysis of *Political And Regulatory Environment (EPS)*-national policies and attitudes and compared the results with the European Schoolnet (2003) results of survey on the use of Virtual Learning Environments in educational settings in Europe. The survey answers show that the attitudes of ministries and national agencies of partner countries towards the benefits of e-learning and application of ICT in education are very similar to the ones stated above.

UNITE schools were asked to fill in the questionnaire where national educational characteristics and existing pedagogical practice were key considerations. Comments are considered as requirements for the pedagogical framework development and are described in (Unite D4.1 , 2006).

4.3 Characteristics of Readiness Component index

Examples of indicators comprising RCI - Readiness Component index are provided in Figure7 and column *Awareness of e-learning of teachers before project* of the Table 4 (see eq. (3)).

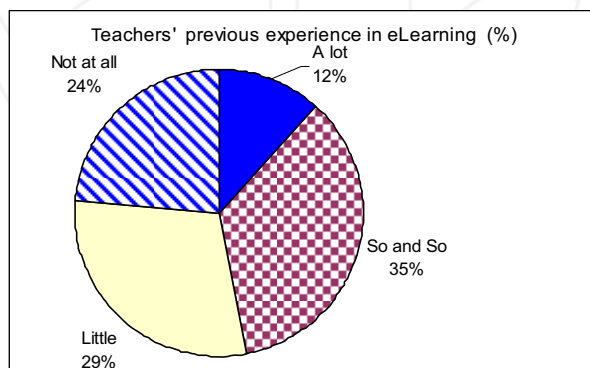


Fig. 7. Readiness of individuals (RIS)- teachers' previous experience in e-learning

4.4 Characteristics of Usage Component index

Some data about interdependence of the UIS and RIS are provided in Table 4 and Figure 8. The indicators of UIS and USS comprising UNITE UCI - Usage Component index are provided in Table 5 and Table 6.

Efforts/ awareness of e- learning	Awareness of e-learning of teachers before project	Average number of hours one teacher spent for one scenario implementation	Number of hours expert consulted
Bulgaria	45	50	30
United Kingdom	45	30	24
Lithuania	36	42	40
Croatia	36	40	75
Slovenia	35	40	20
Latvia	33	50	64
Cyprus	33	26	40
Greece	31	24	24
Malta	25	30	25
Germany	18	17	100

Table 4. Data of the Interdependence of the values of the UIS (efforts of teacher and his consultant in the process of implementation of the scenario) and RIS (teacher awareness of e-learning in different schools) (see chart in Figure 8)

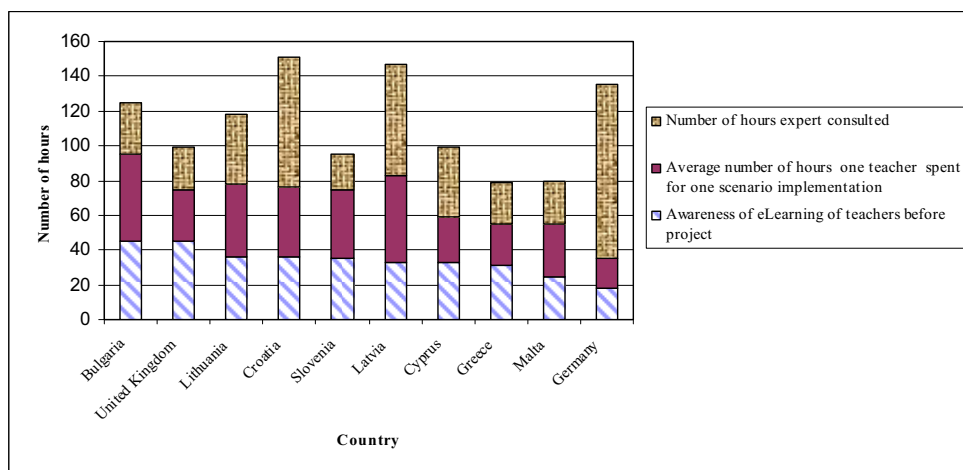


Fig. 8. Chart of the Interdependence of the values of the UIS (efforts of teacher and his consultant in the process of implementation of the scenario) and RIS (teacher awareness of e-learning in different schools) (see data in Table 4)

