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PAPER

Morten Söby and Vibeke Klövstad:

INNOVATION IN TEACHER EDUCATION

PLUTO (The Norwegian Program for Teacher Education, Technology and Change)

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National Network for IT-Research and Competence in Education (ITU),

University of Oslo (ITU), P. O. Box 1161 Blindern, 0317 Oslo.

Phone: +47 92031459

Contact: Morten.Soby@itu.uio.no

<http://www.itu.no/>

More information here: <http://www.luna.itu.no>

Summary

PLUTO (Program for Teacher Education, Technology and Change) deals with innovative and comprehensive change in teacher education. Pedagogical, organizational, technological issues are related to specific knowledge domains and integrated in new ways for design and use of learning environments. The objective of the research and development program was to educate students towards developing skills and knowledge to organize more open-ended and student-centered learning environments. So far as we can see the outcomes this ambitious goal is achieved to a large degree. These imply that teacher students have become able to create a diverse set of teaching and learning activities and use ICT for inquiry-based activities. Teacher education appears as one of the most important fields for addressing ICT and digital literacy in education.

Level: Higher education – teacher education.

Duration of project: January 2000 - December 2003

School of tomorrow

ICT are more and more present in daily activities and thus becoming familiar tools. Innovative policies are needed to ensure teachers enter the digital culture and understand changes ICT introduces in the teaching and learning processes. These policies need to acquaint teachers with digital literacy and the educational uses of ICT, through an understanding of how ICT can augment the teaching and learning processes.

Many countries are implementing educational objectives aimed toward preparing citizens for the information society. The pervasiveness of ICT is seen as both the genesis and potential facilitator of this goal. In this vision of cyberschools; school of tomorrow, the increased flow of information is associated with more autonomous learning environments, environments rich with ICT and people that support students learning.

According to Wim Veen: "The skills screenagers develop while scanning computer screens, zapping the TV channels, crisscross reading' texts, and thus rapidly processing huge amounts of information, will guarantee the survival of our civilization in the 21st century." (Wim Veen, So What ITU conference 2000, University of Oslo). Will the student of tomorrow be more like *Homo Zappiens*? Dealing with information skimming skills, using multiple parts of the brain; visual, textual, sounds, integrate scanning of screens. Adopting a holistic approach instead of an analytical and linear one. Celebrating individuality, mobility, weirdness, inconsistency and global openness?

Young people and children already live partially in cyberspace. They see ICT as a situation in which they themselves participate. Education does not recognize digital literacy and cyber skills developed outside the school. Today's schools are structured in the context of yesterday's problems and based on print as technology. In the future students might expect that their personal choice of ICT would be respected. Mobile phones, PDAs are suitable in Schools. Teachers need to become familiar with digital culture.

Teacher education appears as one the most important fields for addressing ICT and digital literacy in education. The ability of teachers to critically reflect on their own practice, and review what other teachers have done, should be encouraged.

ICT in education is a highly prioritized field in The Norwegian educational system where the government has invested huge sums for building up an infrastructure for schools, providing in-service for teachers and promoting research on the uses of ICT in learning.

Specific strategies has been developed in the area of teacher education. Teacher education institution is seen as an institution that need to transform it self. Innovation at other levels in the school system is dependent on transformation of teacher education institutions, as resource in the perspective of life-long learning for teachers and as models for the design and use of digital learning environments.

Contextual information

PLUTO, which stands for Program for Teacher Education, Technology and Change, is an initiative in the National Research and Competence Network for IT in Education's (ITU) priority focus on innovative change in teacher education. The focus is on organizational and pedagogical innovations within the institutions, based on a total integration of ICT.

The PLUTO program was launched in spring 2000, as part of the Ministry of Education plan for research and development - "ICT in Norwegian Education Plan for 2000-2003". The PLUTO program consists of 10 projects at eight institutions. A key element of these projects is pedagogical, technological and organizational development and change in teacher education through the use of ICT.

ITU was established in 1997 as a key project in the Ministry of Education and Research's first action plan, "IT in Education 1996-1999", and was continued in the second action plan "ICT in Norwegian Education. Plan for 2000-2003". At its establishment in 1997, ITU was founded as a national research and competence network for IT in education, under the administration of the University of Oslo (UiO).

