Distance education and a Realistic Teacher Education Pedagogy in Uganda: impact of an ICT-supported learning environment

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Proefschrift ingediend tot het behalen van de academische graad
van Doctor in de Pedagogische Wetenschappen

2006

Preface

This thesis is a product of research conducted on the use of ICT in instruction in distance teacher education in Uganda which began in April 2002. The research explored the impact of a realistic teacher education pedagogy oriented learning environment supported by ICT on efficiency in terms of flexibility, improving perceptions about instructional approaches and efficacy in terms of levels of cognitive processing and metacognition in distance teacher education in Uganda.

Combined efforts made the once a dream, a reality. Prof. Martin Valcke, the promoter of the research, saw sense in a mere dream and indeed nurtured it to reality. Consistently, he was supportive, motivating and resourceful. He unreservedly provided a conducive academic environment. Dr. Anne Ruhweza Katahoire, the co-promotor of the research was instrumental in contextualizing the research to Uganda. Special thanks to the family members of the promoters for all the support to this research. Great thanks to the support committee Prof. Gilberte Schuyten, Prof. Ronald Soetaert and Prof. Thierry Marchant, whose guidance helped to fine-tune this thesis.

Special thanks go to the Belgian Technical Cooperation - BTC/CTB for funding the research. Connect-ED project Uganda is highly appreciated for providing the electronic infrastructure needed for the experiments free of charge. In addition, for being there whenever needed for planning, advice and technical support. Great thanks to the teacher education students, tutors and lecturers of the six colleges (Bushenyi, Kibuli, Mukujju, Ndegeya, Shimoni and Soroti) and the four universities (Makerere, Kyambogo, Uganda Matryrs- Kisubi Christian Brothers centre and Ndejje) who participated in the research amidst their busy schedule. Great thanks too, go to the ICT in education initiatives (African Virtual University - Makerere University, Connect ED, Curriculum Net, DICTS - Makerere University, IICD - Kyambogo University, School Net and E- learning - Makerere University) in Uganda who participated in the research to help contextualize the whole study to Uganda.

I will remain entirely grateful to my colleagues at the department of educational sciences Gent University, for their collaboration and making my family and I feel at home away from home. I am very grateful to Child Health and Development Centre, Makerere University for providing me an academic environment in Uganda on top of a nice social environment of CCC. To all my dear friends, thank you for the moral support, it meant

the world. You brightened my world and challenged me to live to your expectations. In addition, thank you for constantly encouraging me to keep fit.

To the Blasio and Mary Family (BMS) I will always be grateful for being part of you and for your being YOU when I needed YOU. You have been there throughout my life and I still need you there. In your individual capacities thank you for your endless support. Allow me to single out Matel and Patel for supporting my basic education and providing a good environment all through. In particular, I wish to recognize the support of Julius, Justine and Janice and, Helen while away from home in Belgium. To Jaba, Anis, Moses, Alex, Ronald and Poly thank you for supplementing my roles when I could not be there.

Last but not least to the three men in my life Robert, Bill and Bob thank you for making a sacrifice for your right to a full time wife and mother respectively for this cause. That aside, thank you for the countless support, best wishes and the love. Even when I thought it was too hard to carry on, I had to, because of you.

To all, this is our achievement and I pray that we live to share, enjoy its fruits and improve the lives of mankind.

Gudula Naiga Basaza
Ghent, April, 28th 2006

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General introduction

Distance education and a realistic teacher education pedagogy in Uganda: impact of an ICT-supported learning environment.

General introduction

Distance education and a realistic teacher education pedagogy in Uganda: impact of an ICT-supported learning environment.

An education system is said to be as good as its teachers! This research explores the impact of introducing a realistic teacher education pedagogy (RTEP) oriented learning environment supported by ICT in distance education in Uganda. In this chapter, we first focus on the context in which the research was set up to introduce the general research problem. Next, we present the general hypothesis and a theoretical framework to ground this hypothesis. Consequently, research questions are listed and the overall research design is described. We conclude with an overview of the different research studies and how they are interrelated.

The context of the present research

To underscore the importance of adopting a RTEP oriented learning environment supported by ICT in distance education, it is necessary to understand the status of teachers, teacher education and distance education in Uganda.

The status of primary and secondary school teachers in Uganda

Analysis of the current status of teachers in Uganda draws attention to both quantitative and qualitative elements in relation to teacher qualifications, teacher numbers and teacher attrition rates. Table 1 and 2 give an overview of the proportion of teachers with their qualification in primary and secondary schools from 2000 to 2004.

Table 1.

Qualifications of teachers in primary schools 2000 -2004 (Education Management and Information System (EMIS), 2004)

Qualification	Year 2000		Year 2001		Year 2002		Year 2003		Year 2004	
	Total	%	Total	%	Total	%	Total	%	Total	%
At least Grade IV [a]	11779	10.7	14686	12	17261	12	19071	14.1	22066	15.8
Grade III	71051	64.4	80011	63	86630	62	89792	66.3	93831	67.4
Licensed [b]	17579	15.9	18043	14	24072	17	25879	19.1	22756	16.3
Others [c]	9957	9.0	14293	11	11521	8	660	0.5	661	0.5
Total	110366	100	127038	100	139484	100	135402	100	139314	100

[a] At Least Grade IV: Includes All Graduate, Diploma, Grade V, and Grade IV.

[b] These are untrained teachers recommended by the Ministry of education to teach.

[c] Others: Include all grade II teachers and others recorded as Not Stated.

Table 2.

Qualifications of teachers in secondary schools 2000 – 2004 (Education Management and Information System (EMIS), 2004)

Qualification	Year 2000		Year 2001		Year 2002		Year 2003		Year 2004	
	Total	%	Total	%	Total	%	Total	%	Total	%
Graduate	8074	27	7905	26	10100	28	11341	33	12040	33
Diploma	11376	37	11998	39	12124	33	15372	45	15277	42
Grade V	4734	16	4557	15	7423	20	3481	10	3269	9
Licensed[a]	3502	12	1942	6	3438	9	2217	7	1722	5
Others[b]	2698	9	4023	13	3368	9	1522	4	4189	11
Total	30384	100	30425	100	36453	100	33933	100	36497	100

[a] These are untrained teachers recommended by the Ministry of education to teach.

[b] Others: Include all grade II teachers and others recorded as Not Stated.

The minimum qualification for teaching in primary school is a Grade III certificate, for teaching in ordinary level secondary school is a Grade V diploma and for teaching in advanced level secondary school it is a Bachelors degree in Education. As can be derived from both tables, more than two thirds of the teachers have the minimal qualifications required to teach in the schools where they are teaching and this has been improving with each year. However, two concerns are raised in relation to the data in the two tables: First, there is still a significant percentage of teachers without the minimal qualifications. Secondly, there are also teachers whose

qualifications are not suited for the school level where they are teaching. This becomes especially clear when we study the detailed data in Table 3.

Table 3.
Teachers in primary and secondary schools by qualification 2002 and 2004 (Ministry of education and sports, 2002 and Education Management and Information System (EMIS), 2004)

Year	Year 2002				Year 2004 National	
Level	Primary		Secondary		Secondary	
Teacher Grade	*N*	%	*N*	%	*N*	%
Diploma in Primary Education	10284	7.4	12341	33.2	15281	41.0
Grade II Teacher	3118	2.2	48	0.1	70	0.2
Grade III Teacher	86630	62.1	96	0.3	159	0.4
Grade IV Teacher	939	0.7	100	0.3	571	1.5
Grade V Teacher	5147	3.7	7513	20.2	3269	8.8
Graduate Teacher	891	0.6	10400	27.9	12042	32.3
Licensed Teacher/Untrained [a]	24072	17.3	3512	9.4	1722	4.6
Not Stated[b]	8403	6.0	3217	8.6	4199	11.3
TOTAL	139484	100	37227	100	37313	100

[a] These are untrained teachers recommended by the Ministry of education to teach.

[b] Not Stated: unqualified and not recognised by the Ministry of education

In the primary school sector slightly more than a third of the teachers teaching in this sector should not be teaching at this level or teaching at all as is the case with the 17.3% untrained teachers. In the secondary school sector more than half of the teachers teaching in secondary schools are not qualified to do so. Grade II and IV teachers were phased out of the education system however they are still prevalent. Teachers with a diploma in primary education are teaching in secondary school and those with Grade V – diploma in secondary education are also teaching in primary schools.

Next to teacher qualifications, also the teacher student ratio is a major concern in the Ugandan context. Considering the earlier observation about a persistent percentage of under qualified teachers in the school system, this puts forward challenges for both inservice and preservice teacher education.
Table 4 summarizes data to calculate teacher student ratios, both at primary and secondary school level. The introduction of Universal Primary

Education (UPE) in 1997 negatively affected the teacher student ratio in primary schools. We can observe an increase from 1:38 to higher ratios in the consecutive years and a ratio of 1:50 in 2004. At secondary school level, the teacher/student ratio remains rather stable. But the table also illustrates the pressure on teacher education to deliver growing numbers of teachers to cope with the growing numbers of students in the school system.

Table 4.
Teacher pupil ratio 1995 – 2004 (Education Management and Information System (EMIS), 2004)

Primary School	**1995**	**1996**	**1997**	**1998**	**1999**	**2000**	**2001**	**2002**	**2003**	**2004**
Total pupils N	2636409	3068626	5303564	5806385	6288239	6559013	6900916	7354153	7633314	7377292
Schools N	8531	8531	8600	9916	10597	11578	13219	13332	13353	13407
Teachers N	76111	81564	89247	99237	109733	110366	127038	139484	145587	141,461
Teacher pupil ratio	1:35	1:38	1:59	1:59	1:57	1:59	1:54	1:53	1:52	1:50
Secondary School	**1995**	**1996**	**1997**	**1998**	**1999**	**2000**	**2001**	**2002**	**2003**	**2004**
Total Students N	256259	256731	445676	265676	258263	518931	539786	655951	683609	697507
Total Schools N	619	619	621	837	1633	1892	2400	2198	2863	2969
Total Teachers N	14447	15783	15995	16206	23295	30384	30425	37227	38549	37313
Teacher student ratio	1:18	1:16	1:28	1:16	1:11	1:17	1:18	1:18	1:18	1:19

Linking the information from Table 1, 2 and Table 4, we have to consider in the teacher student ratio also the number of unqualified or lower qualified teachers that have to cope with growing numbers of primary school children. Although the teacher student ratio at secondary school level looks much better as compared to primary school level, there is the question of what will happen when Universal Secondary Education is introduced in 2007. The growing number of teachers entering the profession, and based on the right qualifications, looks hopeful. Statistics of the EFA Assessment (2000), indicate that up to 75% of teachers have now sufficient qualifications. But, one should consider the level of attrition in this context. Table 5 summarizes how teacher attrition is not at all stable.

Table 5.
Teacher attrition (The EFA 2000 Assessment, 2000)

	% New Teachers			% Teacher leaving the system		
Year	Trained	Untrained	Total	Trained	Untrained	Total
1986	11	20	31	10	15	25
1989	9	17	26	5	9	14
1991	8	13	21	3	6	9
1993	9	11	20	10	10	20
1995	7	4	11	2	4	6
1998	67	33	14	38	[a]	38

[a] The exact % of untrained teachers leaving the profession for this year is missing.

Table 5 shows the number of new teachers entering both primary and secondary education and the percentage leaving the teaching profession. The data indicates that teacher attrition is a problem and that it affects both trained and untrained teachers. Although the net number of teachers increases yearly, it is evident that problematic teacher student ratios also include shifting number of teachers entering and leaving the profession.

Teacher education

Teacher education in Uganda reflects a variety of approaches to become a qualified teacher. In the next paragraphs we describe the alternative programs, data about enrolment and graduation numbers and we finish with a discussion of the predominant pedagogy adopted in teacher education.

Alternative teacher education programs in Uganda

Four educational levels can be distinguished in the Uganda educational system: Primary (7 years), Secondary school comprises ordinary (4 years) and advanced level (2 years) and tertiary level (2-5 years). Pre-primary education or Kindergarten exists although it is not a compulsory part of the Uganda's educational system.

The lowest teacher qualification level is a grade III certificate. These candidates obtained two credits at ordinary level in order to enrol in a

primary teachers college. The majority of teacher education institutions in Uganda focus on this teacher education level. Table 6 illustrates for example, that Grade III certificate teachers have an option of upgrading to a higher level. But since this implies that one has to leave their actual teaching position for about 2 to 5 years, this poses a challenge to upgrading.

Table 6.

Relationship between entry requirements and teacher education qualifications in Uganda

Qualification obtained / Entry requirements	**Grade III certificate** (2 years at a Primary teachers' College)	**Diploma in primary education** (2 years at a Grade V teacher education institute of at University)	**Diploma in secondary education** (2 years at a Grade V teacher education institute of at University)	**Bachelors degree in Primary education** (3 years at a university)	**Bachelors degree in Secondary education** (3 years at a university)	**Post graduate diploma in education** (1 year at university)
Number of specific institutions offering*	45	10 – NTCs + 19 Universities		19 (6 government & 13 private)		
Ordinary level certificate						
Advanced level certificate						
Grade III certificate						
Diploma in primary education						
Diploma in secondary education						
Mature Age Entry teachers						
Bachelors degree						

**Some universities offer teacher education in view of primary, secondary or both educational levels.*

Enrolment and graduation of teachers

Only incomplete statistics exist regarding the enrolment and graduation of teachers in Uganda. Table 7 summarizes the available data. The data is organized according to the types of institutions where the alternative teacher education qualifications can be obtained. There is an increasing trend in the number of teachers trained from the different institutions over the years. Considering the figures for Makerere University and Kyambogo the graduates are far less than the enrolment three years before and yet it is the graduates' numbers that give us an indication of the number of teachers

that are ready for deployment. Is it possible that once students are enrolled in the university they change courses or dropout, thus explaining the discrepancy between the numbers of those enrolled in education and the actual number of graduates? Again the trend of this number is varying. We also established already that the net number of new trained teachers joining the education system each year is small and the numbers of graduates has a stake in this.

Table 7.

Teacher enrolment and graduates 1989- 2004
Based on Uganda Bureau Statistics (2005)

Year	1989	1991	1993	1994	1995	1996	1997	1998	2004
Teacher training colleges (Enrolment) – N= 45	15166	14305	17541	18512	22703	13339	26418	4756	37,061
National Teacher Colleges (Enrolment) – N=10	3008	4534	5703	6017	8044	7955	8760	11130	16,170
National Teacher Colleges (Graduates) – N=10									6,778
Makerere university B. Educ (Kyambogo) - Enrolment		399		263	326	703		784	
Makerere university B. Educ (Kyambogo) - Graduates	220	189	58		70	4	94	62	
Makerere university B. Educ (BSc & BA) - Enrolment	487	775	901	862	820	1509	941	1167	
Makerere university B. Educ (BSc & BA) - Graduates	149	168	305	276	232	256	312	326	

Teacher Education Pedagogy in Uganda

In this section we discuss the dominant pedagogical approach adopted in the Uganda teacher education context. A critical issue is the relationship between the introduction into the theoretical knowledge base and the development of the practical knowledge and skills (building on personal and professional experiences) necessary to become a proficient teacher. This practical knowledge goes beyond practices about navigating the classroom since it also highlights the complexities of interactive teaching and thinking in action (Munby, Russell, and Martin, 2001). Practical knowledge both focuses on subject matter, students and student learning and understanding (Meijer, 1999). Although teacher education institutions aim at equipping student teachers with this theoretical and practical knowledge base, the dominant teacher education pedagogy questions the potential to attain these objectives.

In Uganda, a typical student teacher follows a curriculum consisting of (1) a subject matter domain (specific subjects the future teacher will teach), (2) foundations of education (history of education, sociology of education, philosophy of education, economics of education and comparative education) (3) professional studies (education psychology, curriculum studies, subject methods) and (4) the practicum (school practice) (Aguti, 2003). In view of the four curriculum domains, the lecturer or tutor defines the knowledge, skills and competencies to become a teacher. The main didactic approach is based on whole classroom teaching during which specialist lecturers or tutors teach the different subjects. School practice takes place at least once a year. During school practice, a student teacher is expected to prepare a scheme of work and lesson plans in order to teach in live classrooms. Some of these are supervised by the lecturer or tutor, but supervision is mainly done by the regular teachers of this class. Student teachers also receive some responsibilities to organise extra school activities, such as addressing the school assembly, supervision, and individual child study activities. Student teachers are evaluated separately in view of the four curriculum areas.

This description of this dominant Uganda teacher education pedagogy fits into the scientific or mechanic view of Hoban (2002). According to this view courses are taught independently of one another. This is also referred to as the technical rationality (Korthagen, 2005; Korthagen, 2001a). This approach equips student teachers with the necessary theoretical base, but does not guarantee the transfer from theory to practice (Korthagen, 2005; Korthagen, 2001a; Hoban, 2002). Because of the disconnected nature of developing the theoretical base, there is the danger that this theory is presented too early or too late in view of becoming relevant for teaching practice (Korthagen, 2001b). This, more often than not, can lead to misinterpretation of the complexity of the school as a system (Hoban, 2002). In the end, this teacher education pedagogy will result in a disconnected personal base to direct the future teaching practice. Theoretical knowledge is considered to be linked to rational, logical, analytical thinking, whereas the practical knowledge is rather based on gestalts, personal conglomerates of needs, concerns, values, meanings, preferences, feelings and behavioural tendencies (Korthagen, 2001b).

The technical rationality approach stresses a prescriptive approach towards teaching by adopting a particular, prerequisite set of skills, disconnected from the founding theory and or research base (Munby et al., 2001). This technical rationality teacher education pedagogy can result into a conception of teaching as a craft - a repertoire of skills or competencies that are accrued over time and are the result of developing a set of technical skills, based on a set of goals, lesson plans (Hoban, 2002). In addition, "teaching as a craft" starts from a teacher centred point of view that puts the teaching subject at the core of the teaching activity and not the learner. Knowledge and skills are passed on without student teachers knowing what the relevance of this set of knowledge might be (Phillion and Connelly, 2004).

The former paragraphs help us to approach the dominant teacher education pedagogy in Uganda in a critical way. As previously mentioned the technical rationality approach forms the basis for Uganda's dominant teacher education pedagogy. Theory and practice are not developed in an integrated way. Pulling together the information of the former paragraphs, the issue of upgrading teacher education in Uganda is not only important from a quantitative perspective. Key questions can be put forward as to the quality of current teacher education that embraces to a dominant extent the technical rationality approach.

In the context of the present study, alternative approaches are presented that help to answer both elements of the problem. To meet the quantitative demands, distance education is put forward. In addition Information and Communication technologies (ICT) are presented as additional elements to cope with the quantitative dimension in the teacher education problem. To meet the qualitative critiques, an alternative teacher education pedagogy is suggested. ICT is in this context also expected to support this alternative teacher education pedagogy.

Distance teacher education to improve the quantity of teachers

In this section we explore distance teacher education in Uganda in light of improving the quantity of teachers. In particular we look at the current

demand for distance education, its format, and the instructional approaches adopted in the systems. We are challenged however by the lack of literature to describe distance teacher education in Uganda and this explains why the same authors will be constantly quoted.

The Demand for Distance teacher education

In Uganda, there is a gradual increase in the number of students enrolled in distance education courses and also an increase in the number of institutions offering distance education (Ouma, 2003). Distance education is expected to increase the number of student teachers in initial teacher education and in in-service teacher education. As to the latter, it is expected that this might solve the challenge of lower qualified teachers to upgrade their qualifications without having to leave the school system. Other teachers could opt for distance teacher education in view of further career development like attaining extra qualifications that guarantee higher wages, pension, prestige and/or promotion, or to meet the needs to develop uptodate knowledge, skills and competences.

The format of distance teacher education in Uganda

To understand the general format of distance teacher education in Uganda, it is helpful to have a closer look at the mission statements of some typical teacher education institutions (that have offered distance teacher education extensively), characteristics of the current student target population and the nature of the delivery format in distance education approaches.

The goal of the Department of Distance Education in Makerere University is to offer a wide variety of educational programmes for adult students, by adopting a flexible multi-media approach. The department promotes open access to lifelong education, in particular at the level of higher education (Institute of Adult and Continuing education, 2005). At the Uganda Martyrs University (UMU) the mission of the Centre for Extra-mural Studies and Distance Learning is to make available a wide range of programmes and courses geared towards the needs of the community, and as such beyond the boundaries of the university (Uganda Martyrs University, 2005). The External Diploma in Primary Education launched in

April 1999 at the then Institute of Teacher Education (ITEK), now Kyambogo University to upgrade Grade III teachers to Diploma level uses distance education. Among the aims of the program according to Aguti (2002) is to provide opportunity to eligible and interested teachers who can not pursue full-time courses in the colleges/institutions or Universities. Also to develop a more flexible mode of education that caters for a variety of needs, changing circumstances and learning requirements of the teachers. The mission of Ndejje University is tailored to suit student needs for the new millennium. At governmental level, the Teacher Development Management systems project (TDMS) reformed in-service training for primary teachers by promoting distance education (Ministry of Education and Sports, 2003).

The examples cited clearly indicate that increasing flexibility and access to teacher education is a shared objective of these initiatives. Distance teacher education in Uganda targets both pre and in service teachers at primary and secondary school level teachers working towards attaining a diploma or a degree level. For example, the Teacher Development Management Systems project (TDMS) is set up in primary teacher education colleges targeting untrained/licensed teachers in primary schools. Distance teacher education at universities targets both pre and in-service teachers.

The delivery format of distance teacher education in Uganda is predominately through printed modules enriched with traditional face to face sessions during holiday periods (Institute of Adult and Continuing education, 2005). This delivery format will be discussed in more detail in Chapter 2. In the TDMS project, the delivery of distance education is in addition enriched with peer group meetings, study visits, and short courses at the coordinating centres during the holidays (Ministry of Education and Sports, 2003). The face to face sessions are either offered at the institution (Makerere University and Ndejje) or in study centres (Kyambogo University and Uganda Martyrs University). These study centres are geographically closer to where student teachers live. In the case of Makerere University the study centres are expected to encourage group discussions and the dissemination of information and news. But, contrary to expectations about the role of study centres, no additional student support, such as counselling and library services are available. Most of such

services are only available at the central level (Aguti, 1999; Aguti, 2003). In light of the above description, the current distance education is not very flexible. In addition, the current approaches reflect a rather limited set of instructional approaches that hardly stimulate a variety of perceptions of student teachers about instructional approaches.

Instructional Approaches in distance teacher education in Uganda

Distance teacher education needs to follow sound instructional approaches to achieve its purpose. The theoretical basis on which instructional models are based affects not only the way in which information is communicated to the student, but also the way in which the student makes sense and constructs new knowledge from the information which is presented (Sherry, 1996). Instructional approaches can be viewed from different perspectives, regardless they put into consideration the interaction of the student, the instructor and the learning environment. Given the unavailability of literature, the findings of this section are based on a comprehensive study of distance teacher education in Uganda (Aguti, 2003). These findings are based on responses of students, prospective students, tutors, managers and policy makers. The respondents were from five different distance teacher education programs run by different institutions. The respondents highlighted the strength and weakness of distance education.

In general the instruction in distance teacher education involves use of printed modules, face to face sessions, study group meetings and assignments. In relation to instruction is also communication between actors, planning and coordination of the program, access to reference resources and the use of ICT. They are applauded to have their strength but also are said to have pertinent weaknesses as will be summarised below.

The content of distance teacher education curriculum is said to be relevant to the student teachers in terms of giving them skills and knowledge needed in their responsibilities. The curriculum is however criticized for being irrelevant, theoretical (little emphasis on skills needed in the field and lack of practical application of what is learnt) and having inadequate coverage (there is specialising in the training, yet in the field primary

teachers are expected to teach all subjects and also heavy workload for the available time).

Print modules used are said to be user friendly and legible. However, respondents are concerned about the slow pace of their production, poor provision and at times unavailability. In addition, the quality of some is queried. There is a fear of plagiarism in the materials. Next to this, is also inadequate reference material.

Face to face sessions were applauded for minimising isolation of student teachers. There is a concern however that these sessions are brief thus limiting the coverage of the course. They are also said to be intensive thus limiting interaction. There is also a dependency on face to face sessions to cover for all the instruction. In addition, there is a concern that they are held in centralised places instead of regional centres thus increasing the crowding and expense on the student teachers. Although running face to face sessions during holidays offers some flexibility it is a challenge in that it leaves virtually no time for the in service student teachers to relax.

Study group meetings offer learners an opportunity to interact, network and support one another. There was a concern however that no support is provided during these meeting. Assignments are essential and an opportunity for students to reflect on their experiences. Continuous assessment of this nature is said to motivate students to keep focused on the course. However, according to the student teachers the nature of these assignments can promote cheating and marking is not properly and promptly done. In addition, records are not well kept. The instruction is also challenged by poor communication between the student teacher and the instructors, inadequate interaction and lack of an opportunity to help students individually.

There is a concern that the programs are poorly planned and coordinated resulting in confusion and frustration of both the students and staff. There is also a worry that the number of students enrolled out numbers the staff available. The staff are said to be not only inadequate in numbers but also abilities. There is also a challenge of inadequate follow up of students.

Access to resourceful libraries was applauded. However there was need to have this access more decentralised at regional or district level. The regional and district centres also need to be equipped with up-to-date study materials.

In response to what ICT distance teacher education is exposed to; radio stands out while video, computer and internet seems to be out of reach for many. Students identified places like hotels/bars, schools, computer kiosks, post office, workplace and coordinating centres as places where they could access ICT. The policy makers indicated that access to ICT is still a big challenge. The lack of integrated ICT use in distance teacher education posed a challenge (Ouma, 2003).

To wrap up this section, we are compelled to conclude that the instructional approaches currently in use do not promote active involvement and interaction of the student teacher in the learning environment. Collaboration is somewhat minimized because of poor communication between the student teachers. Moderation by a lecturer or tutor is hardly there partly because of the numbers and also if they are distributed in the different study centers communication at a distance becomes a barrier. The learning environment is the intensive face to face classroom and the printed module. ICTs are hardly used in distance teacher education. Considering the critical state of teacher education and distance teacher education in Uganda, and the lack of integrated use of ICT in instruction, we summarise the problem context then put forward the research focus in the next section of this chapter of this PhD study.

Problem context

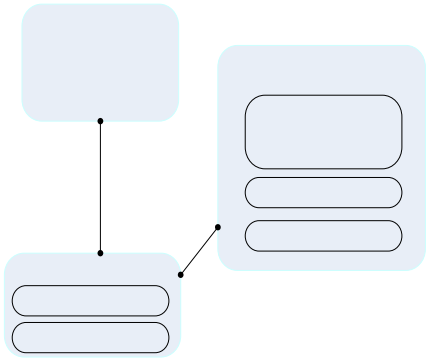

Figure 1. Problem context

Figure 1 summarizes the key elements of the general research problem for the present study. Bearing in mind the quantitative and qualitative needs of teachers in Uganda in both primary and secondary schools, a through rethinking of preservice and inservice teacher education is needed. The existing alternative routes to becoming a teacher in Uganda only cater to a limited extent opportunities to improve the quality and quantity of teachers; especially the unqualified teachers. The routes to upgrade teachers imply a too long disruption of the current classroom practice. In addition we pointed at the critical state of the current dominant teacher education pedagogy in teacher education which leaves a lot to be desired. Whilst distance teacher education is available in Uganda, it lacks the necessary flexibility (in terms of time, the mode of instruction, the location of study, choice of communication modes and the level of interaction between the student teachers and their entire learning environment) to cope with the particular demands of inservice teachers. In addition, the instructional approaches adopted in this delivery format of teacher education are very limited. The potential of ICT is not fully exploited to shore up distance education and/or to improve flexibility and the quality of the instructional approaches.

The research focus and research hypothesis

To tackle the general research problem, the present research addresses three major issues. First, the study set out to improve the quality of the

educational approaches by implementing a realistic teacher education pedagogy, implemented in an ICT-based environment. Secondly, the study targets improving the efficiency of the current distance teacher education by increasing its flexibility. Thirdly, the research aims at increasing the efficacy of teacher education. Efficiency and efficacy are expected to be fostered by integrating the use of ICT in a distance teacher education setting. This brings us to the general research hypothesis: *Realistic teacher education pedagogy oriented learning environment supported by ICT enhances efficiency in terms of flexibility, improves the perceptions about instructional approaches and promotes the efficacy of distance teacher education.* Figure 2 gives a schematic overview of the key variables in the research hypothesis.

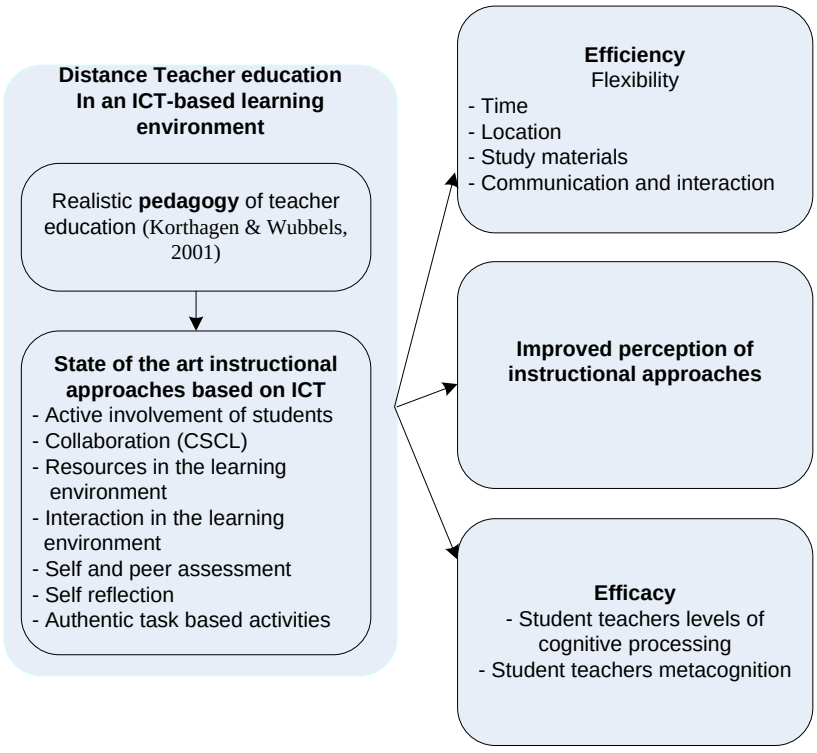

Figure 2. The impact of a realistic teacher education pedagogy oriented learning environment supported by ICT on distance teacher education

The general research hypothesis builds on a number of assumptions that will be discussed in the next sections. First we highlight the terms that will be used to describe the ICT supported learning environment in this research. Next we describe the realistic teacher education pedagogy and how it was implemented in an ICT-based learning environment. Also the link with the three types of dependent variables is discussed: efficiency, impact on perceptions about instructional approaches and the efficacy of the learning experience.

ICT supported learning environment

The ICT based learning environment as discussed in this research is labelled differently in the literature. Alternative conceptualisations are: virtual learning environment - Boulton (2002), web based learning environment - Khan (1997), www environment - Collis and Van der Wende (1999), online learning environment - Chen (2002) and Uys (1998), etc. In the context of the following chapters, these concepts will be used as synonyms.

The Realistic Teacher Education Pedagogy (RTEP)

In this section we define the RTEP and describe how it was implemented in an ICT-based learning environment for distance education.

As explained earlier, the realistic teacher education pedagogy focuses on the integration of theory and practice. Realistic teacher education starts from the student teachers' experiences and their "Gestalts" rather than from the objective theories on learning and teaching in the literature (Korthagen and Wubbels, 2001). In this way, teacher education helps student teachers to become aware of their needs, to find useful experiences, and to reflect on these experiences (Korthagen, 2001b). At the *Gestalt* level, actions are typically based on unconsciously triggered needs, values, meanings, feelings and behavioral inclinations. This leads to the *schema* level, involving the actor reflecting on action (-in or -on action) and on other situations to form concepts, characteristics, and principles that are helpful in describing practice. The *theory* level, at which a logical ordering is constructed in the knowledge formed before as relationships between schema are examined

and several schemata may be connected into one coherent theory. The three level model connects several notions about teacher behaviour and teacher education into a coherent framework, and leads to tangible consequences for the work of teacher educators (Korthagen, 2001b). The realistic teacher education pedagogy is clearly reflected in the model of professional learning as developed by Korthagen and his colleagues (Kane, 2003). The five tenets of a realistic teacher education pedagogy are:

1. Realistic teacher education starts from concrete practical problems and the concerns as experienced by (student) teachers in realistic contexts.
2. It aims at the promotion of systematic reflection of (student) teachers on their practices and experiences, on the role of the context, and on the relationships between these aspects.
3. It builds on the personal interaction between the teacher educator and the (student) teacher and on the interaction among the (student) teachers.
4. It takes the three levels of professional learning (*Gestalt, schema and theory)* into account, as well as the consequences of reflection at each level.
5. It has a strong integrative character. Two types of integration are central: integration of theory and practice and integration of subject disciplines.

Distance education in a RTEP oriented learning environment supported by ICT influences key aspects of an instructional context; i.e. the learning environment, the instructor roles and the student teacher roles.

Implications of a RTEP oriented learning environment supported by ICT in a distance education context

As to the learning environment, the design of learning activities, provision of learning resources can be affected by adopting the RTEP.

In *designing the learning activities*, it is important to consider the promotion of realistic teacher education tenets. Education starts from *concrete practical problems* and what the student teachers experience in real life contexts. Therefore, authentic learning activities should be presented to help

students to draw from their experiences. In the ICT-based learning environment these activities help to link theory and practice. Approaches that value both teachers practical knowledge and formal theories as relevant components of the knowledge base of teaching, and which confront each element with the other, are expected to enhance the quality of the teacher education experience (Verloop, Van Driel, and Meijer, 2001). Presenting activities that challenge personal teaching and learning activities are considered to foster problem solving and are helpful to elicit multiple perspectives from different students (Brookfield, 1995).

The learning environment should continuously challenge the student to adopt the *self reflection* attitude (Korthagen et al., 2001). In the learning environment there should be avenues to reflect on individual work and the work of others. Formative assessment can be embedded to support the gradual progress in learning through immediate, contextualized feedback and self reflection (Boulton, 2002). According to Rovai (2004), establishing asynchronous learning networks will activate a reflective and thoughtful type of communication between students and encourage critical thinking. Authors also link reflection to the deeper levels of cognitive processing because of the opportunities that emerge to generating links between old schemas and new information. Systematic reflection invokes the combination, extension or alteration of the schemas and also support better retention of new learning content (Mergel, 1998). Farrell (1998) describes five components of the teacher development model that provide opportunities for reflection that have implications for promoting reflection in the activities.

1) Provide opportunities for teachers to reflect through different activities that can be carried out alone, in pairs, or as a group such as group discussions, observation, journal writing, critical friends.
2) Establish some basic rules as to the process and each activity. A minimum set of guidelines are to be negotiated to insure a deeper, critical level of reflection beyond the mere descriptions of teaching activities.
3) Make provisions for four different kinds of time to reflect on their work

a) Individual - a certain level of commitment by individual participants in terms of time availability should be negotiated by the group at the start of the process.
b) Activity - time that should be spent on each activity.
c) Development - this is the time it takes to develop analytical reflection and only progresses at a rate which individual teachers are ready to reflect critically.
d) Period of reflection - the time frame for the project as a whole. How long should a group, a pair, or an individual reflect?

4) Provide external input to enrich the reflection - input from "various experiences, other peoples' observations and reflection, and from other peoples' experiments, and from theories learned from research and the literature".
5) Provide for a non-threatening environment. Ways to establish a low anxiety level are to be incorporated, such as emphasizing description and observation rather than judging teacher input.

Learning in an ICT-based learning environment should be based on the *three levels of professional learning* in RTEP. This is fostered by knowledge construction in electronic discussion groups (Dougiamas, 1998; Duffy and Cunningham, 1996; Huekler, 2002). Learning in discussion groups is in line with RTEP requirements since knowledge is actively created rather than transmitted by the teacher, mediated by discourse rather than transferred through teacher talk, explored and transformed rather than remembered as an objective set of positivist idea (Holt-Reynolds, 2000). Given the central position of the students, the learning activities ought to be teacher-supported (Ruthven, Hennessy, and Deaney, 2005). This can be realized by adopting a structure with clear guidelines. In designing, the instructor has to analyze a task and to break it down into manageable chunks, to define objectives, and to state performance objectives (Mergel, 1998). Task characteristics are of importance with regard to levels of knowledge construction in such discussion environments (Aviv, Erlich, Ravid, and Geva, 2003; De Wever, Valcke, and Van Winckel, 2003; Schellens, Van Keer, and Valcke, in press). The environment should support either synchronous or and asynchronous communication. Asynchronous communication is said to encourage to a higher extent reflection and

composition (Boulton, 2002). And in the context of distance teacher education, this type of communication promotes the desired RTEP *personal interaction between the teacher educator and the (student) teacher and the interaction among the student teachers.* The online environment is expected to encourage the individual cognitive growth by fostering both independent learning as well as social interaction (Boulton, 2002).

In distance education, *learning resources* have to be prepared and made available in a more organized way as compared to a face-to-face setting (Wilson, 1997). In a web –based learning the same need is present as in traditional distance education settings. But in view of meeting the demands of RTEP, there is extra potential in using ICT: the use of multimedia to provide vivid visual support, alternative assessment approaches building on the use of portfolios, new didactical strategies based on collaborative projects and the provision of assistance and feedback for students after completing tasks (Holt-Reynolds, 2000; Ruthven et al., 2005).

Implications of a RTEP oriented learning environment supported by ICT for instructor roles in teacher education

Moderation is an important element in the communication between the instructor and students in an ICT based learning environment. Rovai (2004) stresses that experienced online instructors can build and sustain levels of community that are at least equal to those experienced in traditional classrooms. In promotion of a realistic teacher education this moderation should promote reflection. This can be through the instructor focusing attention on the reflection content (Korthagen, 2004). Farrell (1998) contends that reflective teaching can advantage student teachers in four ways: (1) it frees the student teachers from impulsive and routine behaviour; (2) it allows student teachers to act in a deliberate, intentional manner and avoid the "I don't know what I will do today" syndrome; (3) it promotes intelligible action; (4) it helps student teachers to grow beyond the initial stages of survival in the classroom and helps them to reconstruct their personal theory about teaching.

This demands from instructors in virtual learning environments efforts to scaffold the learner. The virtual teacher is expected to review the progress of the students, to tailor the tasks or activities for individual students to allow them to expand areas to be developed (Boulton, 2002). A constructivist moderation model (in which the instructor, volunteer teaching assistants and student facilitators learning together) fostered active learning and provided scaffolding for students to become facilitators for learning (Murphy, Mahoney, Chen, Mendoza-Diaz, and Yang, 2005). Peer tutoring plays a significant part in online learning however its behaviour is tutor dependent (De Smet, Van Keer, and Valcke, in press). Moderation in ICT-based learning environment has only been researched to a limited extent. One of the defining authors in the field is Salmon (2000). Her research identified five stages in e-moderation (shown in Figure 3), each focusing on the development of consecutively more complex e-moderating skills and specific technical skills. Each stage is characterised by the following:

At stage one, the moderator supports individual access and the ability of participants to use computer mediated communication (CMC).
At stage two, individual participants have to be fostered to establish their online identities and to find others to interact with.
At stage three, participants are stimulated to exchange information relevant to the course. In this way co-operation is supported in view of shared goals.
At stage four, course-related group discussions are stimulated and a collaborative interaction becomes established. The moderation stresses the creation of shared understanding.
At stage five, participants are supported to achieve the shared goals, to explore to integrate the CMC experience into other forms of learning and to reflect on the actual learning process.

At each stage, moderation focuses on intensifying the level of interaction as indicated by the "interactivity bar" at the right hand side of Figure 3. Initially, interaction is fostered between two to three learners. Later on, interaction with the larger group becomes essential. In addition the moderation also focuses on fostering the number of interactions between

the learners. At the highest level, individual reflection has to occur and the overall number of interactions is expected to become lower.

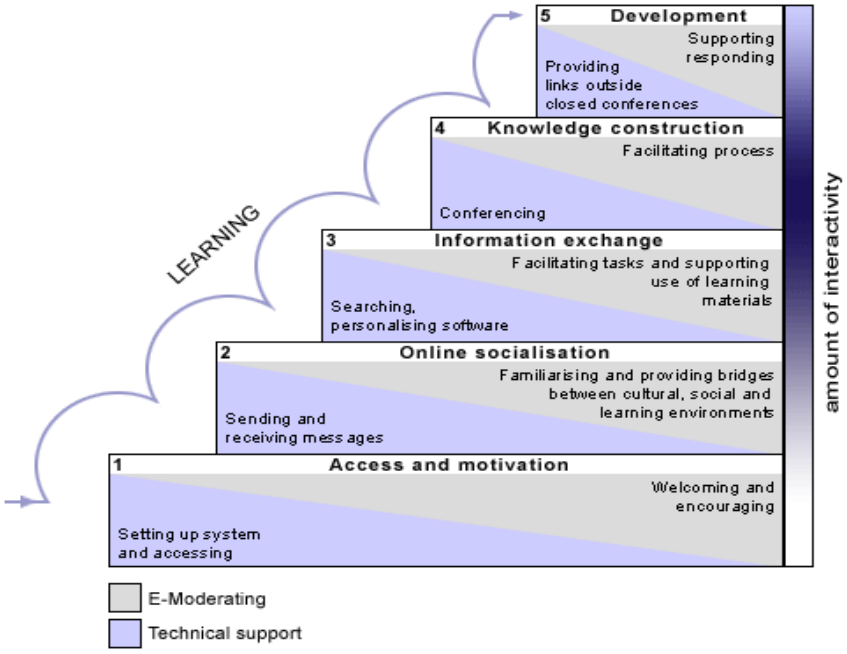

Figure 3. Electronic moderation model (Salmon, 2000).

Implications of a RTEP oriented learning environment supported by ICT for student teacher roles in distance teacher education

The following implications will be discussed in the next paragraphs: the student need to bring their experiences to enrich learning and to play an active role.

Given that most of the distance teacher education students are in-service teachers, we have to consider that these student teachers seek opportunities that challenge them in relation to the daily demands of their classrooms (Sandholtz, 2002). It is therefore important for teachers to build on the *reflection on their practice*, to experiment with new ideas and to share experiences with their fellow students (Hoban, 2002).

The individual student is to adopt an *active role* in the learning process to utilise the learning environment, harness the support of the instructor and benefit from the tenets of realistic teacher education pedagogy. The model of Salmon (2000) described above, also indicates that specific skills have to be supported and developed in students in order to become actively involved in the learning environment. Being active involves the following: self regulation, self reflection and willingness to collaborate.

