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Portfolios and ICT as means of professional learning in teacher education[1]

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Introduction

A growing body of reports and research of the use of portfolios in teacher education contributes to the understanding of a learning and assessment tool conducive to student teachers' professional development. In general portfolios seem to promote reflection in teaching and learning (Zeichner & Wray, 2001; Darling-Hammond & Snyder, 2000; Lyons, 1998; Wade & Yarbrough, 1996; Loughran & Corrigan, 1995). There is a need however, to examine these results in more detail with regard to specific knowledge domains, portfolio purposes, conditions and contexts of use (Delandshere & Arens, 2003; Zeichner & Wray, 2001). There is also a need for clarification of the different aims and functions of portfolios in teacher education in exploring benefits and outcomes.

The present study contributes to this research agenda by focusing on how portfolios combined with new learning technologies interact with student teachers' understanding of teaching and learning. Electronic portfolios have a growing position internationally in different types of education, however little research has yet been documented regarding teacher education (Dysthe & Engelsen, 2003; McKinney, 1998; Wetzel, Zambo, Buss & Arbough, 1996). While the potentials of portfolios and new technologies in teaching and learning seem to be great, successful integration of these tools in education invokes a lot of problems tha t are in need of exploration. This study intends to explore some of these problems in initial teacher education. The education focused upon is a one-year full time practical pedagogical programme reformed by use of new information and communication technology (ICT), learning portfolios, case study methods and new models of practice teaching in partnership schools. This education is a final stage for

[1] This article is a based on a paper written together with Line Wittek: *ICT as a mediator for portfolio work processes in a distributed teacher education environment*, presented at the EARLI 2003 Congress, August, in Padova, Italy. The last version 4.0 is published in *Studies in Educational Evaluation* 32 (2006), pp 23-36.

students in a bachelor or master programme. The present study is part of an extensive follow-up research of the reform programme (Flo & Ludvigsen, 2002; Hauge, 2002; Hauge & Wittek, 2002; Wittek, 2003, Ludvigsen & Flo, 2001).

The study is explorative in nature and focuses on the following research questions:

- how do student teachers perceive portfolios and new learning technologies as means of learning and future teaching in school?
- to what extent do electronic portfolios support student teachers' professional development?

The context of portfolios

The teacher education programme is located at the University of Oslo, Norway. The programme comprises students from all kinds of academic background. One third of them has a Masters degree, the rest of them a Bachelor degree. Approximately half of the programme time is devoted to practice in school. The rest of the time is devoted to studies in pedagogy and subject didactics (e.g. language education, social science or mathematics education).

Normally the student teachers are required to pass three exams in the programme: one in pedagogy and two in school subject didactics. The total number of students in the full-time programme of the year 2002, which is the context for this study, was approximately eighty. The portfolio model is based on a set of assignments based on case methodology (Shulman, 1992; Colbert, Trimble & Desberg, 1996). The assignments represent key learning topics or content areas in the curriculum and intend to integrate theory and practice in the study process. The assignments are integrated parts of the instructional design. The final exam is based on portfolio products collected during the whole programme period. All activities are supported by an online or virtual learning environment.

The individual students' portfolio in the main course of pedagogy comprises seven assignments covering different themes and task genres. Three assignments are connected to activities at the university campus, while the rest rely on observations in the practice school. The school based assignments are produced according to a set of predefined

content criteria adaptable to school settings. The assignment progression follows the study process by alternating individual and collective task requirements. Except for the last one all assignments are part of ongoing discussions in seminars and small student groups during the study. At the end of the course the students have to produce a reflection document integrating all their learning according to a set of predefined criteria.

All activities in the education programme are structured and integrated in a virtual learning environment (*LMS: Learning Management System*), which means that the portfolio production process is regulated by an electronically framework for each individual student, student group and seminar. When it comes to the final exam the students have to deliver a printed version of their portfolios. The education programme is not yet developed into a full scale e-portfolio model using open web based solutions (cf. Otnes 2003).

