MENTORING INNOVATION - A TRIALOGICAL MODEL FOR IN - SERVICE TEACHER TRAINING

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Abstract: Multigrade schools are small primary level institutions situated mostly in villages. They have a single learning space for pupils of different age groups. As the only cultural institutions of these villages, educational methods that use their limitations as benefits and implement multi-age collaboration are needed. Different disciplines taught at the same time to different classes may be connected through an interdisciplinary organisation of learning content. In 2007-2008, teams of teachers at 21 Multigrade schools, local community stakeholders and researchers discussed the "*Multigrade case*" and described it as a set of financial, social and educational problems. A common research and development agenda was negotiated, with the involvement of local community stakeholders (policy makers, parents) to develop a methodological framework and an interdisciplinary curriculum for the primary grades in Arts and Mathematics. In order to develop a sustainable modernisation plan, the UNESCO Chair for Multimedia Education at ELTE University designed a special training program, the Mentored Innovation Model (MIM). Based on this model, a new version of in-service teacher training that unites innovation, research and lifelong learning was developed and tested between 2009-2011. This paper gives an overview of the potentials of ICT in one of the oldest educational environments: the Multigrade school.

Keywords: In-Service Teacher Training, Mentoring, Computer Supported Collaborative Learning

INOVAÇÃO EM TUTORIA - UM MODELO TRIALÓGICO PARA A FORMAÇÃO DE PROFESSORES EM SERVIÇO

Resumo: Escolas multiníveis são pequenas instituições de ensino de nível primário situadas principalmente em aldeias. Elas têm um espaço de aprendizagem individual para alunos de diferentes faixas etárias. Como as instituições culturais únicas destas aldeias, métodos de ensino que utilizam suas limitações como benefícios e a implementação de colaboração multi-etária são indispensáveis. As diferentes disciplinas ensinadas ao mesmo tempo em diferentes aulas podem ser relacionadas por meio de uma organização interdisciplinar de aprendizagem de conteúdo. Em 2007-2008 , equipes de professores em 21 escolas multiníveis, interessados locais e pesquisadores discutiram o caso "multigraduado" e descreveram-no como um conjunto de problemas de caráter

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financeiro, social e educacional. Um projeto de pesquisa conjunto e o desenvolvimento de uma agenda comum foram negociados, havendo o envolvimento das partes comunitárias interessadas (elaboradores de legislações, pais) para desenvolver um quadro metodológico e um currículo interdisciplinar para as séries primárias de Artes e Matemática. A fim de promover um plano sustentável de modernização de ensino, a Cátedra UNESCO de Educação em Multimídia na Universidade ELTE desenvolveu um programa especial de treinamento, o Modelo de Inovação Supervisionado (MIM). Com base nesse modelo, uma nova versão de curso de formação dos professores em serviço, que une inovação, investigação e aprendizagem ao longo da vida, foi desenvolvido e testado entre 2009-2011. Este artigo dá uma visão geral das potencialidades das TIC em um dos ambientes educacionais mais antigos: a escola de multiníveis.

Palavras-chave: Treinamento de Professores em Serviço, Tutoria, Aprendizagem Colaborativa via Computador.

Research context

Multigrade education is an organisational method of primary level education for communities with a small number of school age children from low income families, and consequently, with limited local financial resources for education. Teaching and learning occurs in partially divided school spaces coordinated by a teacher who manages two classes that learn different disciplines at different levels during the same time period. Two grades and age groups (usually first and third grades (ages 6 and 8) and second and fourth grades (ages 7 and 9-10), with about 5-15 pupils in each grade are taught simultaneously. During the past few decades Hungary has seen adecrease in the number of school age children ([1]) and an increase in the number of Multigrade schools.As a result small villages have had to adopt this economical organisational format – two teachers and two classrooms for four grades - to keep their schools functional. Similarly, the 21st-century descendants of the "one room school house" are becoming a significant segment of the educational palette in rural areas all around Europe. [2]At present, Multigrade primary schools constitute one fifth of all Hungarian public schools. In such schools, pupils of different age

[1]In Hungary, the decrease in birth rates was more than 20% between 1983 (127,000), and 2007 (97,000) with a linear decreasing tendency continuing. Since 1998, the number of births has remained stagnant, around 95-97,000 per year until today. Five years ago (2004) was the first year when fewer than 100 000 six-year-olds entered primary education, and the decline in numbers of primary pupils will continue for 8 years until 2012 at least. Since 1994, when the numbers of schools peaked at 4010this number decreased to 3748 by 2004. School closures are still continuing and until 2012 more than 500 closures can be expected. (Imre, 2009)

[2]For data and regional characteristics of European Multigrade education see the web site of the Network of Multigrade Schools in Europe, www.nemed-network.org.

groups (one space for 1st and 3rd graders, another for 2nd and 4th graders in most schools) are taught by only one teacher at the same time, with one class working silently while the other is instructed.

Multigrade schools in Hungary are threatened with closure because their pupils underperform based on national assessment. According to bi-annual national assessments, the knowledge level of pupils in small village schools with a staff of 2-3 primary educators has been significantly lower than the national average in the last decade (KÁRPÁTI, 2004; IMRE, 2009). Several attempts at the modernisation of pedagogy failed because of teachers' reluctance to employ methods adapted from the uni-grade learning environment. In some Hungarian counties, due to poor achievement results, many small village schools were closed and children aged 6-10 years were transferred to town schools. In other counties the issue is still being debated with decisions pending. The loss of these schools could result in depopulation of the area and a subsequent abandonment of farming. The villages organised protests to keep their schools but at the same time realised the need for an improved primary education.The village integrity and self esteem are closely linked to these schools, their only cultural institution. Therefore, even if the schools underperform in learning results, local communities are fighting for their survival and support from regional and national educational allowances (KÁRPÁTI; MOLNÁR, 2005).