The term self-regulated learning (SRL) emphasizes the autonomy and responsibility of students to take charge of their own learning (Paris and Winograd, 2001). Self regulated learning presumes that students who are active take control of their own learning at any age level or in any learning situation perform better and achieve better results (Wilson, 1997). Paris et al. (2001) contend that self-regulated learning is characterized by three central features; awareness of thinking, use of strategies, and situated motivation. This is a compelling learning goal in the context where an instructor is not readily available. But it is also an essential goal, given the job market demands of this specific student target population. Self regulating students have to be intrinsically and extrinsically motivated. They need a strong awareness of their personal cognitive skills to remain focused on their learning. This implies that the ICT based learning environment should enable them to do so (Wilson, 1997).

Reflection is a key element of the RTEP. Reflection in a RTEP oriented learning environment supported by ICT can take various forms; such as regular self-assessment of individual or group learning processes, personal monitoring of progress, or promotion of a feelings of self-efficacy (Paris et al., 2001). This creates a personal need for learning (Korthagen, 2001a; Richardson and Placier, 2001). Student reflection is derived from a cognitive perspective that asks learners to rethink their practice and helps them to cope with similar situations in the future (Hoban, 2002; Wilson, 2005). Farrell (1998) distinguishes five types of student reflection: (1) Technical rational reflection that builds on examining teaching behaviour and personal skills after an event, such as a classroom experience; (2) reflection in action (reflective practice); (3) reflection on action (reflecting on our reflecting-in-action), (4) reflection for action (reflection to guide future action) and (5) action research (transformation of research into

action). Teacher education should aim at helping the student teacher to become aware of these different types of reflection (Korthagen, 2005; Korthagen, 2004).

The realistic teacher education pedagogy builds on a social constructivist paradigm. According to this epistemological and instructional position, cognition does not reside solely in the individual, but emerges collectively, as a distributed social cultural production (Edwards, Gilroy, and Hartley, 2002). The social nature of learning is derived from a situated perspective and supports student teachers to share experiences in view of learning (Hoban, 2002). Increasingly, teacher educators ask student teachers to elicit personal ideas as a basis to construct new, more reasoned, more accurate or more disciplined understanding (Holt-Reynolds, 2000). Moreover, studies indicate a relationship between the development of effective constructivist learning environments and the development of high levels of knowledge in learners (Richardson et al., 2001). Collaboration enables students to construct knowledge in a social environment. To be successful in the learning environment, students need to know how to work independently, how to collaborate with their peers and, and how to balance these two modes of working (Shaffer, 2002; Soraya, Rahman, and Salim, 2004). In the context of an ICT-based course, student teachers particularly value the opportunity to learn from one another (Wiske, Sick, and Wirsig, 2001). Cognitive growth is fostered through dialogue and discourse, making private knowledge public and developing shared understanding (UNESCO, 2002). In the context of distance teacher education this also counters feelings of isolation (Dymock and Hobson, 1998; Henri, 1994; Trindade, Carmo, and Bidarra, 2000). In addition, online collaboration is an avenue for peer coaching and peer evaluation. Peer coaching is the process during which, on the basis of mutual trust, two or more peer students cooperate in order to reflect on their own practice, to exchange ideas, to teach each other, to do action research in their classrooms or to try to solve problems in the work place (Akker and Bergen, 2000). In the literature, peer tutoring is used as a synonym for peer coaching. The feedback from peers gives useful information to rethink one's own contribution. Also the realisation that others will read and judge the personal input in an ICT based learning environment, pushes learners to present their work in a clear and

comprehensible way (de Jong, Kolloffel, van der Meijden, Staarman, and Janssen, 2005; Rovai, 2004).

As previously explained, the realistic teacher education pedagogy and the fact this is to be implemented in an ICT based learning environment, redefines the role of the teacher educator, the student and the learning environment in teacher education. In the next paragraphs we discuss in more detail the expected outcomes of studying in this kind of learning environment. We consecutively focus on the three central dependent variables as represented in Figure 2.

The impact of a RTEP learning environment supported by ICT

In this section we gather evidence for the impact of a RTEP learning environment supported by ICT on the efficiency in terms of flexibility, perceptions of instructional approaches and efficacy (levels of cognitive processing and metacognition).

The impact of a RTEP oriented learning environment supported by ICT on efficiency of distance education

Information and Communication Technologies (ICTs) are yet not fully integrated in distance teacher education in Uganda (Aguti, 2003; Ouma, 2003). In the present study we hypothesize that the integrated use of ICT in distance teacher education will promote the efficiency in terms of flexibility. In view of this hypothesis we build on research that stresses the flexibility in study location, study program, types of interaction, communication channels, alternative learning resources and flexibility in the time (moment, duration) to study (Collis, 2001; van Merrienboer and Brand-Gruwel, 2005). Flexible distance teacher education facilitates school-based training, and enables a close link between theory and practice. This thwarts the emergence of technical rationality as criticized earlier in this chapter (Creed, 2001).

The impact of a RTEP oriented learning environment supported by ICT on student teachers' perceptions of instructional approaches

As already seen in the previous section the elements of instruction (the learning environment, the instructor and the students change their role in an ICT based learning environment supported by RTEP. This change is hoped to impact on student teachers perceptions of the learning environment and instructional preferences.

Notably, the ICT-based learning environment resulted in college students' positive perception of learning with technology in particular for giving more autonomy to the learner (Schonwetter and Francis, 2002). In another example, on the subsequent experience in an internet based course there were significant positive changes in student's satisfaction with the Internet as a delivery medium, their perception of participant interaction, and the usefulness and ease of use of the course software (Arbaugh, 2004).

Students' instructional preferences are influenced by the learning environment. For example, in an Internet-based course students were found to attribute higher importance to values that emphasize independence in thought and action, creativity and curiosity (Beyth-Marom, Chajut, Roccas, and Sagiv, 2003). Internet learning environments that challenge student conceptions influence the preferences for instruction that build on student negotiation, inquiry learning and reflective thinking (Wen, Tsai, Lin, and Chuang, 2004). Due to the collaboration promoted by an ICT-based learning environment, student teachers particularly valued the opportunity to learn from one another (Wiske et al., 2001).

The impact of a RTEP oriented learning environment supported by ICT on efficacy of distance education

To operationalise the efficacy of distance teacher education, we focused in the present study on the levels of cognitive processing that students are able to attain during participation in online asynchronous discussion groups (also called Computer Supported Collaborative Learning – CSCL) and metacognition. We anticipated that during discussions groups, students solve problems from multiple perspectives and evolve beyond their actual

developmental level. This would imply minimal expert guidance and build mainly on collaboration between – equally abled or differently abled - peers (Bednar, Cunningham, Duffy, and Perry, 1992; Shayer, 2003). This can be related to conceptualisations of Vygotsky when he refers to the "zone of proximal learning" (Vygotsky, 1978). Research confirms that exchanging multiple perspectives provokes discussion and leads to enhanced knowledge construction (Johnson and Johnson, 1996; Johnson and Johnson, 1989; Slavin, 1996; Veerman and Veldhuis-Diermanse, 2001). Through collaborative group work, the goal is to share alternative points of view (Cunningham, Duffyand Knuth, 1993; Savery and Duffy, 1995; Sharan and Sharan, 1992). Earlier research puts forward tangible evidence that CSCL influences positively the levels of cognitive processing (De Wever et al., 2003; Gunawardena, Lowe, and Anderson, 1997; Mcloughlin and Luca, 1999; Schellens and Valcke, 2004).

The experience in a RTEP oriented learning environment supported by ICT is hoped to promote student teachers' metacognition. Learning environments that are conducive to the construction and use of metacognition are said to improve self knowledge and regulatory skills (Schraw, 1998). For example, comparable to the individual learning context, monitoring, planning, and evaluation activities are found to frequently occur in the CSCL contexts as well (de Jong et al., 2005). Also, the asynchronicity of online interactions gives participants time to reflect on a topic before commenting or carrying out online tasks (Harasim, Hiltz, Teles, and Turoff, 1995; Swan, 2001). Learning in an ICT-based learning environment involves asking people to focus on their own problem solving, to explain what they are trying to do, and this is said to promote metacognitive processing and leads to more effective problem solving, even when the questions are no longer asked (Dominowski, 1998).

The RTEP oriented learning environment supported by ICT in the context of the present research

This study presents the RTEP oriented learning environment supported by ICT as an alternative to teacher education based on traditional classroom instruction. In order to implement the RTEP oriented learning

environment the tenets of the Realistic Teacher Pedagogy have been operationalised for this study as shown in Table 8.

Table 8

Operationalisation of the RTEP tenets in this research

Tenet	Provision in the learning environment
Starting from concrete practical problems and the concerns as experienced by (student) teachers in realistic contexts.	- Authentic tasks - Guidelines to reflection on student teachers' experience in the brainstorming session
Promotion of systematic reflection of (student) teachers on their practices and experiences, on the role of the context, and on the relationships between these aspects.	- Guidelines for reflection - Checklist for self and peer evaluation. - Questions in the task structure - Phased asynchronous discussions - Flexible time for each activity - Logbook
Personal interaction between the teacher educator and the (student) teacher and on the interaction among the (student) teachers.	- ICT supported learning environment - Electronic discussion groups - Chatroom - Provision for moderation
Three levels of professional learning (*Gestalt, schema and theory)*	- Emphasis on knowledge construction from multiple perspectives - Role assignment in the activities - Structure of the tasks (brainstorming, summarising, questions)
Integration of theory and practice	- Authentic tasks involving students putting themselves into the perspective of teaching. - Links to learning resources

The RTEP oriented learning environment supported by ICT – differs in a clear way from traditional classroom instruction. This is made clear in Table 9.

Table 9.

Distinction between the RTEP oriented learning environment supported by ICT and traditional learning environment

Characteristics	**Face-to-face learning environment**	**ICT-based learning environment**
Instruction	Whole classroom instruction	Self regulated learning in combination with collaborative group work
Main Learning Activities	Based on lectures	Based on problem solving oriented activities and the active use of learning resources
Learning environment	Classroom setting	Online setting
Activity structure	Depends on the interactivity invoked during a classroom setting	Defined by the activity structure and guidelines given
Roles	No specific roles have been defined for the student teacher	Specific roles are defined and prescribed for student involvement in the activities and group discussions
Self and peer evaluation	Not promoted in an explicit way	Promoted explicitly and supported by activities and the provision of checklist
Duration of lesson	Limited within a preset time frame.	Spread in a flexible way over time, but still during a predefined set of days.
Student to student interaction	Not an essential part of the learning setting	Basic element in the learning setting
Student – teacher interaction	Questioning and answering	Moderation by expert/teacher
Assessment	Based on final assessment	Based on the learning process and the final assessment
Resources in the learning environment	Minimal provision and predefined set of printed resources	Extra resources are provided for

In the context of Uganda, the use of a RTEP oriented learning environment supported by ICT in distance teacher education is a new phenomenon. Apart from studying its impact, its feasibility and the whole process it is considered to be a key solution for the future of teacher education in Uganda. In the ICT-based learning environment we tried to model components of the realistic teacher pedagogy. In particular we designed and implemented a learning environment with rich resources, and that builds on authentic and problem based learning activities. The learning activities were task based, prestructured and built on role assignment for students. We integrated the development of personal logbooks, self and peer assessment and the promotion of reflection. The ICT based environment encourages student teachers to construct knowledge from multiple perspectives.

Building on the framework presented in the former paragraphs to ground the general research problem, we present a list of the research questions that will be central in a series of consecutive studies. A number of the research questions will be helpful to gather information as to the actual status of ICT use and the status of distance teacher education, before studying the assumptions about the potential impact on the three sets of dependent variables.

Research questions

In relation to the general research problem, two main themes are studied. We present the research questions related to the two main themes and also indicate a number of derived research questions.

Theme: The status of ICT use in instruction in distance teacher education in Uganda

1. What is the *status of ICT* in instruction in *distance teacher education* in Uganda?
    a) What is the status of ICT use in instruction in distance teacher education in Uganda?
    b) What factors foster the use of ICT in distance teacher education in Uganda?

c) What are the challenges of ICT use in distance teacher education in Uganda?
d) What are solutions put forward to meet the challenges of ICT use in distance teacher education in Uganda?

Theme: The impact of a realistic teacher education pedagogy (RTEP) oriented learning environment supported by ICT on student teachers perceptions, levels of cognitive processing, interaction, flexibility and metacognition in the learning environment.

2. What is the impact of a RTEP oriented learning environment supported by ICT on student teachers *levels of cognitive processing* (LCP)?
3. What is the impact of a RTEP oriented learning environment supported by ICT on *student teachers perceptions*? What is the impact of student teachers perceptions on LCP?
4. What is the impact of a RTEP oriented learning environment supported by ICT on student teachers *interaction* in the learning environment? What is the impact of student teachers interaction in the learning environment on LCP?
5. What is the impact of a RTEP oriented learning environment supported by ICT on student teachers *flexibility*?
6. What is the impact of a RTEP oriented learning environment supported by ICT on student teachers *metacognition*? What is the impact of student teachers metacognition on learning?

The impact of a RTEP oriented learning environment supported by ICT on student teachers levels of cognitive processing (LCP) and metacognition is used to measure the efficacy of the learning environment. Given the fact that the research promotes the adoption of a RTEP, this implies that process features are studied and qualified. The levels of cognitive processing – as reflected in the individual contributions to the group discussions - are considered to be a relevant indicator of efficacy. Also the knowledge of students about cognition and regulation of cognition and ability to use it is an indicator of efficacy.

The study of the impact of a RTEP oriented learning environment supported by ICT on student teachers perceptions is used as a second

impact measure. In this case the student teacher perceptions are studied at the start and at the end of working in the learning environment. This is considered to help to measure changes in perceptions that reflect the adoption of a realistic teacher education pedagogy. The perceptions of interest in this study are:

(1) The perceptions of the learning environment.
(2) Instructional preferences.

We anticipate that students will especially perceive their learning environment as promoting "learning about the world", "learning about science", "learning to learn", "learning to communicate" and "learning to speak out". In addition, we expect them to prefer instruction that is "transforming" instead of "transmitting information". Especially to prefer instruction that promotes collaboration, planning, course that is not assessment targeted, application of knowledge, independence and reflection and authentic tasks. In this study, we consider the student teacher perceptions also as variables that might influence the student teachers levels of cognitive processing. The theoretical base to ground this specific hypothesis will be discussed when presenting the specific studies.

The impact of a RTEP oriented learning environment supported by ICT on the level of student teacher interaction in the learning environment is considered important to achieve the expected efficacy. It is hypothesized that – as explained earlier - a high level of interaction is needed to attain higher levels of cognitive processing. High levels of interaction increases are expected to increase the average level of cognitive processing. Factors in the learning environment that promote this interaction are also studied.

The impact of an ICT based learning environment on student teachers' perceived flexibility is used as a measure of efficiency. The ICT-based learning environment is hoped to increase flexibility in time, location, study material, communication and interaction.

In view of the five central research questions, an exploratory study and four consecutive quasi experimental studies were set up. Figure 4 represents the relationship between the research questions and the different studies.

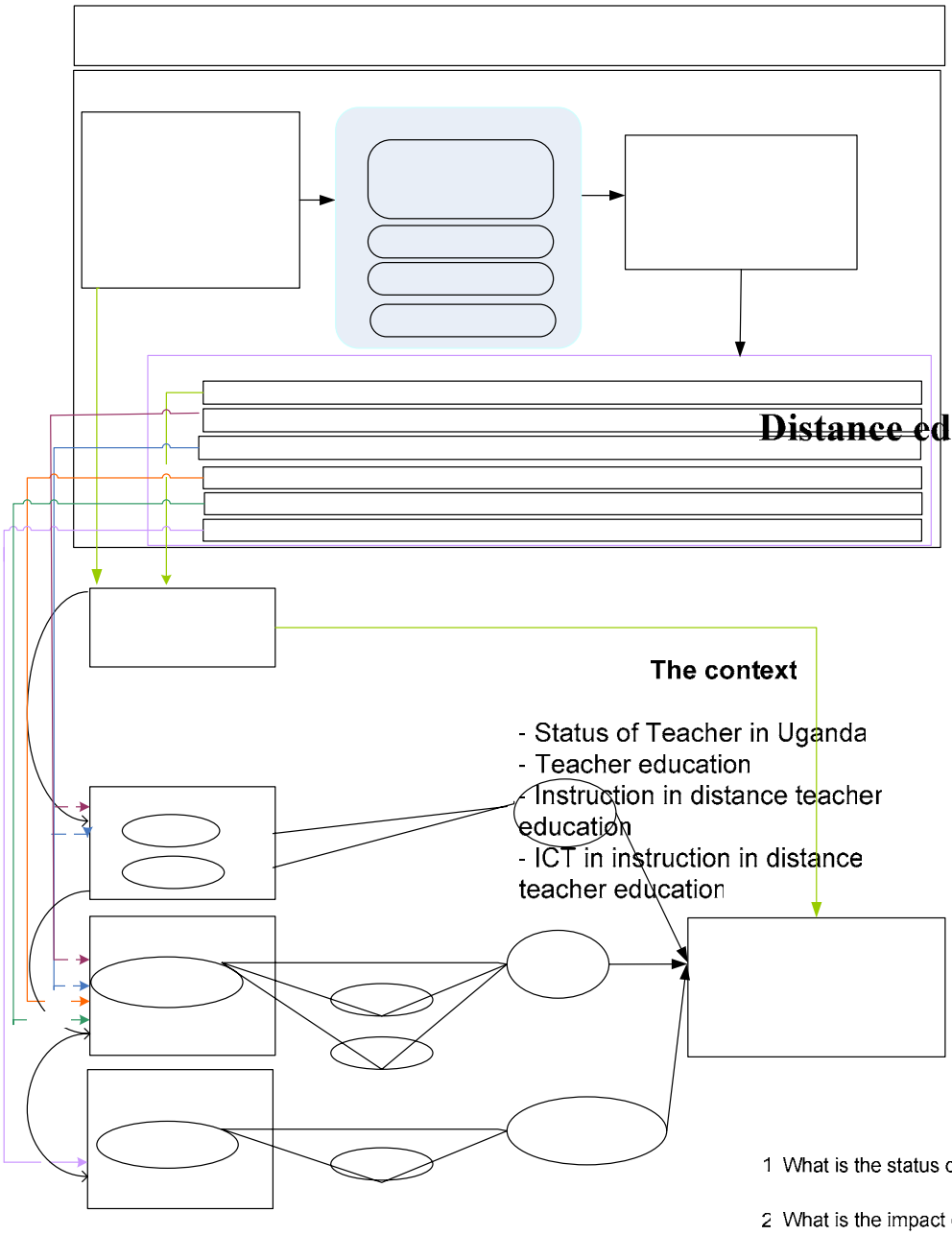

Figure 4. Overview of the research

Chapter 2
Status of distance teacher education
Enabling factors

Research design

The methodologies adopted in the present research are represented in Table 10. They are both qualitative and quantitative in nature. This brings about the possibility to triangulate the results and to corroborate the findings. The findings of the different studies are integrated in Chapter 6.

Table 10.

Study Design

Chapter	Research design
Chapter 1	Review of the literature
Chapter 2	Survey and structured interviews
Chapter 3	Quasi experimental study, involving experimental and control groups in a pretest posttest design
Chapter 4	Quasi experimental design and within groups comparison and Focus Research Groups
Chapter 5	Focus Research Groups
Chapter 6	Integration of research findings

A review of Literature was carried out at the start of the research to contextualize the study to Uganda and to build on a large body of knowledge about distance teacher education and the integrated use of ICT. This review of the literature especially builds on information from 1990 to date and focuses specifically on the use of ICT in distance teacher education.

Surveys were used to explore the current status of ICT use in Uganda. In the context of the quasi-experimental studies, surveys of student teachers perceptions were used before and after each intervention.

Interviews were organized held with key actors in distance teacher education institutions, in addition to managers of ICT in education initiatives, to obtain more qualitative information next to the data gathered via the surveys.

In the context of the quasi experimental studies efficacy indicators were obtained by *analysing the transcripts of the threaded discussions* and the *focus research group*s.

Overview of the thesis research

Chapter 1: General introduction.

[a]Chapter 2: The status of ICT use in instruction in distance teacher education in Uganda.

[b]Chapter 3: The impact of studying in a realistic teacher education pedagogy oriented learning environment supported by ICT: asynchronous collaboration.

[c]Chapter 4: The impact of an innovative learning environment on student teachers' interaction, levels of cognitive processing, perceptions and perceived flexibility in distance education.

[d]Chapter 5: The impact of a realistic teacher education pedagogy oriented learning environment supported by ICT on student teachers' metacognition.

Chapter 6: General discussion, limitations, implications and conclusions.

[a] prepared for submission to International Journal of Educational Development.

[b] prepared for submission to Distance Education (ODLAA).

[c] prepared for submission to Computers in Human Behavior.

[d] prepared for submission to International Journal of Educational Development.

The first study presented in Chapter 2 helps provide a better understanding of the actual status of distance teacher education and the integrated use of ICT in Uganda. It reports the findings of a review of the literature on the use of ICT in instruction and the factors that enable the use of ICT in instruction in distance education. Based on this review of the literature, study instruments were developed to research the status of ICT use in distance teacher education in four selected universities in Uganda. In

addition, the use of ICT in education was explored in a parallel study by involving experts from ICT in education initiatives.

The next table presents an overview of the consecutive quasi-experimental studies.

Table 11.

Characteristics of the quasi-experimental studies

Duration	**Sample**	**Quasi-experimental study design**	**RTEP oriented learning environment supported by ICT**	**Dependent variables**
Pilot study 2003 - 8 weeks	- 36 students - 3 primary teachers' colleges	Experimental and control groups	- 9 activities - Science with health	- LCP - Perceptions
Study 1 2004 - 8 weeks	- 144 student teachers - 6 primary teachers' colleges	Experimental and control groups	- 4 activities - Foundations of education	- LCP - Perceptions
Study 2 2005 - 9 weeks	- 144 student teachers - 3 primary teachers' colleges	Within groups + FRG (n = 30)	- 3 activities - Science with Health - moderation support	- LCP - Perceptions - Interaction
Study 3 2005 - 9 weeks	- 96 student teachers - 4 universities	Focus Research Groups (n = 30)	- 3 activities in Educational psychology course - Moderation support	- Metacognition - learning

Chapter 3 presents a quasi-experimental study 1 that focuses on the impact of synchronous collaboration in a RTEP oriented learning environment supported by ICT on levels of cognitive processing and student teachers perceptions (perceptions of the learning environment and instructional preferences). The RTEP oriented learning environment supported by ICT facilitated task-based learning and computer supported collaborative learning and was contrasted to face-to-face group work of students in the

control condition. A half of the 144 students in this study were put in the electronic learning environment and were involved in asynchronous electronic discussion groups and they were contrasted with the rest in control face to face conditions. The activities were derived from a Foundations of Education course (Unit General Methods, Techniques and Skills of teaching).

Chapter 4 reports the impact of a RTEP oriented learning environment supported by ICT on student teachers interaction, LCP, perceptions and perceived flexibility in distance teacher education. The subject of study was based on the Science with Health course (Unit Human bones, Muscle and Circulatory systems). All students in this study were put in the electronic learning environment and were involved in asynchronous electronic discussion groups.

Chapter 5 reports the impact of a RTEP oriented learning environment supported by ICT on student teachers metacognition in a university setting. The study involved now students from 4 university settings (aiming at training secondary and primary school teachers). The student teachers discussed three task based activities from Educational psychology course: personal growth and development, motivation and effective teaching and learning environments. The discussions were asynchronous. The research design was intended to be both quantitative and qualitative. Due to circumstances at the final moment of data gathering, the report will only focus on the qualitative data.

Chapter 6 presents a general discussion of the findings, the limitations of the study, the implications, recommendations and conclusions.

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2

The status of ICT use in instruction in distance teacher education in Uganda.

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Abstract

Central in this chapter is the exploration of the status of ICT use in distance teacher education in Uganda. Questionnaires were developed based on a review of the literature to set up a survey study. Respondents involved in the survey included policy makers, administrators, teaching staff, and student teachers of distance teacher education from four key universities. The findings of the survey suggest that current distance teacher education is predominately based on printed modules, supplemented with face to face sessions. In comparison to distance teacher education supported by ICT, the current distance teacher education approach is perceived to be more effective to support the acquisition of knowledge, skills and competences, and more efficient and more satisfying. Despite the lack of integrated use of ICT in instruction, there was a positive attitude towards ICT use from the administrators in particular and respondents strongly argued that ICT is a priority. The main reasons for the non-adoption of ICT in the current context do not seem to be clear.
Since ICT use in distance teacher education is perceived as a priority, a second survey was set up involving experts coordinating a variety of ICT and education initiatives in Uganda. These interviews focused on: (1) the motivation to use ICT; (2) key factors fostering ICT use; (3) challenges facing ICT use in Uganda, and (4) recommendations for fostering the implementation of educational ICT use. The results point to the potential for integrated ICT use for distance teacher education in Uganda. Experiences that build on the current initiatives provide good practices that are worth up scaling in the present context.

Research Problem

Background

By of September 2002 the population of Uganda was 24.4 million persons (Uganda Bureau Statistics, 2005). The fertility rate was 6.9 children born per woman and the literacy rate was 69.9 % (M = 79.5%, F = 60.4%). The population growth rate between 1991 and 2002 was estimated at 3.4% (Klasen, 2004). The population of Uganda is projected to be 103 million in 2050 (United Nations Population Division, 2003). The past decade has seen an increase in the demand for education and consequently in the need for trained teachers. This has led to a rapid growth in the provision of higher education as reflected by the number of new universities. However, a large number of students qualifying for higher education still lack access to it. The most significant reasons for this are the limited sizes of the institutions and the cost of setting up and implementing higher education. The Education Policy Review Report of the Uganda Government (1992) recommended in this respect that for students qualifying for higher education but that cannot be accommodated in regular universities, or those who cannot leave their employment to pursue university education, an Open University would be implemented before the year 2000. This objective is yet to be realized. The Government White Paper also highlighted the significance of distance education in training and retraining of teachers.

Trends in Distance Education

Distance education dates back as far as the mid 19th century in Europe (Great Britain, France and Germany) and the United States and was predominantly based on correspondence education. The history of distance education can be summarized in five generations (Taylor , 2002):

1. The correspondence model: this relies mainly on print.
2. The multi-media model: this utilises print, audiotape, video tape, computer based learning and interactive video.
3. The telelearning model: this involves audioteleconferencing, videoconferencing, audiographic communication, broadcast TV/radio and audioconferencing.

4. The flexible learning model: makes use of interactive multimedia online, internet-based access to web resources, computer mediated communication, automated response system, campus portal access to institutional processes and resources and
5. The model capitalizing on features of the Internet and the web. This generation is characterized by management software systems that synthesise administrative and logistic functions, computer-mediated communication (e-mail, bulletin boards, newsgroups etc) and on-line methods of course material delivery (e.g. the WWW) termed as virtual learning environments (Britain and Liber, 2002).

The fifth generation has become the arena for both commercial solutions (such as Blackboard, WebCT) versus open source solutions (e.g., claroline, MOODLE, KEWL). Fifth generation solutions build heavily on the use of ICT. Instructors can e.g., use templates to design their courses. In these environments learning takes place in a shared workspace (Harasim, Hiltz, Teles, and Turoff, 1995).

Distance education in Uganda

In Uganda, the distance education format has been in existence since 1967. It was established at the Centre for Continuing Education, Makerere University for purposes of upgrading teachers – teaching in local languages to grade II. The Centre also set up other certificate courses through *The People Newspaper* as an educational supplement. These distance education courses were set up through correspondence education. In 1991, Makerere University started an external degree program (EDP) for bachelors of Commerce, Education and Science, also building on a distance education mode. Other distance teacher education projects established in Uganda over the last decade as put by Aguti (2003) include:

1. The Mubende Integrated Teacher Education Project (MITEP) launched in 1992 to improve the quality of primary education in Mubende district. The project operated through print materials and student support activities.
2. The Northern Integrated Education Project (NITEP), followed in the footsteps of MITEP. It was launched in 1998 by the Ministry of Education to train unqualified primary school teachers.

3. The Rakai Integrated Teacher Education Project (RITEP) also targeted unqualified primary teachers in Rakai district.
4. The Teacher Development Management System (TDMS). This was a government strategy for primary education reform aiming at improving the quality and quantity of teachers and school mangers. Later it was extended as a national program
5. In 1999 a Diploma in Primary Education was launched by the Institute of Teacher Education Kyambogo (ITEK) to upgrade grade III teachers to diploma level.
6. Of recent, private universities have come on board to provide distance teacher education for a diploma and degree level.

Distance education in Uganda as compared to general trends; statement of the general research problem

Looking at five generations of distance education and comparing them with the current approach in Uganda, we have to conclude that the format adopted to implement distance education is still very restricted. The distance education mode relies on printed modules enhanced with face to face education. The use of ICT is hardly there (Aguti, 2003; Ouma, 2003). Considering Taylor's (2002) model, distance education in Uganda can be described as predominately in the first generation. This suggests the need for an updated picture of the current approaches and a more detailed analysis of design features of distance teacher education from different perspectives.

To obtain this updated picture of distance teacher education in Uganda, a survey study was set up. The questionnaire used in this survey was based on an extensive review of the literature. This brings forward the research problem discussed in this chapter: what is the current state of the art as to ICT use in distance teacher education in Uganda. Moreover, we are also interested in factors of use of ICT that might enable distance teacher education to be effective, efficient and employ improved instructional approaches.

Theoretical Framework

The key questions that direct our study are twofold. On the one hand we question the extent to which ICT is actually being used in the distance education setting. Secondly, we question the factors that enable effective, efficient and satisfying instructional approaches through ICT use in distance teacher education. In view of the first question we listed the technological solutions that are available to support distance education. In view of the second research question we reviewed the literature to trace factors cited by authors in this context.

In view of this study, the focus of the review of the literature was not restricted to distance teacher education and/or ICT use in the context of online learning environments.

Distance education supported by ICT

Technologies to support distance education comprise a wide variety of solutions to enable the roles and functions of an educational institution: providing instructional materials, administration support, setting up interactive teaching activities, access to information, access to research and enabling support services (Hailes and Hazemi, 1998; Lamminaho, 2001).

Technologies can be ordered in a variety of ways depending on the types of data they help to process; e.g., audio (voice), images, video, print or raw data (Willis, 2002; Fisser, 2001). Examples of the technologies are presented in Table 1.

Table 1.

Examples of technologies

Type	Category	Examples
Audio	Interactive	telephone, audioconferencing, and short-wave radio
	Passive (i.e., one-way)	Tapes and radio.
video	Still images	as slides, pre-produced moving images (e.g., film, videotape)
	Real-time moving images	audioconferencing (one-way or two-way video with two-way audio)
Data	Computers applications	*Process, send and receive information electronically

*Computer applications for distance education are varied and include:

(1) *Computer-assisted instruction (CAI*: this approach uses the computer as a self-contained teaching machine to present individual lessons.

(2) *Computer-managed instruction (CMI)*: following this approach, the computer is used to organize instruction and track student records and progress. The instruction itself need not be delivered via a computer, although CAI is often combined with CMI.

(3) *Computer-mediated education (CME)*: in this context, computer applications facilitate the delivery of instruction. Examples include electronic mail, fax, real-time computer conferencing, and World-Wide Web applications.

Analysis of the literature in view of the second research question results in a long list of factors that enable ICT use in view of distance education instruction. In order to structure this long list, we have adopted the clustering approach of Valcke (2000) and using the factors identified by Dillemans, Lowyck, Van der Perre, Claeys, and Elen (1998) and Fisser (2001). Figure 1 represents how this set of factors is hypothesized to enable or challenge ICT use in distance education.

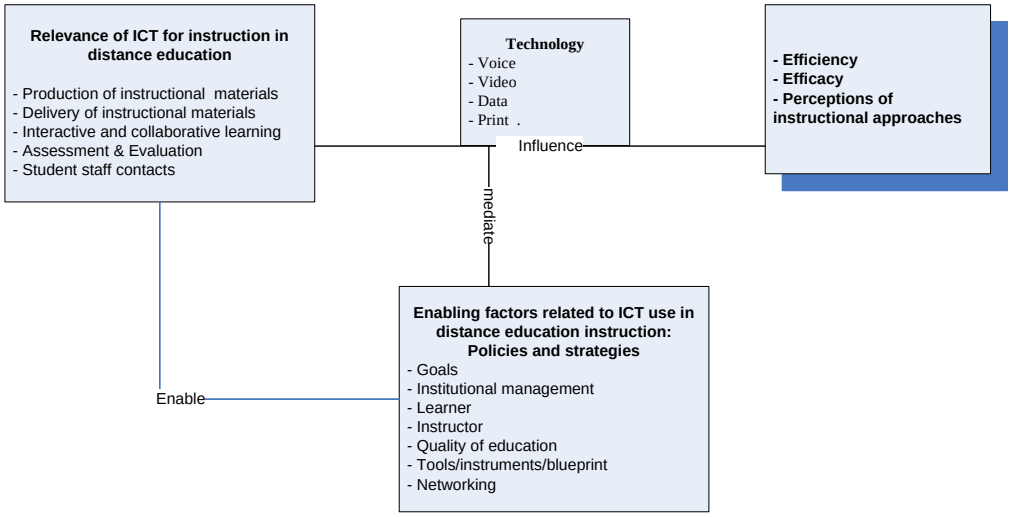

Figure 1. Factors that enable/challenge ICT use in Distance Education

ICT in instruction in distance education

ICT introduces technical functionalities that support instruction (Khan, 1997). These include: multimedia, open system, online search, distance – time independent devices, global access, electronic publishing, standards, online resources, distributed nature, cross cultural interaction, multiple expertise, learner control, etc. Additional features include: convenience, self-contained, ease of use, online support and authenticity. Others are: course security, environmentally friendly, non-discriminatory, cost effective, ease coursework development and maintenance, collaborative learning, formal and informal environments, online evaluation, virtual cultures, etc. These functions when applied in distance education they enhance efficiency, promote efficacy of distance teacher education, and improve in a more general way the instructional approaches.

Efficiency involves the production of the desired output in the cheapest way possible (Claeys, 1997). With regard to pedagogical activities, efficiency could be defined as saving time or energy on certain tasks, without loss of quality (Collis and Van der Wende, 1999). Efficiency of distance teacher education supported by ICT can also be seen in terms of flexibility. Collis (2001) identified five forms of flexibility that can be supported with ICT: in

location, program, types of interaction, forms of communication and time. Efficacy is defined as the achievement of goals and objectives (Willis, 2002). ICT in distance education enhances its efficacy through supporting the process of learning and thus the product. Evidence from literature indicates that ICT use in Education improves technical skills and enables accomplishment of complex tasks (Newlands, Mclean, and Lovie, 1997; Van den Branden, 1997). ICT improves instructional approaches by supporting learner centred instruction that is characterised by active learning, collaboration that keep students motivated. For example with ICT, the learning environment can be designed to be all inclusive, requiring no resources outside the web (Khan, 1997). This allows learners to meet their own special needs in a self-paced, self assessing environment. In addition, ICT increases motivation and self esteem through creating more enabling and more initiative on the part of students (Newlands et al., 1997). The shared workspace tools along with other communication and reporting tools in the WWW site allow group members to work collaboratively on complex projects without needing to be physically together (Collis, 1998). ICT increased communication and collaboration among teachers within the school (Newlands et al., 1997). The rapid levels of to resources in WBI can promote high levels of student involvement and motivation (Khan, 1997).

Instruction involves the production of instructional materials, the delivery of instructional materials, interactive and collaborative learning, assessment and evaluation and staff and students contacts (Hailes et al., 1998). Next we explore how each of the above is enhanced by ICT.

The production of instructional materials

ICT is considered to enhance the quality of instructional materials and reduce the costs to produce teaching and learning materials. The instructional materials are the primary medium through which the students are informed about the course content (Hailes et al., 1998). By using ICT the instructor adopts the role of a designer, and resource researcher. He/she has to consider with care the quality of the material presentation. In the literature it is stressed – in view of instructional material design - to consider the perspective of the learner (Lamminaho, 2001; Newlands et al., 1997). Khan (1997) stresses in this context the multimedia nature of the variety of instructional materials. This might – in his opinion – help to meet individual differences, such as those related to learning styles. ICT offers better instructional presentation in some fields e.g. the study of foreign language with enabled immersion of sights and sounds of a culture (OECD Proceedings, 1996).

Information and communication technologies can also save time in the routine tasks that are related to instructional material development. Up-to-date systems allow both the instructor and student to developed materials and to add them to the course site by providing uploading functionalities (Collis et al., 1999; Khan, 1997).

The delivery of instructional material

ICT has provided broad, unlimited and flexible access to information and, increased the modes of delivery for distance education. Printed content enriched with sound, images, graphics, video,… can now be distributed through local, regional or international telephone/computer networks (Collis et al., 1999; Hailes et al., 1998; Trindade, Carmo, and Bidarra, 2000).

The instructor and the student can access the distributed (online) learning site from any place at any time – considering there is Internet access - and carry out course related activities (Collis et al., 1999; Collis, 1998; Khan, 1997; Trindade et al., 2000; Van den Branden, 1997). Students who miss sessions can review instructor notes, listen or see the instructor explaining

particular points, and review materials created and posted by the students who present in the sessions (Collis, 1998).

A particular dimension related to delivery is the unlimited geographical nature of the Internet (Uys, 1998; Zhang, Nui, and Jiang, 2002). ICT can support large numbers of students regardless of their national or international geographical location (OECD Proceedings, 1996; Taylor , 2002; Trindade et al., 2000; Zhang et al., 2002). ICT improves communication and access to information (Harasim et al., 1995; Newlands et al., 1997; Phillips, 2001; Trindade et al., 2000; Uys, 1998).

Other authors stress that the distributed nature of online learning stresses the self-regulated nature of learning. Distributed on-line education enables students to control their learning and to develop life skills like high levels of student involvement and motivation (Chen, 2002; Khan, 1997; McGraw-Hill Ryerson, 2000; Uys, 1998)

Interactive and Collaborative learning

The use of ICT has the potential to support communication within groups to enhance interaction, collaboration, cooperation, cohesion, and reflection during learning processes. Almost all online courses imply group based learning activities (Hailes et al., 1998). In these groups, students learn through sharing, interaction, and cooperation to create meaning (Collis, 1998; Harasim et al., 1995; Khan, 1997; Newlands et al., 1997; Trindade et al., 2000). The sharing of knowledge and resources is expected to promote active learning, experiences knowledge from multiple perspectives and to engage students in higher levels of thinking (Khan, 1997).

Interaction and collaboration can be either synchronous (all participants "present" at the same time; chat) or asynchronous (participation is spread over time; e.g., threaded discussion groups). The asynchronous nature of online communication gives participants time to reflect on a topic before commenting or carrying out online tasks (Harasim et al., 1995; Swan, 2001). Building on this potential, ICT is expected to promote peer support by facilitating instant and asynchronous communication between students. In many cases, students learn effectively when being allowed to discuss

matters amongst themselves (Hailes et al., 1998). Sharing resources is possible through the asynchronous nature of the medium (Trindade et al., 2000). Conferencing is an opportunity to increase the level of communication and interaction in the distance education process (Bregar, 1998). Indeed, students' felt that the asynchronous format actually supported interactivity and involvement, lead to higher levels of satisfaction and learning (Ouma, 2003). Collaborative learning can also be an effective tool to counter isolation felt by distance education students (Dymock and Hobson, 1998; Henri, 1994; Trindade et al., 2000).

Assessment and Evaluation

The integrated use of ICT enables flexible, instant and multiple assessment and evaluation. Responsibilities can be distributed in this context: self-assessment, peer-assessment and assessment by experts, teachers, instructors (Hailes et al., 1998). In online learning, the instructors can access the learning environment at any time and place and check student assignment submissions, give feedback, and/or mark their work (Collis et al., 1999).

Student-staff contact

Online learning has the potential to reinforce student-staff contact that were critical in earlier generations of distance education (Collis, 1998). Different levels of contact can be established. Frequently asked questions and sample questions from previous years can be available in the online learning environment, making student-staff contact less needed for delivering routine information (Collis et al., 1999). When personal contact is needed, the online provision supports efficient student-staff contact without the student needing to wait to see the instructor face to face (Collis, 1998). In general, teachers report increased levels of communication and collaboration between teachers and students in online learning environments (Newlands et al., 1997).

Factors that enable/challenge ICT Use in Distance Education

Policies and strategies are key enabling factors that influence ICT use in distance education. They can be structured at three levels: the macrolevel (international and national), mesolevel (institutional dimension of teaching learning process) and microlevel (focus on actual teaching and learning processes) (Dillemans, Lowyck, Van der Perre, Claeys, and Elen, 1998). These factors embrace goals, institutional management, learner and instructor characteristics, quality of education, tools and networking as summarized in Table 2 below.

Table 2.

Factors that enable the use of ICT in distance education - based on Valcke (2000).

Factor		Macro	Meso	Micro
1.	Goals	Establish goals	Specify goals	Elaborate and negotiate goals
			Specify Curriculum	Select content within and / or between domains
			Determine instructional philosophy/ approach	Support learner activities
2.	Institutional management	Control school management	Organise school time / roster	Organisation of study /learning activities Organise instruction
		Manage financial resources	Acquire and distribute funds	Use funds to facilitate learning and instruction
3.	Learner	Learner characteristics	Analyse the learner	Group the learner
4.	Instructor	Establish human resource requirement	Select and organise human resources	Instructor characteristics
5.	Quality of education	Establish quality indicators and criteria: Quality assessment procedure	Elaborate quality assessment system	Assess learning outcomes and instructional quality
6.	Tools	Facilitate access to and or produce tools, instruments, or blue print	Select technology	Match technology with appropriate use
			Organise infrastructural technology	Use technology
7.	Networking	International and National networking	Collaboration within the institution	Collaboration at individual and student group level

Goals

The established goals of education at macro level are specified in relation to the curriculum at meso level. They help to determine the instructional approach to be adopted. At micro level, the goals are elaborated, guide the selection of learning content and the learning activities.

At macrolevel, a large variety of economic, political and cultural influences the nature of the curriculum (Cadariu, 1998; Fisser, 2001). A typical example is the projection of societal accountability of higher education in view of the labour market and economic development (Fisser, 2001). This results in a discourse that states that schools and universities should train their students to acquire the necessary skills to work with new technologies in their future jobs. If the labour market demands self directed workers that are competent in working together in teams, this will imply the adoption of instructional approaches – and in addition ICT-based solutions - that move from an instructor-centred approach to a more student-centred and collaborative approach (Fisser, 2001). Consequently, the ICT based learning environments will present technical functionalities that support self-directed learning (Aguti, 2003). Also the ICT based instructional approaches will foster collaboration. The goals at macrolevel influence the curricula and lesson plans put forward at meso- and microlevel. At micro level, the goals will push learners – applying the relevant ICT tools - to engage in e.g. collaborative learning activities.