Analytical framework

The research study questions how student teachers perceive e-portfolios as means of learning and professional development and to what extent the portfolios and technologies are supporting this process. When answering these questions it should be clear what types of portfolios the study is focusing upon. Education programmes vary greatly in terms of structure, content and purposes of portfolios. In reviewing "teaching portfolios" in US initial teacher education programmes Zeichner & Wray (2001) identified several kinds: 1) A "learning portfolio" with the purpose to engage student teachers in inquiry about their teaching and to document growth in teaching over time. 2) A "credential portfolio" with the purpose to assess prospective teachers' readiness to receive their teaching license. Such a portfolio is used to determine whether student teachers have demonstrated a certain level of proficiency on a set of teaching standards. 3) A professional portfolio organized for employment use, comprising a sample of assignments and documents representing the students' best work. Compared to this framework the present portfolio model mostly resembles a *learning portfolio*.

Another classification scheme is proposed by Smith & Tillema (2003) who identified four differently labeled portfolio types in professional education programmes: 1) A "dossier" portfolio used as a mandated collection of work for selection or promotional

purposes required for entry to profession or a programme. 2) A "training" portfolio that is required or mandated to exhibit efforts collected during a programme. It is a representative sample of the students' work taken from an actual course. 3) A reflective portfolio that is a purposeful and personal collection of work to be brought forward for promotion and admission to further studies. This is a compilation of "best practices". 4) A "personal development" portfolio that comprises a personal evaluation and account of professional growth during a long-term process. According to this conceptual framework the portfolios in question may be looked upon as a mixture of a *training portfolio* and a *personal development portfolio.* In other words portfolios can be seen as supporting means for learning and development in teacher education.

In higher education students have an extensive educational and non-educational history that has shaped their experiences and perspectives on learning and teaching, making it difficult to foresee how different students will participate, contribute and learn from the same portfolio task. Most likely, different students will perceive the collaborative and interaction processes differently. These differences have to be counted for when looking into the large body of teacher research relevant for the understanding of the present study (Sweeney, 2003; Burn, Hagger, Mutton & Everton, 2003; Lang, Olson, Hansen & Bünder 1999; Tatto, 1999; Calderhead & Shorrock, 1997; Tillema & Knol, 1997; Korthagen & Lagerwerf, 1996). This will be an analytical viewpoint in studying the student teachers' portfolio perceptions.

Earlier studies of the teacher education reform programme have pointed to findings of the portfolios playing a significant role as an institutional change agent, tool or artefact (Flo & Ludvigsen, 2002; Ludvigsen & Flo, 2001). However, the institutional aspects do not transfer to individual levels automatically. We have to chosen to analyze this individual learning problem by using a three- level tool or artefact conception developed by Wartofsky (1983) and later commented upon by Cole (1996). The first level in this framework consists of what is called *primary artefacts*, those directly used in a work process. In the present study the portfolio assignment procedures and the specified communication activities in the virtual environment may be looked upon as such artefacts. *Secondary artefacts* consist of representations of primary artefacts and modes of actions using primary artefacts. These artefacts play a central role in preserving and

transmitting modes of action and beliefs. In our case they comprise the students' portfolio assignments, beliefs of learning and teaching, norms of actions and conditions in the teacher education environment. The third level is a class of artefacts which can come to constitute a relatively autonomous "world" in which the rules, conventions and outcomes no longer appear directly practical, or which, indeed, seem to constitute an arena of non practical, "free" play or game activity (Wartofsky, 1983). At this level the artefacts have become a part of a person's or an institution's way of acting. These *tertiary artefacts* are imaginative, they can come to colour the way our students see the world and providing tools for changing current praxis. Modes of behaviors acquired when interacting with tertiary artefacts can transfer beyond the immediate contexts of their use. This artefact conception is especially interesting when analyzing how the student teachers' describe their experiences and perceptions of teaching and learning by the use of ICT and portfolio concepts.

Methods and data

Five student teachers, three female and two male, were invited to be interviewed twice about their values, preferences and experiences with ICT and portfolios during the education programme. The students varied in age, gender and educational and professional background. They were selected to represent different subject positions and background experiences among the students in the programme. The second interview was conducted immediately before or, for some, after the final exam. The interview guide was open-ended and revised after experiences with three earlier student surveys in 2000-2002. The interviews were taped and analyzed.