ITU's goals for its research projects are that they should contribute to raise the Norwegian educational system from the traditional, teacher-focused transfer of knowledge, towards more

active, participatory, problem-oriented, project-based learning and work. Pedagogically, this points in the direction of digital literacy, a constructivist classroom and collaborative learning. At the same time, this also implies reorganization, where schools leaders' development and teacher competencies are central.

ITU's projects aim at optimization in the use of ICT. ICT must be adapted to the various learning situations, the teacher, context, pupil/student and content. Through its activities, ITU can contribute to the implementation and use of ICT in education, as well as to draw implications of ICT's incorporation in education, where ITU also focuses on multicultural and gender aspects. ITU's development projects are built on the results of research.

ITU has been given the following mandate:

- The ITU academic unit shall contribute to national knowledge building about digital literacy and digital skills.
- ITU shall be an innovative national R&D unit in the field of ICT and education.
- Through its R&D activities ITU shall develop and disseminate knowledge to relevant players in the education sector within the main focus areas outlined below.

ITU shall be proactive and help put relevant ICT topics on the education policy agenda. Its dissemination role and user perspective will be key. ITU shall also have a network-creating role within its area vis-à-vis other relevant academic communities.

ITU's goals are to:

- Initiate and foster innovation in the academic and pedagogical use of ICT in learning and education – in primary and secondary education and teacher education.
- Contribute to the development of a national knowledge base relating to the development of pupils', students' and teachers' digital literacy and digital skills.
- Ensure the development of R&D-based knowledge about the development and use of digital learning resources within the framework of Programme for Digital Competence 2004-2008¹.
- Stay updated on international development trends in the digital skills field.
- Initiate and coordinate national programmes and projects in the field of digital literacy and digital skills.
- Enter into agreements with collaborating R&D institutions and other relevant environments, and establish collaborative forums and learning arenas where ITU can play a communication and networking role.

Through its activities ITU shall be an agenda-setter and dialogue partner in the areas of education policy and ICT.

¹ Ministry of Education and Research's "Program for Digital Competence 2004-2008"
(<http://www.odin.dep.no/ufd/norsk/satsingsomraade/ikt/index-b-n-a.html>)

Assumption for the PLUTO program

In today's society teacher education institutions around the world try to develop programs which will give student-teachers opportunities to develop competence and skills to orchestrate students of different backgrounds and interests. The demands of schools and students are increasing rapidly. If we go back only a few years' memory and reproduction of knowledge was enough to master activities in a school setting Today we expect most of the students too read and understand scientific texts and set up and carry out both closed and open scientific experiments in the natural science. We expect the students to develop abilities to take part in scientific discourses that go beyond following procedures and problem solving of simple problems. The explosion in knowledge the last 50 years makes it more and more important to develop conceptual knowledge, be familiar with accepted methods and be part of work teams which have value for complex work activities and problem solving.

The cognitive and social complexity we have pointed towards is also related to the fast-growing medium and information source, the Internet, and to the diversity, hybridity multi-voicedness among students. Classrooms and other learning environments are places where students and teachers meets with different goals, ambitions and backgrounds.

The argument of the increased complexity of today's schools, classrooms and learning environments suggests the need for understanding educational activities in new ways and for developing new analytic models and practices of how educational activities could be organized. Teacher education becomes one of the most important arenas for the transformation of schools in a networked society.

Aims and objectives in the PLUTO-program

In the Norwegian ICT action plan "ICT in Norwegian Education- Plan for 2000-2003" the aims for the period are formulated as follows:

*"ICT is to be used in education in order to contribute to better organization, greater skills and pedagogical competence within an education system that develops and exploits ICT as a subject. The potential of ICT is to be exploited within teaching and learning so that the skills requirements of the individual and the society as a whole can be met."*²

Teacher education is a priority in the action plan, and the following challenge is directed towards pre-service teacher education:

*" ICT provides new opportunities for practicing open and flexible study methods. Prospective teachers will have to be able to make use of the opportunities - to develop their own skills and to be able to advise students in school situations where learning and teaching become ever more learner-directed. A basis for such skills must be created during the study period by employing new study methods and by project work. The teacher training institutions must overcome these challenges"*³

The main goal of the PLUTO-program is to contribute to innovative restructuring of teacher education through the use of ICT. While the project's aims are more specific to develop pedagogical and organizational models for the adaptation and accomplishment of study and learning activities in teacher education, where ICT makes up a substantial part.