Institutional management

Management entails efficient use of resources like time, finances, infrastructure and expertise. ICT is expected to promote the management of these resources. Appropriate operations management processes are essential in view of distance education (Lucy, 2001). Effective incorporation of new technologies requires commitment by all relevant segments of an institution (Farrell, 1999). Many institutions still continue to deploy and use information technologies without due planning which is one of the reasons for delayed adoption of ICT based strategies in traditional institutions (Collis et al., 1999). Universities need to develop strategies at institutional level for online learning (Hewett, 1999).

Learner and instructor characteristics

As a consequence of the growing numbers of new kinds of students such as part timers and long life learners, the university has to deal with the fact that the characteristics of their students are changing (Fisser, 2001). At micro level the learners and instructors need to be prepared to ensure the relevant use of ICT-based learning environments. Successful open learning requires students to have the ability to work adequately with the learning resources (Moore, 2002; Kurtz, Privman, and Bregman, 1998; Ottewill, Fletcher, and Jennings, 1997). The new learning paradigm embedded in a variety of online learning environments stresses the importance of conditional student competencies in view of knowledge construction, critical thinking, teamwork and cooperative learning (Chen, 2002; Guri-Rosenblit, 2002; Zhang et al., 2002). Therefore the learners engaging in web-based programs must have acquired the conditional competencies or attention must be paid to the acquisition of them (Zhang et al., 2002). Personal traits and characteristics dimension offers a perspective on fundamental ways in which individuals actually handle their daily activities, and patterns of behaviour that go far beyond school related issues (Schrum, 2001). The outcomes of the analysis of the learners inform the grouping at micro level.

Staff development is needed to help instructors to develop adequate uses of ICT in education (Albirini, 2006; Fisser, 2001). Online learning demands a different educational methodology as compared to face-to-face education (Sevilla and Wells, 2000). Teachers' preparation for ICT use necessitates not merely providing training opportunities, but also aiding them in experimenting with ICT before being required to use online learning in their classrooms (Albirini, 2006). Teachers play a significant role as facilitators (Guri-Rosenblit, 2002; Zhang et al., 2002). Teacher's beliefs may have the greatest impact on what teachers do in the classroom, the ways they conceptualise their instruction, and learning from experience (Brody, 1998). Unfortunately, Collis and Van der Wende (1999) state that conservative tendencies of the staff are among the reasons for delayed adoption of ICT based instruction strategies in traditional institutions. Training of staff in distance education programmes can be set up in a variety of ways namely: on-the-job training by distance education techniques, face-to-face training sessions and courses (Cadariu, 1998). Training workshops are needed to improve the technical skills, but also to foster the process of integrating ICT in the teaching and learning practices (Zhang et al., 2002). Inadequate staff and programme development has caused a lot of failures in the context of ICT and education (OECD Proceedings, 1996).

Quality of education

Quality and standards are critical for the integrated use of ICT use in distance education. Quality and standards help to focus on the critical factors discussed in the other paragraphs. This is exemplified with the list of quality indicators that are e.g. used in the context of the University of Wisconsin-Extension (2002) quality distance education:

- Knowing the learners
- Creating confident and committed faculty
- Designing for active and effective learning including the distance education bibliography
- Supporting the needs of learners
- Maintaining the technical infrastructure
- Sustaining administrative commitment
- Evaluating for continuous improvement

The list of criteria and quality indicators stresses critical issues that - especially in online learning environments – have to redefined. A particular example of this is the design and development of an adapted Baldridge quality model to discuss the concept of quality in distance education in general and in view of online learning in particular (Gómez, Feijoo, Sánchez, and Asanza, 2004). This was designed in the context of an alfa-project.

In order for institutions to ensure the quality of their distance learning, it was concluded that they must commit to developing quality integrated institutional support systems for faculty members and students involved in their distance classrooms (Wiesenberg and Stacey, 2005). The premise is that the underlying philosophy, values, and norms reflected in the quality assurance approach have to be appropriate to (online) distance education (Kess and Pyykönen, 1998). These include: (1) an emphasis on student services; (2) anticipating and meeting the needs and expectations of all actors involved; (3) recognising and improving transformation processes and systems; (4) implementing teamwork and collaboration; (5) management based on shared leadership, knowledge-based decisions, and actor involvement; (6) problem solving based on systematic data gathering, and feedback loop systems; and (7) a specific human resource management approach.

Tools

The difficulty of online instruction is not in the transfer of knowledge but in creating the most apt learning environments for students to acquire knowledge (Gold, 2001). Therefore, online learning depends heavily on the availability of adequate tools to support the teaching and learning processes. The choice of the tools is to be based on a blueprint of the projected use of ICT in this context (Van der Perre and Claeys, 1998). Students indicate that there is a wealth of learning experience that build on Internet based tools (Carswell, Thomas, Price, and Richards, 1999). But the choice of the tools should be driven by functional needs derived from learner and educational variables; it should not depend on its novelty (Bates, 1995). A typical example is the requirement to support collaborative

learning at a distance. This directs the choice of specific tools to support this collaborative dimension (Dymock et al., 1998; Ruthven, Hennessy, and Deaney, 2005).

Since the ICT-based tools are not always available for all learner, solutions have to be found to enable access for all learners (Trindade et al., 2000). A solution commonly adopted in distance education settings is to set up a number of resource centres or study centres, where the necessary tools are available for students (Buitendach, 1997).

Networking

It is generally agreed that governments should establish educational networks to support the development of services and to agree on common standards and collaboration (Collis et al., 1999). Collaboration is described as an inherent part of education from teachers co-labouring with students in one-on-one tutoring to learning communities and from teachers collaborating in the preparation of materials to students collaborating in studying and even in attempts to cheat (Norman, 1998). Therefore, the principle of sharing research findings between institutions without the limitation of borders should be encouraged (Yawan, 2000). Indeed, it is widely acknowledged that intersectoral collaboration is necessary and that many initiatives are resulting from cooperation among companies, universities, and governments (Collis et al., 1999). Successful teams in academia have something to contribute, and lack some capability provided by other members of the team but should have compatible cultures (Kasser, 2000; Yawan, 2000).

The better understanding of the potential of ICT and the factors supporting or challenging the integrated use of ICT in distance education, is helpful to direct the study of the state of the art as to ICT in distance teacher education in Uganda.
In the next paragraphs, we discuss the design, implementation and results of this study.

Research design

Two approaches were adopted. First, a survey was conducted involving respondents of four key universities offering distance teacher education. Next, a structured interview was set up with experts responsible for ICT in education initiatives in Uganda.

Research questions

The following research questions directed the research:

1. What is the status of ICT use in instruction in distance teacher education in Uganda?
2. What factors foster the use of ICT in distance teacher education in Uganda?
3. What are the challenges of ICT use in distance teacher education in Uganda?
4. What are solutions put forward to meet the challenges of ICT use in distance teacher education in Uganda?

Research samples

The first sample consisted of key actors from four universities that offer distance teacher education: Policy makers, administrators, instructors and distance teacher students. Policy makers are responsible for taking decisions about distance teacher education like the head of department distance education. Administrators are in charge of daily management of distance education (administration and logistics). The four universities comprise two private (P) and two government institutions (G) that can be considered as – historically – the oldest (O) and most recently established institutions (R): Makerere University (MUK - GO), Kyambogo University (KYU - GO), Uganda Martys University (UMU - PR) and Ndejje University (PR). In each institution at least 50 second year students and two respondents from the other respondent categories were selected at random. The students from Makerere and Uganda Martyrs University were undergraduate students, while those of Kyambogo pursued diploma level,

and the students of Ndejje studied at diploma and undergraduate level. Table 3 gives an overview of the characteristics of the participants in our study. Analysis indicates that the proportions of female/male students and the distribution of student over different knowledge domains are not significantly different from the proportions in the population.

Table 3.

Numbers of Actors from the four universities who participated in the study

University	Total number of students	Male students	Female students	Science students	Arts students	Employed students	Teaching staff	Administrators	Policy makers	Total actors
Makerere University	47	33	14	8	36	43	1	2	2	52
Kyambogo University	46	25	19	15	30	46	2	1	1	50
Ndejje University	33	29	3	2	31	30	2		1	36
Uganda Martyrs University	5	4	1	2	3	5	2	1	1	9
TOTAL	131	91	36	26	100	124	7	4	5	147

We focus on second year students, since they were expected to have already fully experienced the educational system at the time of the research.

A second sample consisted of eight experts, each representing an ICT in education initiative in Uganda. The eight initiatives were traced by adopting a snow balling sampling technique. Actors (policy makers and administrators) from the four universities were asked to select relevant ICT-related education initiatives. The initiatives cited most were selected for this part of the study. The majority of the initiatives aimed at improving ICT competencies of specific audiences, varying primary schools to university level education and community development. The initiatives build on – combinations of - various technologies such as voice, video, data and print and focus both on online and offline solutions. Details for each initiative are in Appendix 1.

Research instruments

Two instruments, a questionnaire and an interview protocol were developed to gather data from respondents from universities and ICT-projects. The study instruments reflect the outcomes of the review of the literature. The review identified key impact variables efficiency (flexibility, money, time and reuse), changes in the perception of instructional approaches (motivation, collaboration and active learning) and promoting the efficacy of education (acquisition of knowledge, skills and competencies). The instrument also captures the description of the modes of distance education and analyses as such the types of ICT used to support distance education. Next, factors that foster and/or challenge ICT use in distance education were explored. In addition, possible solutions that might be helpful to address the challenges in distance teacher education were discussed. Questionnaire items reflected the issues presented earlier and were presented as statements. Respondents were asked to reply their agreement with the statement on a 10 point Likert scale (1 ~ I strongly disagree and 10 ~ I strongly agree). Questions were asked in relation to current – non ICT-based - distance teacher education approaches and in relation to ICT based distance teacher education approaches.

From the ICT experts of the different initiatives, collection of data was directed by an interview protocol.

Analysis of the results

Data generated with the questionnaires were analysed with SPSS 11. Data entry errors were minimised by double cross-checking the entries. Reliability analysis was based on calculation of Cronbach alpha, focusing on the different subsets of questionnaire items. Table 4 summarizes the results of the reliability analysis.

Table 4.

Reliability analysis of the questionnaire exploring use of ICT in distance teacher education in Uganda

Items	Non ICT-based distance teacher education - α	Distance teacher education with ICT - α
Efficiency of DTE	.90	.98
Efficacy of DTE	.90	.97
Satisfaction of DTE	.83	.97
Factors fostering DTE	.90	.97
Challenges in relation to DTE	.91	.97
Solutions to meet challenges	.95	.96
Actual use of ICT		.94
Types of ICT used		.93
Reasons for not using ICT in DTE		.93

Considering the exploratory nature of the study, analysis of the results remains mainly descriptive. Means are presented to represent ratings of respondents about the item clusters.

To determine the significance of differences between the different actors Kruskal Wallis is used because in most cases the homogeneity of variance in violated.

The responses to the interviews were recorded on audio tape and subsequently transcribed. Analysis of the interviews focused on identifying themes that were in line with the items clusters presented above. To guarantee reliability in coding, the categorisation process was done twice by different coders. Interrater reliability exceeded 90 % (percentage agreement).

Results

1. What is the status of ICT use in instruction in distance teacher education in Uganda?

The results reflect the status of use of ICT in distance teacher education considering the format of distance education, the type of instruction, the nature of interaction with learners and student demographics. In addition, we focus on the actual use of ICT and the types of ICT-use. Lastly, we explore the perception of the respondents as to the perceived potential of ICT in distance teacher education.

The format of distance teacher education, type of instruction and interaction

The four universities adopt varying strategies in implementing their distance teacher education. Differences are in the position of the central organisation, the nature of the teaching in the distance education courses, and the role and position of study centres.
For instance, Makerere and Ndejje Universities used the university premises to organise admission, student administration and to set up face-to-face sessions. On the other hand, at Kyambogo and Uganda Martyrs Universities lecturers start by taking a central refresher course, and next start working with groups of students in the various study centres. Makerere. University runs eight study centres – spread around the country - each offering face-to-face sessions, making available venues for group work and offer links with the university. The Makerere Distance Education department organises regularly tutorials for students in the study centres. The study centres of Kyambogo University are located in selected teacher education colleges also geographically spread over the country. The admission and administration of the students is carried out in these centres. At Uganda Martyrs University, the study centres are again regionally distributed throughout Uganda. Each centre recruits students from the specific area.

Regardless of the institution, student teachers have to follow the same national curriculum and courses build on the same syllabus. As a consequence they also take comparable examinations in relation to the knowledge domain they focus upon during their teacher education.

The predominant mode of instruction for distance education in the four institutes is print, supplemented with face-to-face sessions either centrally or in regional study centres. Face to face sessions are according to the respondents an opportunity to promote student-student and student-teacher interaction, and to give students access to additional learning resources, especially library books.

Student teacher demographics

The input of the respondents presented in Table 5 gives a clearer picture of the demographics of student teachers. Regardless of the university, both male and female students are enrolled. All the universities offer both a science and arts curriculum. Over 90% of the respondents are students combining working and studying. The majority of the students have been working for over five years. Over 50% of the students are between 31 and 40 years of age. In the four universities, students do come from varying geographical background.

Table 5.

Students Demographics - N = 131

Characteric	Category of characteristic	Makerere N = 47	%	Kyambogo N = 46	%	Ndejje N = 33	%	Uganda Martyrs N = 5	%
Gender	Male	33	70	25	54.3	29	87.8	4	80
	Female	14	30	19	41.4	3	09.1	-	-
	Not stated	-	-	02	.4	1	.3	1	20
Curriculum	Arts	36	76.5	30	65.2	31	93.9	3	60
	Science	8	17	15	32.6	2	6.1	-	-
	Not stated	3	6.4	1	2.2	-	-	2	40
Employed		43	92	46	100	30	91	5	100
Age	18-25 years	2	04	2	4.3	2	06	-	-
	26-30 years	13	28	19	41.3	12	36	1	20
	31-40 years	26	55	18	39.1	15	46	3	60
	41- 50 years	6	13	5	10.9	4	15	1	20
	Not stated	-	-	2	4.3	-	-	-	-
Prior education	Secondary	4	09	-		3	09	1	20
	Certificate	-	-	44	96	10	30	-	-
	Diploma	41	87	-		20	61	4	80
	Not stated	2	04	2	04	-	-	-	-
Working experience	2 years	3	06	1	02	1	03	-	-
	3 years	3	06	-	-	1	03	-	-
	4 Years	3	06	1	02	4	12	-	-
	5 years and above	35	75	44	96	9	27	5	100
	Not stated	6	13	-	-	19	56	-	-
Distance from university	Same city	18	38	18	39	14	42	2	40
	Different cities	23	49	24	52	15	46	3	60
	Different countries	4	09	1	02	-	-	-	-
	Not stated	2	04	3	7	4	15	-	-

Actual use of ICT

The actual use of ICT by the respondents was explored on the base of four questions: (1) does your institution use ICT in distance teacher education? (2) does your Institution have an ICT policy? (3) rate in which way ICT is used in the following responsibilities of distance teacher education in your university and (4) rate the extent of use of the following ICT in your distance teacher education.

Nearly two thirds (61%) of the respondents indicate that they do not use ICT in their distance teacher education. Moreover, 74% indicate that they are not aware that their institution adopted an ICT policy. Furthermore, they were asked to specify the actual use of ICT in relation to a list of key field of applications within the university context. Figure 2 summarizes the answers of the different groups of respondents. It is clear that overall ICT use is restricted, but that the perceptions of different actors differ. The observations of the administrator seem to be inconsistent with the observations of the other actors.

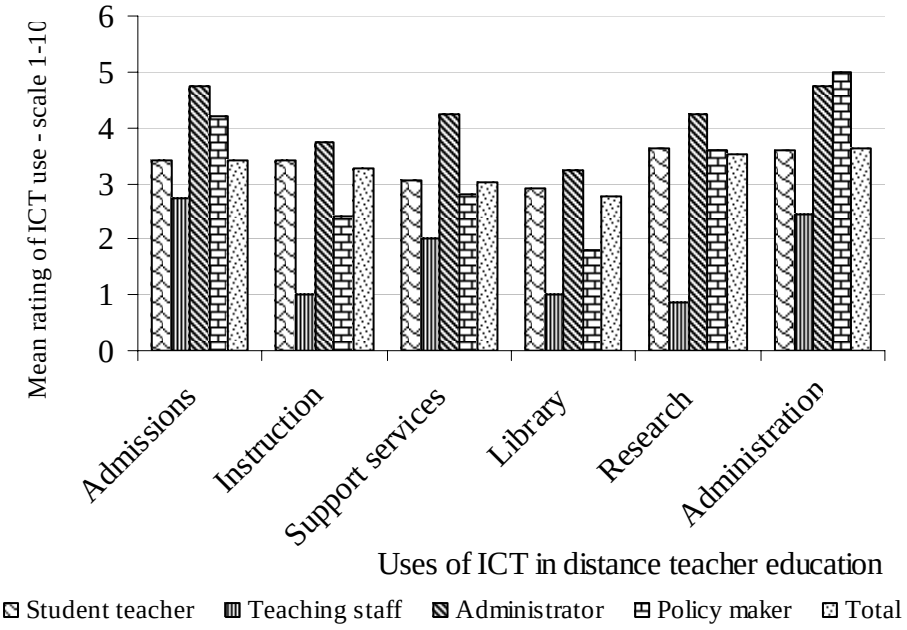

Figure 2. Uses of ICT in distance teacher education in Uganda - *N*= 147

The major university functions that seem to be supported by ICT, are administration, research and student admission.

The data of Figure 2 can be linked to the extra information found in Table 6. The differences in opinion between the respondents are reflected in the large standard deviation values.

Table 6.

Means and standard deviations for all the actors – uses of ICT (N = 147)

Total - Actors	Admission of students	Teaching and learning	Support services	Access to information - library	Research	Administration
Mean	3.4	3.3	3.0	2.8	3.5	3.6
SD	3.7	3.6	3.3	3.2	3.7	3.7

The differences in the means and the standard deviation are also high when focusing on values of different actors. The teaching staff report the lowest ratings in relation to the functional uses of ICT. The administrators and policy makers report higher levels of ICT use. Further analysis using Kruskal Wallis test for the third confidence rating there were no significant differences between the different actors.

Figure 3 suggests that respondents can hardly specify what kinds of ICT are being used. From the figure it becomes clear – as was partly already stated earlier – that printed modules and audio seem to be used to the largest extent. Again it is interesting to note that the standard deviations in the reported values are high (see Table 7).

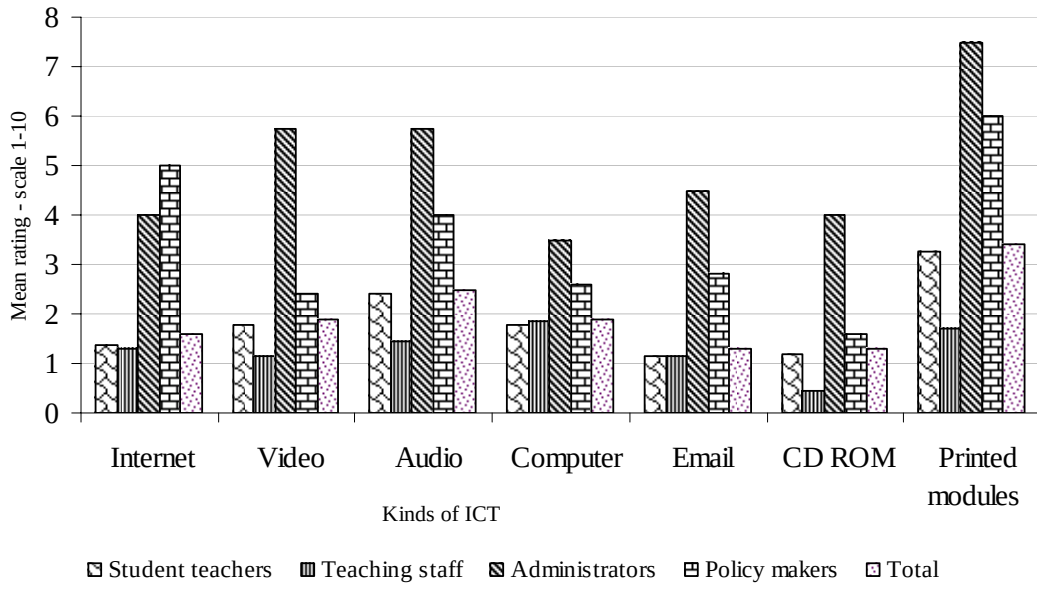

Figure 3. Kinds of ICT used in distance teacher education – *N*= 147

The administrators and policy makers differ again in their rating of ICT types used in distance teacher education.

Table 7.

Means and standard deviations for all the actors – kinds of ICT (N = 147)

Total Actors	Internet	Video	Audio	Computer	Email	CD ROM	Printed modules
Mean	1.6	1.9	2.5	1.9	1.3	1.3	3.4
SD	2.6	2.8	3.4	2.7	2.2	2.1	4.1

In Figure 4, we list the reasons reported by the respondents for not using ICT in distance teacher education. It seems that the respondents differ in their observations. Table 8 documents these differences. The large standard deviations are clear pointers of these differences. However, for the third confidence rating there were no significant differences between the different actors. A general observation is that the ratings for the reasons

presented to the respondents are generally rather low. Only one of the reasons receives an average rating $M > 5$.

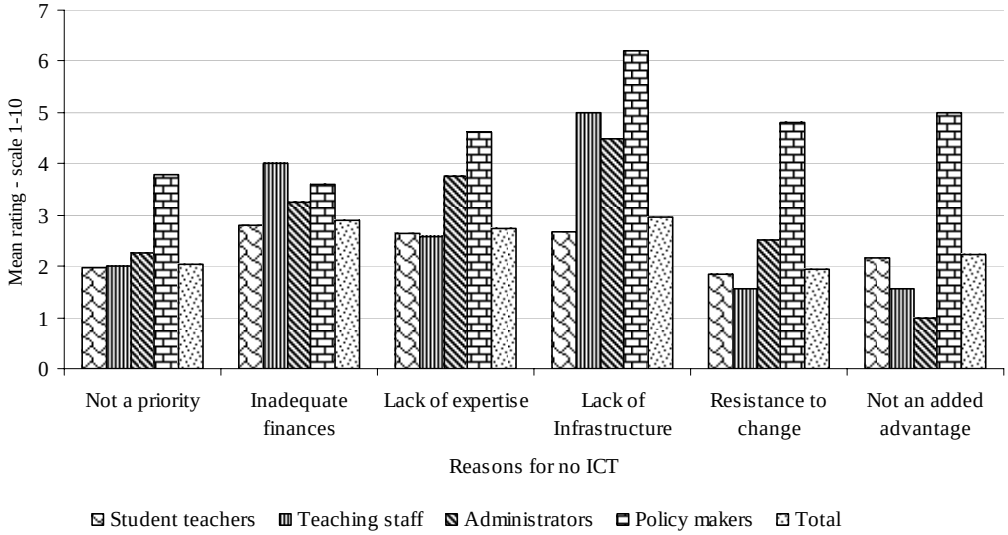

Figure 4. Reasons for not using ICT – (N = 147)

Policy makers perceive the lack of infrastructure as the most important challenge, next to doubts about the added value of ICT, resistance to change and lack of ICT expertise. The teaching staff especially points at the lack of finances and the lack of infrastructure. Administrators point at the lack of infrastructure and the lack of expertise. Student teachers don't point in a very specific way at possible reasons for the lack of ICT use. The differences between the different actors were not significant (Kruskal Wallis test).

Table 8.

Means and standard deviations for all the actors – Reasons for not using ICT (N = 147)

	Not a priority	Inadequate finances	Lack of expertise	Lack of Infrastructure	Resistance to change	Not an added advantage
Mean	2.1	2.9	2.7	3.0	1.9	2.2
SD	3.2	3.9	3.6	3.8	3.0	3.3

Distance teacher education with or without ICT

Respondents were asked to rate the efficacy, efficiency and instructional approaches of distance teacher education with and next without ICT.
Figure 5 summarizes the results. In general the respondents report high ratings in view of acquiring or developing knowledge, skills and competences (M = 7) when it comes to the traditional approach. In contrast, the perceived appreciation for distance teacher education enriched with ICT, is rated significantly lower. The differences in rating both with and without ICT are not significantly different in the different actors (Kruskal Wallis test).

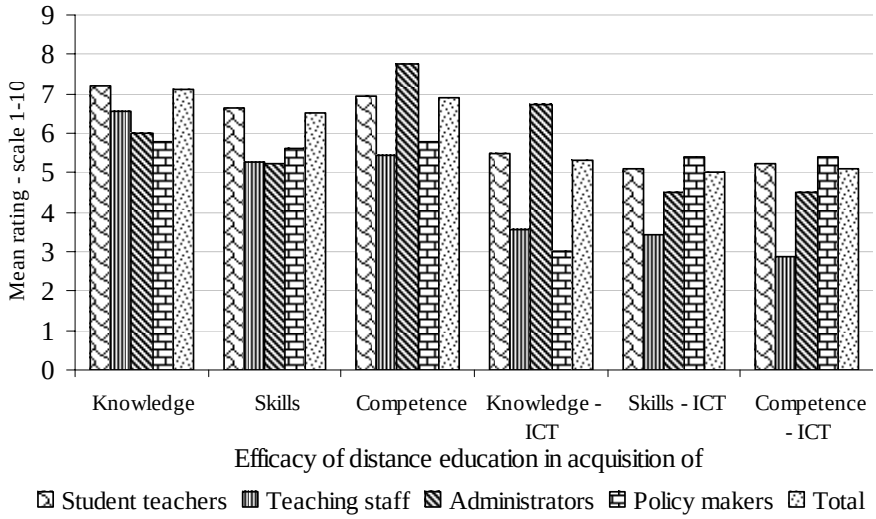

Figure 5. Efficacy of distance education

In particular, policy makers rate the efficacy of ICT-supported teacher education in a rather low way.

Table 9.

Means and standard deviations for all the actors – efficacy of distance education (N = 147)

Total	Acquisition of knowledge	Acquisition of skills	Acquisition of competence	Acquisition of knowledge-ICT	Acquisition of skills-ICT	Acquisition of competence-ICT
Mean	7.1	6.5	6.9	5.3	5.0	5.1
SD	2.9	3.1	3.2	4.3	4.1	4.1

We have to conclude that the current distance teacher education is well perceived in view of enabling the acquisition of knowledge, skills and competences, but that the potential of ICT is yet not recognized.

Figures 6 and 7 summarize ratings of respondents about the perceived efficiency of distance teacher education, based on 11 indicators. Again, it is clear that the actors do not judge the efficiency of the current distance education approach and the distance teacher education with ICT in the same way as seen in Table 10. In general, the current distance teaching education (DTE) approach is perceived to be more efficient than DTE supported with ICT. Administrators differ somewhat in this context, since they reflect a more positive attitude towards both approaches. However, the difference in ratings between actors is not significant.

It is striking that the overall efficiency ratings are low, also for traditional DTE. Considering all actors, the three main strengths of the current DTE approach are that materials are reusable and does not require a lot of infrastructure or human resources. However even these ratings vary between 4-5 which could be called "medium efficient".

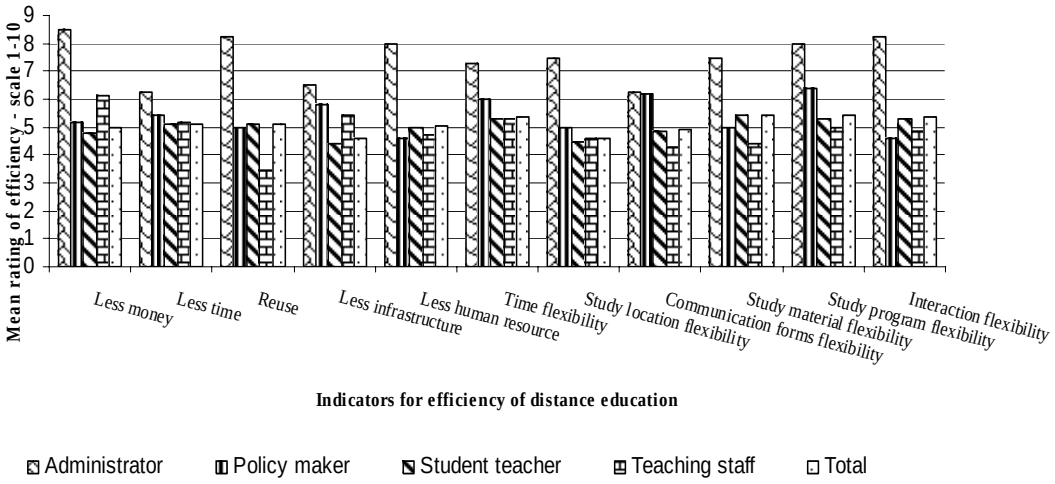

Figure 6. Indicators of efficiency of distance education

Table 10.

Means and standard deviations for all the actors – Efficiency of current DTE (N = 147)

	Less money	Less time	Reuse	Less infrastructure	Less human resource	Time flexibility	Study location flexibility	Communication forms flexibility	Study material flexibility	Study program flexibility	Interaction flexibility
Mean	5.0	5.1	5.1	4.6	5.1	5.4	4.6	4.9	5.4	5.4	5.3
SD	3.8	3.6	3.6	3.6	3.7	3.3	3.5	3.3	3.4	3.4	3.5

Distance teacher education with ICT is not envisaged to be very efficient, building on the perceptions of the respondents. There are no significant differences between the ratings of the different types of respondents and the standard deviation is high as shown in Table 11.

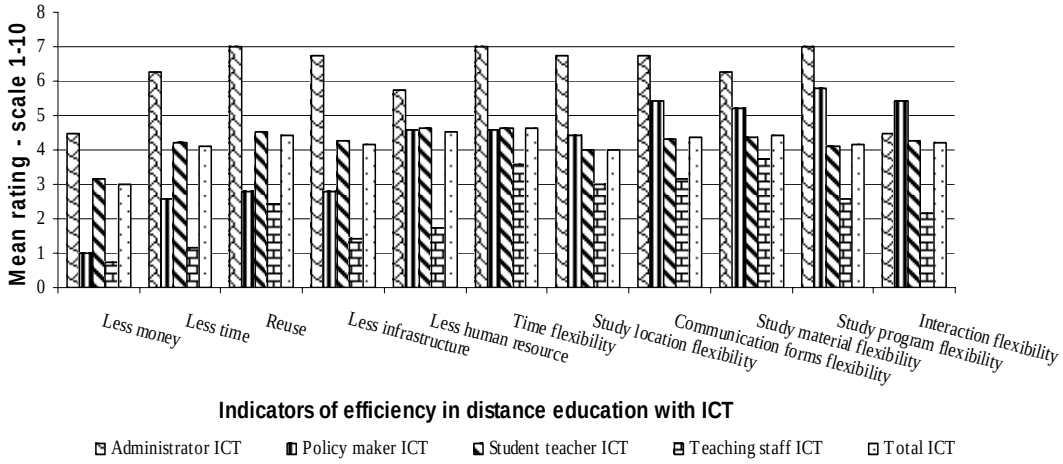

Figure 7. Indicators of efficiency of distance education ICT

Table 11.

Means and standard deviations for all the actors – Efficiency of DTE with ICT (N = 147)

	Less money	Less time	Reuse	Less infrastructure	Less human resource	Time flexibility	Study location flexi	Communication forms flexibility	Study material flexibility	Study program flexibility	Interaction flexibility
Mean	3.0	4.1	4.4	4.2	4.5	4.6	4.0	4.4	4.4	4.2	4.2
SD	3.4	3.9	4.0	3.9	4.1	4.0	3.8	4.0	3.9	3.9	3.9

Three particular instructional approaches were presented to the respondents to be rated as to the extent they are being adopted in tradition DTE and in the context when ICT is available. The current distance teacher education - as indicated in Figure 8 - is considered to be satisfying as to supporting these instructional approaches. There is a reasonably high standard deviation among the different actors as shown in Table 12, however the differences between actors are not significant (Kruskal Wallis test). But, more importantly, all actors expressed an opinion that ICT would not be very supportive of these instructional approaches in the context of distance teacher education.

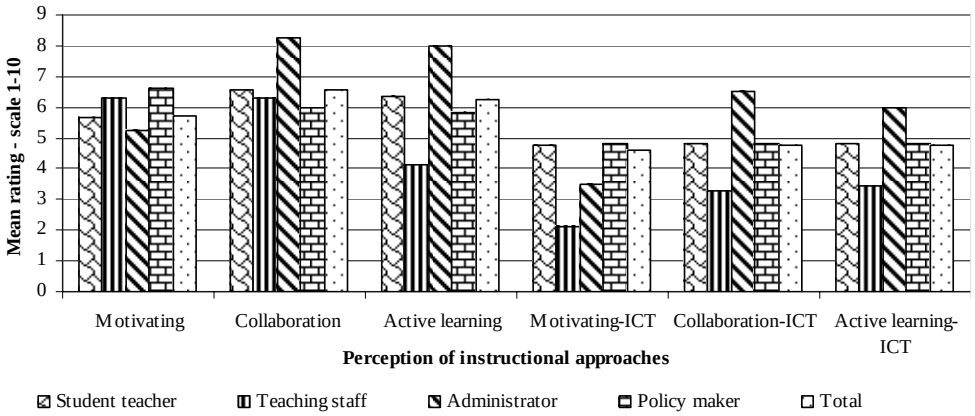

Figure 8. Perceptions of instructional approaches

Table 12.

Means and standard deviations for all the actors – perception of instructional approach in DTE (N = 147)

Total	Motivating	Collaboration	Active learning	Motivating-ICT	Collaboration-ICT	Active learning-ICT
Mean	5.7	6.6	6.3	4.6	4.8	4.8
SD	3.2	3.2	3.2	4.0	4.0	4.2

2. What factors foster ICT use in distance teacher education?

Thirteen (13) factors –based on the review of the literature - that foster distance teacher education with or without ICT were presented to the respondents. Figure 9 indicates that current distance teacher education is considered to be fostered by the number of students, the quality standards, availability of monitoring and evaluation facilities, the instructor characteristics and the support from administration. Considering the same factors in the context of distance teacher education with ICT, the ratings are clearly lower. The standard deviation is high see Table 13. The differences between actors are not significant (Kruskal Wallis test).

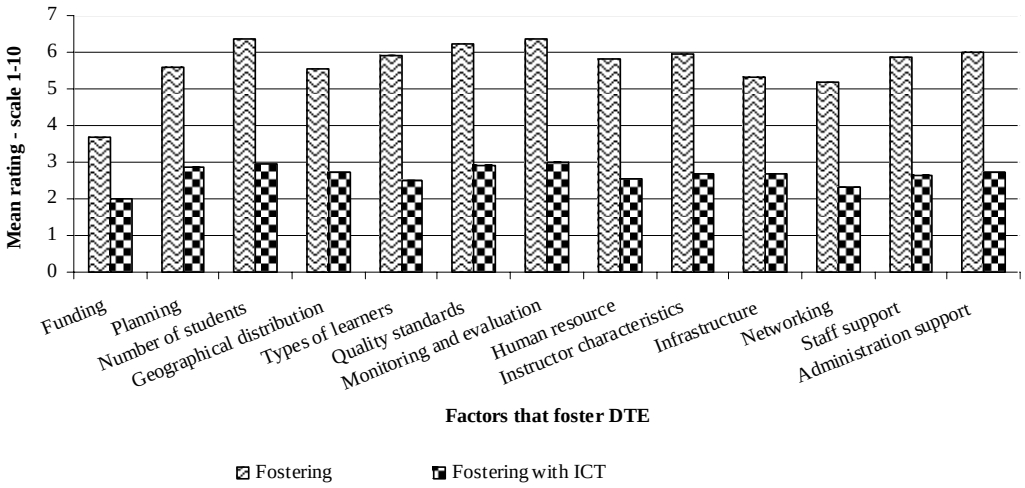

Figure 9. Factors that foster distance teacher education with or without ICT

Table 13.

Standard deviations for all the actors – Factors that foster ICT use (N = 147)

	Funding	Planning	Number of students Geographical distribution	Types of learners	Quality standards Monitoring and evaluation	Human resource Instructor characteristics	Infrastructure	Networking	Staff support	Administration support
Means DTE	3.7	5.6	6.3	5.5	5.9	6.2	6.4	5.8	6.0	5.3	5.2	5.9	6.0
SD DTE	3.3	3.2	3.2	3.3	3.1	3.2	3.4	3.0	3.3	3.0	3.1	3.1	3.2
Mean DTE with ICT	2	2.9	3.0	2.7	2.5	2.9	3.0	2.6	2.7	2.7	2.3	2.6	2.7
SD DTE with ICT	2.9	3.6	3.6	3.4	3.1	3.5	3.5	3.2	3.2	3.2	3.1	3.3	3.5

When analysing the interviews set up with key players of the ICT in education initiatives in Uganda, the following list of factors is considered of prime importance to promote or challenge ICT in education: government commitment, long and middle term planning, available resources, availability of technology and support from the private sector. A detailed overview of the analysis results are represented in Table 14.

Table 14.

Factors that foster the implementation of ICT use in education in Uganda

Factor	Sub factor	AVU	Connect ED	Curriculum Net	DICTS	IICD	School Net	E- learning	MOES
Government commitment	Goodwill						√		√
	Policy development						√		√
	Syllabi production						√		√
	Removal of taxes on computers						√		
	Defining a budget line						√		
Long and middle term planning	Decentralised planning with no bureaucracy	√					√		
	Institutional policies	√							
	Administration		√			√			√
	Realistic objectives								√
	Developing a learning organisation						√		
Available resources	Human resources : Teamwork		√						
	Enthusiasm							√	
	Expertise		√			√		√	√
	Financial resources					√			√
	Infrastructural resources	√			√			√	√
Availability of technology		√	√				√	√	
	Capabilities of technology						√		
Support of private sector		√					√		

3. What are the challenges of ICT use in distance teacher education?

Taking into consideration the factors that are – based on the review of the literature –considered as important to challenge distance teacher education, nearly all were rated as challenging by the respondents. But when the respondents were asked to indicate the challenges related to ICT based DTE, the challenges were considered to be less critical (see Figure 8).

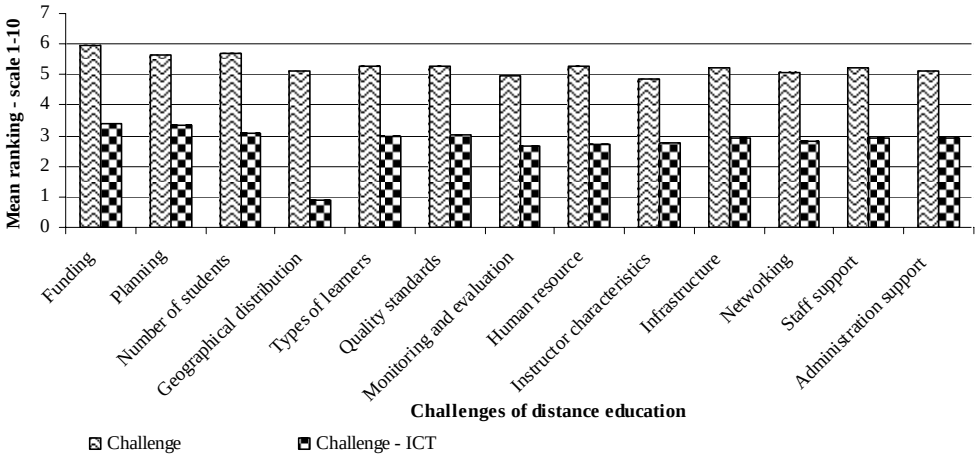

Figure 10. Challenges of distance education with or without ICT

Table 15.

Standard deviation – challenges of distance education (N = 147)

	Funding	Planning	Number of students	Geographical distribution	Types of learners	Quality standards	Monitoring and evaluation	Human resource	Instructor characteristics	Infrastructure	Networking	Staff support	Administration support
Mean DTE	5.9	5.6	5.7	5.1	5.3	5.3	5.0	5.3	4.8	5.2	5.0	5.2	5.1
SD DTE	3.7	3.1	3.4	3.4	3.1	3.2	3.3	3.1	3.2	3.1	3.1	3.2	3.2
Mean DTE with ICT	3.4	3.4	3.1	0.9	3.0	3.0	2.7	2.7	2.8	2.9	2.8	2.9	2.9
SD DTE with ICT	4.2	3.7	3.7	2.4	3.4	3.5	3.3	3.2	3.2	3.3	3.3	3.4	3.5

When we analyse the interviews with representatives of major ICT in education initiatives, the following challenges are put forward: the lack of adequate resources, the lack of standards, a negative attitude towards ICT and the lack of an ICT policy to guide the implementation. There were no significant differences between the actors (Kruskal Wallis).

Table 16.

Challenges of ICT use in education in Uganda

Challenge	Sub challenge	AVU	Connect ED	Curriculum Net	DICTS	IICD	School Net	E- learning
Resources	Human expertise	√	√	√	√		√	√
	Financial	√				√	√	
	Infrastructure	√	√	√			√	√
Standards		√			√			
Attitude		√	√				√	
ICT Policy		√				√	√	

4. What are solutions put forward to meet the challenges of ICT use in distance teacher education in Uganda?

Considering the current distance teacher education approach, most solutions put forward to meet the challenges were considered to be valid. As compared to the challenges put forward in the context of DTE with ICT it is important to notice that in Figure 10, less critical challenges were put forward.

In Figure 11, these data are mirrored in the way solutions are stressed to meet the challenges.