Several efforts have been made to improve Multigrade pedagogy in Hungary with modest success. (Imre, 2009) Researchers approached the schools with pre-determined learning objectives and ready-to-use curricula that Multigrade teachers found difficult to identify with. We decided to employ a different approach: participant observation followed by joint discussion of educational problems identified. Innovative ICT solutions were offered by researchers that Multigrade teachers tested in their classrooms. The last phase was mentoring for innovation: the new ICT solutions and the pedagogical strategies associated with them were learnt by the Multigrade teachers through an on-line mentoring process. Between 2006-2010, in the framework of UNESCO and EU supported research projects [3] aimed at promoting equal access to learning, we embarked on improving Multigrade education through the introduction of collaborative Information and Communication Technologies (ICTs) solutions in in-service teacher training and, as a consequence, in classroom education.

[3]In this paper, results of two projects on the use of ICT in Multigrade schools are reported:
"*Knowledge Practice Laboratory*", an EU IST project, 2008-2011, www.kp-lab.org.
"Development of communication and learning to learn skills of socially disadvantaged students through interdisciplinary arts and science programmes", a UNESCO Participation Project, 2008-2010

The first research question addressed teachers' willingness to innovate. Our national survey on Multigrade pedagogy[4] revealed that Multigrade teachers did not want to be confronted with the unique pedagogical situation – they did not want to be different. In small village schools, the two-person staff made every effort to conceal the specialities of their learning environment (perceived by them as handicaps) and teach with exactly the same methods as traditional one grade per classroom institutions. These methods were mostly frontal teaching practices, with discipline-based, highly verbal content defined by our National Core Curriculum. No ICT-supported teaching aids were employed or even available. In the course of the first year of our three-year teaching experiment, we wanted to find out if teachers would be able to change their educational strategies and adopt new forms of classroom management and curriculum content better suited to the Multigrade school environment. In terms of change in role models, would they reconceptualise their teaching strategies from imitating of teachers of "normal," one grade per classroom schools to developing a new Multigrade pedagogy?

The second research question addressed teachers' ability to increase their professional competence and modernise Multigrade education. We developed and piloted the Multigrade Curriculumcollectively in the course of the research project to answer this question. The curriculum is based on the interdisciplinary organisation of knowledge, individualised instruction through ICT tools, project work and portfolio assessment. None of these features were to be found in the standard teaching repertoire of the respondents of our national survey, although occasional school-wide projects and multidisciplinary activities in connection with the celebration of holidays were reported. Therefore, sustainability of innovation was a related issue to be explored: will the Multigrade curriculum be transferable and in use after the end of the research and development project?

Mentored innovation: participants and procedure

To support the collaborative development of the Multigrade methodology and curriculum, a new form of in-service training called *Mentored Innovation Model (MIM)* was developed. Table 1 shows key elements of the model in comparison to the monological model (self-improvement) and

[4]In 2008, the survey was conducted through questionnaires sent to all Hungarian Multigrade schools and one grade per classroom institutions with Multigrade classes by mail and was also accessible online. The list of addresses and other school data were furnished by the Hungarian Ministry of Education and Culture.

dialogical model (the trainer-trainee dichotomy). The most important difference is the empowerment of the learner: collaboration in all phases of the innovation process.

1. Table: Monological, dialogical and trialogical models for in-service teacher education

Activities of Training	**Monological model**	**Dialogical model**	**Trialogical model**
Problems are identified and elaborated...	... separately by individual teachers and researchers	... by teams of teachers and teams of and researchers working separately	....by teams including both teachers and researchers
Research and development agenda are...	... identified by the individual in response to needs on the job or personal improvement plan	identified by researchers who invite teachers to realise a program designed by the research team	... shared objects of activity (innovative teaching practices / tools) that are identified and developed during the mentoring process
Supporting structures (mentoring):	help sought individually (use of textbooks and web based information services)	mentoring is provided by researchers and training experts (*mentoring*)	mentoring is provided on demand, during the innovation process (mentored innovation)
Cognitive tools employed during training ...	... promote one's own professional development process	... promote understanding of researcher's innovative methods / content	... promote scaffolding through structuring inquirers' activities to facilitate complex problem solving
Innovative teaching practice is	... realised voluntarily	... not part of the training process but is expected to happen after the course	... essential part of the training course: design based research through school experiments in several iterations
Dissemination is	... realised voluntarily	... encouraged through competitions	... realised on local and national level through a wide variety of channels. Both teachers and researchers act as innovators and mentors for new adaptors of teaching programs.

MIM is a reinterpretation of the classic *Computer Supported Collaborative Learning (CSCL)* model (SCARDAMALIA; BEREITER, 2003) enriched with collaborative techniques of *Trialogical Learning Theory* (PAAVOLA; LIPPONEN; HAKKARAINEN, 2004). We established a knowledge construction environment enriched with Web 2.0 solutions and invited Multigrade

teachers to act as innovators in identifying and implementing ICT solutions best fitted to the undivided, multi-age and multi-skills learning space. Mentoring this innovation effort is a special lifelong learning framework, where teachers and researchers share and distribute knowledge and expertise among community members (LIPPONEN, 2002).

Stahl (2003) argues that an adequate theoretical foundation for CSCL must explain *how individual practices are social* without forgetting that the social is grounded in individual activities. Therefore, we studied not only teaching praxis and learning activities, but also social issues related to the Multigrade school culture. Planning an intervention had to be preceded by a socio-anthropological study of the Multigrade school as a professional context. Two or three teachers who work at a Multigrade school are supposed to act as a cultural role model for the village community and be versatile and flexible educators for their students. Teachers in Multigrade schools work alone or in teams of twoor three teachers, one of whom undertakes only leadership tasks. Substitution is difficult to organise, and participation in training or information events is extremely difficult. In order to elicit change of teaching practice, their professional isolation, caused by the lack of opportunities for discourse with peers, would be dissolved through the establishment of a knowledge building community.