An electronic survey study was conducted for all students at the end of the education programme. The questionnaire was a revised version of an earlier instrument used for students the previous years. The instrument seeks to elicit the students' perceptions and experiences about teaching, learning and assessment in the programme. The response rate was seventy two percent based on seventy six students. The main part of the instrument is constructed as a Likert-scale based on items with four agreement answers covering four main activity or knowledge domains in the programme (cf. table one). For the purpose of this study these item domains have been factor analyzed and reduced to item groups with

acceptable internal consistency and reliability. Each of these item groups have then been transformed to summary categories or indexes. Characteristics of these indexes are described in the forthcoming.

A. *Community and participation.* This index covers items describing attributes of the community study context, students' participation and involvement in developing the learning environment, collaboration and support being a teacher. Eight items belongs to this index. The internal consistency of this index is alfa = .79.
B. *Portfolio and learning.* This index comprises eleven items and describes to what extent students' work with the portfolios has been productive for transformation of theory into practice, reflection about content matter, knowledge application, student task collaboration and student – teacher dialogue. The alfa coefficient = .88.
C. *ICT and learning.* Eight items in this category describe how ICT has contributed to student – teacher collaboration, collaboration between students, sharing of thoughts, facilitating learning opportunities and understanding of learning and transfer of teaching methods to the school context. The alfa coeffisient = .86.
D. *School practice learning.* The constitutive elements of this index are six items describing how the students perceive the context of learning in school, their relationships to supervisors, support from fellow students, learning experiences and the way of knowledge sharing. The alfa coefficient = .76.

The inter reliability between items in the four indexes is alfa = .69. Based on this finding the indexes seem to be the best fit to analyses of the survey data. It seems reasonable to conclude that these categories measure somewhat different aspects of student teachers' perceptions of the teacher education programme. The bivariate correlations between the four indexes range between r = .11 - .50. Examples of scale items are translated into English and presented in table one.

Student characteristics

The students in the survey vary in age, gender, school teaching experience, experience with ICT, study motivation and motivation for being a teacher. The majority of the students are aged between 23 – 30 years, very few are older. Sixty seven percent is female, thirty three percent is male. About half of the group has no school teaching experience at all when entering the study programme, fifteen percent has one or two years of teaching experience, only six percent has more than two years. One fourth of the students have been working as teachers for periods less than one year. When looking at

motivation for being a teacher about seventy percent has decided to be a teacher. The others have not decided yet. About thirty percent of the students are well motivated for teacher education, while fifty percent is strongly motivated. Twenty percent has a weak motivation for the study. Only five percent of the students report that they are very well experienced users of new technologies, while forty two percent says they are well experienced users. Thirty eight percent has only some experience and fifteen percent has nothing.

It has to be mentioned as a positive characteristic of the study programme that about eighty percent of the students graduated from the programme by saying that their ICT competence was quite good, ten percent said very good. Only ten percent still assessed their competence to be weak at this final stage.

Student interviews

The five interviewed students' opinions at the end of their teacher education may be described in this way: All students express that the teacher education programme has been a vehicle for their understanding of what learning is about and that the new learning experiences differed a lot from earlier ones. They emphasize that the study processes have been richer and more deep-going than ever before. The way that portfolios and electronic activities have been structured and contextualized seems to be significant for these experiences. One of the female students expresses a common attitude of the five interviewed students: She states that her learning outcomes of this specific study have been better than before, something that most of her fellow students also would agree upon. "Even those who are critical to the education programme think they have learned more this year than before", she says. Four of the five students state that they have changed their opinions about teacher education during the programme. From being quite critical and "laid back" in the beginning they have moved towards a more positive position and commitment at the end.

All the informants mostly agree that the portfolio writing process has been quite productive for their learning and professional understanding. Working with individual as well as collective assignments has contributed to this end, they say. One of the students elaborates this position by saying: "It [the learning portfolios] makes it easier to

understand the theoretical perspectives and make them my own". She also states that her thoughts about teaching and learning have been changed towards more practical oriented knowledge of teaching and pragmatic concerns about classroom work.