² *ICT in Norwegian Education – Plan for 2000-2003:9*

³ *ICT in Norwegian Education – Plan for 2000-2003:11*

More specific goals are to:

- develop new digital services and learning resources, which support technology rich environments,
- develop new pedagogical practices, develop models for reuse of content and technological solutions,
- develop teacher education students towards professional teachers in new types of learning environment.

Implementation of the PLUTO-program

The ongoing follow-up of the academic activities in the PLUTO program has been delegated to the PLUTO-Program Committee (PLUTO-PC) by Network for IT-Research and Competence in Education (ITU). The task of the PLUTO-Program Committee is to follow up the projects at each individual institution, and to support and challenge them in their respective institutional development work.

As part of the work with all the institutions involved the PLUTO-PC has initiated several workshops, meetings, traveling to international conferences, academic writing etc. The project leaders and other significant actors in the projects have taken part in these activities. To develop a strong national community has been an important part of the strategy for institutional innovation.

The PLUTO-PC has also followed up the projects each year with visits (at least one visit). The meetings with the project leaders, the management for the whole institution and members of the project group have been an important part of the strategy for transformation in each project.

Developmental contracts were used to create clear developmental trajectories for each institution based on clear goals.

Evaluation criteria used for selecting this policy as good

The Ministry of Education, ITU and the PLUTO-PC have initiated evaluation of the PLUTO program. Survey investigation has been used as part of the external program evaluation and survey and qualitative data has been used in the internal evaluation. In addition to the evaluation at the national level, each institutions have performed evaluations and in-depth studies of different aspects of there programs.

PLUTO is directly related to the needs in Europe of transforming teacher education. To educate teachers to design digital learning environments is a key issue in the transformation of the school system.

The need for all students to develop more advanced higher order thinking skills is crucial for being able to perform in a complex and knowledge intensive society. The PLUTO projects takes important steps in this direction.

The PLUTO program has addressed fundamental issues related to the understanding of transformation of educational institutions. The program has bridged the relation between educational policy and research in new and innovative ways.

There has been used a fine tuned combination of top-down and bottom up strategy in the follow up work. This seems to be a condition to create the kinds of sustainable change which the PLUTO-projects have been able to create.

In the design process of the program the expectation to theoretical grounding, focus on teaching and learning, contents and organizational and technological issues where made clear and developmental contracts between the institutions and PC was signed. The contracts were part of the on-going follow up work.

In the implementation phase the institutions were followed up on different levels. The management for the whole institutions in how they created condition for the transformation and change, and at project level related to goals of the innovative efforts. The institutions were also followed up on if the external and internal funding was used according to the goal and plans for the project.

The PLUTO-PC have had regular (around four each year) meeting to monitor the activities in all projects, both as part of role to support and to challenge the direction of the development of the institutions.

Evaluation

The focus on evaluation has been a key issue from day one of the projects. Every half year the projects have performed evaluation of the project and some chosen in-dept aspects.

Milestones has been used and different kinds of survey methods directed to how the students have experienced the innovations. These imply that student evaluations has been part of the institutional strategy for creating change.

A key theme in the meetings between the institutions and the PC has been how they develop strategies for sustainable change. These imply for example creating a continuity of persons and leaders in key roles over certain period of time.

Status and so far results from some of the PLUTO Projects

Case 1: ICT as a Factor of Change in Teacher Education

Institution:	Teacher Education Department, Østfold University College (HiØ)
Project manager:	Odd Eriksen (odd.eriksen@hiof.no)
Contact persons:	Ray Svanberg (ray.svanberg@hiof.no)
Partners:	Telenor Mobil, Halden Dataservice, HP Compaq Norge
Period:	1999-2003
URL:	http://ruff.hiof.no/www/lu/iktprosjekt/

An extensive change project with respect to general teacher education has been under way at Østfold University College over the last three years. The project was inspired by the Swedish trials with laptop PCs at Färila School and Mönsterås Upper Secondary School.