Stahl, Koschmann and Suthers (2006) shows how software objects designed to support collaborative learning may act as mediational artifacts and result in a profound change in educational culture. After laying the foundations of a special Multigrade curriculum with multi-age, multidisciplinary activities, teachers were invited to develop digital teaching aids and discuss methodological issues related to teaching the curriculum through an object-centred activity. This process-oriented collaboration (DILLENBOURG; BAKER, et al., 1995; ENGESTRÖM et al., 2002; PAAVOLA; LIPPONEN; HAKKARAINEN, 2004), characterised our co-operation with the teachers of Multigrade schools. The elaboration of the new Multigrade curriculum was initiated by a small group of participating teachers who started working individually and were joined by fellow teachers from different schools. In the second school year, the professional community was established and called the Gárdonyi Circle of Multigrade Educators, a professional community in which groups interact with other groups to create knowledge (ENGESTRÖM, 2004). Collaborative knowledge-building in our case involved a coordinated effort to design effective teaching strategies using up-to-date educational technology for an old learning environment that is generally considered inhibiting. Multigrade school practitioners participated in our inquiries during a process

that can be characterised as a transformative communication for learning (SCARDAMALIA; BEREITER, 2003).

An important source for our "democratic" approach to in-service teacher training and educational strategies employed in the Multigrade Curriculum was the *trialogical knowledge creation* framework of learning (PAAVOLA; LIPPONEN; HAKKARAINEN, 2004). The collective knowledge creation metaphor is aimed at understanding how new educational practices and / or artefacts are born.This is exactly what our research interests are.We are intent on saving the cultural centres of small villages but also conscious of the dangers of educational romanticism that conserves an out-dated model that does not teach effectively. A central feature of the knowledgecreation metaphor is *acting around shared objects* thatare likely to change during the knowledge creation processes as they work as objects to reflect on, but also as tools for mediating collaborative activities (PAAVOLA; LIPPONEN; HAKKARAINEN, 2004).

Research procedure and evaluation instruments

In previous studies, Multigrade schools were often surveyed for student performance, but teachers were never asked about their professional problems and perspectives. In 2006, we administered a *national survey* targeting all 620 Multigrade schools in Hungary and elicited the opinion of 83 % of them on professional goals, ICT competence, educational strategies and training needs of teachers, head teachers and regional school inspectors. Survey results were discussed with local stakeholders (school leaders, teachers, parents, policy makers and employment providers) to identify the potentials and problem areas of Multigrade school settings. Ideas emerging from this national "wish list' helped us form the contents and methodology of our innovation project to be discussed later. As a follow-up, we recorded in films, and virtual, as well as real life exhibitions, the histories of schools and their settlement and the processes of change resulting from collaborative ICT use. Through these methods of cultural anthropology, we captured the structuring and enactment of traditions and innovative endeavours and documented ways in which these (meaning-making) practices are mediated through designed artifacts.

Participants of our study were selected from the participants of this national survey on village schools involving all schools that had at least two Multigrade classes. From among 600 institutions surveyed, 21 schools were selected that constituted a representative sample for geographical location, staff and student numbers and the quality of education (slightly below

average results in national measurements of Mathematics and Mother Tongue). All teachers, 46 in total (9 males and 35 females) participated in the in-service training courses preceding and accompanying the three- year teaching experiment. Teachers were between 35 and 47 years. 40 of them held B. A. degrees in Elementary Education, 6 teachers held M. A. degrees. 3 in Mother Tongue, 2 in Biology and one in Geography. None of them had special training in computing or the role of ICTs in education, moreover, 37 of them did not even have their own e-mail address and used that of the school in the first month of the project.

Based on interview results and audio-visual documentation analyses of potentials, capacity and needs, a new, *networked learning model for in-service teacher education* using Social Web solutions and traditional collaboration tools was developed to support teachers in implementing a sustainable learning program. We established the Multigrade Teachers' Community, where project participants (the ELTE mentoring team and teacher-mentees) developed innovative, interdisciplinary Multigrade curricula: the Authentic Mathematics and Integrated Arts programs (KÁRPÁTI; MUNKÁCSY, 2010; KÁRPÁTI, submitted).

We designed a *training system based on the Mentored Innovation Model* described above that focused on the social practices of joint meaning-making, rather than the modification of individual practices.In the national survey, teachers reported suffering from increased professional isolation after the short and intensive in-service training programs held in big city laboratories so much unlike their own school. They also complained about the irrelevance of both pre- and in-service training programs, which targeted single-grade schools, to their special needs. Therefore, we developed a school-based, training system using blended learning methodology (an integration of face-to-face and online interventions). In order to meet the needs of the one-room, multi-class environment, teaching methods based on cooperation among students of different ages and grades as well as interdisciplinary content had to be developed. Since many of the new methods involved using ICT, digital literacy development became a major part of the training. Multigrade teachers and ELTE researchers mediated new teaching practices through designed artefacts (curricula, lesson plans, digital and paper based teaching aids and tools).

In order to create new social settings for the collaboration of stakeholders, including regional policy makers, parents and students, not just teachers and researchers, we developeda collaborative environment to facilitate learning, mentoring and communication. Project participants were invited to use those parts of the environment that suited their needs best: policy makers had access to all educational resources as they evolved and could thus develop a better understanding

about the quality of Multigrade education. Parents and teachers shared an active discussion forum. Supporting structures to solve complex pedagogical problems were provided by researchers and training experts through a specially designed Moodle virtual learning environment. For teachers and students, this was the most frequently employed cognitive tool for sharing resources and mentoring. Teachers and researchers used the MapIt collaborative knowledge building platform at least once a month or as often as needed (cf. KÁRPÁTI; MOLNÁR; DRACHMANN, 2008) for exchanging ideas, [5] to discuss educational and technical problems and design, and later evaluate, new teaching aids. Every two weeks, the Sematic Multimedia Annotation Tool (SMAT; PAKSI; KÁRPÁTI, 2008), wasused by teachers as an environment for reflecting on film documents of the problems facing Multigrade education. Multimedia materials used for annotation were filmed and edited by researchers first, and by teachers in later phases of the project, to illustrate problematic Multigrade teaching and learning situations or successful educational interventions.This tool also facilitated the acquaintance and bonding of school staff who could experience the school environment and teaching practice of those living far away and still sharing the same problems. All the cognitive tools shared one important function: decreasing the professional isolation of Multigrade teachers.