When looking at the virtual learning environment and the digital activities, the five students seem to agree that activities in this system have contributed positively to the development of collective work and communication in the small student groups they belonged to. However, some frustrations seem appear: "There is too much uncertainty connected to the guidelines of the portfolio work and ICT". Contradictory messages and requirements given from teachers in the study programme seem to have contributed to these frustrations. Despite this problem the digital tools are looked upon as important elements of the programme and for the students' learning. The LMS as a communication system is highlighted by all the five students. They appreciate the flexibility and freedom offered them in this electronic environment. One of the male student s states that he has gradually become aware of the learning possibilities situated in this digital medium. This is also more or less the case for the other students. He reports that he has been using the LMS tools extensively both at the campus and in school when practicing teaching. He finds the tools very useful for his own learning, although he believes the education programme is going too far in relying on the specific LMS technology, as long as different teachers of the department transmit different information. By doing this, the responsible people of the programme hand over to the students their own unsolved problems, he says. This male student has picked up many ideas about how to use digital media in teaching, and he wants to practice and develop them further when working as a teacher later on. He is especially concerned about how the new technology is changing teacher and student roles in school.

In particular, the flexibility of working in the LMS environment is commented upon by all the students in the group. One of the females says: "I have been able to sit at home and work with my portfolio assignments in the middle of the night". She has a small child, and has appreciated this flexibility in time and space for studying. The system seems to have afforded her writings. In the same way as with the male student above this female student has gradually become aware of the facilities and affordances of the LMS. All the students appreciate the possibilities to communicate with teachers and other fellow

students whenever it suits them. When looking at the interviewed students as a group, their technological competences at the entrance of the study seem to be important for what they have learned and experienced during the study. The male and female students mentioned above went into the programme with a lot of prior digital experiences. Some of the others in the group had hardly any experience with such tools. This fact seems to have influenced their opinions about technology and portfolios as useful means of learning.

The general picture of the student interviews can be summed up as follows: the students seem to appreciate the electronic communication structure in the programme both in itself and as a means for stimulating the portfolio working processes. The interviews indicate a meaningful interplay between portfolios and technological tools during the study. These two main artefacts seem to have matured as conceptual tools in the students' minds.

Survey results

The interviews contribute to the understanding of a mutual relationship between portfolios and technology enriching the students' professional learning. However, low technological competence and interest at the entrance of the study programme seem to blur this picture. By moving into the survey data some constrains and conditions in this learning process are illuminated.

The students' answers at item level and index level are presented in table one and two. In table one a sample of three representative items in each of the indexes A – D are presented. Summaries of answers on the four point agreement scale are counted in percent. Also, mean values are offered.

Table 1 Student teachers' perceptions of programme features

Category A items: Community learning and participation	**Strongly disagree 1**	**2 %**	**3 %**	**Strongly agree 4**	**Mean N=55**
In this study it is easy to be accepted as a real partner in the learning community	3.6	16.4	38.2	41.8	3.2
In this study I have a feeling that everyone has contributed in developing the learning environment	12.7	38.2	34.5	14.5	2.5
In my opinion there has been a high degree of	5.5	40.0	41.8	12.7	2.6

student participation in the teaching courses					
Category B items: Portfolio and learning					
The portfolio work has been helpful in concretising theory in the study programme	11.1	16.7	42.6	29.6	2.9
The writing of portfolio assignments has helped me to reflect on the subject matter in the study programme	0.0	18.9	37.7	43.4	3.1
The portfolio work has contributed a lot to the contacts and collaboration with fellow students	9.3	27.8	31.5	31.5	2.8
Category C items: ICT and learning					
The use of ICT has made it easier to share thoughts and ideas with other students	11.3	39.6	39.6	9.4	2.4
The work with ICT has contributed positively to the collaboration with student educators at campus	14.8	44.4	27.8	13.0	2.4
By the use of ICT I have learned new ways of teaching that I can apply to school settings	7.5	13.2	45.3	34.0	3.0
Category D items: School practice learning					
The supervisors in school have helped me to understand the importance of planning a good learning environment	9.1	14.5	25.5	50.9	3.2
The fellow student collaboration in school has meant a lot for my own learning and development	9.1	10.9	30.9	49.1	3.2
In this study I have learned the importance of diagnosing classroom environment and culture	0.0	9.1	41.8	49.1	3.4

According to the item values in table one the students are clearly in favor of learning experiences connected to the portfolios and the setting of school practice. About to third of the students are looking at portfolios as helpful means in concretizing theory in the study programme, in reflecting on subject matter and contributing to contact and collaboration with fellow students. The same phenomenon seems to have happened concerning school practice learning. Both fellow students and supervisors are positive contributors to this experience. These relations are also confirmed by relative high mean scores for individual items in table one, also for the index means presented in table two.