The content and organisation of the teacher education programme is now better adapted to the vocational orientation requirements. The student teaching system has been made more flexible,

and the students and practice schools take responsibility for ensuring that the students gain realistic experience in the teaching profession, and ICT is becoming an integral part of the students' everyday life. Three hundred students have laptop PCs as tools and have to a large degree used both wireless local networks and GSM high-speed connections to the Internet in their studies, student teaching and leisure time. In this way the technology permits more extensive interplay between the various arenas in the programme, and the students develop ICT competence through learning activities in their everyday studies.

The university college's subject teachers are organised in interdisciplinary stage teams, with studies alternating between subject periods and multi-subject topic and project periods. The students are organised in small base groups to develop skills through teamwork and gain experience in learning as social practice. An active effort is being made to change the focus of the subjects by orienting the teaching and project work more towards subject matter that is relevant to the classroom. A fundamental aim is to combine good teacher-guided instruction with student-active working methods in a learning environment where human relationships are strengthened, and where provisions are made for a network-based learning environment to support this.

The reason for the measures in general teacher education at Østfold University College was an analysis of the types of academic, social and technological skills and competence tomorrow's teachers will require, as well as ideas about the type of teacher role that the students will be expected to fill in the next 10 years.

All together, the experiences from the project have laid the foundation for restructuring the general teacher training programme at HiØ into a profession-oriented and ICT-based programme, and now embrace the entire compulsory part of general teacher training. Planning is under way to develop corresponding work and organisation methods in specialisation units and Practical Pedagogical Education.

Case2: Practical Pedagogical Education in Digital Learning Environments

Institution:	Department of Teacher Education and School Development (ILS), University of Oslo (UiO)
Project manager:	Trond Eiliv Hauge (t.e.hauge@ils.uio.no)
Contact persons:	Elisabeth Ibsen (e.b.ibsen@ils.uio.no), Kari Anne Rødnes (k.a.rodnes@ils.uio.no)
Partners:	InterMedia, University of Oslo, primary and secondary schools in Oslo and Akershus and it: solutions
Period:	1999-2003
URL:	http://www.ils.uio.no/omenheten/ikt.html

Three years of intensive development work on the use of new technology has reoriented Practical Pedagogical Education at the Department of Teacher Education and School Development. In the period from 2000 the department completely reorganised its information and communication routines vis-à-vis the students. A learning management system (LMS) shared by all components under Practical Pedagogical Education has been put into service. This is also used as a planning and organising tool for teaching students and following up practice teaching. The students now receive training in applying new technology to learning and teaching in many parts of the programme, including practice teaching.

Even though the PLUTO project at the Department of Teacher Education and School Development has new technology as an important hallmark, the restructuring work has been driven forward by the interplay of pedagogical and technological innovations. The department has adopted completely new assessment and examination procedures in all subject areas on the basis of ideas about portfolio assessment and portfolio examination. Pedagogy training has been overhauled extensively to incorporate case studies and problem-based learning. In addition, the department is in the process of reorganising the entire practical training through binding and long-term cooperation agreements with practice schools focusing on developing competence in the use of ICT in teaching.

Restructuring work started with 25 students in 2000. During the 2003-2004 academic year all students in full and part-time studies were organised within the new studies model. This covers around 400 students. In addition, the department implemented new ways of organising the studies of 140 students in the ex.paed. part of the secondary teaching programme at UiO.

Evaluations and project follow-ups show that the new study model has led to increased student participation and input in the programme. The new work methods with the use of case studies, learning portfolios and portfolio examination, besides intensive employment of a learning management system are generally well received by the students. Also well received were the new routines in the schools for student teaching, whereby the students student teach at the same school during their studies (students in the full-time programme), are members of a base group and meet with a team of teaching supervisors at the practice school. The evaluations confirm that the Department of Teacher Education and School Development has managed to institutionalise a new teacher education organisation based on new technology, new forms of study and collaborative solutions with the school.

The first main phase of restructuring efforts at the Department of Teacher Education and School Development is now over. Much work, however, remains for developing and ensuring good cooperation with the partner schools. The department also needs to develop new digital content solutions that can support the students in their efforts to acquire all-round skills for applying technology to teaching.