Authoring tools	Schools										Number of schools
	BG	CY	HR	DE	GR	LV	LT	ML	SLO	UK	
Text processors	x	x	x	x	x	x	x	x	x	x	10
Subject specific		x	x			x	x	x		x	5
Image makers	x						x	x	x		4
Video makers					x	x	x	x			4

Table 5. Indicators of UNITE UIS- Usage by individuals - tools used by individuals teachers and students in UNITE e-learning scenarios implementation (see eq. (4))

Name of e-learning scenario	ICT	English language	Environmental	Student Project
Type of collaboration	Teachers	Teachers	Teachers	Teachers & students
Countries	Bulgaria, Latvia, Lithuania, Slovenia	Germany, Malta	Cyprus, Greece	Croatia, Lithuania, United Kingdom
Number of countries	4	2	2	3

Table 6. Indicators of UNITE USS- Usage in institutions- Collaboration in the e-learning scenario implementation

5. Summary and conclusions

The ongoing shift from the traditional learning to e-learning and m-learning is indeed the challenging issue to individual actors, schools and society in the whole because it opens new technological capabilities to obtain, share, transfer information, and on this basis teach, learn more effectively using traditional models and frameworks and beyond them, such as learning models at any time and at any place. Along with the pedagogical challenges and requirements for new kinds of learning scenarios, all this enlarges the role of social aspects in e-learning environments since a new collaborative links are created and new cultural and social dimensions are emerging. The new challenges are to be understood, addressed and evaluated. The proposed methodology seeks at some aspects to address these issues.

This chapter includes the methodology that was applied for the qualitative and quantitative evaluation of social aspects of the network of schools within the UNITE project. The methodology is designed in the way to take into account all factors, influencing the implementation and use of e-learning in schools of the formed network. These factors are related to the individuals, to the schools and to the society as a whole and are aimed at exploiting the relation between these components, their characteristics and the tendencies in the approach to learning in technologically supported environments. The evaluation of social aspects provides an understanding of what are the requirements of the users and the context for implementing and successfully use e-learning environment in school.

We have presented some results of the validation of the outcomes of the project UNITE to support e-learning in the European assigned schools. To implement the managing procedure of the validation process in some well-established manner, we propose a model

of the network of schools called the evolutionary model. As the model describes explicitly of how the essential activities of the network of schools take place in the e-learning framework development, the model contributes to the systematization of the managing procedure by providing some guidelines for:

- (a) Gathering and specifying of users requirements for the e-learning platform development,
- (b) Testing of the e-learning environment and providing a feedback from end users,
- (c) Smooth adaptation and customization of the e-learning scenarios examples and the development of new ones,
- (d) Collecting the re-usable e-learning content created by teachers and learners,
- (e) Validating e-learning and m-learning environment and scenarios,
- (f) Managers to monitoring the use of the UNITE platform in everyday learning and teaching, monitoring the evolution and evaluation the progress of the planned activities, and to better understanding of the whole activities in schools and among partners.

Involvement of the European schools (end users) into the development of the UNITE e-learning framework bring dramatic and transformative improvements in the teachers work and pupils learning.

From the conceptual viewpoint of the proposed methodology, the model can also contribute to the issues of network of school analysis and investigation. As formation of network of schools has social context and content, the proposed framework and statistical data to be collected will help to provide the more insight view to the network of school problems. Thus we suggest the further extending of the concept of "evolutionary growth" and using it to provide analysis of the network of schools. Schools understand the advantages that ICT brings in learning process but the popularization of it should be done by ministries and national agencies that set national curriculum and standards.

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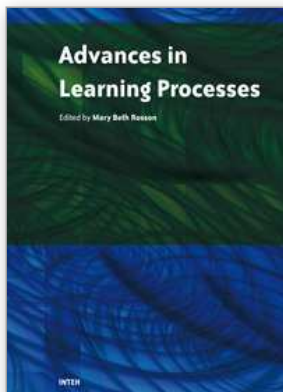
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