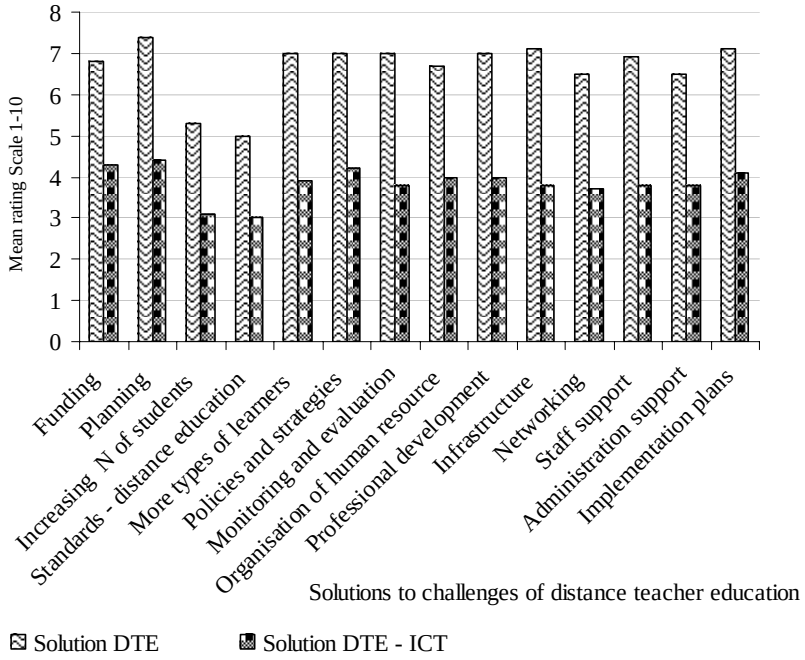

Figure 11. Solutions to challenges of distance teacher education

Table 17.

Standard deviation – Solutions to challenges of distance teacher education with or without ICT (N = 147)

	Funding	Planning	Increasing Number of students	Standards of distance education	Types of learners	Policies and strategies	Monitoring and evaluation	Human resource Professional development	Infrastructure	Networking	Staff support	Administration support	Implementation plans
Mean DTE	6.8	7.4	5.3	5.0	7.0	7.0	7.0	6.7	7.0	7.1	6.5	6.9	6.5	7.1
SD DTE	3.7	3.1	3.4	3.3	3.2	3.2	3.2	3.2	3.2	3.4	3.4	3.4	3.4	3.6
Mean DTE - ICT	4.3	4.4	3.1	3.0	3.9	4.2	3.8	4.0	4.0	3.8	3.7	3.8	3.8	4.1
SD DTE with ICT	4.4	4.3	3.8	3.8	9.2	4.1	4.2	4.0	4.1	4.1	4.0	4.1	4.2	4.3

Analysis of the interviews results in a number of extra ways to meet the challenges. In Table 18 it is clear that additional resources are stressed by most respondents. Next, the interviewees stress policy development and awareness development. The latter can clearly be related to developing skills suited to design and implement DTE and ICT.

Table 18.

Recommendations for better use of ICT in education in Uganda

Recommendation	**Sub recommendation**	**AVU**	**Connect ED**	**Curriculum Net**	**DICTS**	**IICD**	**School Net**	**E- learning**	**MOES**
Making extra resources available	Human expertise	√	√	√	√		√		√
	Break bureaucracy	√							
	Infrastructure	√	√	√	√	√	√	√	√
	Financial	√		√			√		√
Develop a DTE and ICT related policy		√	√	√		√	√	√	√
	Syllabus	√							
Coordination							√	√	
Sensitisation and awareness		√	√	√			√	√	√
Skills development		√	√	√			√	√	
Standards	Legal and regulatory framework	√							√
Maintenance of ICT									√

Discussion

The discussion is structured along the four research questions.

1. *What is the status of ICT use in instruction in distance teacher education in Uganda?*

In discussing the status of ICT use in distance teacher education we studied the instructional format, the instructional approach, the level of interaction with the learners, student demographics in DTE and the perceptions about DTE with and without ICT.

Considering that there is virtually no communication between the student teachers and the universities when they are away from the main campus, it is no wonder that Universities in Uganda play a centre role in instructional processes. However, some institutions make use of study centres. In addition - and confirming available evidence from the literature - the predominant delivery mode of education is through print and the dominant mode of interaction is face-to-face (Aguti, 2003; Ouma, 2003). This is hardly supported by ICT. The face-to-face approach, does meet the need for person to person activities and reinforces the traditional interaction pattern in instruction (Trindade et al., 2000). In Uganda, face to face interaction is organised during school holidays to enable in-service teachers to attend the sessions. This causes these periods to be very intense, and is counterproductive to foster well developed interaction between learners in the learning environment. Teacher centred interaction is predominant. Nevertheless, this face-to-face interaction is perceived as efficient, and convenient (Aguti, 2003).

In regard to student demographics, current DTE approaches give access to both a balanced number of female and male students. DTE supports a wide variety of programmes; from the science to arts curriculum. The data point at a critical characteristics of the student population; the majority is employed and most of them for more than five years. The distance teacher education program tends to favour the upgrading of teachers. This is reflected in the age levels: a large percentage is between 31 to 40 years. Since the majority of the students do not live close to the teacher education

centre, they clearly experience a distance barrier. In view of this format and the varying student demographics established, we question the flexibility and interaction this current distance education is able to offer to the different students without ICT use in instruction.
Pulling this information together, the current DTE approach seems to meet the basic needs to upgrade in-service teachers.

Only Makerere University has an ICT policy in place at the time of the research (Makerere University, 2004). This points at a clear lack of policy orientation and development in DTE. ICT is especially used in the context of administration, research and student admission, but not in the context of instruction. This might explain the difficulties of respondents to identify the types of ICT use in DTE. Also, this can explain the differences in point of view between the different respondents. As has been stated earlier, printed modules is the dominant mode of delivery. Next especially video and audio use seem to major technologies used in DTE.

The respondents indicate that ICT should be a priority; its added value is recognized. Main reasons for actually not integrating ICT are related to a lack of infrastructure, resistance to change and lack of expertise. But, the results also indicate that the different actors are not clear about these reasons and differences in perceptions can be observed. We discuss these results in the next paragraphs.

The efficacy of the current distance education format is rated highly, when focusing on the potential to support the acquisition of knowledge, skills and competences. It is not surprising that the teaching staff consequently rated the potential of ICT use to enhance the efficacy of distance teacher education rather low. Policy makers expressed even a less supportive attitude.

The efficiency of the current distance teacher education approach is rated rather poorly (< 5). Respondents do also not shift in their perception when presented ICT use in this context. Strikingly, the administrators express a different opinion. They are more positive as to the efficiency of the current approaches and in addition are also positive about the efficiency of ICT use in DTE. They anticipate that ICT in distance education will enhance its

efficiency by demanding less human resources and by enhancing flexibility in terms of location of the study, the study materials, the study programs and the nature of the interaction with/between students. The potential of ICT to increase flexibility is clearly acknowledged (Collis, 2001 and Khan, 1997).
What could be the source of this difference in perceptions? The administrators have a very specific role in the DTE context. They look at the processes from an administrative and logistic point of view. These processes are currently already supported by ICT. In other words, they experience both the efficiency of the current DTE model and also experienced the beneficial impact of ICT to enhance efficiency. The other groups of respondents did yet not have experience with DTE in the context of ICT and are in a difficult position to express an informed and unbiased point of view.

The instructional approaches in current distance teacher education are perceived to be satisfying. They enable active learning, motivate learners and support collaboration. All the actors did not perceive ICT use to promote these instructional approaches. Given the lack of experience of the respondents with integrated use of ICT in DTE, this response pattern is not surprising. They yet had no opportunity to compare. These results are clearly not in line with the theoretical and empirical positions found in the literature. There is clear research evidence that shows that ICT contributes to alleviating student isolation, and lack of social interaction (Henri, 1994; Khan, 1997; Kretovics and McCambridge, 2002).

We have to conclude that the current distance teacher education is well perceived, from an efficacy, and efficiency point of view. According to the respondents, the traditional approach also fosters sound instructional approaches. The perceptions about and attitude towards ICT are less clear. Giving concrete experiences with ICT, awareness development and sensitisation seems to be necessary to get an informed opinion from the respondents.

2. What factors foster the use of ICT in distance teacher education?

The actual ICT experience of respondents in DTE was minimal. Thus, the respondents were hardly able to highlight the key factors that might foster ICT use in distance teacher education. In contrast, the interviewees from the ICT in education initiatives were able to mention important factors: government commitment, long term and middle term planning, sufficient resources and support of private sector.

Government commitment was suggested by the respondents as a key factor. In particular, the policy, goodwill, syllabus, budget line and removal of taxes on computers and their accessories for fostering the use of ICT in education. The government of Uganda (Ministry of Education and Sports, MOES) established policies that are supportive towards ICT implementation: the National ICT Policy, the Communication Act and the draft version of the ICT in Education Policy. The MOES also launched a computer studies syllabus for O' level in 2002. In addition, the MOES defined a budget for the implementation of ICT. This relates to emphasis that educational processes should be goal-oriented at micro-, meso- and the macro-level (Cadariu, 1998; Fisser, 2001).

Planning in particular decentralisation, developing and adopting institutional policies, and setting realistic objectives for ICT use is seen to foster ICT use. Decentralisation is hoped to result in minimizing bureaucracy thus promoting efficient decision making regarding the implementation of ICT. Some institutions, such as Makerere University, went a long way to produce ICT policies and to elaborate implementation guidelines. Both the local and donor administration were highly praised for being supportive. Lack of planning is viewed as another reason to explain the delay in the adoption of ICT based strategies; this is consistent with findings in the literature (Collis et al., 1999; Taylor and Swannell, 2001). Other studies stress the critical nature of concrete plans for distance education as a key factor to foster use of ICT (Hewett, 1999; Trindade et al., 2000).

When discussing resources as a critical factor, it is not surprising that financial resources are stressed to a high extent. Though cost is stressed by most respondents, it is also known that the costs of ICT use in education is inversely proportional to the number of users (OECD Proceedings, 1996; Taylor, 2002; Trindade et al., 2000; Zhang et al., 2002).
Resources, in particular infrastructure, and human resources, have been and will continue to be critical factors that define the implementation of ICT in education. Respondents of the ICT in education initiatives recognised the issue of a good ICT infrastructure. For example, Makerere University could profit from the installation of the fibre optic back bone that interconnected the existing local area networks and several free computer kiosks in faculties and departments. In other studies access to technology is recommended be given due consideration in implementation of ICT (Jung, 2001; Dymock et al., 1998; Trindade et al., 2000). Human expertise and team work were critical in this context.

Considering the cost of ICT the respondents applauded support of the private sector. The respondents pointed at various private ICT initiatives that propel ICT implementation in education in Uganda. Typical examples are: CurriculumNet (IDRC), Connect-ED (USAID), EMIS, IICD, SchoolNet Uganda, Bill and Melinda Gates Foundation, the World Bank Institute, and Schools on line. Also, projects like Acasia were applauded for enabling people to become computer literate e.g. in Nabweru and Buwama, and School-Net for putting a number of schools on an ICT network. Their willingness to network and share experiences is an enabling factor. In the context of the present study, linking DTE to these projects could help to solve issues about capacity building, sharing of expertise and reuse of existing solutions.

3. What are the challenges of ICT use in distance teacher education.

All factors that were presented to the respondents were considered as challenging to distance teacher education in Uganda. It was unclear which factors would challenge the use of ICT in distance teacher education given the lack of actual experience with ICT. The reasons for not adopting ICT (lack of infrastructure, resistance to change and lack of expertise) are put forward as challenges. The interviews with respondents from ICT in

education revealed as major challenges: the lack of adequate resources, lack of quality standards, a negative attitude towards ICT and the lack of an ICT policy to guide ICT and DTE implementation.

In the Uganda context, policy development was stressed as a challenging factor. As was explained earlier, some policy is in place. But the most promising policy statement is still a draft version. Lack of an approved policy results in lack of assigned budgets from the ministries. Draft policies are said to limit government commitment to funding and provision of an enabling environment for ICT use (Chifwepa, 2006).

Human resources are challenging, mainly considering the lack of expertise. It was acknowledged that e-learning implies new teaching skills. In the literature, authors stress in this context the development of coaching and tutoring skills, or the adoption of new assessment approaches (Fisher and Churach, 1998; Pelgrum, 2001). Also in the study of Chifwepa (2006) lack of skills both for the lecturers and students was a challenge.

Financial resources are – as expected – put forward as a challenge, especially since the cost of the technologies are beyond per capita income level in Uganda. Besides the cost of hardware, there is the high cost of connectivity as mentioned in many comparable studies (Chen, 2002). There were no funds from the ministries to take charge of these costs.

Infrastructure is still a challenge to ICT use in Uganda. This was equally a challenge in Chifwepa (2006) in mainstreaming ICT in teacher education is Zambia. In Uganda, the cost of ICT is still out of reach and thus the distribution is consequently affected. For example internet access is restricted to a few urban places where it makes economic sense. This is mainly spearheaded by the private sector.

Some initiatives stressed the lack of set standards to direct ICT implementation as a challenge. Discussion with respondents clarified that this also refers to standardisation of hardware and software.

The negative attitude towards ICT use is also a challenge. This can be also relate to resistance to change.

4. What are solutions put forward to meet the challenges of ICT use in distance teacher education in Uganda?

Solutions put forward with a high priority were: formulation of supportive policies, adequate planning, professional development, infrastructure development, collaboration with other institutions and support from the central administration. Respondents from the ICT in education initiatives recommended guaranteeing development and implementing adequate policies, setting quality standards, sufficient resources, better coordination of multiple initiatives, sensitisation and awareness of actors involved and development of skills.

Policies and standards as already mentioned among the fostering factors and challenges are hoped to be a solution to ICT implementation if they are in place. Implementation of some current policy directives could help in this perspective: the Communication Act, the National ICT Policy and the Policy for ICT in education. Individual institutions should be encouraged to derive from the national policy their institutional policy. These policies should be relevant to their context as also stressed by Fisser (2001).

Making available sufficient resources (human, financial and infrastructure) was recommended as a key in view of successful implementation of ICT in distance teacher education.
With regard to infrastructure, consideration is also to be given to the number of computers that is needed in a specific educational setting. For example, Makerere University (2004) was of the view that adequate resources in terms of computers would include 1 computer for 5 undergraduates, and 1 computer for each post graduate and staff. Exploring a mix of online and offline technologies is hoped to address the apparent problem of low bandwidth. Print should not be avoided given the tradition to rely heavily on printed resources. Nevertheless, the government will have to address the issues of connectivity, and improved electricity power provision in all parts of the country.

It was further strongly expressed that mechanisms should be in place to raise funds for implementation and relying on donors should be minimised as also acknowledged by Yawan (2000). Proper budgeting for ICT implementation should explore the possibility of sharing resources. A collaboration with current ICT in education initiatives is a promising direction. In harnessing ICT for education, reinventing the wheel should be avoided, and efforts should therefore be made to share experiences and resources (Yawan, 2000).

The study also revealed a less favourable attitude towards ICT. To combat negative attitudes, recommendations were presented to focus on awareness development and sensitisation of actors involved. This could help to demystify the perceptions about ICT.

Skills were also identified as a challenge and it is recommended that a deliberate effort address the skills gap. This is for both the student teachers and other actors because they work as a team.

Conclusions

Based on the survey described in this chapter, we conclude that the respondents applaud the current distance teacher education approach in Uganda. ICT is hardly used and as a consequence perceptions of the target audience as to the potential of ICT are less developed. Nevertheless, there is a positive attitude towards ICT use. Some even see its implementation as a priority. In addition, the experiences derived from current ICT in education initiatives suggest the potential of ICT in terms of flexibility and the improvement of quality of the distance teacher education approaches.

To achieve the potential of ICT, key factors that were considered as critical for a successful implementation: (1) thorough planning focusing on administration, clear and realistic objectives, adequate resources, (i.e. human, financial, and infrastructure); (2) government commitment (i.e. policy, curriculum, and budget) and (3) a collaboration between private and public sector (networking). It is hoped that dealing with these key factors will direct a successful implementation of ICT in distance teacher education. However, first, some challenges in relation to this

implementation have to be overcome, such as inadequate resources, lack of policy to guide the implementation, a lack of quality standards and dealing with less positive attitudes towards ICT. The possible solutions to deal with these challenges are: availing policies and standards, provision of resources, collaboration to minimise costs, developing awareness and sensitisation, skills development.

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Appendix 1*: ICT in Education initiatives in Uganda*

Factor	Sub factor	AVU (African Virtual University, 2004)	Connect ED (Connect ED, 2004)	Curriculum Net (Curriculum Net, 2004)	DICTS (Directorate of Information and Communication Technology support, 2004)	IICD (International Institute of Communication Development, 2004)	School Net (World Links SchoolNet Uganda, 2004)	E- learning	MOES
Objective	Formulating of policy								√
	Improve ICT skills and competencies		√	√	√	√	√	√	√
	Increase flexibility of learning with ICT	√	√	√		√		√	
	Bridge rural - urban divide	√					√		
	Research								√
	Education communication network		√				√		
	Funding ICT programs								√
	Establish a unit of ICT experts				√				
	Promote e-learning				√			√	
	Development of ICT curricular					√			√
	Produce courseware					√			
	Produce electronic content			√		√			
	Create awareness of role of ICT in education					√			
	Mainstream ICT in quality education					√			
	Infrastructure		√			√	√		
	Distance education	√							
	Improve service delivery		√	√			√	√	
Target	Policy makers								√
	Professionals	√							
	Staff		√		√	√		√	
	Students				√	√	√		
	Community						√		
	Youth						√		
	Secondary schools			√			√		
	Primary schools			√					
	Student Teachers		√						

Factor	Sub factor	AVU (African Virtual University, 2004)	Connect ED (Connect ED, 2004)	Curriculum Net (Curriculum Net, 2004)	DICTS (Directorate of Information and Communication Technology support, 2004)	IICD (International Institute of Communication Development, 2004)	School Net (World Links SchoolNet Uganda, 2004)	E- learning	MOES
ICT	Wireless microwave link						√		
	Printed material			√			√		
	Computer based	√				√			√
	Networks								√
	Radio								√
	Television								√
	Offline tools like seamless interface						√		
	Video					√			
	CDRom		√	√		√	√		
	Collaboration tools	√	√				√		
	Email	√	√						
	Internet	√	√						
	WWW		√	√		√			
	Satellite	√				√	√		
	Virtual learning environment		√					√	
	Telephone								√

3

The impact of studying in a realistic teacher education pedagogy oriented learning environment supported by ICT: asynchronous collaboration

The impact of studying in a realistic teacher education pedagogy oriented learning environment supported by ICT: asynchronous collaboration

Abstract

This chapter presents the results of a quasi-experimental study set up in the context of an innovative learning environment that reflects characteristics of a realistic teacher education pedagogy (RTEP) and the potential of information and communication technologies (ICT). The study focused on the impact of studying in this environment on student teachers' levels of interaction, cognitive processing and their perceptions. These perceptions comprise perceptions of the learning environment and instructional preferences. The experimental learning environment contrasted group work in an e-learning environment with group work in face-to-face control conditions. The study involved 144 student teachers from 6 colleges.
The results point at a significant impact of the RTEP-oriented learning environment on student teacher levels interaction and a medium effect on cognitive processing. The experimental learning environment influenced students to learn to speak out. But student perceptions did not predict levels of cognitive processing. Student teachers acknowledged the RTEP-characteristics of the learning environment and preferred instructional approaches that reflect elements of a realistic teacher education pedagogy.

Introduction and general research question

In Chapter 1 distance teacher education was presented as a solution to improve qualitative and quantitative characteristics of teacher education in Uganda. It was also stated that there was a need to increase the flexibility of teacher education and to redirect the current technical rationality approach towards a realistic teacher education pedagogy. It was hypothesized that the integrated use of ICT in the distance teacher education setting might help to attain both the quantitative and qualitative changes put forward.

Distance education was put forward as a more flexible context to be able to cope with the demands of growing numbers of teacher that want to become qualified or upgrade their present education. A realistic teacher

education pedagogy (RTEP) was put forward as a solution to meet the demand for critical changes in current teacher education approaches. The RTEP puts forward an instructional design approach that builds on students tackling authentic tasks, solving problems, researching the resources, and this in a collaborative setting. The RTEP-approach builds on the work of Korthagen (2001) and is considered to help to counter the technical rationality approach where theory and practice are disconnected (Munby, Russell, and Martin, 2001).

On the basis of a study about the state of the art in distance teacher education and the related use of ICT in Uganda - reported in Chapter 2 – some of the recommendations point to awareness and skills development. Basing on the identified instructional approaches of distance teacher education, we concluded that there was need to adopt innovative approaches to instruction. In the recent past, a substantial number of secondary schools, teacher education colleges and universities in Uganda have been provided with up-to-date information and communication technologies (ICT). Specific programs were set up to foster the development of basic ICT-skills in students and staff members. These include World links SchoolNet Uganda, Curriculum Net -National Curriculum and Development Center, Connectivity for Educator Development project (Connect ED), the African Virtual University, Directorate of Information and Communication Technologies Support (DICTs) - Makerere University and the International Institute for Communication and Development (IICD). The results of the study suggested that the technology has hardly been used as an integrated tool to foster learning and instruction. It was therefore concluded that there was a strong need for capacity building that focuses on educational uses of ICT.

The pilot study

Prior to this study, a pilot was carried out. In a quasi-experimental setting, the impact was researched of the learning environment on student teachers' interaction, levels of cognitive processing and their perceptions of the learning environment and instructional preferences. The experimental learning environment represented an operational elaboration of the realistic teacher education pedagogy and it was contrasted to a traditional learning environment, comprising group work in a control condition. The study involved 36 student teachers from 3 primary teacher education colleges. Although the results were not wholly significant, there were indications of a positive impact of adoption of a realistic teacher education pedagogy in the ICT based learning environment towards improving student teachers' perceptions and levels of cognitive processing.

The qualitative information helped to point at critical internal and external factors that might have influenced this low level of interaction and levels of cognitive processing. Analysis of the open ended questions help to document the quantitative results. Students reported the following most positive experiences: 1) Exposure to a new learning style (interaction and collaboration in learning, free expression, regardless of distance); 2) Adoption of new skills (searching for information, typing, reading other peoples messages, team work, critical thinking, time management and reaching consensus); and 3) getting the opportunity to communicate with fellow students (respecting each others' opinion and guidance from colleagues). Students also mentioned negative experiences due to working in the RTEP-oriented environment: 1) Technical difficulties due to electricity ruptures or poor internet connectivity; 2) Weak group dynamics (poor turn up, less active group members, many typing errors and poor adoption of the roles assigned to the students; 3) Lack of incentives (there were no tangible rewards for participation; 4) Time constraints (additional time demands due to online activities). Asynchronous as opposed to synchronous collaboration were recommended in the future to allow time flexibility thus minimizing the influence of these factors.

The low level of interaction could help to explain the limited differences in levels of cognitive processing between the control and experimental group.

The fact that nevertheless the experimental group outperformed the control group in relation to one of the three discussion activities - a significant result suggested that the RTEP-oriented environment might have had a positive impact. But the overall low mean level of cognitive processing suggests that the educational experience ought to be enhanced in a more thorough way. Suggestions were made about scaffolding the structure of the collaboration tasks, to provide coaching or to implement role assignment in a stricter way. The experience in the learning environment affected student perceptions to a significant but limited extent, and not as largely as hypothesized. In this context, it was suggested that future studies should be set up at a larger scale and during, longer period of time and more students should be involved. To foster interaction more attention should be paid to the role assignments, and larger groups should be considered.

The present study

The present study builds on the recommendations of the pilot study. Students studied in a comparable ICT-based learning environment that was expected to clearly reflect the characteristics of the RTEP. But the study also differed in a number of ways. Collaborative learning is in the present study only researched in the context of asynchronous discussions. Secondly, the students were involved in less discussions, but during a longer period of time. Also, more students participated in the present study (144 instead of 36). The group size was larger; an increase from 6 to 12 students. Considering the latter, also the number of colleges were increased from three to six. The knowledge domain of the study changed to "foundations of education" from science with health. More research variables were considered and a new focus was added.

The present study was set up as in the authentic teacher education context of six colleges in Uganda: two from Kampala and one from each of the districts of Bushenyi, Masaka, Tororo and Soroti districts. The study also aimed at being a showcase to foster capacity building in these colleges and to demonstrate the educational potential of ICT. In view of the showcase, an existing teacher education course was redesigned. This explains why the objectives of the course and the knowledge resources remained the same.

The critical differences were: (1) the course now built on activities, instead of themes derived from the knowledge domain, and (2) all the experimental students discussed the activities on-line in asynchronous electronic discussion groups. The learning environment was considered to promote a realistic teacher education pedagogy (RTEP), because it builds on authentic task based activities, learning from experience, active participation of the student teachers, student reflection, student interaction and collaboration in knowledge construction. Access to extra resource was provided for. The control condition was provided with a hard copy of the learning resource and they carried out the same activities as the experimental albeit in face to face discussions.

The general research question for this study is - Does active involvement in an RTEP-oriented learning environment at a distance have a positive influence on their cognitive processing and does it result in desirable changes in student teacher perceptions? A detailed description is elaborated in the theoretical base.

Theoretical framework

Figure 1 represents the key variables and processes that are central in the present study. The figure also positions the hypotheses – discussed later in this article – that build on this theoretical base. The RTEP-oriented learning environment represents a set of characteristics that are considered to influence dependent variables in the student teachers. A key characteristic – next to others - is the fact that students collaborate in asynchronous online discussion groups. This is expected to influence the nature of cognitive processing as it is reflected in levels of interaction and the level of cognitive processing. Next, also student perceptions are considered to be influenced. It is important to note that student teachers already have adopted specific perceptions before entering the traditional or the RTEP-oriented learning environment. The model in Figure 1 suggests that these perceptions will be influenced by the learning experience and consequently change to become more in line with RTEP-characteristics. The model also suggests that a – direct or indirect - impact could be

expected on actual academic performance. In the present study, this is not tested.

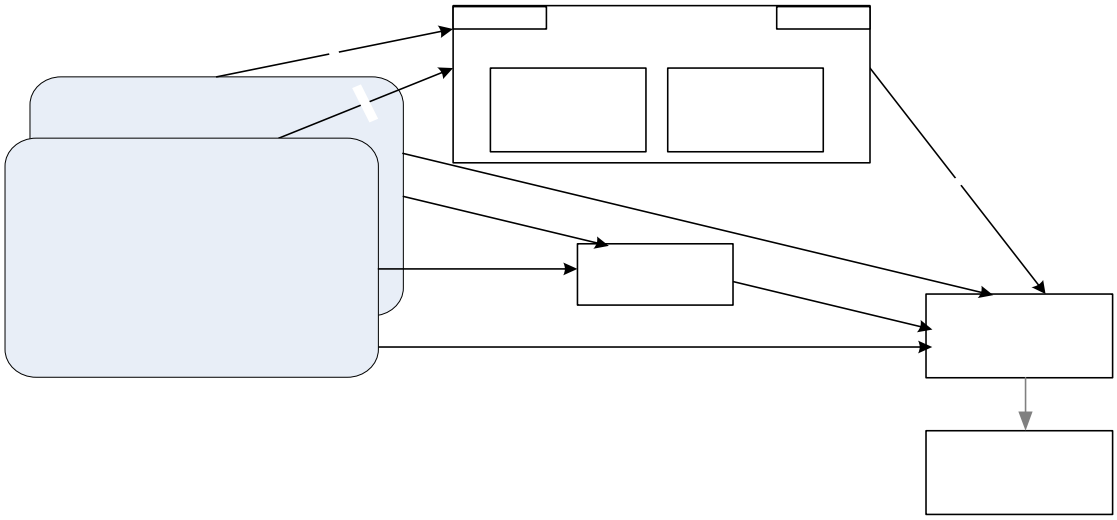

Figure 1. The impact of a traditional and RTEP-oriented learning environment on student teacher interaction, cognitive processing and perceptions.

The impact on cognitive processing

The experimental learning environment is set up in an ICT-based context and has been designed to promote a realistic teacher education pedagogy (RTEP). RTEP can, according to Korthagen (2001) be described thus:

- It starts from concrete practical problems and the concerns experienced by (student) teachers in real contexts.
- It promotes systematic reflection of (student) teachers on their own and their students' motives, feelings, thinking, and acting, on the role of the context, and on the relationships between those aspects.
- It builds on the personal interaction between the teacher educator and the (student) teacher and on the interaction among the (student) teachers.

- It takes into account the three levels of professional learning, as well as the consequences of the three-level model for the kind of theory that is offered
  - Gestalts: actions based on unconsciously triggered needs, values, meanings, feelings and a behavioural inclination.
  - Schema: reflection on situations and actions.
  - Theory: studying and connecting relations between different schemas.
- It promotes two types of integration: integration of theory and practice and integration of several knowledge domains.

In this context, learning is not the result of a transmission process by a teacher or an expert but an active process primarily monitored by the learner (Bednar, Cunningham, Duffy, and Perry, 1992; Dougiamas, 1998; Duffy and Cunningham, 1996; Mestre, 2003). This implies active experimentation, thus resulting in real-life experiences (Kelly, 2000; Merrill, 1992). During the active processing, it is important he/she reflects on these experiences (Bednar et al., 1992). Active processing is stated to entail higher order thinking (Jonassen, 1992). This guarantees the construction of mental structures (also called models or schemas) through processes of elaboration and organisation. These schemas are continuously contrasted to new experiences (evaluation and testing), resulting in better organised mental structures (Perkins, 1992).

The ICT-based learning environment is envisaged to promote aspects of RTEP. There is empirical evidence that supports this beneficial effect of learning on-line. For instance, course interactivity, flexibility in time and location, attractiveness, student communication and well elaborated content were found to be essential in achieving learning outcomes (Selim, 2003). Fisher and Churach (1998) revealed that higher internet usage in classroom results in more constructivist oriented learning. Beyth-Marom, Chajut, Roccas, and Sagiv (2003) and Dutton, Dutton, and Perry (2002) report higher academic achievement, higher grades, higher grade point average and a better knowledge of the subject in students taking an internet-based course as compared to traditional course students.

Impact on interaction and levels of cognitive processing

The RTEP emphasizes interaction and collaboration. This is envisaged to promote construction of knowledge fostered through collaborative activities (Dougiamas, 1998). Vygotsky refers in this context to the "zone of proximal learning," according to which students solve problems beyond their actual developmental level under adult guidance or in collaboration with peers (Vygotsky, 1978). A cooperative learning environment offers opportunities to experience multiple perspectives in the process of knowledge construction (Bednar et al., 1992). Research confirms that exchanging multiple perspectives provokes discussion and leads to enhanced knowledge construction (Veerman and Veldhuis-Diermanse, 2001). Meta-analysis of cooperative learning research presents convincing evidence of the beneficial impact of exchanging multiple perspectives (Johnson and Johnson, 1996; Johnson and Johnson, 1989; Slavin, 1996)

Research clearly points at the link between on-line courses and the fostering of collaborative learning. A critical variable is the extent to which active participation is fostered, a prerequisite in order to foster knowledge construction. Computer conferencing was found to have potential to increase the level of participation and interaction among students (Pena-Shaff and Nicholls, 2004). Swan (2001) reported that students in asynchronous electronic discussion groups report high levels of interactivity and involvement, higher levels of satisfaction and higher levels of learning. Question sharing and interactive assignments in on-line learning was found to foster individual learning and the promotion of high order thinking skills (Rafaeli, Barak, Dan-Gur, and Toch, 2004). The study of McKenzie and Murphy (2000) is of interest in the context of this teacher education study. They conclude that a learning environment that promoted discussion enabled participants to explore content covered, to discuss practical problems and alternative strategies for improving their own teaching.

A large body of the research literature about computer supported collaborative learning (CSCL) relies on content analysis of electronic discussion groups (De Wever, Schellens, Valcke, and Van Keer, 2006). The study of Benbunan-Fich, Hiltz, and Turoff (2003) demonstrated that

students in asynchronous discussion groups reach superior performance and report higher learning outcomes compared to students working in a face to face setting. But research results are not always consistent. Mcloughlin and Luca (1999) analyzed an online forum; the results indicate that most of the messages reflected rather low cognitive processing activities, such as comparing and sharing information. This implies that care has to be taken in the design of the group discussions. When structure was added to group tasks in CSCL settings significantly higher proportions of high cognitive processing was observed (Aviv, Erlich, Ravid, and Geva, 2003; Baker, Quignard, Lund, and Sejourne, 2003; De Wever, Valcke, and Van Winckel, 2003; Schellens and Valcke, 2004). Already earlier, scaffolding of individual and group process in was recognized as critical in CSCL research (Henri, 1994; Shaffer, 2002). In order to be successful in the learning environment, students need to know how to work independently, how to collaborate with their peers and, and how to balance these two modes of working (Shaffer, 2002; Soraya, Rahman, and Salim, 2004).

In the context of the present study, the impact on cognitive processing is studied by analyzing the level of cognitive processing that can be observed in student-student interaction when working on collaborative tasks. This approach builds on an established tradition in the CSCL-research field (Gunawardena, Lowe, and Anderson, 1997).

The impact on student teacher perceptions

Based on their experiences in a learning environment, students develop perceptions about this environment and develop certain instructional preferences. Considering the experimental RTEP-oriented learning environment, specific changes in perceptions and preferences are expected to be attained. In the context of this study, these are projected to be in line with a RTEP.

Empirical evidence states that for example, college students studying via online learning adopted a positive perception about learning with technology, about autonomous learning and learning via communication. This seems especially to be related to the fact that more control is given to the learner (Schonwetter and Francis, 2002). The RTEP-oriented learning environment is said to enable students to choose between learning alternatives (Yazon, Mayer-Smith, and Redfield, 2002). A computer-mediated communication environment lowered students' psychological barriers and enabled them to express their opinions more freely and to communicate actively via the Internet (Young, 2003). Also, teachers' experience in web-based collaborative learning environment influenced the perception of the learning environment as a new classroom promoting instruction integrated with assessment and collaboration and interaction regardless of distance between the students (Kollias, Mamalougos, Vamvakoussi, Lakkala, and Vosniadou, 2005).

Instructional preferences are especially influenced with regard to independence and collaboration (Yazon et al., 2002). Students in an Internet-based course were found to attribute higher importance to values that emphasize independence in thought and action, creativity and curiosity (Beyth-Marom, Chajut, Roccas, and Sagiv, 2003). Internet learning environments that challenge student conceptions, influence the preferences for instruction that build on student negotiation, inquiry learning and reflective thinking (Wen, Tsai, Lin, and Chuang, 2004). In the context of an online course, student teachers adopted in particular a perception of the learning environment that stressed learning from one another (Wiske, Sick, and Wirsig, 2001). Learners' attitudes toward e-learning as an efficient learning tool can be predicted positively by three factors (e-learning as a

self-paced learning environment, e-learning as a form of multimedia instruction, and e-learning as an instructor-led learning environment) (Liaw, Huang, and Chen, 2006).

In the context of the present study, two types of student perceptions will be included in the study. In particular we focus on perceptions that might be helpful to detect the impact of the RTEP oriented learning environment. When it comes to the student perceptions about the learning environment, we focus upon: a perception of the learning environment as encouraging to learn how to learn, to learn how to communicate, to learn to speak out and to take an active role in their learning and to reflect more. When it comes to instructional preferences, we centre on the distinctions in the instructional preferences instrument (IPI) of Schellens (2004) which measures the perception of the learning environment as focused on collaboration, planning, not assessment targeted, knowledge application oriented, fostering independence and self reflection and builds on authentic tasks.

The impact of student perceptions on levels of cognitive processing

In this study, perceptions of the learning environment and instructional preferences are expected to influence levels of cognitive processing during the learning process. In the literature, the impact of student perceptions on levels of cognitive processing is hardly discussed or studied. Therefore we build on literature referring to the impact on cognitive learning outcomes.

The effect of the learning environment has been found to be mediated by the students' own perception of those environments (Entwistle and Tait, 1990). Student attitudes toward the online learning environment were significant predictors of mean levels of knowledge construction (Schellens, Van Keer, and Valcke, 2005). Considering teaching and course preferences of students, Entwistle, Tait, and McCune (2000) distinguish between *transmitting information* and *supporting understanding* (implying communication and interaction). The latter is in line with the RTEP discussed earlier in this chapter. The specific perceptions may influence cognitive processing in different ways. For example, student perceptions in favour of a strong social presence in the learning environment, contributed significantly to

perceived learning outcomes (Picciano, 2002; Richardson and Swan, 2003). Student achievement was highest when students conceived their classes as combining high teacher and student control (Esthel and Kohavi, 2003). Students perceptions of the classroom environment were found to influence student outcomes (Fraser, 1994). For example, their perceptions were found to be positively correlated to their GPA (Telli, Rakici, and Cakiroglu, 2003). Students who reported positive student- instructor interactions demonstrated improved grades, next to a higher course satisfaction (Hong, 2002).

From a theoretical perspective, we state that specific perceptions: a perception of the learning environment as encouraging to learn how to learn, to learn how to communicate, to learn to speak out and to take an active role in their learning and to reflect more will invoke higher levels of cognitive processing. When it comes to instructional preferences, we state that a preference for instruction that supports collaboration, planning, not assessment targeted instruction, an application orientation, the fostering independence and self reflection and instruction that builds on authentic tasks is also expected to promote cognitive processing. Students with this type of instructional preferences and perception of the learning environment will question new knowledge elements, compare them, look for similarities and differences, contrast new information with information available, look for abstraction, etc. In contrast, student that do not reflect these perceptions or preferences will rather focus on memorising invoke knowledge without a personal elaboration and/or organisation of schemas in working memory. These students will be less active, be less involved in the activities. This will result in discussions that reflect lower levels of cognitive processing, e.g., reproducing information. They will hardly relate the input of others to their own ideas, will not focus on similarities and differences, etc.

The RTEP oriented learning environment is expected to promote student interaction. In turn, higher levels of interaction are expected to promote cognitive processing activities, such as negotiation of meaning, co-construction of knowledge, testing and modification of proposed hypotheses or development and application of newly constructed knowledge.

Hypotheses

Considering the theoretical base, the following hypotheses have been put forward:

1. Discussions of the student teachers in an RTEP-oriented learning environment invoke higher levels of interaction (number of messages) as compared to the control group.
2. Discussions of the student teachers in the RTEP-oriented learning environment reflect higher levels of cognitive processing as compared to students in the control group.
3. The experience of experimental student teachers in the RTEP-oriented learning environment results in significant changes in their perceptions.
   a) At the end of the experience in the learning environment perceptions of students - in the experimental condition - about the learning environment reflect higher ratings for learning environment characteristics that promote the RTEP (learning to speak out, learning to learn and learning to communicate) as compared to students in the control condition.
   b) At the end of the experience in the experimental learning environment student teachers' instructional preferences will be more in favour of RTEP (collaboration, planning, course that is not assessment targeted, application of knowledge, independence and reflection and authentic tasks), as compared to students in the control condition.
4. Specific student teachers perceptions predict higher levels of cognitive processing.
   a) The student teachers perceptions of the learning environment, such as promoting learning to learn, learning to speak out and learning to communicate predict higher levels of cognitive processing.
   b) Instructional preferences, such as collaboration, planning, course that is not assessment targeted, application of knowledge, independence and reflection and authentic tasks predict higher levels of cognitive processing.
5. Levels of interaction predict higher levels of cognitive processing.

Research design

A quasi-experimental study was set up, involving student teachers of six different teacher education colleges in Uganda. Teacher training colleges of the following districts were involved in the study: Bushenyi, Kampala, Masaka Tororo and Soroti. All student teachers were in 2nd year. Test administration – prior and after the experimental treatment period – helped to determine and identify student teacher perceptions. In addition, analysis of the group work (4 discussions) helped to determine the level of interaction and the level of cognitive processing.

Research Sample

In this study equal numbers of students were assigned at random to either the experimental (*N* =72) or control condition (*N* =72). In each condition, the six groups consisted of 12 students. Each group in the experimental condition brought together students from the six different teacher education colleges (2 x 6=12 students). Control groups consisted of 12 students studying at the same institute. In both cases all participants mastered basic ICT skills.

Research instruments

Research instruments were used from previous and/or comparable studies. Student teacher perceptions of the learning environment were identified by using the Constructivist Learning Environments Survey (CLES) of Aldridge, Fraser, Taylor, and Chen (2000). The CLES measures perceptions of the learning environment along 5 scales, each building on five items. The scales reflect perceptions of the learning environment as (1) promoting learning about the world, (2) learning science, (3) learning to learn, (4) learning to speak out and (5) learning to communicate. In the context of the present study that builds on a course about "Foundations of education", only the last three scales were considered to be relevant. Instructional preferences were measured with the 12 item Instructional Preferences Instrument (IPI) of Schellens (2004). The instrument distinguishes between 6 preferences: (1) collaboration, (2) planning, (3) preferences for courses that are not assessment targeted, (4) application of

knowledge, (5) fostering independence and reflection and (6) building on authentic task.

The student teacher discussions were analyzed by applying three different instruments. The instrument of Henri (1992) was applied to classify the messages as task or non task related. Second, the instrument of McKenzie and Murphy (2000) was applied to classify the non task messages into either technical, social or administrative. Thirdly, the interaction analysis model of Gunawardena, Lowe, and Anderson (1997) was used to determine the levels of cognitive processing. The model studies the process of knowledge construction along five levels.

- Level 1. Sharing and/or comparing of information; e.g.,: "*The following are the indicators of child centered methods: When the teacher allows learners to take active participation in the learning environment, if learners can form their own discussions with the teachers guidance other than active participation in teaching/learning environment, when learners can do experiments".*
- Level 2. The discovery and exploration of dissonance or inconsistency in ideas, concepts and statements; e.g.,: *"Since government is the source of instruction materials which facilitate child centered methods of teaching; How can it improve on the services provided to primary schools?"*
- Level 3. Negotiation of meaning and/or co-construction of knowledge; e.g.,: *"During the teaching learning process using the child centered methods, pupils are expected to do the following; Pupils will have to discover knowledge as they play with the variety of instructional materials provided by the teacher. They role-play by acting specific roles directed by the teacher. For instance roles of the Mother, father, nurse among others. Participating in the discussion groups where each pupil is expected to be actively involved. They should also participate in instructional games in order to build up competencies to be later developed into practical skills. Participating in drama and debates to develop confidence in life."*
- Level 4. Testing and modification of proposed synthesis or construction; e.g.,: *"Child centered methods are basically methods that put the child at the center of the teaching/learning process. In these methods the needs of learners should determine what is learnt at school, children should learn skills and activities within their stage of mental development, also incentives and rewards should be used to motivate learners, finally, the methods used should be of learners interest…… All in all the child centered methods emphasize putting the child at the center of the learning process and the teacher here acts as a model of all the*

activities. The best way to evaluate in the child centered methods is by examining conclusions made and arrived at in relation to the stated objectives".