Case 3: New Work Methods and New Roles – Student Teachers in ICT-assisted Learning Processes

Institution:	Volda University College (HVO)
Project manager:	Roy-Asle Andreassen (RoyAsle.Andreassen@hivolda.no)
Contact person:	Anne Øie (ao@hivolda.no)
Period:	2001-2003
URL:	http://www.hivolda.no/index.php?ID=829

A key point in the project was to give the students all-round learning experiences in line with the curriculum for primary and secondary schools and teacher education. Student-active learning methods and pupil responsibility for their own learning were a challenge for students and teachers alike, which requires flexibility and change in both the student and teacher role.

The project focused on learning as social practice, where ICT is an active agent in learning and in the change processes that the students participate in. Testing ICT in various work methods in the course and practical training has also been a key.

The project covered the entire general teacher training programme in Volda, where traditional class organisation was replaced by base groups as the primary learning group in the programme. The base group was also a practice group, where a regular supervisor from the university college together with the student teaching supervisor at the practice school have had supervisory and follow-up responsibilities.

The university college entered into an agreement with ten practice schools closely associated with the programme through the use of ICT. These schools were connected with the project in a separate subproject, and took part in the development of new practice models in which the students worked on the integration of ICT in the learning environment at these schools.

The final report from the project provides the following summary:

- The project has led to a sweeping reorganisation of the students in general teacher training, from ordinary classes to more self-governed and self-regulated learning groups, the base groups.
- ICT has become an important element in the new work methods through supervision and extensive use of learning portfolios.
- During the project period more varied forms of evaluation have evolved, in which digitised distribution and supervision along the way ensure greater emphasis on the formative aspects of the evaluation. At the same time digitisation has led to more portfolio assessment.
- The project has put the focus on the role of the teacher and student/pupil roles. This has led to the development of decision-making skills through improved guidance skills and use of ICT, for both teachers and students.
- The project has contributed to a targeted implementation of comprehensive skills enhancement relating to ICT in the entire teacher training programme.
- There has been a significant increase in students' didactic ICT competence.
- Teacher education's professionalism been strengthened through the use of ICT and LMS in formalised collaboration on practical training at the university college and the teachers at the practice schools.
- There has been considerable upgrading of ICT equipment and establishment of ICT solutions accessible to both students and teachers in the department, including also a wireless network.
- Several R&D projects relating to the use of ICT in teacher education and in the practical segment have been initiated.

Case 4: ICT and New Learning Processes

Institution:	Vestfold University College (HVE)
Project manager:	Mattias Øhra (Mattias.Ohra@hive.no)
Partners:	Workshop for Technology in the Schools, National Education Office in Vestfold and the practice schools in the region
Period:	1999–2003
URL:	http://moses2.hive.no/iktnlp/

The project ICT and new learning processes was initiated in autumn 2000 with two experimental classes in general and preschool teacher education. One year later the project was scaled up to apply to all new students who started the teacher education programme.

The goals of the project were to gain experience in:

- Content changes against a socio-cultural learning community
- Learning with ICT
- Organising with emphasis on interdisciplinary team

To realise the above-mentioned objectives, work on digital portfolios was chosen as an interface for learning with ICT, combined with a perspective on learning based on a socio-cultural theory of learning. The department implemented fundamental systematic measures in which technology and learning processes are placed in a long-term perspective. There was also a desire to give the students more control over their own teaching and thus incorporate the students in the practice community as genuine and legitimate participants.

Some summaries from the project:

- Work on digital portfolios will continue, and the emphasis will be moved from summative final evaluation to formative in-progress assessment.
- The students must be given more control and co-determination with respect to work on formative assessment of the portfolio assessment.
- The students should have access to each other's portfolios, which in turn provides opportunities for cooperative learning and collective products and processes.
- Assessment criteria should be presented to students in an open and clear manner. Students shall also be included in drafting them.
- The aim should be for more pragmatic procedures for supervising students to avoid overloading teachers with work. Among other things, this can be done by limiting what shall be assessed and increasing the degree of self-assessment and peer evaluations.
- Clear and explicit common criteria must be drafted for portfolio methods, team organising, subject and interdisciplinary cooperation.