When looking at the student s' answers for items in category A and C, the learning experiences seem to be more varied than for category B and D. As an overall impression the students agree very much upon that the learning environment has been inclusive for

all partners, however they disagree far more in relation to how much these partners have contributed to and participated in the development of it.

The majority of the students say that they have learned a lot of how ICT can be used for teaching and learning in school. However, they are far more reluctant to say that the technologies have been useful for collaborative purposes and mutual sharing of ideas.

The data in table one triggers the question of how and to what extent differences between students or subsystems in the programme may contribute to the mixed picture of learning experiences. By using the summary indexes for the items in category A – D the differences between the students may be described in more detail. Regression analyses based on the indexes are shown in table two. In these analyses the background variables gender, students' ICT experience, study motivation and attitudes to the portfolio exam are used as predictors.

Table 2 Regression analysis of study programme and background variables

Study programme categories	Mean	Gender		ICT-experience		Study motivation		Portfolio exam		Multiple R square
	N=55	beta	F	beta	F	beta	F	beta	F	
Category A: Community and participation	2.8	.02	.02	-.14	1.17	-.56	13.87*	-.31	4.46*	.27
Category B: Portfolio and learning	2.8	.07	.34	-.20	2.69*	-.53	18.33*	.05	.15	.36
Category C: ICT and learning	2.5	.03	.04	.38	7.90*	.12	.78	.22	2.56	.22
Category D: School practice and learning	3.1	-.08	.39	.11	.67	-.39	7.49*	-.30	4.37*	.18

* means a statistical significant value of < .05. Mean values are weighted for differences in item numbers in the categories.

Table two reveals that all but one of the four study programme categories, as experienced by the students, are strongly related to study motivation. With the exception of category C: ICT and learning, study motivation is a good predictor for positive learning experiences on community learning and participation, portfolio learning and school

practice learning. The beta values are relatively high and significant for all these three cases. The negative beta value for study motivation means that weakly motivated students at the entrance of the study are relatively more positive to what they have been exposed to than strongly motivated students.

The students' level of ICT experience when entering the study programme is positively related to ICT learning activities in the programme, i.e. a high entrance level corresponds to a positive appraisal of ICT learning activities in the programme. The beta value is relatively high (.38) and significant. Students' entrance level of ICT experience is also related to what degree they appreciate the portfolio model in the programme.

Regression analysis on the portfolio category and the community, ICT and school practice categories as predictors reveal strong relations to community and ICT variables, but not to the practice variable (beta for category B = .56, F = 39.6*, beta for category C = .45, F = 24.7*). This means that students with low portfolio values or preferences also have low preferences for the community learning and ICT activities, and vice versa for students with high portfolio values.

When looking at how the students perceive the final portfolio exam, the beta values show that students who are positive to the exam model, also are positive to community learning and participation in the programme and school practice learning. There are no such significant relations with the portfolio learning process or the ICT learning activities in the study programme. The regression analyses do not reveal any significant gender differences in any of the programme variables. This is underlined by rather low beta values across all the variables. The squared multiple regression coefficients for the programme categories across the background variables range between R square = .18 - .36. The highest value belongs to programme category A: Portfolio and learning, whereas study motivation and ICT experience most of all account for the size of this coefficient. The background variables explain least variance for activities in programme category D: School practice learning.

The regression analyses contribute to the understanding of the teacher education programme having differentially impacts on the students' learning and development. However, by and large the students report a positive attitude to the portfolio model,

community structures and school practices, when looking at the grand mean values for all programme categories. The ICT field has the lowest rank in such a comparison. However, students entering the programme with some adequate ICT experiences seem to have benefited most from the integrated technology and portfolio solution.