- Level 5. Agreement statement(s)/application of newly-constructed meaning; e.g.,: Activity 2 "*For a teacher to be well acquainted with child centered teaching methods, teacher training colleges should endeavor to encourage micro teaching in student teachers so that they develop specific skills in questioning, use of instructional materials which they shall be expected to pass on to their learners in the primary school when they qualify. Also encouraging peer teaching which involves a peer communicating a specific skill already mastered. Organizing team teaching where teachers share their responsibilities".*

Research procedure

Consent to participate in the experiment was guaranteed at the level of administration and at individual student teacher level. The treatment period was preceded by a hands-on orientation session for both the control and experimental student teachers. Students in the experimental condition were provided with the URL of the learning environment http://users.ugent.be/~mvalcke/teaching/index.htm, usernames and passwords to access the discussion forum of their respective groups, two diskettes to be used as an electronic logbook, a hard copy of the activities and learning resources, and a user guide explaining key functionalities of the learning environment. The computer lab was provided with extra printing paper and printer cartridges. The student teachers in the control conditions were given a hardcopy of the activities, the learning resources, an audiorecorder, batteries, pen and papers.

Prior to embarking on the course, student teachers filled out the research instruments about student perceptions. In doing so, they were asked to build on the experiences from their regular classroom activities. Students of both the experimental and control group studied the same learning materials about "Foundations of education". Students in the experimental condition were also involved in electronic asynchronous discussion groups, supported. These students could also consult and study additional online materials. The learning environment also provided them with information about this research study, the staff involved, the learning resources, introductions to the discussion activities, and most importantly access to

the electronic asynchronous discussion environment. In view of these discussions, roles were assigned to some students. During each discussion, the following roles were assigned randomly to a student: chairperson or summarizer. To support role assignment, the website included additional information for these students that helped to direct their work. The chairperson for example was given the following roles:

- Breaking the ice with a motivating yet activity related post.
- Leading the selection of and consensus on the most relevant guidelines to use in building or refuting a relationship between the hot air balloon and the different experiments, and for constructing knowledge on application of the different properties of air demonstrated by the experiments in real life situations.
- Moderating the groups' responses using the relevant guidelines agreed upon.
- Facilitating seeking more clarification on responses raised for example by challenging group mates to react to one another's post.
- Rephrasing any question not responded to.
- Time keeper for the session.
- Closing the session.

On the other hand the summariser was given the following roles:

- Read through the print out of the discussion of the first session of this activity
- Relate responses and reactions posted to the relevant guidelines for building or refuting a relationship between the hot air balloon and the different experiments. And to the guidelines for constructing knowledge regarding the application of the different properties of air demonstrated by the experiments in real life situations.
- Make sure that responses to the relevant guidelines drawing support from evidence from others, prior knowledge, experience, literature or evidence from research.
- Evaluate the accuracy of others' responses using prior knowledge, experience, literature or from research.
- List the best responses to relevant guidelines for building or refuting a relationship between the hot air balloon and the different experiments. And guidelines for constructing knowledge regarding the application of

the different properties of air demonstrated by the experiments in real life situations.

- Send the list both by mail to all students and to the activity discussion forum of your group.

The experimental condition experienced RTEP tenets as highlighted in Table 1

Table 1.

Elaboration of RTEP in the experimental condition

Tenet	Provision in the learning environment

Starting from concrete practical problems and the concerns as experienced by (student) teachers in realistic contexts.	- Authentic tasks e.g. identification of suitable teaching methods in a large classroom in light of universal primary education (UPE), Investigating and child centred teaching and doing a project on teaching techniques and skills.
	- Guidelines to reflection on student teachers' experience in the brainstorming session e.g.
	  - Refer to your experience and that of others in a UPE classroom to elaborate the suitability of teaching methods.
	  - Be concrete. Give examples, refer to existing practices, sources, references, etc. Add arguments to your input. Do not forget to do this. This is central to obtain a good discussion.

Promotion of systematic reflection of (student) teachers on their practices and experiences, on the role of the context, and on the relationships between these aspects.	- Guidelines for reflection
	  - Read through all the ideas generated during brainstorming.
	  - Pick on at least two ideas you do not fully agree with and indicate why not with a reason. Then suggest how best you can improve the ideas with real life examples.
	  - Select two recommendations that you consider key and illustrate how they can be implemented using your experience.

Tenet	Provision in the learning environment

	- Checklist for self and peer evaluation e.g.
	  - I made a record note of what I understood was required of me and my group.
	  - My group mates presented original ideas without duplicating other peoples'.
	- Phased asynchronous discussions – brainstorming and summarising phase.
	- Flexible time for each activity – two weeks
	- Logbook

Personal interaction between the teacher educator and the (student) teacher and on the interaction among the (student) teachers.	- ICT supported learning environment - Electronic discussion groups - Chatroom - Provision for moderation
Three levels of professional learning (*Gestalt, schema and theory)*	- Emphasis on knowledge construction from multiple perspectives - Role assignment in the activities - Structure of the tasks (brainstorming, summarising)
Integration of theory and practice	- Authentic tasks involving students putting themselves into the perspective of teaching. - Links to learning resources

Students in the control condition worked in a traditional face-to-face learning environment. They were invited to plan their group meetings in order to discuss in a comparable way the activities. Their group discussions were audio taped for future analysis purposes. The number of recordings indicates that they met at least once a week to discuss and finalise the activities.

At the end of the study both groups filled out again the study instruments; this time building on the experiences in the control or experimental

condition. Afterwards, the student teachers were given a certificate of attendance.

Coding of the discussion transcripts

The transcripts of the second and fourth discussions were used for analysis purposes to study changes over time. In the control condition, the analysis was based on the audio recordings. In the experimental condition, a printout of the discussion threads was used for analysis purposes. The complete message was chosen as the unit of analysis. Two coders were trained in the use of the instrument and analyzed the transcripts of the first discussion for training purposes. Each message was first documented by identifying the data source (student, group and college). After determining the task or non-task related nature of the message, the schema of Gunawardena at al., (1997) was used to determine the levels of cognitive processing. Interrater reliability was calculated by comparing the coding of 20% of the messages (De Wever et al., 2006). Cronbach's alpha consistently exceeded 0.82

Statistical analysis

All instruments adopted in the study proved to result in reliable measures (Cronbach's alpha). The CLES instruction and the Instructional Preferences Instrument (IPI) reflect an alpha of .90.

In view of testing the different hypothesis different statistical techniques were applied.

1. Differences in levels of interaction and levels of cognitive processing between control and experimental group were tested by applying nonparametric tests (Mann-Whitney U test) because the homogeneity of variance was violated.
2. To establish the differential impact of the control and experimental learning environment on student teachers perception, analysis of covariance (ANCOVA) was applied. In cases of violation of statistical assumptions, Mann-Whitney U test was used.
3. To test the predictive value of student perceptions or level of interaction on levels of cognitive processing, linear regression

techniques were used. Only student perceptions that proved to change in a significant way will be included in the regression analyses.

4. Given the small sample size, effect size were calculated using Cohen's *d* to estimate the magnitude of the impact or difference (Kramer and Rosenthal, 1999).
5. In reporting the results p => .05 is significant and p < .05> .1 is reported as meaningful.

Results

Table 2 summarizes the descriptive statistics by presenting means, and standard deviations that were calculated for each subscale in each main scale. A distinction between experimental and control group, prior and post experiment was respected.

Analysis results are presented according to the different hypotheses.

Table 2.

Descriptive data of the experimental and control group, prior (1) and post (2) to the experimental treatment

Type of group	Experimental			Control			Total			
	M	*n*	*SD*	*M*	*n*	*SD*	*M*	*n*	*SD*	*ES*
Mean [a] LCP Activity 2	1.7	17	0.87	1.29	22	0.24	1.47	39	0.63	0.7
Mean [a] LCP Activity 4	1.3	36	0.42	1.13	28	0.20	1.24	64	0.35	0.5
Number of messages in activity 2	3	57	1.8	2	105	2.7	3	162	3.8	0.3
Number of messages in activity 4	7	288	4.5	4	118	2.7	6	406	2.3	1.3
Perceptions of the learning environment										
Learning to speak out 1	3.52	36	1.08	2.91	21	1.33	3.30	57	1.20	0.5
Learning to learn 1	3.96	36	0.80	3.86	21	1.09	3.92	57	0.91	0.1
learn to communicate 1	3.98	36	1.19	4.30	21	0.82	4.10	57	1.07	-0.3

Table 2 (continued)

Learning to speak out 2	3.66	20	1.23	3.18	13	1.25	3.47	33	1.24	0.4
Learning to learn 2	3.85	20	0.83	4.08	13	0.78	3.94	33	0.81	-0.3
Learn to communicate 2	3.95	20	1.03	4.25	13	0.84	4.07	33	0.95	-0.3
Instructional preferences										
Collaboration 1	4.50	31	0.82	4.65	20	0.61	4.56	51	0.74	-0.2
Planning 1	4.17	31	0.68	4.34	20	0.59	4.24	51	0.64	-0.3
Assessment 1	4.15	31	1.01	4.28	20	0.75	4.20	51	0.91	-0.1
Application 1	4.29	31	0.90	4.50	20	0.83	4.37	51	0.87	-0.2
Independence 1	4.26	31	0.77	3.85	20	1.18	4.10	51	0.96	0.4
Authentic task 1	4.19	31	0.98	4.40	20	0.94	4.27	51	0.96	-0.2
Collaboration 2	4.59	16	0.58	4.23	11	1.21	4.44	27	0.89	0.4
Planning 2	4.14	16	0.82	3.73	11	0.99	3.97	27	0.90	0.5
Assessment 2	4.34	16	0.75	3.86	11	1.05	4.15	27	0.90	0.5
Application 2	4.44	16	0.81	3.73	11	1.10	4.15	27	0.99	0.7
Independence 2	4.38	16	1.02	3.64	11	1.43	4.07	27	1.24	0.6
Authentic task 2	4.19	16	1.22	3.91	11	1.30	4.07	27	1.24	0.2

[a] LCP refers to Levels of Cognitive Processing

n refers to different number characteristics depending on the row – for LCP it refers to number of students that contributed task oriented posts, for messages it refers to number of messages and for perceptions and instructional preferences it refers to number of students.

M refers to the mean in relation to the respective *n* and not the total number of students.

The *Total* column refers to the sum of *n* values in experimental and control conditions.

Test administration was marred by a number of technical difficulties (e.g., electricity breakdowns, sudden changes in student time tables). This explains the varying values of *n* in the table.

Results

Hypothesis 1. Discussions of the student teachers in an RTEP-oriented learning environment invoke higher levels of interaction (number of messages) as compared to the control group.

Considering the number of messages shown in Table 2, students in the experimental submitted more messages as compared to students in the control condition; and this in both activities. The Man-Whitney U test results reflect significant differences between the experimental and the control group in activity 4 ($U = 2186.5$, $n = 17$, $n_2 = 22$, $p < .05$, 1 tailed).

Discussions in the RTEP-oriented learning environment reflect significantly higher levels of interaction as compared to the control group. Students in the experimental group contributed significantly more messages as compared to students in the control group.

Hypothesis 2. Discussions of the student teachers in the RTEP-oriented learning environment reflect higher levels of cognitive processing as compared to students in the control group.

Table 3 gives a distribution of messages in the different levels of cognitive processing as observed in the two activities in each condition.

Table 3.

Number and percentage of messages at each level in each group

	Experimental				Control			
	Activity 2		Activity 4		Activity 2		Activity 4	
Level	*N*	%	*N*	%	*N*	%	*N*	%
1	33	57.5	175	77	74	70	104	88
2	10	17.5	26	11	29	28	13	11
3	12	21	25	11	1	1	1	1
4	1	2	0	0	1	1	0	0
5	1	2	2	1	0	0	0	0
Total	57	100	228	100	105	100	118	100

The majority of the messages were classified as level one or level two in the control group. In the experimental group, the cognitive processing levels varied from level one to three. The data in Table 3 suggests that the experimental group achieved a higher mean level of cognitive processing as compared to the control group in both activities. Given the skewed distribution, a nonparametric test was used to test significance of this difference. Mann-Whitney U tests revealed only a marginal significant difference in activity 4 (U = 399.00, n = 36, n_2 = 28, p = .06, 1 tailed).

Hypothesis 3. The experience of experimental student teachers in the RTEP-oriented learning environment results in significant changes in student perceptions.

We anticipated that student teachers in the RTEP-oriented learning environment would perceive their learning environment as promoting tenets of RTEP at the end of the experiment and this in contrast to the students in the control condition.

a) At the end of the experience in the learning environment perceptions of students - in the experimental condition - about the learning environment reflect higher ratings for learning environment characteristics that promote the RTEP (learning to speak out, learning to learn and learning to communicate) as compared to students in the control condition.

- Student teachers in the experimental condition will perceive the learning environment as promoting to a higher extent "*learning to speak out*" as compared to students in the control condition.

The data of the experimental group reflected higher means in "learning to speak out" as compared to the control group, both prior and post to the experiment. Analysis of covariance (ANCOVA) was applied to consider pre-test difference. A significant between-subject effect was observed ($F_{(2,19)}$ = 8.392, p < .05), with a medium effect size d = .4 (Cohen, 1988).

- Student teachers in the experimental condition will perceive the learning environment as promoting to a higher extent "*learning to learn*" as compared to students in the control condition.

Considering the fact that unequal variance were observed, a non parametric test was used to test this hypothesis. The experimental group reported higher means than the control group prior to the experiment. Post to the experiment, the reverse was true. Test of the differences with Mann Whitney U test, reveals non-significant differences (U = 109, n = 20, n_2 = 13, p = .23, 1 tailed).

- Student teachers in the experimental condition will perceive the learning environment as promoting to a higher extent "*learning to communicate*" as compared to students in the control condition.

Considering the fact that unequal variance were observed, a non parametric tests was used to test this hypothesis. Again, the experimental group reported higher means than the control group prior to the experiment. Post to the experiment, the reverse was true. Tests of the differences between the experimental and control group with Mann-Whitney U test, result in non-significant differences (U = 106, n = 20, n_2 = 13, p = .19, 1 tailed).

In summary we have to conclude that the students in the RTEP-oriented learning environment only significantly changed in their learning environment perceptions when we consider the characteristics "promoting learning to speak out", as compared to students in the control condition. There was no significant change their other perceptions: learning to learn or learning to communicate.

b) *At the end of the experience in the experimental learning environment student teachers' instructional preferences will be more in favour of RTEP (collaboration, planning, course that is not assessment targeted, application of knowledge, independence and reflection and authentic tasks), as compared to students in the control condition.*

Given that some of the instructional preferences violated the homogeneity of variance Mann – Whitney test was used to test the difference between control and experimental at the end. Table 4 summarizes the results of the six different Mann -Whitney U tests.

Table 4.

Mann - Whitney U test of differences in instructional preferences of students in the experimental and control condition at the end of the study

	Mann-Whitney U	*n* – experimental	n_2 - Control	*p* (1-tailed)
Collaboration	79.5	16	11	0.37
Planning	63.5	16	11	0.11
Assessment	62.5	16	11	0.05
Application	49	16	11	0.03
Independence	56.5	16	11	0.05
Authentic tasks	73	16	11	0.21

Considering the means at the beginning and the end in Table 2, the control group had higher means than the experimental group in nearly all the instructional preferences apart from preference of independence and reflection. At the end of the experiment, the experimental group had higher means than the control group in all the preferences. The differences at the end were tested by Mann-Whitney U and we can conclude that, the RTEP-oriented learning environment had a significant differential impact on two out of six instructional preferences: (1) course that is not assessment targeted and (2) application of knowledge. Medium effect sizes are observed.

Hypothesis 4. Specific student teachers perceptions predict higher levels of cognitive processing.

To determine whether student perceptions help to predict levels of cognitive processing a linear and binary logistic regression was calculated only including three perceptions that changed in a significant way at the end of the experiment (see results hypothesis 3): (1) learning to speak out, (2) Course that is not assessment targeted and (3) application of knowledge.

The model of/and the individual predictors (perceptions of students) did not significantly predict levels of cognitive processing.

Hypothesis 5. Levels of interaction predict higher levels of cognitive processing.

Binary regression analysis was used to establish if interaction predicts levels of cognitive processing. A total of 64 cases (number of students that sent content related messages) were analysed and the full model was significantly reliable (Chi-square = 5.694, $df = 1$, $p = 0.02$). This model accounted for between 8.5% to 11.4% of the variance of level of cognitive processing, with 85.3% of low level of cognitive processing and 33.3% of high level of cognitive processing successfully predicted. Overall 60.9% of predictions were accurate. The values of coefficients reveal that an increase in interaction by 1 is associated by an increase in levels of cognitive processing by a factor of 1.179.

Discussion

The present study was set up to demonstrate and evaluate the implementation of an RTEP-oriented learning environment in the context of distance teacher education in Uganda. The learning environment implied the integrated use of information and communication technologies was expected to foster student teachers levels of interaction levels of cognitive processing and their perceptions. The perceptions and performance of students in the RTEP-oriented learning environment were compared with those of students in a traditional face-to-face learning environment.

The study was set up as a replication of the pilot study and tried to meet some of its limitations: synchronous collaboration, a too small sample size, a too short activity-time ratio, too small groups, and a weak role assignment. The results are discussed in relation to the different hypotheses.

Hypothesis 1. Discussions of the student teachers in an RTEP-oriented learning environment invoke higher levels of interaction (number of messages) as compared to the control group.

Discussions in the ICT-based learning environment reflected a slightly but significantly higher levels of interaction than in the control group on the occasion of the last discussion group activity. This is a more positive outcome when comparing the present study with the pilot. The results are also in line with one of the only available comparable studies in the context of African developing countries Alant and Dada (2005) and also the study of Dougiamas (1998) . We attribute the more positive outcomes to the better implementation of the RTEP-characteristics in the present experimental learning environment. The realistic teacher education pedagogy might have given the student teachers extra opportunities for reflection, collaboration and interaction (Korthagen, 2001). Also the availability of and access to additional resources might have stimulated access to new information for students to ground their discussions.

Hypothesis 2. Discussions of the student teachers in the RTEP-oriented learning environment reflect higher levels of cognitive processing as compared to students in the control group.

The process of constructing a personal perspective or understanding in the context of collaboration is considered as a key variable to foster knowledge construction (Bednar et al., 1992). As hypothesised, the experimental group reached a slightly higher level of cognitive processing in the last discussion, as compared to the control group. This is in line with the findings of comparable studies that could conclude that participation of students in asynchronous online discussions increased the levels of cognitive processing (Meyer, 2004; Pena-Shaff et al., 2004; Soraya et al., 2004; Yakimovicz and Murphy, 1995). In a number of studies the learning environment is even reported to promote very high levels of cognitive processing (Benbunan-Fich, Hiltz, and Turoff, 2003; Beyth-Marom et al., 2003; Fisher and Churach, 1998; Swan, 2001). In the experimental condition, student contributions reflected up to three levels of cognitive processing; in the control students contributions were limited to the first

two levels of cognitive processing. But, other studies also reported rather low levels of cognitive processing (De Wever et al., 2003; Gunawardena et al., 1997; Mcloughlin and Luca, 1999; Schellens and Valcke, 2005).

The higher level of interaction (hypothesis 1) and a larger variety of messages is attributed to the RTEP characteristics of the ICT-based learning environment. In the experimental condition the students could spread their discussion contributions during the discussions over a week; thus giving students more time to reflect on their own messages and the contributions of classmates. This is considered to stimulate delayed reactions and to move to a higher level of negotiation of meaning or co-construction of knowledge (Dougiamas, 1998). The fact that students worked on authentic activities with real world relevancy and utility is also considered by Jonassen (1992) to promote higher levels of cognitive processing. The student activities were related to responsibilities as future teachers and this could have made the students more emotionally involved thus in the activities, thus invoking also a more constructive participation (Moje and Wade, 1997).

The higher level of knowledge construction can also be attributed to the more active collaboration (Jonassen, 1992). Other authors point at the nature of the ICT-based learning environment to explain the higher levels of cognitive processing (Meyer, 2004; Pena-Shaff et al., 2004; Soraya et al., 2004; Yakimovicz et al., 1995).

We stressed that more attention was paid to the implementation of roles to direct student participation. The provision of roles is considered as a motivating variable to induce active participation (see e.g., Schellens and Valcke, 2004). Other authors consider roles as a way to provide more structure to students. This is expected to promote consequently cognitive processing (see e.g., Aviv et al., (2003) or De Wever et al., 2003). Nevertheless, we could also observe that the mean level of cognitive processing remained rather low. The number of level 3 messages was still limited. This was also observed by other researchers (De Wever et al., 2003; Gunawardena et al., 1997; Mcloughlin et al., 1999; Schellens et al., 2005). The fact that level 4 and 5 messages have hardly been observed, was also commented upon by these authors. They refer to the introductory nature

of the course, the lack of discussion expertise of the students and the necessity of contributing large numbers of level one and two contributions, before higher levels can be reached. In line with these authors, we expect that the benefits from studying in the RTEP-oriented learning environment will depend on increasing levels of interaction, adding additional structure, and by making the activities more personally relevant to the learners.

Hypothesis 3. The experience of experimental student teachers in the RTEP-oriented learning environment results in significant changes in their perceptions.

The RTEP-oriented learning environment hardly had any differential impact on student teacher perception about the learning environment. These students perceived their environment slightly more as promoting to learn to speak out. This is comparable to what was reported in other studies in view of the impact on student teacher perceptions (Arbaugh, 2004; Lee and Fraser, 2001; Schonwetter et al., 2002; Yazon et al., 2002; Young, 2003). We attribute this result to specific RTEP characteristics of the learning environment. These include the provision of collaboration opportunities, the sharing of experiences during the brainstorming session, the provision of reflection time where, the explicit fostering of self and peer assessment.

But, the experience in an ICT-based learning environment did not significantly change student teacher perception of their learning environment as promoting learning to learn or learning to communicate. The less positive results can be related to the comparable results from the pilot study. Again, we can attribute the limited changes in perceptions to the already high mean perceptions prior to the experiment (> 3.5/5). Even after an 8 week intervention period, it is difficult to determine significant changes, due to a ceiling effect. Qualitative research might help to get a better understanding of the affordances of the learning environment in view of the expected changes.

At the end of the experience a significant difference between the control and experimental groups in specific instructional preferences was observed: (1) Course that is not assessment targeted and (2) application of knowledge. These are key elements that have been promoted by the RTEP

characteristics of the learning environment. The fact that no significant differences were observed in relation to the other instructional preferences can be interpreted in the light of the already high preferences prior to the experiment. Already at the start, the students –both in the control and experimental condition – already preferred RTEP related instructional elements in the learning environment.

Hypothesis 4. Specific student teachers perceptions predict higher levels of cognitive processing.

Perceptions of the learning environment and instructional preferences did not predict levels of cognitive processing. This is in contrast with multiple authors (Esthel et al., 2003; Fraser, 1994; Picciano, 2002; Swan, 2001; Telli et al., 2003) that have attributed student perceptions to levels of cognitive processing or performance or grades. The results of the whole study should be taken into perspective of some limitations beyond our control.

Future research in this area could benefit from ensuring more explicit moderation, a good response rate, a bigger sample, more time for the course and making use of both qualitative and quantitative instruments to collect data on student teachers' perceptions.

Hypothesis 5. Levels of interaction predict higher levels of cognitive processing.

Interaction predicted levels of cognitive processing. No wonder the experimental group had higher interaction levels and also higher levels of cognitive processing compared to the control condition. Interaction predicts levels of cognitive processing because it involves information sharing, negotiation of meaning and supplementing others views. A number of authors acknowledge the impact of interaction on learning outcomes like assimilation of course content, test performance, grades (Alonso and Norman, 1996; Biesenbach-Lucas, 2003; Clark, 2001; Makitalo, Hakkinen, Leinonen, and Jarvela, 2002; Picciano, 2002; Roblyer and Ekhaml, 2000; Swan, 2001). We also attribute the impact of interaction on levels of cognitive processing to the predominately task oriented messages. Other authors Schellens and Valcke M (2005) allude to

discussion being predominately very task oriented and reflecting higher phases in knowledge construction.

Given that interaction predicts levels of cognitive processing, future studies could endeavour to promote it for example through introducing explicit moderation of the discussions, to discuss during a longer period of time and to include a sufficiently large sample. To gain more understanding of how interaction can be promoted, future studies could consider exploring the factors that promote interaction in an ICT-based learning environment preferably both qualitatively and quantitatively.

Although the present study reflects some design characteristics that helped to counter limitations of the pilot study, the research design also reflects some weaknesses that are relevant in the context of the present discussion. Interpretation of the results should take into consideration some critical issues that could have marred the research results. First of all, at the start of the study, participation of students in the pre and post-testing was negatively affected by some technical problems and inconsistent scheduling of educational activities. The number of computers in some computer classes was limited. Student teachers had to share the facilities with other students and staff members. Despite the effort made to involve a larger group of students in the study, the number *(N = 144)* was still too limited to reflect normal distributions in the data; thus forcing the analysis to be based on non parametric tests.

Although the study lasted for eight weeks, this can still be considered rather short to be able to observe changes in student teacher perceptions that are known to be rather persistent to change. Though we cut back on the number of activities, to give student more time to concentrate on activities, this period of time might still have been too short to give them a sufficient large communication base to move beyond the third level of cognitive processing.

In the pilot study, next to quantitative data, also qualitative data had been gathered. This was not the case in the present study. It is therefore recommended that a future study will comprise a qualitative section to be

able to corroborate the findings and or to present additional information to direct the discussion and interpretation of the research results.

From a theoretical perspective, a future study should also focus on additional dependent variables to be able to answer the more general research question about the evaluation of the efficacy, efficiency and improving instructional approaches about the RTEP-oriented learning environment in the Uganda distance education setting.

Conclusions

The experience in the RTEP-oriented learning environment helped students to reach a significant but modest higher level of interaction and a modest increase in the level of cognitive processing. The learning environment influenced student teacher perceptions only to a limited extent. The changes observed, are in line with the hypothesis that students will adopt perceptions that are more in line with the RTEP environment: an environment that fosters learning to speak out, courses that are not assessment targeted and application of knowledge.

But additional research will be needed to get a better understanding of the results of this study. A qualitative focus is needed. In addition, next to the dependent variables focused upon in this study, the RTEP-oriented learning environment might have affected other dependent variables that might be relevant to consider in a future study.

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4

The impact of an innovative learning environment on student teachers' interaction, levels of cognitive processing, perceptions and perceived flexibility in distance education.

The impact of an innovative learning environment on student teachers' interaction, levels of cognitive processing, perceptions and perceived flexibility in distance education.

Abstract

This chapter summarizes the results of a study on the impact of a learning environment that fosters the adoption of a realistic teacher education pedagogy (RTEP) in distance education on student teachers' interaction, levels of cognitive processing, perceptions and perceived flexibility of distance teacher education. The impact on perceived flexibility was explored in a qualitative way. Other dependent variables were explored both qualitatively and quantitatively. Student teachers' (*N=144*) from three teacher education colleges in Uganda studied in an RTEP-oriented learning environment for 9 weeks in the first term of 2005. At content level, students studied three themes for the Science with Health curriculum. Results point at the differential impact of different levels of moderation support on student interaction. Student interaction seemed to be promoted by characteristics in the individual student, group characteristics, the nature of the learning environment and the available learning resources. The experience in the RTEP-oriented learning environment influenced student teacher perceptions of the learning environment and their preference to adopt a realistic teacher education pedagogy in their instruction. The experience in the learning environment was perceived as promoting flexibility in time, study location, mode of study, study materials, communication and interaction.

Introduction

In a state-of-the-art about distance teacher education approaches in Uganda, as reported in chapter 2, it was concluded that current approaches were built to a too limited extent on interaction with or between students and that most contact with other students and/or instructors is limited to a number of face to face sessions. The study also pointed at the limited flexibility in study location, communication, mode of study, time and study materials of current distance teacher education. The present study focuses on researching whether the implementation of an innovative learning

environment is able to prop up the perceived flexibility of distance teacher education. The innovative arrangement represents the implementation of ICT-based tools that students can use at any time and anywhere and allow them to communicate asynchronously with each other and to study a range of alternative electronic learning environments.

The design of the ICT-based learning environment reflects a number of key characteristics of a realistic teacher education approach. A central characteristic of this approach is the promotion of the close interaction between the teacher educator and the (student) teacher and the interaction among (student) teachers (Korthagen, 2001). The key characteristics of the design can be summarized as follows:

- The environment presents concrete practical problems and builds on personal experiences of (student) teachers.
- The environment promotes systematic reflection on their practices and experiences, on the role of the context, and on the relationships between these aspects.
- The environment promotes – as stated above – close interaction between the teacher educator and the (student) teacher and between (student) teachers.
- The learning approach considers the *Gestalt* level, the *schema* level and, the *theory* level when developing knowledge. This implies that knowledge is based on an experiential base and developed through personal reflection on concrete experiences.
- The environment fosters the integration of theory and practice.

A central design feature of the learning environment is the integrated use of asynchronous discussion groups. All students and the tutors in this study collaborate in this ICT-based environment.

The present study builds on the results of a former evaluative study. The results of the earlier study point at a number of critical issues. The results revealed to a better extent a basic impact of the RTEP oriented learning environment on both student interaction levels and the levels of cognitive processing. The study pointed to the importance of ensuring a sufficient level of student interaction in view of fostering the attainment of these higher levels of cognitive processing. In view of future studies, it was

suggested to foresee more explicit moderation of the discussions, to discuss during a longer period of time, to include a sufficiently large sample, and to adopt both a qualitative and quantitative research design to study the impact on the dependent variables. The present study takes into consideration these suggestions.

In the present study, the discussion period is longer and lasts up to three weeks for each activity. To promote student interaction, structured moderation has been implemented. In his review of electronic moderation models and approaches, Wallace (2002) concluded that on-line support is a strategy with great potential to realize the benefits of integrated internet use in the context of teaching and learning. The present moderation approach is based on the model of Salmon (2000) and consists of five different steps in the moderation: (1) promoting access and motivation; (2) fostering online socialisation: (3) invoking information exchange; (4) enticing knowledge construction and (5) encouraging knowledge development through assisting students to monitor and evaluate themselves, in other words by inviting student to reflect on their experiences. The sample of the students involved in the present study is taken from three colleges instead of 6 to maximise supervision. Both qualitative and quantitative data collection methods have been installed.

At a general level, the present study aimed to answer the following research problem: to what extent does the RTEP-oriented learning environment influence (1) the perceived flexibility of distance teacher education, (2) student perceptions and (3) the efficacy of distance teacher education as reflected in learning outcomes that reflect higher levels of cognitive processing.

Theoretical framework

Figure 1 presents the conceptual framework of the present study. The figure also positions the hypotheses – discussed later in this article – that build on this theoretical base.

The RTEP oriented learning environment is presented as the central independent variable. In addition levels of moderation are being manipulated to influence a number of dependent variables: level of interaction and level of cognitive processing. Levels of interaction are presented as both a dependent and a moderating variable in view of attaining higher levels of cognitive processing. The study also focuses on perceptions of students and the perceived flexibility of the distance teacher education setting as dependent variables.

In the next paragraphs, we present the theoretical and empirical base as derived from the literature. Next we present the research design, a discussion of the results and we conclude by pointing at some limitations and, implications of the present study.

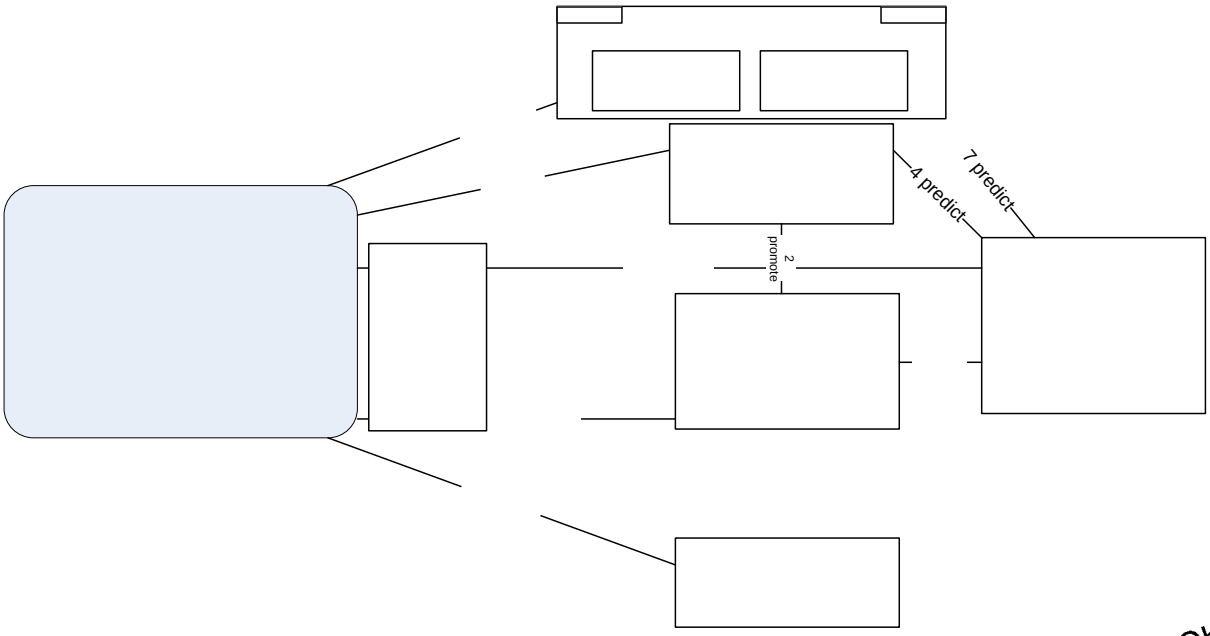

Figure 1. The impact of the RTEP-oriented learning environment and levels of moderation on a variety of dependent variables.

There is empirical evidence that Information and Communication Technologies (ICT) foster exchanges between students and instructors, and between students in a classroom (Barak, in press; Passerini and Granger, 2000). A collaborative environment involves continuous interactions among two sets of agents (instructors and students) and two sets of objects (course materials and course products) (Norman, 1998). The RTEP-oriented learning environment is expected to foster in this way the active involvement of students, student collaboration and interaction, interaction of students with the instructor and interaction with alternative learning resources. Each of the tenets in the ICT based learning environment is expected to influence student interaction.

Active involvement of students

Successful learning in a discursive interaction environment requires participants to adopt a high level of motivation and to be able to be involved in the interaction from the start till the end (Rovai, 2004; Schrum and Hong, 2002). In an ICT based learning environment interaction is promoted by a number of features: anonymity, no domination of particular student, continuous questioning, and the possibility of role adoption. Students report the advantage of being "anonymous" in the asynchronous discussion groups, thus allowing more easily to ask questions to the instructor (Vonderwell, 2003). Online discussions have clearly been found to encourage all students to participate without a direct domination from particular students (Meyer, 2004). In the study of Makitalo, Hakkinen, Leinonen, and Jarvela (2002) it was stated that continuous questioning invoked deeper level interaction. The nature of the questions in the discussion influenced the sharing of experiences and student reflection in an online learning classroom (Vonderwell, 2003). Also high participation and strong support in the virtual network was attributed to the drive of the group of active student members (Dwyer, 2004). In the study of Rovai (2004), the assignment of roles (encourager, harmoniser, compromise, gatekeeper or stand setter) were useful to facilitate group discussion and to promote a sense of community. In addition, role-taking is said to help to shift the initiative power distribution from the tutor to the students (Aviv et al., 2003).

Active involvement of students in an ICT based learning environment is also influenced by basic student characteristics. For instance, computer skills, perceptions about ICT and level of education influenced whether or not students engaged in group tasks (Seale et al., 2002). Similarly, experience with writing has become of importance in an online setting (Meyer, 2004). Students need to have acquired a basic level of user experience with the tools, experience in solving problems, in checking email and in accomplishing basic tasks with the technology available (Schrum et al., 2002). Successful open learning requires the students to have the ability to work consistently through the learning resources, incorporating self assessment activities over a sustained period (Biesenbach-Lucas, 2003; Ottewill, Fletcher, and Jennings, 1997).

Collaboration

Web based instruction creates a new medium in view of collaboration, conversation, discussion, exchange, and communication of ideas (Dwyer, 2003; Khan, 1997). For instance, students in different locations who wish to meet and discuss can use asynchronous or real time communication tools (Collis, 1998; Khan, 1997). Students are said to learn well when allowed to discuss matters amongst themselves (Hailes and Hazemi, 1998). The delay factor in asynchronous discussions allows for reflection thus fostering learning and interaction in asynchronous communication (Biesenbach-Lucas, 2003; Meyer, 2004; Vonderwell, 2003).

The value of ICT-based collaboration has been described intensively in the literature. Collaboration is expected to be valuable due to the fact that students share information, start to negotiate about meanings and create a sense of community. Asynchronous discussions have been employed for both information sharing and decision making (Berge and Collins, 1995). In discussion groups students create meaning, explore topics, and improve their skills (Biesenbach-Lucas, 2003; Harasim, Hiltz, Teles, and Turoff, 1995; Newlands, Mclean, and Lovie, 1997; Trindade, Carmo, and Bidarra, 2000). In the context of distance education where conversations lack physical proximity, more attempts are made to guarantee that group members understand each other and build on a 'common ground' (de Jong, Kolloffel, van der Meijden, Staarman, and Janssen, 2005). Students contend that in order to establish common ground, it is essential for students to present written feedback to others and, to provide support to their peers in their replies (Makitalo, Hakkinen, Leinonen, and Jarvela, 2002; Rovai, 2004). Learner interaction enhances student experiences through establishing a form of social presence, being part of a large community, and enjoying class in general (Driver, 2002).

In the literature, critical variables have been identified that influence the potential of asynchronous discussion groups; Interaction was e.g., found to be influenced by group size (Caspi, Gorsky, and Chajut, 2003). For example, learner to learner interaction increased as the group size increased (Caspi et al., 2003). In a comparable study, students felt more comfortable

when participating in electronic discussions involving smaller groups of students (Biesenbach-Lucas, 2003). Perceptions of classroom interaction and student satisfaction were positively affected by this small group interaction (Driver, 2002). But too few members in a group also risk generating a limited number of contributions, whereas a too large groups might invoke a sense of being overwhelmed (Rovai, 2004). Adding structure to the collaborative activity also affects collaborative activities (Hall et al., 2004). Biesenbach-Lucas (2003) points e.g. at the impact of rules to guide the interaction: order of posting messages, requirements about the number and length of posts, etc.

Interaction between students and the instructor

An ICT-based learning environment creates opportunities for students to interact with their instructors (Khan, 1997). But teaching online is influenced by the absence of the verbal communication that occurs in face to face (Terry, Rourke, Garrison, and Archer, 2001). Students clearly express the need for a high level of instructor presence (Hong, 2002). This is for instance true when the instructors launches the discussions with initial and follow-up questions (Mazzolini and Maddison, in press). The model of Salmon (2000) described earlier is a more advanced example of a structured interaction between students and instructors, referred to as moderation. The necessity for online instructors to provide feedback to distant learners, is clearly underscored by students, even if the feedback consists of a simple acknowledgement of work received (Rovai, 2004; Vonderwell, 2003). Teacher interventions help learners to feel involved (Rovai, 2004).

The moderation of discussions by an instructor enhances interaction. For example, in the study of King (2002) the moderator was mimicked as one of the students. This proved to make the courses more interesting, more collaborative, and more motivating for the other students. Likewise, instructor contributions – both content-related and non content-related - were found to support the motivational and affective dimension of the learning process (Offir, Barth, Lev, and Shteinbok, 2004; Wu and Hiltz, 2004). Tutor enthusiasm and tutor expertise were found to be the major factors to stimulate student participation in asynchronous discussion

(Oliver and Shaw, 2003). Students who perceived the student instructor contributions in a positive way, felt that their discussion group had performed well during the conferences, evaluated the learning materials in a positive way, demonstrated higher grades and were more satisfied with the course (Hong, 2002). Also reflective thinking has been reported to become facilitated when tutors explicitly state the goals, purpose and expectations of discussion lists (Seale and Cann, 2002). When their online discussion are valued, students learn more and are more satisfied (Fredericksen, Pickett, Shea and Swan, 2004). The explicit grading of the quantity, quality and timeframe of student contributions in discussion groups discourages lurkers (Rovai, 2004). Learners appear to appreciate a larger control of their learning context (Schrum et al., 2002). Basturkmen (2003) added evidence that tutor presence made discussions more solution driven, rather than focused on exchanging ideas. A high correlation was found between students who understood the discussion content and online teacher assistance (Offir et al., 2004).

Interaction with learning resources

Students in a web based instruction have the possibility to interact with extra online resources (Khan, 1997). Also, sharing of resources is possible through the asynchronous nature of the medium (Trindade et al., 2000). An ICT-based learning environment therefore students with more challenging tasks, since next to the presentation of clear objectives, task guidelines, and the assignment of roles, all extra resources can be offered to direct task execution. The following key design characteristics that help to structure tasks were found to be goals, the rules and, rewards (Aviv, Erlich, Ravid, and Geva, 2003). A structured task design is associated with a high degree of cohesion (Aviv et al., 2003). There is empirical evidence that online students collaborate to a lesser extent unless the collaboration is structured (Vonderwell, 2003). Students valued easy access to information on subjects offered on online courses (Helmi, 2002).

The impact of student interaction on levels of cognitive processing

Interaction in the RTEP-oriented learning environment is expected to foster the level of cognitive processing due to a number of reasons. The

acquisition and integration of knowledge on the web is a constructive process in which students engage in knowledge construction rather than its reproduction (Alant and Dada, 2005). A high level of interaction is expected to promote information sharing and the negotiation of meaning. There is a large body of empirical evidence that underpins this assumption. Active involvement in asynchronous discussion groups facilitated e.g., the assimilation of the course content (Biesenbach-Lucas, 2003). Increased student involvement also resulted in increased learning as reflected by test performance, higher grades and higher levels of student satisfaction in the study of Roblyer and Ekhaml (2000). Alonso and Norman (1996) revealed that learning in a learner-controlled context with a high degree of student interaction led to higher marks on a post-lecture quiz and more positive rating on a questionnaire. Other researchers point at the very task oriented nature of intensive discussion that consecutively result in higher levels of knowledge construction (Schellens and Valcke, 2005). Other researchers observed higher mean course grades when students are more visible in discussions (Beaudoin, 2002). Student perception of high social presence demonstrated a strong relationship with performance on written assignments (Picciano, 2002).

Students learn more and enjoy the learning process more when they interact more actively with each other (Clark, 2001). Indeed, students feel that the asynchronous format of discussions supports interactivity and involvement, resulting in higher satisfaction levels and higher learning performance (Makitalo et al., 2002; Swan, 2001). A strong relationship was established between student perceptions of the quality and quantity of their interactions and their perceived performance in an online course (Picciano, 2002).

For extensive information about the theoretical base about the impact of the RTEP-oriented learning environment on student perceptions and the impact of student perceptions on levels of cognitive processing we refer to chapter 3. In the present context, we summarize the main assumptions and empirical findings. A learning environment that builds collaborative learning has been found to promote collaboration, reflection and interaction (Pena-Shaff and Nicholls, 2004; Rafaeli, Barak, Dan-Gur, and Toch, 2004; Selim, 2003; Shaffer, 2002; Soraya, Rahman, and Salim, 2004).