We used mixed method *evaluation instruments* to define changes in teachers'educational practices and ICT competence. Quantitative data were obtained through the ICT Competence Inventory (ICI) and the Educational Strategies Questionnaire (ESQ) at the beginning (September 2007) and at the end of the end of the project (June 2010). The ESQ comprises factors related to teachers' beliefs and attitudes towards frontal, individualised and collaborative teaching strategies, as well as current and planned usage patterns of ICT for individual and educational purposes. The ICI is an index based measuring tool to define teachers' attitudes, motivation and capacities to innovate using computer supported methods. Both survey instruments were used in a previous international study (CALIBRATE; cf. KÁRPÁTI; BLAMIRE, 2007). All teachers in the study completed the survey instruments at the beginning and at the end of the research project. A follow-up study about the sustainability of the Multigrade Curriculum is currently (April 2011) underway and will show if competence and performance improvement detected could be retained.

Qualitative data includes a variety of verbal and visual sources. Discussion maps provided by the MapIt environment and annotations of documentary film clips were also used to assess teacher involvement, professional level of participation and use of the innovative teaching approaches of the Multigrade Curriculum. 39 of 46 teachers had a *teaching blog*: 8 in digital, and 31

[5]MapIt was developed in the course of the KP-Kab project, http://www.knowledgepractices.info/ .

in traditional (paper based) form. 7200 blog entries (500-1500 words in length) were coded and analysed, showing changes in teachers' attitudes and thoughts about a wide range of professional issues at different parts of the project. All teachers were asked to produce and share at least one exemplary lesson description monthly, showing good practice in Multigrade teaching. In the two school years of the experimental teaching period, we collected 742 lesson plans (A representative collection was published in Kárpáti and Munkácsy, 2010).

Field notes and *video interviews* were taken during face-to-face meetings and during the observations of lessons. Log analyses of activities in the "Moodle" virtual learning environment were used for mentoring and collaboration. Discourse analyses of mentoring dialogues and virtual meetings also contributed to our understanding of the sustainability of the new curriculum – the effort necessary to maintain modified teaching practices and reorganise content in all primary grades in an interdisciplinary manner (Data from these instruments are only hinted at here as they were published in two papers: KÁRPÁTI; DORNER 2008, DORNER; KÁRPÁTI, 2010).

Results and discussion

The first research question addressed *teachers' willingness to innovate*. We wanted to find out if teachers will be motivated to leave their inclination to use traditional methodologies, similar to "normal" teaching practice. Professional blog entries, field notes and lesson plans, that were coded to reveal the appearance of innovative methods in theoretical discussions and teaching practice, show how teachersdeveloped new professional models and embraced their special Multigrade learning environment instead of finding it an obstacle. From among the 7200 blog entries coded, we selected two random samples of 144 texts (representing male and female teachers proportionately with their participation in our sample) from the first and last semesters of our research project. 83 % of all first phase entries deal with problems and convey negative feelings (frustration, anger, humiliation). In the last phase, while maintaining a negative attitude towards poor infrastructure and long working hours, only 17 % of entries can be considered negative. The majority of bloggers express vivid interest in new methods to be experimented with, describe success with ICTs solutions "finally mastered" and plans about a new project or tool. Blog entries become longer as the project proceeds, with those teachers who have difficulties writing about themselves, including images of student work and quotes from student text to illustrate an idea. The feeling of community, even friendship is reflected in references to phone calls, Skype meetings and

even visits by teachers or student groups. “Sending stuff” – from useful links, funny images to TV programs to see and cookie recipes – becomes a standard practice also noted in personal blogs. Teachers gradually developed a desire to establish their own community as Multigrade educators. They engage in professional communication regularly, exchange teaching ideas and develop and share teaching aids especially suited to their needs.

Not all of them, of course, were ready to innovate and adopt new learning methods that were developed to turn the handicaps of Multigrade schools into educational benefits. 7 out of 46 teachers of the project used in-service courses as a jump-start toward a higher degree and sought employment in a uni-grade, bigger and better equipped school. *Interviews* also show the benefits and problems of working in a trialogical manner. The essence of the Mentored Innovation Model (MIM) is to make your own problems explicit and try to seek solutions in a mentored, safe environment through collaboration with peers and facilitators. 68 % of the teachers showed progress in self-motivation, empowerment of peers and innovation, while 32 % felt under pressure and resorted to the role of listener and adopter. Thirty-six teachers in our sample worked in pairs in 18 schools, while in 3 schools, there were 3 teachers employed. (One teacher was a special educator assigned to several schools). These pairs and triads developed power structures that allowed “pioneers” to take the lead in innovation and “followers” and “laggards” to keep their own pace.

Lesson plans that were gradually assembled in a Multigrade Curriculum for the first stage of Hungarian primary schools (ages 6-10, grades 1-4), also show willingness to explore new pedagogical trajectories. Innovative practices involved more than one age group – an arrangement that Multigrade teachers avoided before as there were no pedagogical strategies available for the organisation of such lessons. Their new lesson plans included pair and group work involving students of different ages and school grades, site visits to local craftsmen, regional industrial sites or art monuments and production of collaborative documentation involving all age groups and grades, creating art works in multi-age teams etc. A sub-sample of 4 schools (11 teachers in all) was selected to compare changes of methods and learning content before, during and at the end of the research project. We collected 12 lesson plans from each teacher at three stages of the project (month 1, 10 and 23). We observed a gradual and steady increase of collaborative methods (5 % in month 1, 27 % in month 10 and 39 % in month 23). The use of ICT-supported methods showed a slower but also significant growth (2 % in month 1, 15 % in month 10 and 24 % in month 23). As ICT infrastructure also increased considerably, due to donations from local stakeholders (parents and business owners) as well as local and national grants, we hope that ICT use will be as intensive

in the classrooms as it was in the private and professional life of the participating teachers – see discussion below.