Digital portfolio: Alternative Forms of Evaluation in Teacher Education

As a result of the activities in the PLUTO-program, a project has been initiated across all the PLUTO projects: Alternative evaluation. Change in forms of evaluation, focusing on ongoing experiences rather than final examination, is an integrated part of pedagogical and organizational changes that the teacher education at the PLUTO institutions is going through.

Coordinating work with the development of electronic portfolio assessment, such as learning and evaluation tools, in the institutions involved. Establishing synergy effects and principles in relation to methodology, practice and evaluation cultures. The project also aims at finding relation among different disciplines at the institutions, both in relation to the different subjects and education in general. The project also aims at having an overview of international experiences in the use of electronic portfolio assessment, with focus on teacher education.

Institutions:	Stord/Haugesund University College (HSH) Vestfold University College (HVE) University of Oslo (UiO)
Project manager:	Knut Steinar Engelsen (kse@hsh.no)
Contact persons:	Olga Dysthe, UiB, Trond Eiliv Hauge, UiO, Mattias Øhra, HVE, Anne Marie Presthus, HiA, Line Wittek, HiO, Hildegunn Otnes, HVE, Tjalve Madsen, HiB
Period:	1999–2003

URL:	http://luna.itu.no/Fokusomraader/digitale_portfolios/index_html/view
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The project was established by the Ministry of Education and Research to coordinate work on development of new evaluation methods in the PLUTO project at Vestfold University College, Stord/Haugesund University College and the University of Oslo. Another idea was to attempt to find synergies among the experiments in progress at the institutions and in this way attempt to deduce some fundamental principles with respect to methods, practice and evaluation culture.

At the same time the idea was to attempt to get an overview of interesting international experiences with the use of digital portfolios in teacher education.

The project was research-based and emphasised the publishing of results from the project at various levels. People were assigned special responsibility for building up the Digital Portfolios area on the teacher education website LUNA.

Some outcomes:

At all three institutions portfolio-based forms of evaluation are now organised in all subjects in general and preschool teacher education (Vestfold University College and Stord/Haugesund University College) and practical-pedagogical education (UiO). The portfolios are mainly published digitally by the use of both Net-based learning management systems (ClassFronter, it's:learning) and various HTML-based solutions for publishing on the Internet. The portfolio arrangements vary somewhat from programme to programme and from subject to subject.

At all institutions the introduction of portfolios has been viewed as a means of supporting and accelerating efforts in pedagogical innovation. At the same time, the changing of the forms of evaluation in the direction of greater use of portfolio-based schemes is viewed as a natural result of employing more student-active and problem-based forms of learning and work methods.

CONCLUSION: Overall outcomes and results

In a number of the projects, the pedagogy and academic content of the training program has been changed systematically by implementing ICT.

The PLUTO projects create innovation in an important segment of the education sector through development contracts with partner schools. Many of the partner schools have experimented with flexible practice systems or other forms of new practice systems, which means that the students gain experience as teachers in a realistic everyday school situation.

The PLUTO projects have helped create new models for the organization of teacher education, where various forms of ICT are used and the subjects are vitalized in relation to their vocational aspects.

Several sources are reporting that portfolio assessment leads to increased "responsibilising" of the students. The students are working harder at their studies, and this creates better continuity in relation to their comprehension of subjects and their studies in general. The students are gaining a more overall perspective of their own education.

Several institutions can show an improvement in their academic level due to the fact that the PLUTO program was expanded. This also shows that organizational and pedagogical changes are required to achieve a successful integration of ICT.

The PLUTO projects have helped create new models for the organization of teacher education, where various forms of ICT are used and the subjects are vitalized in relation to their vocational aspects. These models should be exploited in a continuation of the initiatives with respect to ICT and teacher education.

Many of the PLUTO projects show that the use of ICT contributes to the reinforcement of variation and differentiation abilities.

A number of the PLUTO projects have been expanded so that they establish the terms for how the teacher education is organized at the institutions that are involved. This means that over 1800 student teachers are exposed to the principles that the PLUTO projects are based on.

Teacher education appears as one of the most important fields for addressing ICT and digital literacy in education. The ability of teachers to critically reflect on their own practice, and review what other teachers have done, should be encouraged.

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