Many researchers put forward evidence about the positive impact student teachers' level of cognitive processing (Aviv, Erlich, Ravid and Geva, 2003; Baker, Quignard, Lund and Sejourne, 2003; De Wever, Valcke, and Van Winckel, 2003; Schellens et al., 2005). The experience in the learning environment also influences perceptions about the learning environment (Arbaugh, 2004; Lee and Fraser, 2001; Schonwetter and Francis, 2002; Yazon, Mayer-Smith, and Redfield, 2002; Young, 2003). It also influences instructional preferences of students (Beyth-Marom, Chajut, Roccas, and Sagiv, 2003; Wen, Tsai, Lin, and Chuang, 2004; Wiske, Sick and Wirsig, 2001; Yazon et al., 2002). The changes in perceptions seem to have a mediating effect on cognitive processing as well (Esthel and Kohavi, 2003; Fraser, 1994; Picciano, 2002; Swan, 2001; Telli, Rakici and Cakiroglu, 2003). The adoption of instructional preferences that are congruent with the characteristics of the learning environment (e.g., preferring collaboration) has been found to promote learning outcomes (Hong, 2002).

The impact of an ICT based learning environment on perceived flexibility of distance teacher education

Collis (2001) identified five types of flexibility that are supported by the integrated use of ICT: flexibility in location, program, types of interaction, forms of communication and time.

Flexibility in location is related to the place where learners carry out the learning activities embedded in the course. As stated by Khan (1997), students can enrol in an online course from any place in the world using any computer platform at anytime of the day. This advantage is stressed by key educational organisations (OECD Proceedings, 1996a; Uys, 1998). Online students applaud e.g., they are able to work at home (Valenta, Therriault and Dieter, 2001).

Flexibility in study program is becoming more and more important in those cases where learners want to put forward previous experiences, or courses can be chosen in line with the learner's needs and interests. Khan (1997) stresses in this context the value of offering students alterative options to take courses.

Flexibility in types of interactions is considered to be important to be able to adapt to preferences of students. Collis (1998) acknowledged that because of the use of ICT, students who missed sessions can review instructors' notes, read or see the instructor explaining particular points (via streaming audio and/video synchronised to text notes), and can review the materials created and posted by the students who present at the sessions. On the other hand flexibility of interaction, according to Khan (1997), promotes student interaction with each other, with instructors, and online resources. The same was reported by Swan (2001) who refers to student comments about the asynchronous nature of the communication that supported interactivity and student involvement. In addition, students who reported higher levels of interaction with the instructor and classmates, also reported higher levels of course satisfaction.

Flexibility in forms of communication within a course enables the learners and instructors to have a wider variety of ways of communicating with each other. Collis (1998) noted that students in different locations who wish to meet and discuss can use real time communication tools via the WWW. In the study of differences between asynchronous interactions and traditional classroom communication, students applaud especially the communication that is afforded through email and bulletin boards (Spiceland and Hawkins, 2002).

Flexibility in study materials ensures that the students have a wider choice of resources and modalities (e.g., multimedia features) to support their study. These alternatives could also include Internet materials, e-mail exchange, videos based, video conferencing, and originating from face-to-face meetings. Information sources can be made immediately available to students via hyperlinks, as additions to local resources that are part of the course (Khan, 1997; Uys, 1998). An online course is stated to address a variety of student learning styles since it incorporates a variety of multimedia elements such as text, graphics, audio, video, animation, etc. (Khan, 1997).

Time flexibility. According to Collis (1998) and Harasim et al., (1995), ICT based learning tools allow students to enter the study environment whenever they have network access or wish to study. The instructor can

similarly prepare and send his comments in line with his/her planning (Collis, 1998). Time flexibility is a central feature of ICT-based distance education (OECD Proceedings, 1996b).

Hypotheses

Based on the theoretical framework presented above, we put forward the following hypotheses:

1) Different levels of moderation will result in different levels of student interaction.
2) Perceptions about the level of implementation of the realistic teacher education pedagogy in the learning environment (active involvement, authentic task, collaboration, interaction with students, interaction with instructors, interaction with resources and reflection) influence the level of interaction.
3) Differences in levels of moderation have an impact on levels of cognitive processing.
4) Perceptions about the level of implementation of the realistic teacher education pedagogy in the learning environment (active involvement, authentic task, collaboration, interaction with students, interaction with instructors, interaction with resources and reflection) influence student teachers' level of cognitive processing.
5) Levels of interaction predict levels of cognitive processing.
6) The study experiences of student teachers in the RTEP-oriented learning environment result in changes in student perceptions.
   (a) The perceptions of students - about the learning environment will reflect higher ratings for learning environment characteristics that promote the Realistic Teacher Education Pedagogy (learning to speak out, learning to learn and learning to communicate) at the end of study.
   (b) Student teachers' instructional preferences will be more in line with RTEP characteristics (collaboration, planning, assessment, application, independence and reflection and authentic tasks) at the end of study.

7) Specific student teachers perceptions predict higher levels of cognitive processing.
   (a) The student teachers perceptions of the learning environment predict levels of cognitive processing.
   (b) Instructional preference of RTEP elements predict levels of cognitive processing.
8) The ICT based learning environment promotes the perceived flexibility of the learning of students.

Research design

Second year student teachers (N = 144) from three different teacher education colleges in Uganda participated in this quasi-experimental research design. All students worked in the same learning environment and participated in asynchronous discussion groups during 9 weeks. During this period of time, the students tackled three activities (each lasting three weeks). The level of moderation was manipulated in the research design. Different groups of students received different levels of moderation. Moderation support of the activities was varied according to the five levels in the moderation model of Salmon's (2000): 1) Access and motivation, 2) Online socialization, 3) Information exchange, 4) Supporting knowledge construction and 5) Development through assisting students to monitor and evaluate themselves. During the three activities all student groups received the first three levels of moderation. During the second and third activity, three different moderation conditions were created. A first group received moderation support up to level three (condition 1). The second group received moderation support up to level four (condition 2) and the third group received support up to the highest level (condition 3).

Care was taken to organize the study in a stable context so that no unforeseen events could interfere with the study. Nevertheless, uncontrolled changes in the planning of school practice and the planning of educational activities of other students interfered to a certain extent with the planning of the study. This has affected the level of student involvement as will be explained later.

Research sample

Student participation in the study was based on a voluntary basis. One hundred and forty four student teachers were divided into 12 groups of 12 students each. Four students of each of the participating colleges were selected at random and allocated to one of the groups. All student teachers mastered basic ICT skills related to word processing, email, chat and the Internet before embarking on the experiment.

Research instruments

The study was based on research instruments that were developed in the previous studies. The following instruments were used to determine student teacher perceptions. Perceptions about the learning environment were explored by using the Constructivist Learning Environments Survey (CLES) of Aldridge, Fraser, Taylor, and Chen (2000). This instrument measure the perceptions along 5 scales; each consisting of five items: perception of the learning environment as promoting learning about the world, learning science, learning to learn, learning to speak out and learning to communicate. Only the last three scales were considered in this study.
Instructional preferences were measured by a 12 item instrument (IPI), consisting of six scales (collaboration, planning, course that is not assessment targeted, application of knowledge, independence and reflection and authentic task); it was developed by (Schellens, 2004). In addition, perceptions about the key characteristics that promote levels of interaction were determined with a newly constructed instrument. The 66 items in the scale reflect characteristics of the RTEP that are considered to promote interaction. Seven subscales can be discerned: active involvement, authentic task, collaboration, interaction with students, interaction with instructors, interaction with resources and reflection.

A second set of research data were derived from the transcripts of the asynchronous discussion groups. Two types of data were generated from these discussion threads: the number of messages per student teacher and the levels of cognitive processing. Student teacher participation in the discussions was measured with the instruments of (Henri, 1992; McKenzie and Murphy, 2000). With the two instruments data was categorised into

task and non task oriented. Further the non task oriented was divided into administrative, technical and social. The interaction analysis model of Gunawardena et al (1997) was applied to determine the levels of cognitive processing as reflected in each individual message. The model distinguishes the following five levels of cognitive processing.

- Level 1. Sharing /Comparing
- Level 2. The discovery and exploration of dissonance or inconsistency among ideas, concepts and statements.
- Level 3. Negotiation of meaning/Co-construction of knowledge.
- Level 4. Testing and modification of proposed synthesis or construction.
- Level 5. Agreement statement(s)/application of newly-constructed meaning.

In addition, a qualitative data was gathered through focus research groups (FRG). These were organised at the end of the study in each of the three colleges and were based on the same set of open questions. The questions covered issues related to the perception of the level of interaction in the RTEP-oriented learning environment and how this differs from other learning environment, questions about the learning environment and their instructional preferences.

Research procedure

At the start of the study, students were asked to give their – written - consent to participate in the study. Next, prior to the experimental treatment, all students participated in a hands-on orientation session both for student teachers and their tutors.
Studying in the RTEP-oriented learning environment was explained and demonstrated in an interactive way: http://allserv.rug.ac.be/~mvalcke/physical/index.htm. Next, students were provided with usernames and passwords to access the asynchronous discussions, two diskettes to save their portfolio, a hard copy of the three activities and learning the resource, and a user guide explaining the learning environment. The computer lab where most students accessed the Internet, was provided with extra printing paper and printer cartridges.

Prior to embarking on the course, student teachers filled out the research instruments. They were first asked to rate their perceptions (learning environment and instructional preferences). Next, they carried out three activities, related to the curriculum of the "Science with health" course (subtopics general muscular, skeletal and circulatory systems). During 9 weeks, the students studied the learning materials and worked in the asynchronous discussion groups. In the learning environment, students could find information about the research study, the staff involved in the study, the learning resources, concrete introductions to the discussion activities, and access to the asynchronous discussion groups. In each of the discussion activities, a role was assigned to some students: the role of a chairperson and the role of a summarizer. As explained earlier, the level of moderation was manipulated depending on the experimental condition. The students experienced RTEP tenets as highlighted in Table 1

Table 1.

Elaboration of RTEP in the learning environment

Tenet	Provision in the learning environment
Starting from concrete practical problems and the concerns as experienced by (student) teachers in realistic contexts.	- Authentic tasks e.g. how to take care of our skeletal system, the impact of physical exercise on muscular system and designing a lesson on the circulatory system. - Guidelines to reflection on student teachers' experience in the brainstorming session e.g. - Given that each member of the group is drawing from their preparation from their life experience, visit to the hospital and literature, challenge your friends to identify the common and best key issues that can be used to handle the task. - Specify how the information gathered can be put to good use in your school setting: - Agree on the kinds of activities in your school setting that could or cause skeletal damage. - Describe the measures that are or could be in place to avoid such damages. - Use clear examples how pupils avoid

Tenet	Provision in the learning environment
	school based causes of damage to the skeletal system?

Promotion of systematic reflection of (student) teachers on their practices and experiences, on the role of the context, and on the relationships between these aspects.	- Guidelines for reflection
	  - Visualize the accident scene and write down your imagination of what skeletal damages could have happened at the accident scene.
	  - Please visit the emergency department of the nearest hospital in your area to see different accident survivors and get from them vital information for this paper.
	  - Compare the skeletal damages you will have observed to those you imagined before visiting and record those that are outstanding in both scenarios.
	- Checklist for self and peer evaluation e.g.
	  - I read and reflected on other people's posts in relation to the purpose of the activity.
	  - My group mates evaluated whatever most of the posts they sent so as to present the most interesting posts.
	- Phased asynchronous discussions – brainstorming and summarising phase.
	- Flexible time for each activity – three weeks
	- Logbook

Table 1 (continued)

Personal interaction between the teacher educator and the (student) teacher and on the interaction among the (student) teachers.	- ICT supported learning environment - Electronic discussion groups - Chatroom - Provision for moderation based on levels of Salmon (2000)
Three levels of professional learning (*Gestalt, schema and theory)*	- Emphasis on knowledge construction from multiple perspectives e.g the guideline to read through the posts of others and single out those you agree or disagree with and, state why/not. For example if you agree with the skeletal damage someone has posted identify any other implications that they may have been left out or post a question to elicit such from the whole group. - Role assignment in the activities - Structure of the tasks (brainstorming, summarising)
Integration of theory and practice	- Authentic tasks involving students putting themselves into the perspective of teaching – designing a lesson on the circulatory system. - Links to learning resources

Finally, student teachers filled out the set of study instruments, considering their experiences in the RTEP-oriented learning environment. In addition, they filled out the newly developed instrument about RTEP-characteristics that were expected to promote interaction.

Focus research groups were organised in each of the three colleges that were based on open questions. Ten students were selected at random from the group of 48 students from each institution that participated in the study. All participating student teachers were given a certificate of attendance.

Statistical analysis

The transcripts of all the different asynchronous discussions in relation to the three activities were used for analysis purposes. Two independent coders were trained in the use of the content analysis instruments. The analysis focused first on distinguishing content related and non-content related messages. Content related messages were next coded on the base of the model of Gunawardena et al., (1997). To study the quality of the coding, interrater reliability was calculated with Cronbach's alpha as advised by De Wever, Schellens, Valcke, and Van Keer (2006). Alpha values consistently exceeded the 0.85 limit.

The psychometric quality of the different scales was determined by determining the internal consistency in the coding (Cronbach's Alpha).

Table 2.

Reliability analysis of the research instruments

Scales	α
CLES	.91
Instructional preferences (IPI)	.90
RTEP characteristics questionnaire	.96

In view of testing the different hypotheses a variety of statistical analysis techniques were applied. To study the impact of the ICT-based learning environment on student perceptions, the following tests were used in specific student perceptions. In addition, also qualitative techniques were adopted in this study to gather research data

1. To establish whether different levels of moderation result in differences in the dependent variables, one way analysis of variance (ANOVA) was applied.
2. Differences between pretest and posttest results were studied with paired samples t-tests.
3. To ascertain which RTEP characteristics and student perceptions predict levels of interaction and levels of cognitive processing, multiple regression were applied.

4. To find out the predictive value of different levels of moderation of levels of cognitive processing (high or low), logistic binary regression was employed. Scheffe's Post Hoc test of multiple comparisons was used to establish the differences in the different conditions.
5. In reporting the results, p => .05 is referred to as significant and p < .05> .1 is reported as meaningful
6. The analysis of the transcripts of the focus research groups (FRG) was guided by the hypotheses put forward in the present study (Krueger, 1998). Audiorecordings of the FRG resulted in written transcripts. The transcripts were analysed in accordance to the different questions. Responses were categorized as emerging themes. Some of these themes were in line with expectations of the researchers. But, there was room for new relevant emerging themes. During the analysis, a clear effort was made to establish the different repertoires (distinctive ways of talking about objects and events) that student teachers adopted in their responses. According to Potter (1996), participants draw on a number of repertoires, flitting between them to construct the sense of a phenomena or perform different actions. This is of interest because people are said to talk or think about things in terms already provided for them in their personal history (Edley, 2001). Student statements were organized into themes by two researchers. In most cases, consensus was reached as to the theme statements belong to. In reporting the results, original quotes of student responses will be given as much as possible.

Descriptive results

Descriptive results are summarized in Table 3. Next, we present the results in line with the consecutive hypotheses.

Table 3.

Descriptive statistics

	Time 1			Time 2			Time 3		
	M	*n*	α	*M*	*n*	α	*M*	*n*	α
Mean LCP [a] Activity 1, 2, 3	1.5	60	0.6	1.3	43	0.6	1.8	42	0.8
Mean no of messages per student	3	60	1.9	3	43	1.6	3	42	1.8
No of messages -Levels of interaction	3	167	1.9	3	114	1.6	3	134	1.8
Perceptions - learning environment									
Learning to speak out	3.9	53	0.8				3.8	36	1.1
Learning to learn	3.3	53	1.2				3.5	36	1.2
Learn to communicate	4.2	53	0.9				3.9	36	1.2
Instructional preferences									
Collaboration	4.7	55	0.5				4.7	38	0.7
Planning	4.4	55	0.5				4.3	38	0.7
Assessment	4.3	55	0.6				4.3	38	0.9
Application	4.2	55	1.0				4.3	38	1.0
Independence	4.1	55	1.2				4.3	38	0.9
Authentic task	4.3	55	0.9				4.2	38	1.0
Experience of RTEP									
Active involvement							4.3	19	.6
Authentic task							4.7	19	.5
Collaboration							4.4	19	.6
Interaction with students							4.3	19	.7
Interaction with instructors							4.8	19	.3
Interaction with resources							4.7	19	.3
Reflection							4.5	19	.4

[a] LCP refers to Levels of Cognitive Processing

n refers to different number characteristics depending on the row – for LCP it refers to number of students that contributed task oriented posts, for messages it refers to number of messages and for perceptions, instructional preferences and experiences it refers to number of students.

M refers to the mean in relation to the respective *n* and not the total number of students.

The *Total* column referes to the combination of students in the experimental and control conditions.

The *n* values reported in the table differ. This is due to unforeseen interference of changes in school curriculum planning and some electricity cut downs at the time of data collection.

Results in relation to hypotheses

1. Different levels of moderation will result in different levels of student interaction.

To establish if the different levels of moderation result in different levels of interaction, one way Analysis of Variance (ANOVA) was used. There were significant differences in the number of messages in activity 3 between the three different groups that received different levels of moderation support ($F_{(2,141)}$ = 3.912, p = .03). Considering Scheffe's Post Hoc test of multiple comparisons in the same activity, there are meaningful mean differences between level of support in condition 1 and level of support in condition 2 (mean difference -.81250, SE = .35, p = .08) and a significant difference between level of support in condition 2 and level of support in condition 3 (mean difference .89583, SE = .35, p = .04).

In the Focus Research Groups (FRG) student teachers acknowledge the support received from the moderator. Their statements reflect the different levels in the moderation model of Salmon. With regard to *access* students said that the moderator was helpful with the interpretation of the messages, was giving tips on how to use the computer effectively and how to handle questions. More so, "*She encouraged us to participate and constantly informed us of what was expected.* "*We had equal access to the teacher unlike in our traditional class".* At *socialization* level the moderator is said to give "*feedback and encouragement on our posts". Information exchange* level was present as the moderator would give us "*guidance on how to use the various resources available".* They recognize the help of the moderator in giving them questions for further reflection and to focus the discussion and asking them to contribute more on a particular issue.

Different levels of moderation support have a differential impact on student teachers' levels of interaction.

2. *Perceptions about the level of implementation of the realistic teacher education pedagogy in the learning environment (active involvement, authentic task, collaboration, interaction with students, interaction with instructors, interaction with resources and reflection) influence the level of interaction.*

Two types of analysis were carried out to address this hypothesis: a) a regression analysis with the student teachers' perceived experiences with RTEP in the ICT based learning environment as predictors for the level of interaction and b) analysis of the emerging themes from FRG transcripts.

a) At the end of the experiment student teachers were asked to rate how they perceived the different RTEP tenets during their experience in the ICT based learning environment. These ratings (active involvement, authentic task, collaboration, interaction with students, interaction with instructors, interaction with resources and reflection) are used to predict the level of interaction. Results in Table 3 indicate – on average - high mean ratings of the RTEP tenets. Only the significant results of the regression analysis are reported in Table 4.

Table 4.

Regression results of tenets of RTEP and interaction in each activity

Model	*F*	*df*	*p*	*R adjusted*	Method	Predictor	*Beta*	*p*	SE
All tenets * Activity 2	9.10	1,17	.008	.31	Enter	Collaboration	.591	.008	.47
Reflection & authentic * activity 2	2.96	2,17	.08	.18	Enter	Reflection	.496	.05	.73

b) In the FRG, students were asked in what ways interaction in an ICT based learning environment had been different from the way they normally interact in their traditional learning environment and in what way this influenced their interaction. The responses in the focus research group were clustered along the RTEP tenets where possible.

Active involvement was expressed in view of what the individual student did in the learning environment and the motivation to do so. They said *"we posted messages which we could discuss and improve in meaning"*. The individual's attitude, curiosity, confidence and enthusiasm promoted their participation. *"There*

was an internal drive to participate". " I wanted to prove that I can study with others at a distance based on what my predecessors had told me". "*It was competitive and I had to make sure I give good answers on behalf of my college". "It was student centered unlike the usual teacher centered". "We have an opportunity to ask any questions".* "*We had a chance of responding individually and often unlike in our normal class".* "*We could not see emotions like harshness, shyness and therefore there was no hindrance". "It broke the barrier of communication through confidence building".*

Working on authentic tasks was expressed as a new and enjoyable experience. "*We were solving problems, which was a new way of learning*". "*The questions were real life that we could identify with and answer them*". "*We studied body systems in real life situation like using muscles in an exercise". "The structure of the task presented cases that were real that could be related to classroom teaching". "The internet enables us to see simulations for example the heart pumping".*

Collaboration is deduced from the way they valued the multiple perspectives from the group mates. In particular they appreciated the questions from group mates *"that stimulated our learning".* Collaboration with others was a source of encouragement. *"We had shared problem solving and most of the group mates had different sources of information". "The role bearers would constantly encourage us to participate*". "*The leaders would help in summarizing".*

Interaction with students was expressed through statements that applauded the ICT based learning environment enabled interaction with distant members. *"We had one-to-one and one- to-many communication at the same time".*

Interaction with resources was indicated by their availability, ease of access and possibility to reuse. They stated they could rely on many resources such as group mates and books and were able to interact with free resources on the internet. "*We used computers unlike books in the normal class. "The learning environment was flexible I could access it anytime and on any computer even outside the college".* The course was "*self contained so we did not need the teachers to be so involved*". The learning "*resources were readily available and this saved time".* The key supportive resources were books from the library, internet, availability of computers, course booklet, course guidelines and search engines like Google.

Reflection was enhanced by self and peer evaluation, flexibility, threaded discussion and the questions within the structure of the activity. *"We could use the checklist to evaluate ourselves and also other members' reactions to our post made us know that we were on track or not". "We enjoyed the flexibility to revise our own work and that of our group members".* They also contend that in the search for new information they learnt other things. "*I would prepare for the activity using the guidelines for reflection before I embarked on the discussion".* Thus "*We had to internalize what we were doing in class and not simply cram. We had elaborate information about the task and we had time to reflect on it, so as to come up with the best answer.*

Challenges to the level of interaction in the learning environment were the workload, no Internet or poor speed, too few computers, lack of time and time management, some negative attitudes in some students and the interferences of an unforeseen examination during the study period. "*It is good but requires more time for interaction*". At times the "*computers would jam or would even be faulty and most of the time they were few we had to compete". "Some tutors had negative attitudes and they would harass us and send us away from the computer labs". "Students who were not participating were jealousy and some members within our group were inactive and not responding to our questions".*

To sum up, student teacher's perception of the RTEP tenets in the ICT based learning environment as promoting collaboration and having opportunities for reflection predicted student teachers interaction. Based on the qualitative results, interaction in an ICT based learning environment seemed to be promoted by the RTEP tenets. These include active involvement, authentic task, collaboration, interaction with students, interaction with instructors, interaction with resources and reflection. However, the level of interaction was also challenged by a high study load, inadequate Internet and computers, time, attitudes and the unforeseen planning of an examination period.

3. Differences in levels of moderation have an impact on levels of cognitive processing.

The students in the different conditions were given varying levels of moderation support. To establish if the different levels of moderation support result in different levels of cognitive processing, one way Analysis

of Variance (ANOVA) was carried out considering activity 2 and 3 separately. No significant differences in levels of cognitive processing could be detected in the three different groups that received different levels of moderation support. Logistic binary regression was carried out to establish whether moderation support predicts levels of cognitive processing (high and low). Still the results were not significant.

The results indicate that differences in moderation levels do not yet result in different levels of cognitive processing.

4. *Perceptions about the level of implementation of the realistic teacher education pedagogy in the learning environment (active involvement, authentic task, collaboration, interaction with students, interaction with instructors, interaction with resources and reflection) influence student teachers' level of cognitive processing.*

Student teacher's rating of how they perceived RTEP tenets (active involvement, authentic task, collaboration, interaction with students, interaction with instructors, interaction with resources and reflection) is used to predict their levels of cognitive processing. Using enter method, data supported to some extent the model ($F_{(7,9)} = 9.829$, $p = .09$). Adjusted R square = .873. Only the significant and meaningful results are summarized in Table 5.

Table 5.

Regression results of tenets of RTEP and levels of cognitive processing

	Beta	*p*
Authentic task	-.887	.09
Collaboration	3.169	.03
Interaction with instructors	-2.995	.03
Opportunities for reflection	1.669	.11

Dependent Variable: Levels of cognitive processing activity 2

The negative beta value for authentic task and interaction with instructors indicates that these tenets are negatively correlated to the levels of cognitive processing. The more they are emphasized in the learning environment, the lower are the levels of cognitive processing. We therefore conclude that

only student teachers' perceptions of the RTEP tenets in the ICT based learning environment as promoting collaboration predicts levels of cognitive processing.

5. *Levels of interaction predict levels of cognitive processing.*

A logistic regression analysis was performed with levels of cognitive processing (high and low) in activity 1, 2 and 3 as the dependent variable and count of messages in activity 1, 2 and 3 respectively as predictor variables.
A meaningful model and prediction was only possible with LCP of activity 1 and count of messages of activity 1. A total of 59 cases - building on the number of students who contributed content related messages - were analyzed and the full model was meaningful (chi-square = 3.579, $df = 1$, $p = .06$). This model accounted for 6% to 8% of the variance in the groups with 28.6% high LCP and 77.4% low LCP accurate. Overall 54.2% of the predictors were accurate. There is a meaningful prediction ($B = .259$, SE = .15, Wald = 3.045, $df = 1$, $p = .08$, Exp (B) = 1.295).

On the basis of the results we cannot conclude that interaction has implications for levels of cognitive processing.

6. *The study experiences of student teachers in the RTEP-oriented learning environment result in changes in student perceptions.*

Student teacher perceptions included their perceptions of the learning environment and their instructional preferences. Both the results of a qualitative and quantitative analysis are reported below.

a. *The perceptions of students - about the learning environment will reflect higher ratings for learning environment characteristics that promote the Realistic Teacher Education Pedagogy (learning to speak out, learning to learn and learning to communicate) at the* end of study.

Comparison of the perceptions prior and post to the intervention did not reveal significant changes in student teacher perceptions. Only in view of

the perception of the learning environment as promoting "learning to speak out" a trend could be detected ($t = 1.155$, $df = 31$, $p = .13$).

Students in the FRG were asked about their perceptions in a traditional learning environment as compared to those in the RTEP oriented learning environment. We present quotes that illustrate some changes/differences in student perceptions.

"The learning environment in the traditional class is different from the electronic learning environment in that it is poor with no learning aids to stimulate the mind, it does not promote incidental learning and the classrooms are crowded". "The normal learning environment is rather boring, however, it has fresh air, it is spacious, we have a calendar, nice seats, a sealing, flexible structures, fan and good lighting". "The normal learning environment has no resources, no international sources, not enough sharing, some tutors not adequately informed". "Projected media, black board and at times handwriting not that good". The ICT based learning environment was described as resourceful. "*There are guidelines and a users' guide, free from noise, we have time for research". "Regardless of no speech there is felt interaction and we could do more than one thing". "E-learning offers so many resources, and access to links". "Up-to-date content compared to old in our classes.* In an ICT based learning environment *"there is use of different learning materials, yet in class you can use only the tutor and a book". "We use a computer for illustrations".*

"It is predominately teacher centered classrooms they should try to involve students". In the RTEP oriented learning environment *"We saw real like seeing a heart pumping"; "it improves our observation skills, reflective learning environment, no interruptions". "In e-learning answers are more readily available, more detailed, a lot of freedom".*

"There is interaction, collaboration, free expression and reduced shyness". However there is a challenge inactive members, internet and log in problems".

Students perceived the ICT-based learning environment to be resourceful, stimulate the mind with authentic tasks and resources, and encouraging active involvement of students through collaboration. But the changes – reported in the qualitative study – could yet not be detected in the quantitative part of the study.

b. Student teachers' instructional preferences will be more in line with RTEP characteristics (collaboration, planning, assessment, application, independence and reflection and authentic tasks) at the end of study.

No significant difference in student teacher instructional preferences could be detected when comparing pre- and post-test results. It is important to indicate that the initial ratings were already very high.

In the FRG, students contrasted their normal class to the RTEP-oriented learning environment. We prefer *"Learner centered active participation, increased thinking and increased memorization". "In a normal class as an individual I sit in a lecture room and listen to the tutor"*. Student teachers preferences include the use of teaching aids, illustrations, real objects, "*I prefer child centered and involving students in teaching". "Teachers should guide us through problem solving and motivate us".*

"*I also prefer flexible communication and thus interaction.* Also to be taught in groups for interaction and involvement. *"We need to share experiences from others than relying on the same source"*. We *"make a broad research, interacting with people regardless of distance". "In e-learning I interact with my group to solve a problem through discussion". "I use guiding questions, summarize, challenge my group, use resources, notes and books, ask others them make a summary".*

"Learning should be an in context experience". "We should share with the teacher". "I need to be encouraged to learn more, use resources, have practical, demonstrations and real life experience". "We should learn from concrete to abstract. Involve more discovery method".

In the focus research group students indicate that they prefer instruction that is child centred (active involvement), interactive and collaborative. This clearly reflects elements of the RTEP-oriented environment.

7) Specific student teachers perceptions predict higher levels of cognitive processing

Regression analysis was performed with levels of cognitive processing as the dependent variable and specific student teachers perceptions

(perceptions of the learning environment and instructional preferences) as the predictors. The analysis focused on predicting levels of cognitive processing at the start of the experiment (activity 1) and at the end of the experiment (activity 3). Only the significant and meaningful prediction results are reported below.

a. The student teachers perceptions of the learning environment predict levels of cognitive processing.

The results of the different analyses do only reveal significant predictions at the start of the experiment (activity 1). The predictors "Learn to communicate 1" and "Learn to learn 1" have a meaningful impact on the levels of cognitive processing in activity 1. Using the enter method, the model was supported to some extent ($F_{(3,34)}$ = 7.617, p = .1). Adjusted R square = .087. Significant and meaningful variables are shown in Table 6.

Table 6.

Regression analysis results of cognitive processing and perceptions of the learning environment

	Beta	t	Sig.
Learn to learn 1	-.303	-1.832	.076
Learn to communicate 1	.425	2.106	.043

The negative beta value for learning how to learn indicates that this perception of students of the learning environment is negatively correlated to levels of cognitive processing. We therefore conclude that in this study, levels of cognitive processing could only predicted by student teachers' perception of the learning environment as promoting learning to communicate.

b. Instructional preferences for RTEP elements predict levels of cognitive processing.

Table 7 summarizes the results of the regression analyses. It is clear that the instructional preferences are strong predictors at the end of the experiment.

Table 7.

Regression analysis results of instructional preferences (Instr pref) as predictors of LCP

Model	*F*	*df*	*p*	R adjusted	Predictor	Beta	*p*	*SE*
Instr pref *Activity 1	8.674	3,42	.01	.15	Assessment	.414	.01	.14
Instr pref *Activity 3	3.432	6,14	.03	.42	Collaboration	.831	.008	.43
					Assessment	-.524	.08	.26
					Authentic activities	.645	.02	.20
					Independence	-.775	.01	.22

The tenets of course that is not assessment targeted (in activity 1) and independence have negative beta which indicates that they are negatively correlated to levels of cognitive processing. However in the third activity the instructional preference of a course that is not assessment targeted, significantly predicts levels of cognitive processing. We therefore conclude that student teachers' levels of cognitive processing are only predicted by the students teachers' preference for courses that are not assessment targeted and reflecting collaboration.

8. *The ICT based learning environment promotes the perceived flexibility of the learning of student.*

Student teacher views of the impact of an ICT based learning environment on their flexibility were elicited in a FRG by raising a number of questions. These included asking their views about the new way of interacting as related to learning, and how different this experience was from their normal learning? They were also asked what they consider as the major benefit from this kind of learning and to contrast it with their former way of learning. They were asked to indicate how different it was to study in the RTEP-oriented learning environment. Results reveal that student teachers perceived the RTEP-oriented learning environment as promoting flexibility in time, location of study, study mode, study materials, communication and interaction.

With regard to *flexibility in time* they acknowledge that they could afford unlimited time for preparation, research, participation and revision. This

was echoed in statements like "*we had ample time for preparation*", the RTEP oriented learning environment "*was flexible we could come in when we are ready*" and we had "*time to reflect and reconsider even ignore questions*". "*The learning environment was flexible I could access it anytime and on any computer even outside the college"*. More specifically they contend that they could participate "*anytime*" and they had "*unlimited access*".

They felt *flexibility in location* of study because they "*could use any computer with internet even when it was outside the college to be in touch with the learning*".

The RTEP-oriented learning environment is implied to have enabled *flexibility in the mode of study* by encouraging the student teacher to take control of the learning. They say the experience in the ICT based learning environment "*encourages expression*" especially of own "*perspective… than in the normal class*" at times we "*had to search for answers through search engines*" and other times we had to "*reason*". The "*learning was relevant with daily experiences*" and it "*surprised us that it was relevant to our own learning*". The "*structure of the task presented cases that were real that could be related to classroom*". They contend that they had to internalise what they were doing. We also used "*question technique*" at times and "*more analysis was involved*". They were encouraged to do "*self evaluation*". They appreciate the freedom "*to ask questions*" and "*a chance of responding unlike in our normal class*". In addition, "*we could not see emotions like harshness, shyness and therefore there was no hindrance*".

Flexibility in *relation to study materials* was related to unlimited access and the large variety in sources. For example, they said "*in class when you get a question you may be required to go to the library and may fail to get the answer*, [yet in the RTEP-oriented learning environment] *from the very computer you could get a response then post it*". They acknowledged having access to "*up-to-date content*", "*instant source*", "*readily available*", "*resources were many unlike the case of only the teacher*" "*like group mates and books*" and this resulted in using "*many references*". In addition, they recognise "*wider knowledge on the topic* [guaranteeing] *unlimited research*". The simulations enabled by the environment were also appreciated "*we saw real like seeing a heart pumping* [this] *improves our observation skills, reflective learning environment, no interruptions*". There is an expression of freedom "*we interacted with free resources*". They appreciate "*use of real objects for more emphasis*". They contend that "*tutors were free than in class when they have a*

well thought outline". They appreciate that "*references were provided … unlike in normal class reference to the library and even if you search you may not trust the sources" and they say these were detailed*". They liked "*information on the computers that is elaborate*"

Student teachers in the RTEP-oriented learning environment acknowledge *flexibility in communication* especially in that the environment "*breaks the barrier of distance*" more so "*through confidence building*" and "*links students in different parts of the world*". Because of which they contend "*we made friend through email*", and "*increased the number of friends in solving academic and social problems*". Further, "*regardless of no speech there is felt interaction*" and we had "*one to one, one to many communication*".

Students expressed *flexibility in interaction* by stating that "*more interaction with distant members*" was achieved and were "*confident to interact with anyone in our class*". They also said "*we posted messages which we could discuss and improve its meaning*". They acknowledge that they "*could do more than one thing*" at a time. The RTEP-oriented learning environment encouraged "*student to student*" interaction, "*cooperation to discussion*" and we could also "*reflect on what others have written*". At times we were "*stimulated by others' response to tackle challenging questions*" and "*there was a lot of trust in other people's participation unlike always*" They recognise that "*there is interaction, collaboration, free expression and reduced shyness*" in addition to "*involvement of other members online*"

We conclude that the attributes of the RTEP-oriented learning environment, supported by ICT, promoted flexibility of student teachers in regard to time, study location, mode of study, study materials, communication and interaction.

Discussion

Prior to starting the discussion of the results, we have to stress the fact that the discussion should take into consideration some critical events – outside the control of the researchers - that may have influenced the results. The number of active students was lower over time due to a change in the school planning. Some technical problems challenged the study; in particular electricity and Internet access problems interfered with student

participation. In one college, there was hardly electricity during one month; in another college the Internet broke down on a more than regular base. This put pressure on the time available for each individual student to have access to the limited amount of computers available in the college.

1. *Different levels of moderation result in different levels of student interaction.*

Different levels of moderation support seem to have a significant differential impact on student teacher levels of interaction. This is in line with other studies that reported that moderation promotes interaction (Basturkmen, 2003; Holliman and Scanlon, 2006; Hong, 2002; King, 2002; Offir et al., 2004; Oliver and Shaw, 2003; Wu et al., 2004). The focus research group results can also be related to the results of other studies. Vonderwell (2003) and Rovai (2004) report that instructors were applauded for providing instant feedback to distant learners, even if the feedback consists of simple acknowledgements that work was received This study also confirms that the instructor plays an important role to motivate effective online discussions and indeed more guidance, and considerable time devotion are expected for instructors (Wu et al., 2004). In addition, this study suggests that this support should be as uniform as possible to all students to make it possible that all students benefit in an equal way.

2. *Perceptions about the level of implementation of the realistic teacher education pedagogy in the learning environment (active involvement, authentic task, collaboration, interaction with students, interaction with instructors, interaction with resources and reflection) influence the level of interaction.*

The experience in the ICT-based learning environment did have some influence on the level of student teacher interaction (especially in view of activity 2). Level of interaction could be predicted by the possibilities for collaboration and the opportunities for reflection. The analysis of the qualitative data present evidence that the level of interaction in the learning environment was enhanced by the tenets of realistic teacher education pedagogy (active involvement, authentic task, collaboration, interaction with students, interaction with instructors, interaction with resources and reflection learning environment, available resources, and availability of tools) and others such as available time. The FRG results also point at

some challenging issues. Some of them can be linked to the uncontrollable contextual interferences presented at the start of this discussion: study load, inadequate Internet and computer access, time management, a negative attitude and awkward planning of the examination period. We discuss the findings in relation to the impact of the perceptions by reviewing empirical findings in relation to the different perceptions.

Perceptions that confirm the active involvement of the student teachers foster interaction. This is in line with results of other researchers, such as (Collis, 1998; Makitalo et al., 2002; Meyer, 2004; Khan, 1997; Schrum et al., 2002; Rovai, 2004; Vonderwell, 2003). The group characteristics seem to have influenced collaboration and interaction, as suggested by a variety of authors (Aviv et al., 2003; Caspi, Gorsky, and Chajut, 2003; Dwyer, 2003; Rovai, 2004). In this study students were divided at random in the groups and we ensured that each institution was represented. Next, roles were assigned with clear guidelines as to the expectations about student involvement. This could clearly have influenced student perceptions about being actively involved. Also characteristics of the learner could have influenced their active involvement (Arbaugh, 2002; Biesenbach-Lucas, 2003; Hong, 2002; Meyer, 2004; Schrum et al., 2002; Seale and Cann, 2000). These include their enthusiasm, competence and skills. All students in the present study had received a hands-on training about the basic use of computers and a clear orientation on how to work in the learning environment. This implies that a successful RTEP-oriented learning environment in distance education should initially improve student competencies related to relevant computer skills. This can make the students confident and increase their enthusiasm for the online course. This helps to create a medium of collaboration, conversation, discussion, exchange, and communication of ideas as advised by (Khan, 1997).

In the past, discussion groups were found to support interaction of students with other students (Biesenbach-Lucas, 2003; Khan, 1997; Passerini et al., 2000). In the present study collaboration was emphasised and guidelines were presented to enhance this collaboration in the learning environment. It is therefore not a surprise that the provision of discussion groups fostered the perception about collaboration (Dwyer, 2003; Khan, 1997). This is a recurrent theme in the collaboration literature (Berge et al.,

1995; Biesenbach-Lucas, 2003; de Jong et al., 2005; Driver, 2002; Hailes et al., 1998; Harasim et al., 1995; Makitalo et al., 2002; Newlands et al., 1997; Rovai, 2004; Trindade et al., 2000).

The learning environment was identified as a key factor in promoting interaction. Learning is enhanced by the active format of online courses (Spiceland et al., 2002). Student teachers appreciated the links to the different resources in the learning environment which eased navigation. This refers to a clear influence on student perceptions. Where appropriate, the structure was enhanced by the nature of the learning resources. In the RTEP-oriented environment, access was given to online simulations that demonstrated a concrete physical process. As already stated, typical design characteristics that support the "structure" of the tasks are goals, strict rules and a reward system (Aviv, Erlich, Ravid, and Geva, 2003). In addition, guiding questions and guides to sequence and time frame are appreciated. Guiding discussion questions are said to influence student reflection and building of shared experience in an online learning classroom (Vonderwell, 2003). There is evidence that students online will not collaborate unless collaboration is structured (Vonderwell, 2003). The peceptions about task structure can be considered as satisfactory since students pointed out that it forced them to study the content (Rovai, 2004). The task structure presented step by step guidelines. However – as suggested in the literature - there is need to balance the structure of the task (amount of control exercised by the instructor) and dialogue (amount of control exercised by the learner) in a discussion group (Rovai, 2004).

The perceptions about the opportunities for reflection also predicted – to a certain extent – the levels of interaction. In the learning environment students were provided with various opportunities for reflection. These included the guiding questions, the phased sessions, the threaded discussion, self and peer assessment checklists and making a personal logbooks in preparation for the discussion. Collaborative strategies and the type of the discussion questions influence student reflection and building of shared experience in an online learning classroom (Vonderwell, 2003). Also the delay factor in asynchronous discussions allows for reflection thus fostering learning and interaction in asynchronous communication (Biesenbach-Lucas, 2003; Meyer, 2004; Vonderwell, 2003). As reported by

other authors, reflective thinking can be facilitated by presenting clear goals, and expectations about the use of the discussion environment (Seale and Cann, 2002).

The focus research groups helped to identify some critical elements that – through student perceptions - can impact the level of interaction. Online instructors should ensure students have sufficient time to be involved in an ICT based learning environment and it is better if this work is allocated sufficiently in the time table (Ottewill et al., 1997). This should go hand in hand with sufficient availability of computers which adequate Internet speed and a reliable level of electricity. The findings in the present study are in line with empirical result of other studies where students referred to the inhibiting impact of inflexible study circumstances (Dutton, Dutton, and Perry, 2002). This study too acknowledges that students ought to be able to devote adequate time to studying (Schrum et al., 2002).

3. *Differences in levels of moderation have an impact on levels of cognitive processing.*

Contrary to our hypothesis, the level of moderation did not predict high or low levels of cognitive processing. This is in contrast with for example the study of Hong (2002) in which perceived positive instructor contributions demonstrated high grades. Basing on the mean levels of cognitive processing, we note that they are so low overall; it is possible that a clear conclusion on this hypothesis may have been hindered by this. Again the effect of moderation may have been affected by other factors beyond the control of the research like low interaction due to electricity and internet cuts and the pressure on the time table.