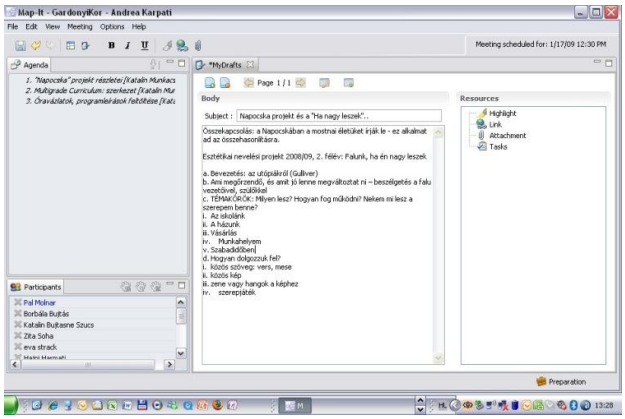
When trying to give a fair answer to our first research question about Multigrade teachers' willingness to innovate, we must admit that in many cases it meant an inclination to follow a progressive lead, to improve methods when asked. The Mentored Innovation Model (MIM) can only succeed when the innovation cycle does not stop with the dissemination of results but starts again with the detection of new issues that need improvement.

The second research question of the study relates to the *ability to innovate*: the long and tedious process of the acquisition of skills and abilities necessary to change a teaching repertoire. Our research aimed at the improvement of the quality of Multigrade education through the introduction of ICT-supported collaboration among learners of different ages and grades through an interdisciplinary design of learning content. Could Multigrade teachers with low digital literacy at the beginning of the project, improve their pedagogical skills through in-service training that was based on ICTs?

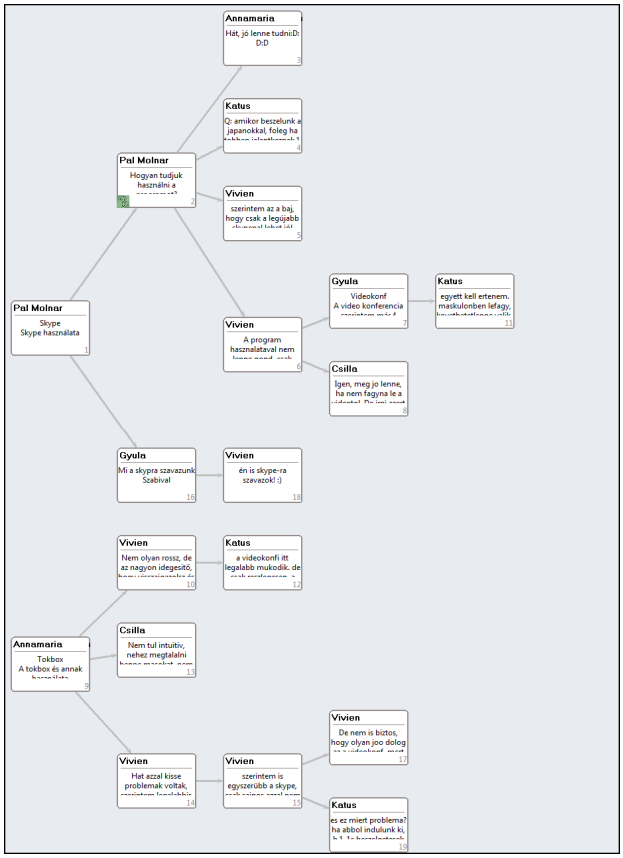
Most collaborative discourse was conducted through online tools, to avoid long travel and, through maintaining multilateral communication, to provide a chance for peer learning. We could evaluate the development of ICT competence necessary for the realisation of the Multigrade Curriculum through digital traces left in the cognitive tools as well as comparison of pre- and post-hoc survey instruments. First, teachers' performance with the cognitive tools will be discussed. An important component of innovative collaboration was work on shared knowledge objects. In the case of the Multigrade project, it was a new, interdisciplinary curriculum for the primary grades (ages 6-10, grades 1-4) that shows structural similarities among the arts, science and maths through integrated, creative problem solving tasks. Both the contents and methods of this curriculum were elaborated through online meetings. The *Map-Itknowledge building* tool helps prepare documents and structure ideas to be used at a meeting and supports its efficient workflow. It also captures emerging ideas and shows how they relate to uploaded discussants resources. The meeting output is a multimedia document that features the sequence of contributions, not only the texts and comments but audio or video recording of the meeting session, with text files and images used and web sites visited during the discussions. The concept map of the meeting, a structural record ofconversation topics as uploaded by discussants while in session, is graphically recorded by the tool. It represents the flow and the directions of the contributions of various participants, and can be used as a reliable reference after finishing the conversation. In fact, it is this combination of the concept map,

discussion contents (textual contributions, links to URLs, attachments, etc.) and a map-based, conveniently accessible audio/video recording, that can be seen as the "Map-It-generated comprehensive minutes" of the discussion. The discussion map helps to reconstruct – also for non-participants – major occurrences of the session, shows exactly who contributed what and when, and which contribution elicited more reactions. It also reveals the flow of ideas and indicates “dead alleys” or heated confrontations during the meeting. The map is synchronised with the oral (and eventual video) recording of the session and facilitates the recall of any given segment (KÁRPÁTI, MOLNÁR; DRACHMAN, 2008).

1. Figure: Preparation for discussion in the MapIt environment: drafting a remark, uploading documents



2. FigureDiscussion map produced by the MapIt software



Map-It was used in the Multigrade project both online as a discussion support environment and offline, for note taking. As the tool is based on the trialogical learning paradigm characterised by work around shared knowledge objects by a team of mentors, mentees and other professionals with relevant expertise for a learning task, we managed to increase learning motivation, improve collaborative skills and increase self-respect of learners as capable professionals at the same time. Increased sophistication of the discussion maps as the project evolved, growth in the number of comments by participants and the increased quality of their contributions (more connections to other speakers, more topic-related remarks and less ‘emotionalising” and off-topic text) showed increased educational skills as well as a more competent utilisation of the digital conferencing environment. The tool was found useful also as a flexible mind mapping application that visualises threads of discourse in relation to predefined thematic areas. In future experiments, we intend to integrate the tool with Web 2.0 applications to create *a network of personalised learning* environments that can, at the same time, accommodate a large number of participating students.