Discussion

The issues raised in this study were how student teachers perceived electronic portfolios as useful means for learning and future teaching and their professional development. The context was a one year teacher education programme focusing on practical pedagogical training and extensively reformed by new technology and use of portfolios. The portfolios in the teacher education programme may be classified as *learning portfolios* (Zeichner & Wray, 2001) or *professional training portfolios* (Smith & Tillema, 2003). The e-portfolio structure is part of an electronic framework based on a specified technology in a virtual learning environment for all students and teachers in the programme. The framework is restricted to a closed virtual environment and the students have to deliver a printed version of their portfolio assignments to the final exam.

The study reveals that the learning portfolios play a significant role for students' learning and development in the education programme. Student interviews and surveys all point to the finding that the working model of the portfolios has been productive in transforming theory into practice, supporting reflection processes about subject matter, content and knowledge application, beside stimulating collaboration and dialogues between partners in the programme. These positive results are expected according to earlier studies of the reform programme (Wittek, 2003; Hauge, 2002; Hauge & Wittek, 2002). However, the present study adds some interesting findings: the portfolios seem to appeal to male and female students on an equal basis. There are no differences between genders when looking at their learning preferences. Few studies about portfolio in teacher education have yet focused on this dimension, despite differences between gender found in studies of computers and writing in interaction at other education levels (Watson, 1997; Lee, 1993).

The new learning technologies are integrated parts of the portfolio model and production cycles for the student s in the programme. The study shows that the students are quite

concerned about the use and importance of technology, but that they differ in opinions about benefits and outcomes for their learning. The e-portfolio structure has been easiest to follow for students with a high level of ICT experience when entering the programme, but all students seem to have learned to navigate with and utilize the technology for communication and portfolio production purposes, despite possible lacks in competences of technology at the beginning. Compared to how the portfolio work has been productive for community building and reflections on learning, the online activities have not become that influential. However, the total picture of technological interactions is contradictory, especially when considering findings about how the majority of the students leave teacher education with much better ICT competence than at their entrance. The study reveals that there is a positive connection between the portfolio work, community learning and online learning activities, but the power in this relation depends on students' motivation and technological skills. This finding underlines that the major programme artefacts (portfolio and ICT) enter into different relationships with the students according to their individual characteristics.

We have asked in this study whether or no t portfolios and technological tools may function as artefacts at different conceptual levels for the students (cf. Wartofsky, 1983; Cole, 1996). We have also asked how these conceptions may vary according to prior learning experiences and professional competences among the students. The interviews and survey data might only indicate some relations that have to be interpreted in light of the interrelated context of portfolio assignment work and online activities. At the end of the study programme the situation is that about one tenth of the students strongly disagree about the usefulness of portfolios as means of facilitating community learning and participation, while on third of the group strongly support such functions. Concerning the use of ICT tools and possible transfer of technological knowledge to teaching and learning in school, the students' opinions are more diversified than for the portfolios. By and large we are inclined to say that a certain portion of the students have run through the programme without any deeper understanding of the potentials of the artefacts for school learning. The basic ideas of the portfolio model seem to have been appropriated better by the students than the technological ideas. This is a conclusion also supported by Ludvigsen & Flo (2002) in their study of the present reform programme based on activity

theoretical perspectives. As a summary conclusion we may say that the portfolios and the technological tools are operating at different conceptual levels for the students. To understand these differences we have to look at the students prior educational and non-educational histories that have shaped their experiences and perspectives on technology, learning and teaching.

There are a lot of limitations that have to be considered when looking at the implications of this study. The sample of students is not very large and the programme is still under construction in a reform cycle. This means that premises and constraints still are changing and that the innovations may be perceived different by other cohort of students. However, the students did not apply for the present study programme. They were organized into it as part of a normal administrative study procedure at the university. The present study should be and is already followed up by content studies of the portfolios (Hauge, 2004), studies of textual activities in the virtual environment and observation studies of students' teaching and learning (forthcoming PhD theses by E. Ottesen and B.O. Fosse). This would help clarifying the interactions found in the actual study.

Zeichner & Wray (2001) claim that it is necessary to conduct studies that moves beyond the obvious conclusion of portfolios promoting reflection in teacher education. The specific qualities of the portfolios in teaching process have to be investigated. The present study contributes to this elaboration and the understanding of some of the prevailing conditions and qualities of portfolios in teacher education.

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