4. *Perceptions about the level of implementation of the realistic teacher education pedagogy in the learning environment (active involvement, authentic task, collaboration, interaction with students, interaction with instructors, interaction with resources and reflection) influence student teachers' level of cognitive processing.*

Only the implementation of the RTEP tenet 'collaboration' helped to predict levels of cognitive processing. Students acknowledge collaboration

as one of the main characteristics of the learning environment. Collaboration was emphasized by the grouping, the guidelines, and the moderation. Also other authors found that student attitudes towards the learning environment and their engagement in the discussion groups were found to be relevant predictors of levels of cognitive processing (Schellens, Van Keer, and Valcke, 2006). In contrast to our expectations, authentic tasks, and interaction with the instructor were negatively correlated with levels of cognitive processing (negative beta-coefficients). The authentic tasks might have caused extraneous cognitive load to the the activity of processing the basic content (Sweller, 1988). The instructor interventions can be related to perceptions that are related to less personal engagement in the discussions and might invoke a perception about the instructor giving structured guidance.

5. Levels of interaction predict levels of cognitive processing.

The present study reveals that the level of student interaction does noet predict the level of cognitive processing. This is in sharp contrast with other similar studies (Biesenbach-Lucas, 2003; Roblyer et al., 2000; Alonso and Norman, 1996; Schellens et al., in press; Beaudoin, 2002; Picciano, 2002). As stated in our pilot study, these results can be explained by the rather low final LCP-level.

6. The study experiences of student teachers in the RTEP-oriented learning environment result in changes in student perceptions.

Quantitatively there were no significant changes that could be observed in student teacher perceptions of the learning environment. The results should be interpreted in the light of the already high initial ratings for these characteristics at the start of study. Again this interpretation can be corroborated with the qualitative findings. In comparison to the traditional learning environment, student teachers appreciate the resourcefulness of the ICT based learning environment, its promotion of communication with them. Students acknowledge an ICT based learning environment for teaching them how to interact and manage their learning. Communication, interaction and consideration of the student perspective in learning are key in realistic teacher education pedagogy

Also there were no quantitative significant differences in student teacher preference of instructional preferences. Still the ratings of the preferences were really high both at the beginning and end of the experiment and indication that the students prefer collaboration, planning courses that are not assessment targeted, application of knowledge, independence and reflection and working with authentic tasks. Qualitative results point to students preferences as a result of an experience with a realistic teacher education pedagogy. In particular they prefer more flexible communication in their learning, interaction with the learning environment and child centred learning unlike the traditional teacher centred. They want to be more practical, have real life situations and do more of problem solving than attending lectures. Therefore an ICT based learning environment influences students preference of teaching from the teacher centred to student centred and this result in changing of roles. The instructor ought to provide a good learning environment rather than transmit information.

These results challenge the ability of the used study instruments to detect the changes in perceptions.

7. Specific student teachers perceptions predict higher levels of cognitive processing

Levels of cognitive processing are – to a certain extent - predicted by the perception of the learning environment and instructional preferences. This seems especially true for activity 3 at the end of the experiment. A learning environment that promotes learning to communicate seems to influence levels of cognitive processing. Learning how to communicate was one of the new techniques student teachers were exposed to in this learning environment. They had to engage in a lot of communication to be able to learn. This implied communication with fellow students, their tutors and the learning resources as a basic prerequisite. The instructional preferences related to collaboration, courses that are not assessment targeted and to authentic learning activities helped to predict levels of cognitive processing. With regard to collaboration this corroborates the impact that was studied in relation to hypothesis 4. The results are more positive as compared to the findings in chapter 3. The three instructional preferences can now clearly be related to characteristics of the elarning environment: the tasks

set for the students build on authentic situations and are related to teaching and learning activities. The tasks require a student to act as a teacher in a concrete context. Assessment of the tasks was based on self and peer assessment; this is in sharp contrast to the regular classroom situation where the main focus is on the final central examination. Though not all perceptions help to predict levels of cognitive processing, the present results give an indication of the role perceptions can play in attaining levels of cognitive processing. Noteworthy are the student perceptions of the learning environment – learning to learn and instructional preferences – instruction that is not assessment targeted and independence and reflection that were negatively correlated to levels of cognitive processing. This is in contrast with our expectation and it points to probably the influence of new experience in the learning environment or even lack of positive correlation due to very low levels of cognitive processing.

8. *The ICT based learning environment promotes the perceived flexibility of the learning of student.*

The ICT based learning environment asked students to work during three weeks on an activity and this - according to them - gave them unlimited time to prepare, research, participate, reflect and revise their contributions unlike in their normal classes. The relaxed and stretched time table gave them freedom to join their group discussion at their convenience termed as time flexibility by different authors in the literature (see among others (Collis, 1998; Harasim et al., 1995; Kim, Liu, and Bonk, 2005). Also because they knew the learning environment and its resources were available at their convenience, they felt relaxed (Clark, 2001; Khan, 1997). The Internet supported nature of the learning environment gave the student flexibility in the place where to study from (Uys, 1998). Thus it enabled flexibility in location of study.

The student teachers were enthused by the ability of the ICT based learning environment to give them autonomy over their study; thus increasing the flexibility of the mode of study. They were more expressive; they could also do a lot of research using the resources and could read other students posts in their learning process. Given that the tasks were authentic, they could relate them easily to their personal experiences and internalise them in view

of future teaching responsibilities. They could find room to enter their own perspectives. They were encouraged to evaluate themselves that was clearly an alternative assessment mode as compared to the traditional final examination orientation.

The RTEP-oriented learning environment offered extra online resources. Also the grouping of students enabled them to get information from each other and the presence of virtual tutors can be considered as another information source. Other flexibility features were related to the simulations that helped to represent specific learning contents in a dynamic way (e.g., circulation of the blood).

Given the fact that each group consisted of students from different teacher training colleges, the ICT-based nature of the learning environment removed the barrier of distance between them (Collis, 1998; Khan, 1997). The flexibility in communication offered the learners and instructors a wider variety of ways of communicating (Collis, 1998). Students could share non academic information in the chatroom, in the asynchronous discussion groups or on a one-to-one base via email. The efficient nature of the communication enhanced the flexibility of communication. Flexibility in communication supported by an ICT based learned environment has been applauded by many authors (Collis, 1998; Khan, 1997). In particular, the tools increased the frequency of the interaction. Students also stressed that the ICT-based interaction freed them from some inhibiting emotions, such as shyness.

In general, the learning environment fostered student teacher study flexibility in terms of time, location of study, study mode, study materials, communication and interaction.

In the focus research groups, students have clearly expressed the potential of the new learning experience. They referred to more opportunities to take control of their learning and the fostering of reflection. Fostering reflection (and the perceptions about reflection) seemed to influence the level of interaction and the average level of cognitive processing. Future research could focus in more detail on the impact of reflection as a basic tenet of

RTEP. Also a higher level of moderation seemed to have an impact and should be studied further.

On the other hand, the quasi-experimental nature of the study presented again challenges to the students and the researchers. The interpretation of the results should take this into account.

Conclusions

This study focused on the impact of an RTEP-oriented learning environment. In designing the quasi-experimental study, care was taken to take into account the findings of earlier studies. Key design characteristics of the learning environment were related to adding levels of moderation in the the experimental conditions. In addition, the research design was enriched by a qualitative strand of research based on the organisation of focus research groups. The RTEP-oriented learning environment was designed in such a way that special care was taken in providing students with adequate resources, structured activities, extra communication tools and a more relaxed time table.

The RTEP-oriented learning environment – supported by ICT - was found to have an impact on most of the dependent variables: student perceptions, levels of interaction and levels of cognitive processing and finally perceived study flexibility. The environment seemed to promote student interaction. The learning environment influenced student teachers perceptions, since they finally prefer more communication, interaction and student centred learning. Certain perceptions of the learning environment and RTEP tenets help to predict the average level of cognitive processing.

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5

The impact of an innovative learning environment on student teachers' metacognition

The impact of an innovative learning environment on student teachers' metacognition

Abstract

Student teachers (*N=96*) from four Universities in Uganda were involved in a Realistic Teacher Education Pedagogy (RTEP) oriented learning environment for a period of nine weeks. They covered topics in an educational psychology course. At the end of the course focus research groups were organized with some of the student teachers who participated in the course from the different universities. The research groups explored the influence of the RTEP oriented learning environment on student teachers' metacognition and the perceived impact on their learning. The results of this qualitative study confirm that the Realistic Teacher Education Pedagogy (RTEP) learning environment has potential to rejuvenate distance teacher education in Uganda through promoting metacognition and advancing academic performance.

Introduction

In 2002 four universities in Uganda participated in an exploratory study on the status of ICT use in distance teacher education. It was established that ICT was not used as an integrated part of the curriculum in distance teacher education and that the distance education format was mainly realized through printed modules and face to face meetings. Two consecutive showcases of ICT use in distance teacher education were set up in teacher education colleges with an emphasis on the implementation of a Realistic Teacher Education Pedagogy. The studies examined the impact of studying in the learning environment on levels of interaction, levels of cognitive processing, student teacher perceptions, and perceived flexibility. It was noted that student teachers' experience in the RTEP oriented learning environment supported by ICT exposed them to a new way of learning that put new demands on their study approach. The present study focuses on the impact the RTEP oriented learning environment supported by ICT on student teachers' metacognition and the consequently the impact on learning.

This study built on the general hypothesis that the specific design of an ICT based learning environment enhances efficiency in terms of flexibility, improves instructional approaches and promotes the efficacy of distance teacher education. The study puts forward the assumption that an RTEP oriented learning environment supported by ICT would support student teachers' metacognition and hence enhance their learning performance.

The design of the ICT-based learning environment reflected a number of key characteristics of a realistic teacher education approach (Korthagen, 2001). Central to it was promotion of the interaction between teachers and student teachers and the interaction amongst the student teachers. The key characteristics of the design can be summarized as follows:

- The learning environment builds on authentic problems; in view of solving the problems students have to build on their personal experiences.
- The environment promotes systematic reflection on the problem solution, their personal experiences, the context, and the relationship between context and experiences.
- The environment promotes the systematic interaction between teachers and students.
- The learning approach considers the development of theoretical knowledge (*theory* level) by building on personal schemes (*schema* level) that are derived from whole problem experiences (*Gestalt* level).
- The environment fosters the close integration of theoretical knowledge and teaching practices.

Theoretical base for this study: metacognition and the RTEP-environment

Metacognition has been referred to as the ability to reflect upon, understand and control one's learning (Fernandez-Duque, Baird, and Posner, 2000; Hacker, 1998; Schraw and Dennison, 1994). Metacognition involves thinking about one's own thoughts – what one knows (metacognitive knowledge), what one is currently doing (metacognitive skill) and what one's current cognitive and affective state is (metacognitive experience) (Hacker, 1998). Knowledge of cognition and regulation of cognition are not independent (Schraw and Moshman, 1995). For example, knowledge about cognition facilitates reflection onto knowledge about self

and about strategies (declarative knowledge), knowledge about how to use these strategies (procedural knowledge) and knowledge about when and why to use strategies (conditional knowledge) (Schraw et al., 1994; Schraw et al., 1995). Five skills are related to regulation of cognition: planning, information management strategies, comprehension monitoring, debugging strategies and evaluation. Metacognitive knowledge can also lead to metacognitive experiences concerning the self, tasks, goals and strategies, and can help to interpret the meaning and behavioral implications of these experiences (Flavell, 1979). For example self- regulated strategies are used from a greater to lesser degree depending on the student, task, environment, and a myriad of possible interactions among other variables (Flavell, 1979; Fuller Richard, 1999; Manning and Glasner, 1996). Metacognition is summarized in Figure 1.

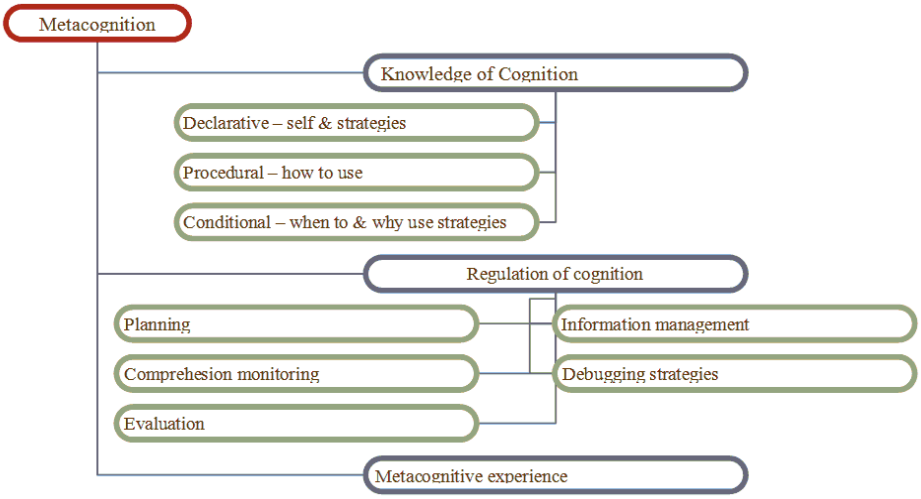

Figure 1. Components of Metacognition

Why is metacognition of importance for the present study? Metacognition plays a critical role in successful learning. Individuals with excellent metacognitive skills are said to excel in planning, managing information, monitoring, debugging and evaluating (Schraw et al., 1994; Schraw, 1998). Given that the RTEP-oriented learning environment was a new experience for the student teachers, and presented them challenging tasks, it was envisaged that students would need to develop their metacognition to assist

them in monitoring, evaluating and solving the problems related to the study tasks (Shia, Howard, and McGee, 2005).
In addition, the learning environment reflects design characteristics that aimed at the development of metacognition. In particular, the promotion of self reflection while working on the authentic tasks, is one of the features that is expected to play a role in this context.

The central research question of this study is whether studying in the RTEP oriented learning environment will influence student teachers' metacognition and consecutively whether this influences their learning. Given the qualitative nature of the study, we will also try to establish what specific design characteristics of the environment play a role in this relationship.

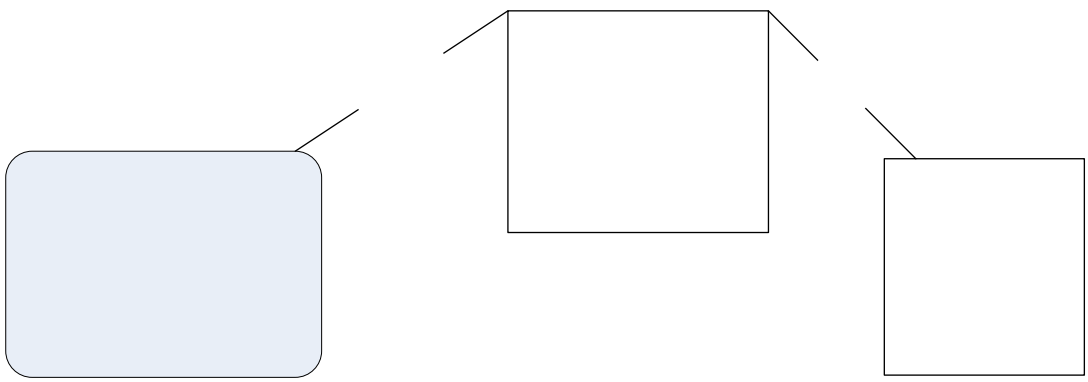

Figure 2. The impact of a RTEP oriented learning environment on student teachers' metacognition and consequently their on learning

The impact of a RTEP oriented learning environment on students' metacognition

Instructional strategies that promote the development of metacognition are said to include promoting general metacognitive awareness, improving self knowledge and regulatory skills, promoting learning environments that are conducive to the construction and use of metacognition (Schraw, 1998). Metacognitive experiences are especially likely to occur in situations that stimulate a lot of careful, highly conscious thinking (Flavell, 1979). Schraw et al., (1995) - after reviewing a number of studies - concluded that

significant improvement in learning is realized when regulatory skills and an understanding of how to use these skills are included in classroom instruction. In the RTEP-oriented learning environment opportunities for metacognition were provided in the elaborated structure of the activities. These included authentic activities, individual preparation of discussions, note taking in a logbook, resources for individual inspection and an explicit phase of self and peer evaluation. In each activity there was a phase for reflection after the group brain storming session and also within each phase questions were presented to individual students to focus their reflection.

Considering the central position of collaboration in the RTEP-oriented environment, students were also engaged in explaining and argumentation. This was expected to foster the development of integrated visual and verbal declarative knowledge and the gradual development of less shallow procedural knowledge (Aleven and Koedinger, 2002). RTEP characteristics explicitly promoted collaboration. Comparable to individual learning, the group work is expected to invoke monitoring, planning, and evaluation activities. These have frequently been reported as central in computer supported collaborative learning contexts (de Jong, Kolloffel, van der Meijden, Staarman, and Janssen, 2005). Most important, metacognition has been considered as a good predictor for cooperative learning abilities (Shia et al., 2005). Through peer discussions, students clarify their conceptions and improve complex problem solving activities (Schraw et al., 1995).

The experience in the ICT-based learning environment that promotes RTEP was meant to foster metacognition. When students are taught metacognitive strategies, they are more likely to generalize the strategy to new situations (Hacker, 1998; Manning et al., 1996). For example, students who were exposed to metacognitive treatment become more aware of their cognitive processes and this influenced their mathematical learning (Su Kwanga, 2003). A SMART learning environment that promoted monitoring, reflection and revision supported metacognitive activities like monitoring learning, comprehension and selection of strategies (Vye, Schwartz, Bransford, and Zech, 1998). Pressley, Van Etten, Yokoi, Freebern, and Van Meter (1998) applauds context by suggesting that the nature of studying is a function of the student strategies and knowledge,

perceptions, understanding of the demands, instructor characteristics and peer support and demands.

Given the context of distance teacher education, there is no physical presence of the teacher. This creates the need for a motivational and novice-expert link between the instructor and student (Gold, 2001). The challenge of the teacher is to find ways of engaging students in the emotionally uncertain experience of sustained critical self reflection, evaluation, and reconstruction (Fisher and Churach, 1998). The asynchronous nature of the online interactions in the discussion groups gives participants time to reflect on a topic before commenting on or contributing to the discussions (Harasim, Hiltz, Teles, and Turoff, 1995; Swan, 2001). This design feature requires students to challenge existing concepts and facilitates negotiation, inquiry learning and reflective thinking (Wen, Tsai, Lin, and Chuang, 2004). Asking people to focus on their own problem solving, to explain what they are trying to do, promotes metacognitive processing and leads to more effective problem solving, even when an explicit invitation to do so is no longer available (Dominowski, 1998). The present learning environment also required from students to develop a personal portfolio. These are known to facilitate metacognition because their creation involves reflection on how learning occurs (Farrell, 1998).

The influence of metacognition on learning

Given that metacognition allows individuals to plan, sequence and monitor the way they learn, there is an indication that metacognitively aware learners are more strategic and perform better than unaware learners. Metacognitive skills have been shown to lead to higher performance (Coutinho, Wiemer-Hastings, Skowronski, and Britt, 2005; Schraw et al., 1995). More so, metacognitive skillfulness has been found to outweigh intelligence as a predictor of learning performance (Veenman and Spaans, 2005). This is most likely so because metacognitive knowledge is said to play a compensatory role in cognitive performance by improving strategy use (Schraw et al., 1994). Therefore, students with higher metacognitive abilities would be more aware of learning requirements and thus contribute significantly more in a cooperative group (Shia et al., 2005). Metacognitive

knowledge can have concrete and important effects on cognitive enterprises of children and adults. For example, it monitors the selection, evaluation, revision, and abandoning of goals, cognitive tasks, and strategies (Flavell, 1979). In addition, metacognition enables individuals to better manage their cognitive skills and determine their weaknesses that can be corrected by construction of new cognitive skills (Coutinho et al., 2005; Ohio Literacy Resource Center, 2004). Metacognition has been found to control functions like perception and attention (Shia et al., 2005).

Regulation, in general, is important for both individual and collaborative learning (de Jong et al., 2005). For example, metacognitive planning and strategy selection is said to help one determine where to begin and what outcomes to expect along the way (Davidson and Sternberg, 1998; Schraw et al., 1995). Monitoring of a variety of cognitive enterprises is said to occur through interactions among metacognitive knowledge, metacognitive experiences, goals (tasks), and actions or strategies (Flavell, 1979).

Considering the literature base, we describe the relationship between the RTEP-oriented learning environment and student teachers' metacognition and learning. The ICT-based learning environment that promotes a RTEP will increase student teachers' metacognition. In turn this will enable the students to make better use of their knowledge and skills and as such will enhance their learning. Students who are highly metacognitive will be able to identify good strategies and recognise how and when to use them. They will regulate their learning through planning, managing information, monitoring, debugging, self and peer evaluation. At a concrete level, these students will carry out self and peer reflection. They will prepare adequately for discussion in the activities, thus take an active role. This will enable them to generate new information through comparison and identification of gaps. When they learn something new they will contrast this with information available, look for abstraction, etc. On the other hand, students who are not involved in metacognition will not reflect on their learning and strategies. Therefore these students will not be able to regulate their learning. This type of students may not make use of the resources available in the environment.

Research questions

1) How do student teachers describe metacognition?
2) How do student teachers carry out metacognitive activities in an RTEP oriented learning environment?
3) What are the perceived opportunities for promoting metacognitive activities in the RTEP-oriented learning environment?
4) What do student teachers' perceive to be the impact of metacognition on their learning?

Research design

In a quasi-experimental setting, second year university student teachers (*N*=96) from four universities in Uganda participated in a RTEP oriented learning environment http://allserv.rug.ac.be/~mvalcke/elearn/index.htm for nine weeks. This started after a hands-on orientation session and trial period in order to gain sufficient experience to study in the ICT-based learning environment. They covered three topics in educational psychology: personal and social development, motivation of students and creating effective learning environments for effective teaching. They were involved in asynchronous discussions about three activities; each lasting three weeks. Teacher support was controlled by building on model of Salmon (2000). She distinguishes five levels of moderation: (1) access and motivation, (2) online socialization, (3) information exchange, (4) supporting knowledge construction and (5) development through assisting students to monitor and evaluate themselves. In all the asynchronous collaborative activities, the student groups received the first three levels of support. When tackling the study activities in discussion theme two and three, student groups were put in one of three different conditions; Four groups only received support up to level three only (condition 1), another four groups received support up to level four (Condition 2) and the other four groups received support up to level five (Condition 3).

Research sample

Student participation in the study was based on a voluntary basis. The 96 student teachers from four universities were put at random in one of 12 groups. In each group, this resulted in groups of eight students: 4 times 2 students from each university. Student teachers mastered basic ICT skills: Microsoft word, email, chat and Internet-navigation before embarking on the experiment.

Research instruments

The data to answer the research questions were gathered through focus research groups (FRG). A discussion protocol was developed after a review of the literature about metacognition and the development of metacognition. The study instrument was designed to capture information about student teachers' experiences about metacognition, the nature of the learning environment in view of the fostering of metacognition and the perceived impact on their learning. Table 1 summarizes the protocol used in the FRG.

Table 1. *Focus research group protocol for University students*

Metacognition: awareness and metacognitive activities

Objectives:

- Establish whether the students thought about the way they were learning during the e-learning experience.
- Ascertain the influence of e-learning onto metacognition awareness and metacognitive activities.
- Find out students' opinion of the impact of metacognition onto their learning.

1. How different was e-learning compared to your normal class?
2. What did/not you like most about e-learning
3. Have you ever thought about the way you learn?
4. How do you learn?
5. When you think about the way you learn what exactly comes to your mind? Please mention the process you go through while thinking about the way you learn? *Give examples of the thoughts that cross your mind.*
6. During e-learning did you ever think about the way you learn? If so, what exactly did you think? What conclusions did you draw from that thinking?

- *What kind of plans did you develop for your e-learning?*

  - Establish prior knowledge to help with this particular task.
  - In what direction do I want my thinking to take me?
  - What should I do first?
  - Why am I reading this selection?
  - How much time do I have to complete the task?

- *How were you monitoring and maintaining your plans for e-learning?*

  - How am I doing?
  - Am I on the right track?
  - How should I proceed?
  - What information is important to remember?
  - Should I move in a different direction?
  - Should I adjust the pace depending on the difficulty?
  - What do I need to do if I do not understand?

Table 1 (continued)

- *How and when did you evaluate your plans for e-learning?*

  - How well did I do?
  - Did my particular course of thinking produce more or less than I had expected?
  - What could I have done differently?
  - How might I apply this line of thinking to other problems?
  - Do I need to go back through the task to fill in any "blanks" in my understanding?

7. Under what circumstances did you think about the way you learn during e-learning?
8. What opportunities are there in e-learning to help you think about the way you learn?
   - Questions for reflection
   - Guidelines onto making a portfolio
   - Learning resources
   - Collaborating students
   - Moderator support
   - Tips for self evaluation
   - Tips for peer evaluation
   - Reflection phase
9. What do you think about the way you learn during e-learning?
10. What is your opinion about thinking about the way you learn?
    a. Advantages of thinking about the way they learn.
    b. How can you help someone think more about the way they learn.
11. How would you compare the opportunities for thinking about the way you learn in an e-learning situation and in our normal lectures?
12. What is your opinion about the impact of thinking about the way you learn on learning?

Final question: Would you consider taking this e-learning course again?

* E-learning was used to refer to the RTEP oriented learning environment supported by ICT

* Thinking about way you learn was used for metacognition

Research procedure

At the start of the study, students were asked to give their – written - consent to participate in the study. Next, prior to the experimental treatment, all students participated in a hands-on orientation session, involving both the student teachers and their regular lecturers.

Student teachers were provided with the URL of the learning environment http://allserv.rug.ac.be/~mvalcke/elearn/index.htm, usernames and passwords to access the discussion forum of their respective groups, two diskettes to serve as their portfolio, a hard copy of the activities and learning resources, and a user guide to help them working in the learning environment. The computer lab was provided with extra printing paper and printer cartridges. The student teachers were given a certificate of attendance at the end of the experiment.

In the learning environment, students could find information about the research study, the staff, the learning resources, an introduction to the different discussion activities, and most importantly access to the asynchronous electronic discussion environment. In view of participation in the discussion activities, two students were given a role (chairperson or summarizer). Extra information was provided to give additional information about the tasks related to the specific role. Each activity had two main phases of discussion (the brainstorming and summarising session). The two had different guidelines for reflection for the student teachers. The student teachers experienced RTEP tenets as highlighted in Table 2

Table 2
Elaboration of RTEP in the learning environment

Tenet	Provision in the learning environment
Starting from concrete practical problems and the concerns as experienced by (student) teachers in realistic contexts.	- Authentic tasks e.g. Ensuring personal and social development of students is insured in the day to teaching, solving a problem of a student with no motivation to study and debating the importance of an effective classroom environment vs. effective teaching. - Guidelines to reflection on student teachers' experience in the brainstorming session e.g. o You could consider giving practical ways into which students personal

Tenet	Provision in the learning environment
	and social development can be enhanced by a teacher. Try to recall how this was done to you when you were a student. o Put yourself into the perspective of John and figure out what could be the possible causes of lack of motivation.
Promotion of systematic reflection of (student) teachers on their practices and experiences, on the role of the context, and on the relationships between these aspects.	- Guidelines for reflection e.g. o Present the importance of your stand for effective learning and teaching especially by putting yourself into the perspective of a student and how this would benefit you. - Questions e.g. - What does this imply for you as a teacher? - How would you ensure that this is integrated and achieved within your day today teaching? - Checklist for self and peer evaluation e.g. o I explored my learning environment and used my experience to generate responses with well documented real examples within my experience backed by evidence from literature. o I am confident when faced with such a scenario our discussion would be a rich resource for promoting students' personal and social development. - Phased asynchronous discussions – brainstorming and summarising phase. - Flexible time for each activity – three weeks - Logbook

Tenet	Provision in the learning environment
Personal interaction between the teacher educator and the (student) teacher and on the interaction among the (student) teachers.	- ICT supported learning environment - Electronic discussion groups - Chatroom - Provision for moderation based on levels of Salmon (2000)
Three levels of professional learning (*Gestalt, schema and theory)*	- Emphasis on knowledge construction from multiple perspectives e.g weigh new evidence provided and select the most appropriate then use the information generated over the whole discussion period produce a write-up Collaborate with your group to agree and justify the structure of the write up on how and why help your students acquire personal and social development in their pursuit of their academics that can stand the test of time. - Role assignment in the activities - Structure of the tasks (brainstorming, summarising)
Integration of theory and practice	- Authentic tasks involving students putting themselves into the perspective of teaching – creating an effective learning environment - Links to learning resources

Three focus research groups were organised, based on the protocol presented above. 10 - randomly selected - student teachers were asked to participate in the FRG.

Focus research groups

An email message was sent to each of the technical coordinators in the Universities to select at random ten participants from the students involved in the study. Equal numbers of male and female student teachers were selected. A discussion time and venue for each university was agreed upon. Prior to the discussion, the consent was asked of the participants to record their discussions. The ten student teachers were asked to base their input on their personal experiences with the learning environment. They were informed about the overall context of the study: the evaluation of the online learning environment in view of improving distance teacher education in Uganda. A discussion procedure was agreed upon:

1. Listening attentively to the question.
2. Seek clarification of concepts in case the question is not clear.
3. Use a reflection time of about three minutes to digest the question and jot down individually key words to document your responses before getting involved in the discussion.
4. Allow one student to respond at a time.
5. Avoid duplication of responses; encourage supplementing new input.
6. Understand that there is not a right/wrong answer, considering the nature of the questions about perceptions, opinions.

The discussion was conducted in a calm physical setting. The deliberations were both audio recorded and notes were taken by a secretary (a research assistants, supporting the researcher). The discussion was guided by the protocol which was used by the researcher to ask questions and to probe for more information. Each discussion lasted for three hours at most.

Qualitative analysis

The audio recorded data was transcribed into written transcripts by two research assistants. Their transcripts were compared and where there was a discrepancy the tapes were replayed to sort it out. The written transcripts were typed. The printouts were then compared to the written transcripts and corrections made where appropriate. In this study data analysis is based on content analysis of words, phrases and sentences. The analysis of FRG transcripts was guided by the research questions as recommended by (Krueger, 1998). Two coders were trained. The training included an insight into the discussion protocol and how each question relates to the research questions and identification of key concepts of metacognition awareness and activities in the transcripts. The coders carried out analysis independent of each other. Using cut and paste, the typed transcripts from the audio recordings were sorted into themes of the research questions: (1) description metacognition, (2) how student teachers carried out metacognitive activities, (3) perceived opportunities in the environment that promoted metacognitive activities and (4) perceived impact of metacognition on learning. Then the coders and the researcher met to discuss the sorting into themes. Intercoder reliability exceeded 90%. Together the researchers reviewed the list for each theme among others duplicates where eliminated.

Considering theme by theme, latent coding ensued by the researcher using the knowledge of metacognition presented in the theoretical framework and research questions. Judgement was done on explicit, implicit and doubtful content. Care was also taken to highlight ideological dilemmas. This is particularly important when it comes to contrary and competing augments (Edley, 2001). Stanley (2004) contends that statements/beliefs are always given in particular social context and therefore discourse analysts need to pay attention to the variability of participants' discourse, and particular social functions which this variability might serve. According to Potter (1996), participants draw on a number of repertoires, flitting between them to construct the sense of a phenomena or perform different actions. Therefore the results are presented in relation to the different interpretive repertoires they represent. In reporting the results are documented with student quotes.

Results

Results are structured following the research questions that were used to elicit student responses. An introduction is given in relation to each "theme" that was identified in the student responses. Metacognition in the context of the FRG is used as a container concept because it is hardly possible to indicate whether students point at metacognitive experiences, strategies or knowledge. Next, we document the theme with quotations from the students. The quotations have not been edited as to the English grammatical structure. A summary about the results is presented at the end of a section related to the research question and the concepts of metacognition in the strategic framework.

1) How do student teachers describe metacognition?

To elicit responses to this research question, two questions were asked: Have you ever thought about the way you learn? When you think about the way you learn what exactly comes to your mind? Cues were also given to stimulate discussion: *Please mention the process you go through while thinking about the way you learn? Give examples of the thoughts that cross your mind.*

Student teachers in the three groups unanimously agreed they had explicitly reflected upon the way they learn. Student teachers describe metacognition in three main categories: as important, continuous and challenging. They are clear that metacognition is a responsibility of the individual.

When it comes to metacognition being important, student teachers spell out its role in motivation, planning, monitoring and self awareness. Thinking about the way one learns *is relevant apart from being the best way to study. It makes one prepared for what they are about to do, then give what you ought to give and strategies for better learning. Monitoring myself would show me where I was. It makes you aware of when and how you need to learn and when you cannot learn.*

Metacognition is acknowledged as being continuous in relation to learning new things and monitoring which are geared towards improvement. For

instance it is referred to as: *It motivates to go on and find out more. It is a process of discovering new things. It is a continuous process*. It has *application in future.*

Metacognition being a responsibility of an individual was echoed in statements like:
I need to think about what I am learning and to learn it myself. It is my role for example *before the lesson I read ahead so that I am active in class.*

Despite its acknowledged importance, student teachers hasten to indicate that it can be challenging especially when one identifies their weakness that can be discouraging. *It is good and challenging and it helps one to identify failure and improvement areas. At times it can be discouraging.*

We can conclude that metacognition is described in terms of why it has to be done, how it is done and who ought to do it. Student teachers attach value to thinking about the way they learn, and recognize this is their individual responsibility. The description is predominately related to regulation of cognition. They describe it in terms of planning of what to do, when and how in addition to monitoring. There is also a tendency to acknowledge knowledge of cognition for example procedural (how to learn), declarative (strategies) and when to or not to learn (conditional). They equally underscore it as a continuous process characterized by a need for improvement, continuous monitoring and application of what works. They hasten to mention that it helps to identify areas of failure and those to be improved; which can be discouraging and challenging at times.

2) *How do student teachers carry out metacognitive activities in an RTEP oriented learning environment?*

Responses to this research question were brought forth by the following questions: during e-learning did you ever think about the way you learn? If so, what exactly did you think? What conclusions did you draw from that thinking? The responses stimulated other probes like: What kind of plans did you develop for your e-learning? How were you monitoring and maintaining your plans for e-learning? and how and when did you evaluate your plans for e-learning?

The experience of a RTEP oriented learning environment supported by ICT is said to have made all student teachers think about the way they learn and consequently they took action to address its revelation. The actions taken can be broadly grouped following four themes: planning, embracing required skills and strategies, monitoring and debugging.

a) Planning in the learning environment is said to be related to time allocation (for research, preparation and participation) and time to find answers to anticipated questions. This was echoed in the following statements: *I also put time aside for library research, during e-learning I did a lot of planning before hand what I was to do* and *I decided to allocate 1 hour for e-learning daily*. In comparison to normal class student teachers said *I try to analyze what I have been taught as I prepare for examinations. When I am preparing for examinations is when I think about the way I learn.*

b) Thinking about required skills and strategies was pertinent to the student teachers. This was related to different stages in their experience with the online course (before the course and during participation).

Before the course student teachers were already thinking about the skills required and the strategies to adopt. For example students indicate that *I had to consider skills required for the research like typing and reading online etc, I re-apportioned my timetable and I would wake up early to enable me use the computers.* This thinking guided the preparation phase. Preparation mainly involved adequate research activities and being guided by the available resources.

Students said they would: *Read about the topics given to us, research* and *I access previous knowledge that may help me to connect to the new knowledge.* Preparation also involved looking ahead for example, *thought of chatting process,* got *questions from the activities, I would also imagine and spot what the group mates could write then try to respond to them in advance,* got *notes put all together answers to particular questions* and *in my room I try to reflect and write down solutions.*

With regard to participation, they thought about their collaboration: *Discuss with other, I contacted fellow individuals for help, took on other peoples role that were not doing their part like to summarize, put feedback forward and read others people's work, criticize others work and improve it* and used *textbooks to respond and also other students.*

c) *Monitoring* of progress was stimulated by - among others - feedback from other students, explicit reference to the task goals, the self assessment activities, feedback from the moderator and the use of previous experience.

The group was emphasized as a monitoring tool, in particular for giving feedback: w*riting down very fast then trying to establish whether I am on track by checking other people's views from their reactions to my post, I monitored our learning through taking note of group member's comments, the group feedback was my monitoring tool* and *when no one was not responding.*

Self evaluation was considered to help to monitor their involvement; in particular to identify goals and shortfalls when acting upon them: *I would carefully read to establish what is intended to be presented in the activity, whether I was doing well, refer to instructions, I related the questions to my day to day thinking and I would also gauge the worth of my post for passing and examination. At times I would find that I need to give more information, examples and clarifications, I would edit my posts or send correction, I read my work to check whether I was in line with my group members and when I read others' comments I revisited my response.*

The moderator's comments and tips gave the students feedback, and were used to monitor their progress: *I took keen interest in the moderator's comments.* The tips emphasized a link to previous experiences: *Try to follow up from the previous.* The moderator helped in time management by encouraging us work within the time available.

d) In their experience student met some challenges that called for *debugging: whenever there would be no headway I could do more focused reading in the library, I would leave the difficult areas at times and I would consult others or the lecturers. In a difficult situation I would allot more time to think about the problem* or *wait.*

In summary, in a RTEP oriented learning environment supported by ICT students are involved in metacognitive activities (planning, embracing skills and strategies required, monitoring and debugging). These activities lead to metacognitive experience – in particular establishing one's cognitive state. This tends to be related to the different phases in getting involved in the study experience: before starting and during participation. The key actors that play a role in this impact on metacognition are the individual student, the group, the moderator, tenets of the learning environment and the available resources.

3) What are the perceived opportunities for promoting metacognitive activities in the RTEP-oriented learning environment?

Opportunities for metacognition were asked via three questions. (1) How different was e-learning compared to your normal class? (2) Under what circumstances did you think about the way you learn during e-learning? (3)What opportunities are there in e-learning to help you think about the way you learn? (4) How would you compare the opportunities for thinking about the way you learn in an e-learning situation and in our normal lectures?

The RTEP oriented learning environment offered different opportunities to promote metacognition. These are related to the activities (structure of the task, nature of the content and authenticity), the online pedagogy (asynchronous discussions, self-directed learning and absence of face to face), support from other students, resources (availability and challenging nature) and course flexibility.

a) The activities' task structure, content and authenticity are said to have provided opportunities for metacognition in the RTEP oriented learning environment.

Task structure an opportunity for metacognition was through the purpose of the activity, the guiding questions, the self and peer evaluation and the phased discussions.

The *purpose* of the activity was mentioned as an opportunity for metacognition for example *the purpose of the activity focused me to think about the way to approach it.* The questions are said to stimulate thinking, as mentioned below: *the type of questions, like what does it imply for you as a teacher?, questions that stimulate thinking, the kind of questions that provoke you to study a lot and the guiding questions in the activities especially when reread.*
Both self and peer evaluation were given as opportunities for metacognition. Self evaluation is considered an opportunity to assess individual input, ones' approach, and to identify weakness for example in reference to self evaluation students said - it is i*mportant to know where you stand, in addition you know which questions were answered well, I also find out if I followed the right approach and I crosscheck with the notes.* They also said: *I identify what made me fail,* I also identify my weaknesses and it motivates me and gives me means of passing better. *One said I normally do self evaluation when still in the lab, or when stuck for better strategies. As I write I reflect onto what is being done and more often I do this evaluation at the end of the activity.* The self evaluation benefited from the possibility to compare individual input with input from others and through feedback provided by other students: s*ome people did self and peer evaluation, evaluating your self and comparing yourself to others and the small group helped us to identify each others' weakness.*

The phased discussion (first a brainstorming session; next summarizing session): *The different phases including brainstorming* were an opportunity for metacognition.

The *content* of a task also provided opportunities for metacognitive activities: a*ctivities were a motivating factor already, the remedial nature of the activities and activity 2 on motivation.*

Authenticity of the activities: e-*learning opened us to the world outside us, relevant issues in our day today, relevancy and real life of the activities and the world of reality.*

b) The *online pedagogy* (asynchronous discussions, self-directed learning and absence of face to face meetings) provided opportunities to get involved in metacognitive activities.

Asynchronous discussions were an opportunity for metacognition in particular regarding student interaction, collaboration, getting feedback and reading other student contributions: Interaction was applauded in t*he interactive nature of the discussion and sharing experiences.* Collaboration was mentioned as *group work arguing to convince, group work for one to have read through and group mates made me know what I had done and mixing the university challenge to keep your university name high. Positive feedback* was also acknowledged as an opportunity. Colleagues' motivation was also an opportunity: a *colleague in the group, reading other people's view and gender issues especially ladies questions.*

The RTEP oriented learning environment required the student teachers to employ a different learning style. Opportunities for metacognition mentioned include self-directed learning, collaboration, active involvement without a hierarchical structure in the interaction. Self directed learning was echoed as: *in e-learning one does things for self, in the traditional classroom you have to listen to the teacher, e-learning is more challenging you alone have to generate your own ideas unlike in the normal class where it is on a silver plate, e -learning is personal for you discover things for yourself and less guidance gives you time to do your work.* Collaboration as an opportunity also was mentioned as*: it was good, we learnt though discussions, we also taught and e-learning is an interesting exposure to sharing.* E-learning promoted active involvement as indicated by the following sentences: it g*ives a sense of responsibility, thought about our opinions, e-learning is practical and more active than the normal class, everyone has a chance to take part and can only be done when you think.* Absence of face to face interaction was also mentioned as an opportunity for metacognition: *interacting at a distance, anxiety to learn with people you with people you do not see and we do not have face to face contact.*

c) *Support* from moderators stimulated metacognition: *moderator's and technician's encouragement, the moderators' remarks, some mail with positive feedback. [Our technician] would ask us how far we were, [Our technician] read to us the letters and he [Our technician] encouraged us to the extent of going to our rooms.* In contrast to their normal class students describe *a lecturer is more like spoon feeding.*

d) Both availability and absence of specific *resources* provided opportunities for metacognition: *the user's manual and references in the activity booklet, guidelines could help us identify our mistakes, the availability of the learning resources so that we can go back to it any time and resources are used economically and can be reused.* Other opportunities for metacognition in the resources were based on: *the working environment was interactive, e-learning resources were motivating, access to the internet and more chance to visit other sites and supplement what you have.*

Students contend that some challenges were an opportunity for metacognition like w*hen I would get stuck with the computer.*

e) *Flexibility* of the course was an opportunity for metacognition as indicated: the course had *no pressure and was free, more time for reflection than in normal class where you have to follow a schedule, e-learning offers flexibility in learning unlike the restrictions in our classrooms where you are working towards examinations, more time to react, edit and self evaluate and anytime flexible.*

In summary, the RTEP oriented learning environment has presented opportunities that promote metacognition: experiences, strategies and metacognitive knowledge. These are related to the activities (structure of the task, content and authentic nature of the activities), the online pedagogy (asynchronous discussions, self-directed learning and absence of face to face), support from other students, the learning resources (availability and challenges) and the perceived flexibility of the course.