Viddler, (www.viddler.com), the second collaborative tool used while mentoring innovation efforts of teachers, is a social networking site with integrated powerful video-based features. Individual users are able to pick friends and create a friend list; moreover, groups of users (like our Multigrade teacher community) are also supported. Groups have their own space with a built-in forum and video repository, but communication is also possible between two users by a private message-sending option. When starting an annotation process, users upload their videos first, as content cannot be taken over from other video sites. Several formats are supported, so this process is neither long nor complicated. It is possible to record a video directly through Viddler by using a web cam on the record page. It is possible to share films with a group or with friends but private and public options are also available. Viddler has three types of tags to identify content, Global, Timed, and User tags. The users are able to add textual or video comments. The added annotation items are listed under the video film but they are viewable on the player and on the timeline of the player as well. The users who have the right to annotate are able to add new comments and discuss existing ones. There are other features like basic statistics on every video or Twitter and Flickr data access but the main advantage of Viddler is the unique interface of a social networking and a video-sharing and annotating service (PAKSI; KÁRPÁTI, 2008).

We used Viddler to elicit professional responses to teaching situations unique for Multigrade schools shown in short videos. Every teacher was invited to view our selection of 3-4 minute video sketches of classroom situations in each phase of the research project: after the first mentoring session, after the end of the first semester of planning the Multigrade curriculum and at the last phase of the project, when all teachers used ICT tools regularly. The teachers watched the videos once or several times, then assigned annotation terms to significant parts of the learning process shown, and finally summarised their views in a longer comment. The comparison of annotations and comments from the first phase of the research project with those of the last two phases show increased competence with the tool (a sign of development of ICT competence) as well as increased observation and critical skills. Teachers developed a vocabulary for case descriptions enriched with funny phrases and personal remarks. First phase annotations were very short (3-6 words), and mostly descriptive, while later annotations could be perceived as professional discourse. They increased significantly in length and contained evaluation and assessment as well as descriptions of observations.

About 11 % of the teachers did not feel comfortable with any of the cognitive tools and resorted to e-mails and Skype entries (text and voice messages) to reflect on the videos seen. When

asked about their reluctance, they said they hated the lack of immediacy of the tools. By the time they manage to record responses, the first inspirational remarks are gone, they complained. Development of ICTcompetence showed great differences in the group, and, not surprisingly, those who had to struggle with the composition of an e-mail with an attachment did not like the idea of digitally annotating a video instead of just telling ideas about it. In the future, the infrastructure we use for mentoring will be selected after surveys of ICTs competence are taken and evaluated – not beforehand, in the hope of getting teachers into the bed of Procrustes of contemporary communication solutions.

Digital literacy was also evaluated by the *ICT Competence Inventory (IC*I), a survey tool developed by Balazs Török and used successfully in 7 European countries outside Hungary. The survey instrument evaluates teachers' attitudes, motivation and capacities to innovative educational practices by using computer supported teaching and learning models according to five indices:

> Index (1), *School access to ICT*: through constant mentoring while working on innovation projects, teachers realised educational opportunities of ICT and could convince local sponsors to support the schools through used computers and peripherals. Project funds were also used to improve infrastructure, so 87 % of teachers reported high and 13 % medium values for better access both for students and teachers in the second survey.
>
> Index (2), *Home access to ICT*: teachers' PC and internet access increased significantly during the project, with 57 % of teachers reporting high, 27 % medium and only 16 % low increase in this index. Purchases were mostly driven by personal goals: better communication, more access to friends and relatives living in other areas of Hungary. While working with their mentors, internet based communication options were acquired and Skype, MSN and Web 2.0 platforms (Facebook and YouTube) were employed for personal as well as professional purposes. Participation in social computing resulted in high improvement of home access and use.
>
> Index (3), *ICT related attitudes*: here we witnessed the most significant increase between the two surveys before and after the project. The majority of teachers (68 %), reported low, 28 % medium and only 4 % high values about the appreciation of ICT-supported methods and motivation for ICT use. The respective responses were 8, 45 and 47 % at the end. We found no correlation between the quality of infrastructure and positive attitudes. When comparing teachers' blog entries with survey responses, we realised that the majority of increase in

positive attitudes was due to satisfactory user experiences and not to improved infrastructure.

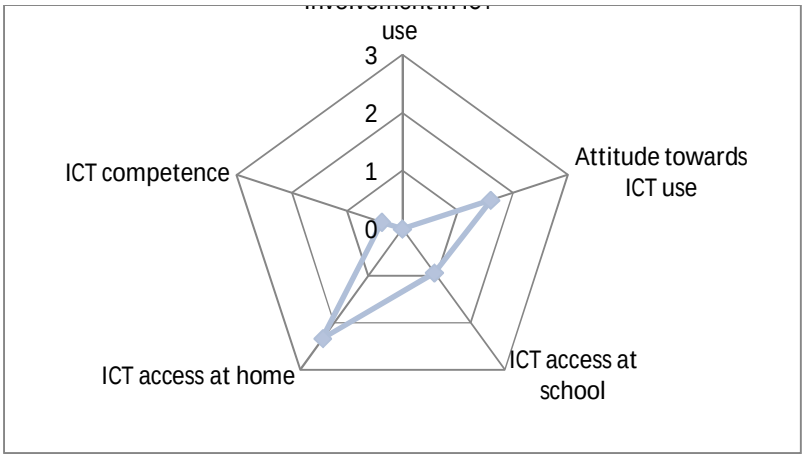
Index (4), *ICT related competencies*: many teachers did not even have an e-mail address at the beginning of the project, so the increase of teachers with medium competence (from 17 % to 43 %) is a considerable success. There were no "high" values for this index in the pre-experiment survey and we found 14 % in the post-hoc ICI. The group produced top ICT users to provide examples of good practice and peer support, while a robust medium level user group guaranteed sustainability of computer-based educational innovations in the Multigrade school community.