4) *What do student teachers' perceive to be the impact of metacognition on their learning?*

Responses to this research question were elicited by one single question: What is your opinion about the impact of thinking about the way you learn on learning? The impact of metacognition on learning given was two fold: the impact on the student and on the learning process.

a) Metacognition was implied to support learning through making students reflective, self-aware and able to take decisions. At times it can be challenging.

With regard to influencing reflection metacognition is described thus: *It can act as an eye opener, it sharpens our minds makes us philosophers we meet in our day to day life,* encourages *deep critical thoughts* and we are able to *criticize selves what is going on in our mind and externally.*

Metacognition is said to promote learning through encouraging self-awareness: *When you get to know who you are it can help you to style up,* it makes us *be masters of ourselves, makes us analytical and know your limitations*. In addition metacognition is said to influence students to be more confident of themselves: *you surpass any body in your way of thinking, makes me confident of myself, sharpens our reasoning capacity, ever ready for all kinds of questions and makes your brain sharp that you can answer everything.*

Metacognition influences learning because of being instrumental in taking decisions: *You make the right option regarding your future career, enables one to self evaluate then revisit the method of teaching or learning and to avoid the mistakes. It* enables one *to react and change issues and makes one identify alternative ways of learning.*

The influence of metacognition of learning at times can be challenging for the students: negative thinking about the way you learn can make you theoretical and wonder in the world of ideas and may be a challenge if your best situation is not provided.

b) Metacognition is said to have an impact on learning through influencing the learning process. This in particular is through promoting assimilation of knowledge and improved conditions of learning.

Metacognition is applauded for making *one understand the content rather than memorize it and broadens or panorama of looking at thing, only when you are concrete is when it makes sense puts ideas into practice* and it *makes you produce something good and presentable.*

The process of learning is enhanced through improving conditions of learning: *It is crucial because it can help you to know how we learn best, you take time to put thoughts into practice, thinking twice before you do anything you become confident with what you have done.* Metacognition also influences the process of learning

through *making one more practical and it makes the teacher teach the way we want to learn.*

In summary, the impact of metacognition on learning relates to metacognitive experience especially of the cognitive state thus influencing the student – especially the regulation of cognition and the learning process – facilitates reflection onto knowledge about self and about strategies (declarative knowledge) and knowledge about when and why to use strategies (conditional knowledge). Metacognition is also stated as posing challenges to learning e.g. when it promotes negative thoughts and helps to detect unfulfilled conditions.

Discussion

The discussion of the results will be structured along the research questions and will be related to the available literature. The results should be interpreted in the light of what students perceived through the exposure to RTEP oriented learning environment in relation to their normal class. In their normal class the student teachers take on a passive role where they receive from the lecturer and in sharp contrast to the experience in this study they were involved in their own learning. Where appropriate and available the distinction between the two environments will be given to put student perceptions into perspective.

1) How do student teachers describe metacognition?

Student teachers are very clear that they carry out metacognition. Their description of metacogition relates to other authors' Fernandez-Duque et al (2000), Hacker (1998) and Schraw et al (1994) as the ability to reflect upon, understand and control one's learning. Student teachers contend that they were expected to build on their own motivation to foster their metacognition. This agrees with the authors that put the self at the centre of metacognition (Fernandez-Duque et al., 2000; Hacker, 1998; Schraw et al., 1994). Student teachers metacognition encompasses cognitive and regulatory aspects. Knowledge about cognition is described by referring to procedural, declarative and conditional knowledge: knowledge about how

to do what, about what strategies are to be applied, and when they are or are not to be applied. The regulation aspect of metacognition is reflected in student references to planning, monitoring and identifying areas of failure and improvement. The description relates largely to definitions of metacognition of other authors, such as (Schraw et al., 1994; Schraw et al., 1995). That withstanding, results indicate that given the regulation of cognition can be a challenge especially when the outcome is discouraging. This presents an ideological dilemma in comparison to when the very students suggest that regulation of cognition helps one to improve.

2) *How do student teachers carry out metacognitive activities in an RTEP oriented learning environment?*

This question was poised to corroborate the findings in the first question. Apart from student teachers describing metacognition, we thought it important to establish their description of exactly how they did it, to gain more insight. Indeed results are clear that in the RTEP-oriented learning environment students carry out metacognitive activities. They refer to considering both metacognitive knowledge (knowledge about specific skills and strategies) and the regulation of their cognition (planning, monitoring and debugging) during different phases of the learning experience. Linking the two questions we see similarities in regard to procedural knowledge and regulation of cognition. The results also indicate that this metacognition is promoted by how the individual student relates with the group, the moderator, the learning environment and the available learning resources. These findings relate to the components of metacognition that were presented in the theoretical framework: metacognitive knowledge, regulation of cognition and metacognitive experience (Hacker, 1998). More specifically it relates to the argument of Flavell (1979) that metacognitive knowledge can also lead to metacognitive experiences concerning the self, tasks, goals and strategies, and this in turn can help to interpret the meaning and behavioral implications of these experiences. This result reveals a challenge of student teachers to carryout metacognition in their normal class where there is minimal involvement in carrying out tasks because the learning is lecturer centered, no phases of learning for an individual task and collaboration is minimal.

3) *What are the perceived opportunities for promoting metacognitive activities in the RTEP-oriented learning environment?*

The RTEP-oriented learning environment presents opportunities for getting involved in metacognitive activities involving metacognitive experiences, knowledge of cognition and regulation of cognition. This echoes what other authors Vye et al (1998) concluded earlier; enhancing students' metacognitive skills by providing them greater opportunities to participate in classroom activities that clearly support the use of particular strategies.

In the learning environment we paid much attention to developing the structure of the learning activities. Authenticity, goal-directedness, presentation of a clear task structure are the typical characteristics that were expected to direct student involvement. Building on the student responses in the FRG, these characteristics encouraged them to put themselves into the position of a teacher handling those problems. It promoted translating theory into practice. The embedded questions seemed to have the desired impact: they fostered reflection. These were applauded by the students as opportunities for being involved with metacognition. Each activity comprised a two-phased discussion: a brainstorming part and a summarizing part. The time in-between served as an opportunity for reflection; with the logbook as an explicit reflection base. At the end of the activity student teachers were given a checklist to guide their self and peer evaluation. Student teachers were constantly encouraged to reflect upon their contributions and to evaluate themselves and their colleagues. The RTEP oriented learning environment seemed to have significantly influenced their evaluation approach. The FRG transcripts can be related to evidence that the environment facilitated reflection for some students (Seale and Cann, 2000). The peer evaluation results had to be sent to the other group members. This evaluation component was again an opportunity for reflection. This is in line with the observations of de Jong, Kolloffel, van der Meijden, Staarman, Kleine, and Janssen, (2005) that concluded that computer mediated communication interactions also promoted their students to monitor the collaborative process and to evaluate the learning process in terms of the group and task goals.

Learning online was a new experience for the student teachers and this positioned them in the context of an online pedagogy. Asynchronous discussions were promoted, lacking the face to face communication as experienced in normal classroom settings. Nevertheless, they reported that the text-based nature of the communication tool fostered reflection. Also other authors refer to the positive impact of the asynchronous nature. It gives time to reflect before commenting or carrying out a task (Harasim et al., 1995; Swan, 2001). In addition, students felt to have control of their learning unlike in their normal class where the teacher is in control. The experience forced them to be metacognitively involved. They had to focus on their problem solving and to explain what they are trying to do. This is reported to promote metacognition (Dominowski, 1998). This finding can also be related to the study of Flavell (1979) who ascertained that situations that stimulate a lot of careful, highly conscious thinking promote metacognition.

The student teachers hasten to add that they were encouraged by others like the group, the moderator and the resources. This finding tends to support the augment of Carr and Biddlecomb (1998) that the development of metacognitive knowledge occurs through interactions with a child's past experience, interaction with peers and teachers, and input from the environment. Collaboration was emphasized as the gist of the course. The moderator played a role in directing metacognition because of the questioning, the feedback and the proposals to further their thoughts. The learning resources were also applauded in this context. There was unlimited access to online learning resources; thus invoking reflections about "there is more information out there"; "we should build our input on more than what is available here". The flexibility of working on the learning activities gave students an opportunity to discuss their work during a longer period of time. This was applauded as an opportunity for metacognition. It gave extra time for reflection and acting on its consequences. The above provide time for metacognitve experience. The learning environment is key in promoting metacognition (Flavell, 1979; Pressley, Van Etten, Yokoi, Freebern, and Van Meter, 1998; Schraw, 1998; Vye et al., 1998). Student teachers responses point to inadequacy of these opportunities in the normal learning environement for example where students applaud taking

an active part in their learning as an opportunity for metacognition they go ahead to say that in the normal class there is "spoon feeding". Time available for an activity as an opportunity is also a challenge for the normal class teaching because each lecturer is scheduled for one hour and this does not allow the mentioned flexibility needed for metacognition.

4) *What do student teachers' perceive to be the impact of metacognition on their learning?*

The student responses in the FRG present indicators of their perceived impact of metacognition on their learning process and performance.

Evaluating what you know and what you do not know, as well as discerning your personal depth of understanding about key points, promotes efficient effort allocation (Coutinho et al., 2005; Paris and Winograd, 2005; Schraw et al., 1994). This is fostered through design features of the learning environment: the inclusion of guiding questions, evaluation checklist, and reflection phases. The learning environment promoted RTEP which explicitly encouraged a lot of reflection. Cognition facilities reflection on self and strategies, how to use the strategies and when and why use the strategies (Schraw et al., 1995).

The findings of this study are in line with other studies that state that the explicit promotion of metacognition plays a critical role in directing information processing activities and successful learning (Coutinho et al., 2005; de Jong et al., 2005; Livingston, 1997; Shia et al., 2005; Schraw, 1998).

The study overall presents a good case for the role of the RTEP oriented learning environment supported by ICT in promoting metacognition. It is important to note that this is based on a qualitative study based on perceptions of students. In future more insight into this could be promoted by a mix of methodologies where the quantitative can triangulate the findings of the qualitative. This study had this intention in mind which was however foiled by the near no response from the student teachers on the quantitative instrument. More so the future studies could consider explicit analysis of metacognitive knowledge and strategy use in discussion

activities; concurrent analysis and post hoc analysis. Similarly, a link between observed metacognitive activity and impact on learning process and performance. That way a conflict between perceptions and actual activities can be identified if it exists.

Metacognition as a concept embraces terms that may not be explicitly communicated or separated in the definitions of student teachers. This could also have resulted in conceptual confusion. Also the challenge of not wanting to define metacognition to avoid biasing the discussants could have been a missed opportunity to elicit more specific responses.

The rhetoric and semi structured nature of the focus research groups may have limited the problematisation of metacognition. Future studies could explore metacognition in a more broad way to elicit more unstructured responses from the students. The students could also be encouraged more to elaborate their responses so as to help identify their interpretative repertoires and ideological dilemmas.

The discussion suffered the lack of adequate literature on the impact of an RTEP oriented learning environment on metacognition. Thus the call to have more impact studies whose findings can be contrasted to gain more insight into metacognition.

Conclusions

Student teachers' description of metacognition relates to that of other authors and encompasses the knowledge of cognitive, regulation of cognition and metacognitive experience. In particular, the RTEP-oriented learning environment promoted the explicit utilization of declarative metacognitive knowledge (skills and strategies) and regulatory metacognition (planning, monitoring and debugging). The perceived involvement in metacognition is reported to have been supported by student involvement, the group discussions, the presence of moderator and tenets of the learning environment. Metacognition is said to have been influenced through the fostering of student self reflection, self-awareness and active decision taking. A relationship was reported with the online

pedagogy that influenced the concrete assimilation and application of the domain knowledge. The results of this qualitative study suggest that a RTEP oriented learning environment - supported by ICT - has the potential to vitalize distance teacher education in Uganda through the promotion of metacognition.

Future studies should corroborate these findings by linking a qualitative study to a quantitative study. This could counter the limitations of the present study that builds on student teacher perceptions. In a future research design, an explicit determination of actual metacognitive processes could be linked in addition to the nature of the student learning process and the nature and quality of the learning outcomes. More so in-depth interviews could also be employed to gain more concrete insight.

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6

General discussion, limitations, implications and final conclusions

General discussion, limitations, implications and final conclusions

Introduction

In this chapter we integrate and discuss the results of the different empirical studies reported in the previous chapters. We relate the findings to the general research problem of the study, elaborated in Chapter 1. In addition to the findings, we spell out limitations of the different studies and present implications about the use of a RTEP oriented learning environment supported by ICT in distance education and present some directions for future research. Lastly, general conclusions are presented.

In the introductory chapter of this PhD we hypothesised that the use of ICT in distance teacher education has the potential to enhance the efficiency of teacher education in terms of flexibility, might influence student teacher's perceptions of instructional approaches and might result in a more effective learning process.

At the start of this study, a review of literature on distance education and the integrated use of ICT in distance teacher education was carried out. The review of the literature helped to develop some research instruments that directed the study of the actual status of ICT use in distance teacher education in four universities in Uganda. Given the very limited use of ICT in distance teacher education, additional data were gathered by interviewing experts from ICT in education initiatives in Uganda and by building on perceptions of the actors of distance teacher education about the envisaged use of ICT.

Next, three quasi experimental studies were implemented that focused on ICT-based distance teacher education in teacher education colleges or in universities. The three studies shared the Realistic Teacher Education Pedagogy approach (RTEP), but differed partly in the way ICT was integrated and the dependent variables studied. The online learning environment reflected the RTEP through the following characteristics:
- Active involvement of students
- Collaboration (CSCL)
- Resources in the learning environment

- Interaction in the learning environment
- Self and peer assessment
- Self reflection
- Authentic task based activities

Overview of the research questions in relation to the central research problem

The first research question centred on obtaining more information on the status of ICT and distance teacher education in Uganda:

1. What is the status of ICT in instruction in distance teacher education in Uganda? Three sub questions were researched:

(a) What factors foster the use of ICT in distance teacher education in Uganda?
(b) What are the challenges of ICT use in distance teacher education in Uganda?
(c) What are the solutions to the challenges of ICT use in distance teacher education in Uganda?

In order to study the impact of a RTEP oriented learning environment supported by ICT on learning efficacy (levels of cognitive processing, level of interaction and metacognition), teachers' perceptions of instructional approaches and perceived efficiency (flexibility) the following research questions were addressed

2. What is the impact of a RTEP oriented learning environment on student teachers *levels of cognitive processing* (LCP)?
3. What is the impact of a RTEP oriented learning environment on *student teachers perceptions*? What is the impact of student teachers perceptions on LCP?
4. What is the impact of a RTEP oriented learning environment on student teachers *interaction* in the learning environment? What is the impact of student teachers interaction in the learning environment on LCP?
5. What is the impact of a RTEP oriented learning environment on student teachers *flexibility*?

6. What is the impact of a RTEP oriented learning environment on student teachers *metacognition*? What is the impact of student teachers metacognition on learning?

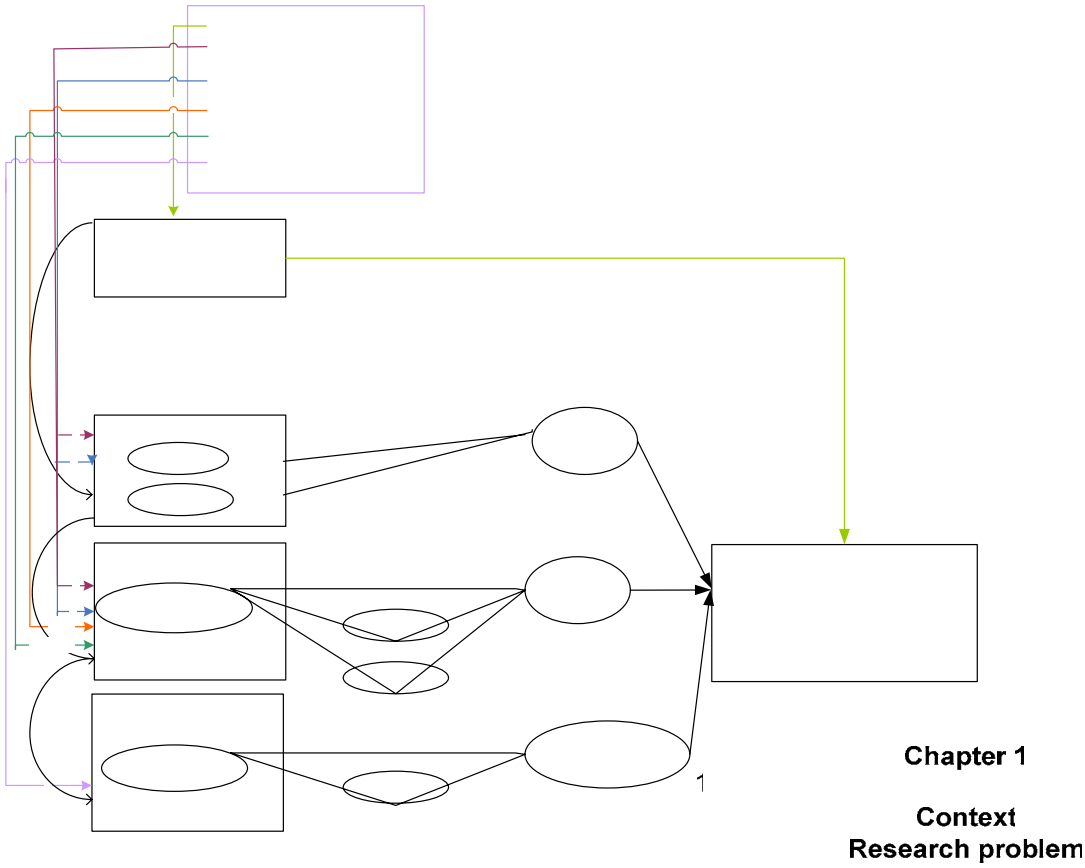

Figure 1. Overview of the research studies

Figure 1 presents a graphical overview of the different studies reported in each chapter and how they differed from each other and build on one another. The numbers in the figure refer to the research questions presented above.

Following an exploratory study of the status of ICT in instruction in distance teacher education in Uganda, four quasi-experimental studies were carried out.

General description of the four quasi-experimental studies

Three quasi-experimental studies were set up between 2003 and 2005. The three studies all built on the implementation of an online learning environment, enriched with asynchronous discussion groups and reflecting the characteristics of a Realistic Teacher Education pedagogy (RTEP). Details of the studies are presented in Table 11 in Chapter 1.

In each of the RTEP oriented learning environments studied in the three studies, each student teacher group consisted of students studying at different teacher education institutions in Uganda. Prior to each study, student teachers participated in an orientation and a hands-on session. In the pilot study, each of the participating student teachers had access to a computer in view of participating in *synchronous* discussions. In all the other studies, students had access to computers and worked together in *asynchronous* discussions. In the first study the activities of the students working in the online environment were contrasted with students in a control condition who carried out the same activities in a face-to-face setting. The knowledge domain of the courses, studied via the RTEP-oriented learning environment differed in the studies: in the first study, students studied "foundations of education", the second the focus was on "science with health education" and in third, the focus was on "educational psychology".
In the first two studies, students were enrolled as second year student teachers in teacher education colleges. In the third study, the students were enrolled at a university as second year bachelor of education students. The group sizes differed in the consecutive studies, with a clear attempt to enlarge the sample sizes. In the second and third study, moderation support was an extra independent variable that was manipulated. Different groups received different levels of moderator support according to the moderation model of Salmon (2000).

In the next sections we discuss the key findings of the three quasi-experimental studies. The key dependent variables are *efficacy* (student teachers levels of cognitive processing and metacognition), student teachers' *perceptions* of instructional approaches (perception of the learning

environment and instructional preferences), and *perceived efficiency* - of the distance education learning environment.

Does a RTEP oriented learning environment result in an effective learning process?

To study the impact of the RTEP oriented learning environment on the efficacy of the learning experience, a variety of dependent variables were studied: level of interaction, Level of Cognitive Processing (LCP) and metacognition. The level of interaction – i.e. the degree to which students were actively involved in the discussions - was also explored as a mediating variable in view of the dependent variable - level LCP. The same applies to the impact of metacognition on learning.

The impact on the level of cognitive processing (LCP)

The results of study 1 reflect a limited impact of studying in the RTEP oriented learning environment on student teacher's levels of cognitive processing. Significant differences between the experimental and control group were observed in at least one activity. These findings are somewhat related to those of other studies in which an ICT-based learning environment promoted high levels of cognitive processing (Aviv, Erlich, Ravid, and Geva, 2003; Aviv et al., 2003; Baker, Quignard, Lund, and Sejourne, 2003; De Wever, Valcke, and Van Winckel, 2003; Gunawardena, Lowe, and Anderson, 1997; Mcloughlin and Luca, 1999; Schellens and Valcke, 2005). The results of the first study can be interpreted in two ways: (1) the RTEP oriented learning environment supported by ICT has an impact on levels of cognitive processing however this impact is task dependent (see also (Schellens, Van Keer, and Valcke, in press) and/or (2) the impact of the RTEP oriented learning environment on the level of cognitive processing depends on the level of experience in the environment. This second interpretation is based on the fact that significant differences only appear later activity e.g., the last activity. The levels of cognitive processing regardless of the study and activity remain low. This was also the case in (De Wever et al., 2003; Gunawardena et al., 1997; Mcloughlin et al., 1999; Schellens et al., 2004a). In a context where the school teaching is very teacher centered, learners are conditioned very early on to rely on the teacher for their learning. The examination system

drives the education system, in that it tests reproduction of knowledge rather than the application of knowledge and skills. This encourages low levels of cognitive processing in that there is very little room for thought and reflection.

The impact on the level of interaction and the mediating effect of interaction on LCP

Studying in the RTEP oriented learning environment was expected to influence the level of student teacher interaction. Both qualitative and quantitative results reported in Chapter 3 (study 1) indicate that a RTEP oriented learning environment positively influenced the level of student interaction. These results are consistent with the overwhelming evidence found in the literature, indicating that an ICT-based learning environment positively promotes student interaction (Aviv et al., 2003; Barak, in press; Berge and Collins, 1995; Biesenbach-Lucas, 2003; Collis, 1998; Dwyer, 2003; Hailes and Hazemi, 1998; Khan, 1997; Makitalo, Hakkinen, Leinonen, and Jarvela, 2002; Meyer, 2004; Newlands, Mclean, and Lovie, 1997; Ottewill, Fletcher, and Jennings, 1997; Passerini and Granger, 2000; Rovai, 2004; Schrum and Hong, 2002; Trindade, Carmo, and Bidarra, 2000; Vonderwell, 2003). In this research, student interaction was promoted by the nature of the RTEP-oriented learning environment. There indications that asynchronous discussions could have been challenged harsh conditions (lack of electricity, fluctuating internet, limited experience and confidence with the learning environment among others). The significant difference in study 1 can be attributed partly to the asynchronous nature of the discussions and number of different colleges involved.

Also the knowledge domain studied by the student teachers could have played a part in this. In the second study the object of subject was "Science with health" while in the first study educational topics were studied and discussed (e.g., foundations of education, teaching methods, teaching techniques and skills which are related to the future responsibilities of the student teachers. Other authors, based on a multilevel analysis, also indicated that the nature of the topic and task could account for a large proportion in explained variance on the dependent variables (see e.g., (Schellens et al., 2004b).

The results of the second study suggest that different levels of moderation support can have a differential impact on the level of student interaction. The positive impact of moderation support was also reported in other studies (King, 2002; Offir, Barth, Lev, and Shteinbok, 2004; Oliver and Shaw, 2003; Rovai, 2004; Seale and Cann, 2000; Wu and Hiltz, 2004). This can also be related to studies that reported how learning outcomes – such as grade point averages (GPA) or grades were influenced by moderator support (Basturkmen, 2003; Fredericksen, Pickett, Shea and Swan, 2004; Hong, 2002; Offir et al., 2004).

The impact on metacognition and the mediating effect of metacognition on Learning

Findings of study 3, reported in Chapter 5, indicate that the RTEP oriented learning environment influences in particular metacognitive knowledge (reflection on knowledge about self and about strategies) and regulatory metacognition (planning, monitoring and debugging) and metacognitive experience. This finding echoes the results of other studies that identified the positive impact of an ICT-based learning environment on metacognition (de Jong, Kolloffel, van der Meijden, Staarman, and Janssen, 2005; Dominowski, 1998; Flavell, 1979; Harasim, Hiltz, Teles, and Turoff, 1995; Swan, 2001). The findings also helped to point out that the impact of the learning environment on metacognition is related to variables in the individual student, the group, the moderator and the available resources.

The qualitative results in the third study confirm the impact of the RTEP-environment on metacognition on learning outcomes through influencing the learning process in particular by promoting assimilation of knowledge and improved conditions of learning

Metacognition is said to play a critical role in successful learning (Coutinho, Wiemer-Hastings, Skowronski, and Britt, 2005; de Jong et al., 2005; Livingston, 1997; Shia, Howard, and McGee, 2005; Schraw, 1998). The results based on the focus research groups reported in relation to the third study, suggest that metacognition is perceived to have an impact on learning through making the student reflective, self-aware and more decisive. This is in agreement with the results of studies that link metacognition to high performance, good strategies and skills for learning

and attention (Coutinho et al., 2005; Ohio Literacy Resource Center, 2004; Schraw and Moshman, 1995; Schraw and Dennison, 1994; Shia et al., 2005; Veenman and Spaans, 2005).

The mediating impact of the level of interaction on the level of cognitive processing

In the first and second study, meaningful and significant results could be presented that support the hypothesis about a mediating effect of interaction levels on levels of cognitive processing. This is in line with the empirical literature that states that student interaction enhances students' learning outcomes such as performance, levels of cognitive processing, grades and learning (Beaudoin, 2002; Bee Tin, 2003; Biesenbach-Lucas, 2003; Clark, 2001; Makitalo et al., 2002; Picciano, 2002; Schellens et al., 2004a; Swan, 2001; Weinberger, Fischer, and Mandl, 2003; Wilson and Whitelock, 1998).

Building on the empirical evidence gathered in the three studies, we conclude that the study experience of the student teachers in the RTEP oriented learning environment has resulted in an effective learning experience; but at a rather basic level. The observed differences were significant or meaningful. The level of interaction seems to be a possible mediating variable. The same applies to the impact on metacognition and its mediating effect on learning.

Does a RTEP oriented learning environment influence student teacher's perceptions?

The ICT-based learning environment promoted tenets of a realistic teacher education pedagogy. It was hoped that these would change student teacher perceptions by the end of studying in the learning environment or in comparison to students in a control condition. Changes were expected to reflect tenets of the RTEP oriented learning environment. The changes in student teachers' perceptions were explored in two studies, while adopting both qualitative and quantitative research approaches. In each study, different changes in student teacher perceptions could be observed. At the end of the first study, student teachers preferred instruction that promotes (1) not being assessment targeted (2) oriented towards the application of knowledge and (3) promoting independence and individual reflection. At

the end of the second study, student teachers preferred instruction that fostered communication, interaction and being child-centred.

These – modest - results have to consider the duration of the experiment and the already high appreciation/perception levels, observed at the start of the studies. Differences in the observed changes can be explained by pointing at the different student samples in the three studies, and the fact they were studying different knowledge domains. The initial high ratings of specific instructional preferences indicates that students did – prior to the study – already have a preference for RTEP-related instructional characteristics; such as collaboration, planning, course that is not assessment targeted, application of knowledge, independence and reflection and authentic tasks.

The results of the two studies can partly be related to other empirical studies that pointed at the impact of an ICT-based learning environment on students' perceptions of the learning environment (Schonwetter and Francis, 2002; Yazon, Mayer-Smith, and Redfield, 2002; Lee and Fraser, 2001; Young, 2003; Arbaugh, 2004). The results also corroborate findings of studies that highlighted the effect on students' instructional preferences (Beyth-Marom, Chajut, Roccas, and Sagiv, 2003; Wen, Tsai, Lin, and Chuang, 2004; Wiske, Sick, and Wirsig, 2001; Yazon et al., 2002).

In the second study (Chapter 4), analysis of the results revealed that certain student perceptions helped to predict levels of cognitive processing. In some way this can be related to other studies where perceptions of students enhanced levels of cognitive processing (Esthel and Kohavi, 2003; Fraser, 1994; Picciano, 2002; Swan, 2001; Telli, Rakici, and Cakiroglu, 2003). Of importance is the observation that the perceptions and preferences that are found to predict the levels of cognitive processing are at the centre of a realistic teacher education pedagogy.

The evidence gathered in the present research is not sufficient to conclude that studying in a RTEP oriented learning environment has an impact on student teachers' perceptions. What is clear through all the studies is that students prefer instruction that builds on collaboration, on planning, they prefer a course that is not assessment targeted, one that promotes

application of knowledge, independence and reflection and authentic tasks. They perceive their learning environment as learning to learn, learning to communicate and learning to speak out.

Does a RTEP oriented learning environment supported by ICT enhance student teacher's perceived flexibility?

Perceived flexibility was used as a measure to determine the efficiency of the new learning provision at a distance. This flexibility was considered as critical to accommodate the varying demographics of students. The results of the second study imply that a well designed ICT based learning environment with adequate learning resources, structured activities, varying communication means and a relaxed timetable, promotes student teachers' perceived flexibility in relation to time, location of study, study mode, study materials, communication and interaction.

The conclusion is related to the research results of other authors. Collis (2001) identified five forms of flexibility that can be supported with ICT: in location, program, types of interaction, forms of communication and time. An ICT-based learning environment has been found to support flexibility in time (Harasim et al., 1995; Uys, 1998; OECD Proceedings, 1996). ICT to support for flexibility in location has been echoed by other authors (Khan, 1997; OECD Proceedings, 1996; Uys, 1998; Valenta, Therriault and Dieter, 2001). Khan (1997) also alludes to the impact ICT on the flexibility in the program of study and interaction. ICT also is known to support flexibility in approaches to communication (Khan, 1997; Spiceland and Hawkins, 2002) and also flexibility in study materials (Khan, 1997; Uys, 1998).

The results of the present study help us to conclude that the RTEP oriented learning environment – due to its ICT based nature - has promoted student teachers' perceived flexibility of their learning situation at a distance.

Limitations of the studies

In this section we outline the limitations of the studies that could have influenced the results and should be taken into account in future studies. The limitations are related to operationalisation of RTEP, the size of the research samples, the timing of the experiments, the incentives for students to study in the learning environment, the available resources, technical challenges, the pioneer experience, the group composition, the study instruments and contextual issues.

In this research RTEP is implemented in a theoretical course thus improvising the assumptions of linking theory and practice. Although effort was made to make the activities authentic so as to appeal to practice, the research would have benefited from a real practical practice. The implications of the challenges of distance education and introduction of ICT on RTEP implementation were not fully underscored. The extent to which the tenets of RTEP were implemented was not fully studied for example the reflection could have benefited from analysis of logbooks as well.

The studies were set up in a quasi experimental setting and with randomly selected students from the natural classroom. This resulted in relatively small sample sizes. The quasi-experimental setting resulted in differing numbers filling out the study instruments. Interference of other courses, changes in planning of school practice, etc. affected student participation. The sample sizes limited the use of more powerful statistical analysis that could focus on the multi level nature of the relationship between independent and dependent variables. In the statistical analyses, we had to consider challenges to the homogeneity of variance, and skewed distributions. We had to shift to nonparametric tests thus clearly affecting statistical power. A clear attempt was made to involve more students in the consecutive studies, but the authentic setting continued to play a role on the student numbers.

The empirical studies were organized during the normal study semester. This resulted in a friction within the timetable of the students to cope with

the different demands of the other courses and the innovative course. Access to the computer and Internet facilities were not always in line with the flexibility expected by the student teachers. This did affect the participation level of students. The studies were set up during a delineated period of time, lasting between eight to nine weeks. An attempt was made to organize longer studies, but we can question whether we could expect a large impact on the dependent variables after a relatively short duration of the experimental treatment. The synchronous nature of the communication in the pilot study was clearly set up at a high cost of the much needed flexibility in the current distance teacher education setting. This made it difficult for students since they had less time to search for information, to produce extended explanations, to evaluate information thoroughly, to ask elaborate questions among others as witnessed by Veerman & Veldhuis-Diermanse (2001).

The studies built on the normal curriculum and where intersected in the course of their study of a particular course. But, we were not able to organize a formal assessment of the learning performance directly after the quasi-experimental study set up. This implies that there was not an immediate reward or formal incentive linked to studying the course. This may have challenged the active participation of some students. Besides, there was also a competition for time from other regular and examinable programs. The orientation of the study on the implementation of a part of a single course in the innovative learning environment is also critical. An orientation that builds on a complete online curriculum would have given the students a more far-reaching learning experience.

According to the student teachers, they were challenged working in the ICT-based learning environment by a number of mainly technical problems. The technical problems were mainly the result of poor or no internet connectivity. The speed of the internet connection was in most cases a frustration for the students. Most students planned their works during the afternoon and evening when this connection was very slow. In addition, power breakdown or unpredicted electricity cuts were an obstacle. Students missed out discussions because of the technical problems and this affected the other students because individual contributions to the discussions dropped. The group discussions had to build on a good input

to be able to develop a group product. Students coming in again later during the discussion had to catch up or started to give off topic input or restarted a part of an already finished discussion.

The technical problems with the computers also affected the number of students filling out the study instruments, since test administration was linked to working with the computers. In the three quasi experimental studies, test administration was done via the computers. At pretest time, this was supervised by the researcher. The planning of the posttest administration was planned in a flexible way to suit the study planning of the individual students. The technical problems did clearly affect the test administration at the end of each study. Pairing of pretest and posttest data was not possible for a number of students and this affected the statistical analyses.

Students – building on the qualitative results – mentioned some problems with the group dynamics related and less favourable expectations. Some group members could not express themselves very well, resulting in an initial misinterpretation of the study activity, delivering less adequate information and giving input with a large number of typing errors. The students differed as to their experience with the use of computers and none had participated in a RTEP oriented learning environment before. So the introduction of the RTEP in distance education for student teachers in itself was an important innovation in this context. However because it was new innovation it needed more time and more preparation. Student teacher confidence to work with the new environment might have taken more than expected in the three studies. In a context where access to ICT cannot always be assumed and where their use is relatively new, basic skills in the use of ICT are poorly developed these include such skills as typing, surfing, use of the internet etc. Even in cases where individuals have been introduced to some of these skills they loose them due to lack of constant use. So this means that time was spent by some of the student teachers either learning new skills or getting reacquainted with the use of the computer.

In the context of Uganda, the use of ICT to foster the learning process is a very new experience. Some students might have been rather anxious about this innovation.

In the first study, students in a control and experimental group were compared. Although students were selected at random, a number of uncontrolled background variables might still have played a role.

The study instruments used in the different studies were taken from the literature. Although the analyses indicate that the instruments were reliable, they were not developed for the specific study context (Africa, Uganda). This might have been especially critical considering the instruments that tried to determine student perceptions.

The regular teachers were encouraged to participate (peripherally) in the study. But to control for side-effects, it was the researcher who coordinated the study activities. The adoption of a coordinating role by their regular teachers might have promoted student participation in the learning activities and be a clear incentive to be involved to a larger extent.

The present studies were implemented in the context of the current distance education approach in Uganda where students are involved in face-to-face education in institutions during a period of time. Although the use of ICT has been introduced it has not been sufficiently exploited for teaching-learning purposes. The choice for this set up was influenced by a number of practical issues: the availability of infrastructure (computers and Internet access), the possibility to bring together students for orientation sessions and test administration, the possibility to control for variables in their home context that might have caused drop-out, etc. Nevertheless, students experienced a distance education format due to the implementation of the ICT-based learning environment and the fact they worked together in the asynchronous discussion groups with students of other teacher institutions in Uganda.

The discussion of the results relies predominately on literature outside Africa, whereas it would have been more appropriate to refer to similar studies in relatively similar situations. However, it was extremely difficult to

access empirical studies in a similar context. It is possible that they do not exist or they could be in grey literature that is hard to access.

Implications of the research findings for distance education in Uganda and directions for future research

Based on the above summary of the research findings and results we put forward a list of implications and directions for future research.

The implications can be structured as follows:

- The RTEP oriented learning approach should be expanded in distance teacher education.
- An increase in the integrated use of ICT in the distance teacher education approach.
- Collaborative learning as a central element of teacher education

The RTEP oriented learning approach was appreciated by the students and the empirical studies could reveal a certain positive impact of the approach on the perceptions, level of interaction and levels of cognitive processing. The RTEP-orientation was only realized in this particular course context. The use RTEP makes an interesting showcase in this context. It should be expanded to impact a complete course and finally the complete curriculum. The conceptualisation of RTEP requires such an orientation (Korthagen 2001). RTEP could be used to revolutionise the current education system. Full implementation should consider the contact with real practice. Teacher education institutions are the best place to start, however, this raises the question of how can the teacher educators be persuaded to adopt this kind of model? do they have the competencies needed to adopt such a model and to use it? what would it take to get them to this level? Future research direction should look at institutionalisation of RTEP in teacher education. In the case of distance education, research should also consider the impact of its constraints on implementation of RTEP.

In the context of distance education, the former could be linked to a stronger and integrated use of ICT in distance teacher education to increase its flexibility, to improve instructional approaches and to enhance its

efficacy. In the current study, ICT was used in view of implementing one particular course. This already implied a large change for the students: working in an online learning environment, self and peer assessment, (a)synchronous discussion groups, the use of the Internet to search for additional resources, etc. This required specific ICT-related capacities of the students that could be beneficial to a larger extent when applied in more courses or the complete curriculum.

The results of the empirical studies point at the value of collaborative learning as a central characteristic of teacher education. Although this is a central tenet of the RTEP, we stress this also separately considering the results in the present research. Both the quantitative and qualitative data put forward the value of the collaborative learning experience: high appreciation levels, central in the perceptions of students and resulting some positive results when it comes to the impact on metacognition, level of interaction and level of cognitive processing;

The directions for future research can be summarized as follows:

- Adoption of a longitudinal approach
- Studying larger groups and a complex set of variables
- Evolving from a course orientation towards a curriculum orientation
- Learning outcomes should be considered
- Different distance education formats should be studied
- Issues related to costs

Future studies should adopt a longitudinal approach to be able to track changes in a larger variety of dependent variables. This is especially true when it comes to studying changes in student teacher perceptions. A longitudinal approach will help to counter negative effects of time limitations, getting acquainted with the environment, and support the increased involvement of the regular teachers in the environment.

Analysis of the data in the present studies was hindered by the sample sizes. This affected not only the type of statistical analysis techniques that could be applied to test the hypotheses, but this also affected the level of complexity that could be researched. Given the complexity of a teaching

and learning context, future research should be able to study variables at different levels: individual level, class or group level, course level, etc. A critical condition is the involvement of a sufficiently large group of students during a longer period of time. Next to a multi-level perspective, the study could also adopt paty analysis techniques to be able to detect to a better extent the mediating impact of specific variables.

Research should evolve from a course orientation towards a curriculum orientation. This is partly related to the adoption of a longitudinal approach, but also to the need to fit the research in the study planning of the student, teachers and institute. In addition, more components of the instructional setting will have to be part of the study. We especially draw attention to the formal evaluation of courses in this context.

The studies focused on a particular set of dependent variables. The impact on study results, academic performance was not considered. Future research should expand the current list of dependent variables with academic outcome measures, but also consider the interaction between these variables.

Future research should attempt to study a fully implemented distance education format where students are in their home place to study. An alternative could be to link a full distance education model with a traditional face-to-face orientation. In the literature this is labelled blended learning. Future research could help to come to conclusions about the feasibility of the different distance education models in the Uganda context.

In the present study, no attention was paid to a cost benefit analysis. An alternative delivery mode of teacher education – especially in the Uganda context - has to consider the changes in the cost structure of education. What are the design and development costs? What are the implementation and maintenance costs? How does this compare with the current cost structure of teacher education? The present research was privileged to make use of the already established infrastructure of Connect–ED in the teacher education colleges and the availability of online course materials for the particular subjects. However, computers and internet are still well out of reach for many student teachers in Uganda. A cost benefit analysis

should therefore include the analysis of models to enlarge access to the infrastructure in e.g., study centres, community centres, primary and secondary schools, etc. This infrastructure is a precondition to ICT-based distance teacher education initiatives in the context of Uganda.

Final conclusions

Until now, ICT is hardly used in Uganda to develop distance teacher education and this despite political goodwill, the positive experiences reflected in some of the showcases and the limited but available infrastructure. Key enabling factors to the use of ICT in instruction in distance teacher education have been identified in this study and are government commitment, planning, availability of resources, technology, private sector partnership and commitment. The major challenges are the lack of adequate resources, the lack of standards, a negative attitude and the lack of an ICT policy to guide implementations.

A central element in the present research was the adoption of an RTEP-oriented learning approach. This approach – building on the literature – was expected to counter the technical rationality that is observed in teacher education. The RTEP was implemented in an ICT-based learning environment, in view of promoting the quality of the teacher education context. In addition, the ICT-based nature of the learning environment was also considered to be helpful to meet the growing need for teacher education in Uganda and to promote more flexible access to teacher education. In three consecutive studies, student teachers studied in an RTEP-oriented and ICT-based learning environment. The impact on a number of dependent variables was studied: the level of student interaction and the level of cognitive processing as reflected in study related discussions, metacognitive variables, the student teacher perceptions about the learning environment and instruction and finally the perceived flexibility of the learning context.

The RTEP oriented learning environment did – at a basic level – enhance the level of student interaction. Student interaction was promoted by individual student competences, the group, the instructor, and the learning environment. Interaction of students in the learning environment also

predicted, to a certain extent, levels of cognitive processing. In the studies indications could be found that the level of cognitive processing was positively influenced. But the latter impact was restricted and not found consistently in the different studies. In the last study a relative impact on metacognition could be observed.

The perceptions of the student teachers were affected to a minimal extent. Student teachers prefer – after studying in the RTEP oriented learning environment – to a larger extent instruction that promotes collaboration, planning, courses that are not assessment targeted, courses that support application of knowledge and build on authentic tasks that promote independency, and reflection. This impact reflects the adoption of perceptions that are in line with the realistic teacher education pedagogy. Additional analyses give some support to the hypothesis that these perceptions predict the attainment of higher levels of cognitive processing in discussions.

According to the students, the RTEP oriented learning environment supported by ICT promoted the perceived flexibility of their distance teacher education context. This measure of efficiency stressed flexibility in time and location of study, communication approaches, interaction, study mode and the available study resources.

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