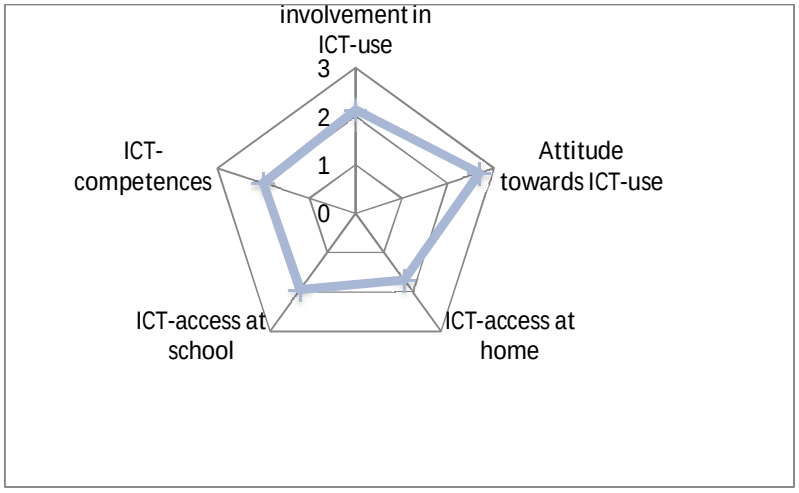
Index (5), *Educational use of ICT:* this index was in the low range for the vast majority of participants (87 %) before the project and showed a significant but not groundbreaking increase in the post-hoc survey: 50% of the low level users achieved medium level. Both in the post-experiment ICI and their blogs, teachers reported growing confidence in the use of ICT. The types of use also showed a very promising shift. While only presentation tools were used before the experiment, the introduction of collaborative tools and related educational methods showed a significant increase thereafter.

A substantial increase in "ICT readiness" was clearly shown in the comparison of the pre- and post hoc surveys. In the course of three years, 46 Multigrade teachers participating in our experiment increased their ICT readiness in the following indices[6]: The typical ICT user of our Multigrade community after the end of the project is characterised by Figure 1 below.

[6]The indexing method was used for data reduction: several variables were composed in one index. For an easier interpretation of results of the ICT Competence Inventory, we have identified four domains for every index:
low (value range: 0,01–1)
medium (value range 1,01–2)
high (value range 2,01–3)
0 value, indicating the non-existence of any interpretable data for the index.
An example: low level ICT access means sporadic, rare access 1, while 0 level indicates that the subject never has access to a PC.

3. Figure Typical ICT access, use and motivation profile of a Multigrade teacher before and after the curriculum design experiment





The development of teaching repertoires and the ability to use innovative educational methods of our project participants was evaluated through the *Educational Strategies Questionnaire (ESQ)*, a self-assessment instrument by Erika Lakatos Török that supplemented qualitative data obtained through teaching: blogs, professional portfolios and on-site observation protocols. The ESQ includes factors relating to teachers' knowledge about and beliefs and attitudes towards frontal, individualised and collaborative teaching strategies. It also assesses current and planned usage patterns of ICTs for individual and educational purposes. The ESQ also reveals attitudes and beliefs about methods as teachers have to mark the level of their agreement with assumptions related to various methodological issues. Some items require selection of actual and future

(planned) use of pedagogical scenarios while others ask for a ranking of different teaching options. [7] Results of this survey were always compared with evidences of teaching practice: portfolios and lesson notes that documented traditional and computer-supported lesson plans and their realisation in the Multigrade classroom. Results of the factor analysis of the pre- and post hoc ESQ survey are briefly summarised in Table 2 below.

2. Table: Results of the Educational Strategies Questionnaire of Multigrade teachers before and after the curriculum design experiment (p = 0.05 for all values)

Factor	**Content**	**Average value, survey 1**	**Average value, survey 2**
1. Aims and objectives of school education – present and future	Values, attitudes and beliefs about teaching and education	2,4	2,6
2. ICT at school: functions and mission	Value of the ICT culture for teaching, learning, assessment and communication; changes in school structure and management resulting from regular ICT use; good practices and problems; milestones of an ICT development plan	1,0	2,8
3. The role, task and mission of the teacher	Strategies for teaching and education; special tasks of the Multigrade teacher	2,1	2,2
4. ICT in teaching practice	Organisation of a new teaching environment; evaluation of ICT infrastructure; related educational paradigms, strategies, methods; motivation for ICT use in teaching	0,9	1,9
5. Innovation experiences	Skills and abilities for innovation; new educational strategies employed and their perceived success / failure	1,1	2,3

N= 46, minimum value for factors: 0, maximum value: 3

[7]Values range from 1 to 3. 1 meaning low and 3 means high agreement with statements.

The indices where we found no changes in strategies were Factor 1 and Factor 3. Our project participants, who were pioneers in the fight for the preservation of their Multigrade schools, showed positive attitudes toward the value of school and their role as teachers, from the beginning of the project, so they needed no development in these variables. In Factor 2 and Factor 4, where educational strategies were employed and problems encountered had to be identified, we found a significant increase in the use of collaborative and integrative teaching methods. The comparison of pre- and post-hoc survey results also showed a significant increase in self-esteem and awareness of potentials of the Multigrade school environment. In Factor 5, teachers redefined their professional selves as innovators, accepted "being different" and identified with the special values of the Multigrade school environment.

Conclusions

Our project attempted to increase ICT competence of Multigrade teachers in order to improve their teaching performance. Educational ICT use was rarely reported in the first survey, while it was prevalent in the second. Personal use of ICT increased even faster than professional use. Two-thirdof our participating teachers were novices to computer culture and had to gain basic skills before employing it for professional collaboration and communication. These beginning ICT users based their digital pedagogy on traditional methods, and mostly employed those tools that support frontal education: presentation, announcements, development of an educational home page. Learning new technological skills and altering teaching methodology, two profound change factors for their teaching practice, could not occur simultaneously. Once they mastered the basics of ICT-supported teaching and learning, they could follow the footsteps of their more experienced peers and change their teaching strategies to better suit the new tools they learned to employ.

The small group of teachers who used ICT more competently before the experiment could focus attention on learning new educational skills right from the start. They soon acquired and employed computer-supported collaborative methods that profoundly altered their teaching repertoire. The question is, why have these accomplished ICT users never utilised their competence before the experiment? Why didn't they facilitate learning in the Multigrade context where individual, pair and group work could so evidently ease the burden of multitasking with two learning groups of different ages? Focus group interviews revealed that those participating teachers who have undergone professional development programs in ICT use were trained through

traditional (dialogical) knowledge transmission processes that resulted only in the enhancement of theoretical knowledge. No relevant connections between everyday practice and new educational methods were identified as these methods were presented through examples from well-equipped schools with single-grade classrooms.

Our school based training and mentoring programs, however, targeted their everyday teaching needs. Through the use of social computing tools, they took ownership of their professional problems, consulted their peers and selected from the methods that fit in with the Multigrade school environment. The Multigrade Curriculum, the result of their collaborative work, is an evidence of this conceptual change.

Mentoring through professional discourse proved to be a key element in preparing for innovation. The Mentored Innovation Model, our in-service training methodology, is highly dependent on the work of the mentoring team: trainers and facilitators. We found the use of collaborative online tools crucial: MapIt, and Viddler and the Moodle open source virtual learning environment proved to be very useful applications to scaffold learning, support and document mentoring while providing an enhanced learning process for teachers.

Our in-service program was the first in Hungary to offer interactive training activities online. Virtual and real learning spaces were organised to create a synergy of experiences. Thus, we could document and evaluate "how shared objects of activity are collaboratively formulated and developed by using mediating tools, signs, and (conceptual and material) artefacts" (PAAVOLA; LIPPONEN; HAKKARAINEN, 2004, p. 4) facilitate the knowledge creation process.

Mentors are much more than instructors and they are most effective if they assume the role of a fellow innovator who is a member of a team that teachers belong to. In our experiment, researchers acted as participating observers and agents at the same time. They supported the experimental teaching process and provided guidance as well as emotional support. Discourse analysis of the Forum area of the Moodle virtual learning environment produced similar results: communication with peers in the experimental group was satisfactory because it involved collaboration on the development of a shared knowledge object: the Multigrade Curriculum. Peer mentoring and emotional support was especially important in times of struggle, when some of our participating schools were threatened by closure. Advice and encouragement by peers using newly acquired social networking solutions and results of improved learning performance of students were vital in meeting political challenges. The mentee satisfaction survey of this trialogical scaffolding

method (involving the mentor, the mentee and the knowledge object – the Multigrade Curriculum – they collaboratively created) showed that the new mentoring model was more motivating and produced more sustainable changes in teaching strategies than the traditional, dialogical mentoring process where the tutor provides knowledge that teachers are supposed to integrate in their teaching practice (DORNER; KÁRPÁTI, 2010).

Our research questions addressed *teachers' ability and willingness to innovate*. In the course of a three year teaching experiment, we observed that teachers are able to change educational strategies and adopt new forms of classroom management and curriculum content, but the process of such a profound conceptual and practice change requires considerable efforts. We decided to collect evidence about the sustainability of innovation and revisited the schools in 2011. The change agents, mentors of ELTE University, managed to catalyse this process, and the teaching aids and manuals co-developed with the stakeholders involved were still in use, two years after the project had finished. Teachers managed to use their e-teaching skills in extreme situations like the big flood of the Danube and the red mud catastrophe in the Fall of 2010 that adversely effected one of our experimental schools. When toxic mud from a nearby aluminium plant covered their homes and old school building forcing evacuation, teachers could rely on the professional support of their newly established network and received digital teaching aids and lesson ideas to continue education through the internet.In the course of these catastrophes, while the homes, shattered by water or red mud, were slowly being rebuilt, we could witness how Multigrade teachers *constructed a new professional repertoire* and managed to transfer their intimate, family-like school atmosphere to the internet based encounters.

Fortunately, the majority of schools we worked with were not subject to such extreme conditions and started on a peaceful, natural process to integrate elements of the Multigrade curriculum into their normal teaching practice.We observed that collaborative teaching and learning methods supported by ICT use were continued. Digital imagery and creative text was also used for creative expression.Our follow-up interviews in early 2011 revealed that collaborative work became standard practice in the course of three years in the project, and they gradually replaced frontal methods in most places. Many of the elements of the curriculum vanished, though, because they were difficult to maintain. Interdisciplinary topics that required long preparation were omitted, but the principle of teaching the arts and mathematics in synergy prevailed. Individualised instruction through ICT tools, project work and portfolio assessment were also observable.

Is “mentored innovation” sustainable without mentoring? Have Multigrade teachers adopted new, ICT-supported methods that they developed in the course of the innovation process supported by the training program? One year after the completion of the project, the answer is a qualified yes.Those teachers who are still with their original schools where they worked while developing the Multigrade Curriculum, (37 out of 46) are active participants of local and national level dissemination of results. One year after the completion of the project, teachers as researcherspresent at educational conferences through Innovation Dialogues – a format that unites academic discussion of methodology and evaluation results with “oral history” narratives by teachers. Both teachers and researchers act as mentors for schools that are interested in the adaptation of the Multigrade Curriculum. Popularisation of the curriculum is being organised through a wide variety of channels ranging from international educational conferences to village fairs. These informal events underline the social relevance of Multigrade education for a wide variety of stakeholders.

Multigrade schools have a special role in rural Hungary: they contribute to the preservation of small villages in important agricultural areas. However, low achievement of students and resulting school closures necessitate the modernisation of this ancient school type. Our networked learning model for in-service teacher education using Social Web solutions and other, more traditional internet-based collaboration tools, successfully supported teachers in producing sustainable changes in the teaching and learning culture of the schools while many previous efforts to modernise Multigrade education failed. The mentored innovation process, a personalised in-service program that caters to the needs of different personalities, ICT competence levels and educational strategies, seems to be crucial for sustainable educational change. In this way, current computer supported methodology helped modernise the oldest school environment, the one room schoolhouse.

Acknowledgements

This paper is based on research supported by an EU funded research and development project, *Knowledge Practice Laboratory Project* (KP-Lab, www.kp-lab.org, 2006-2011). Andrea Kárpáti is member of the Research Group on the Development of Competences of the Hungarian Academy of Science at the University of Szeged, Hungary.

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