

Coping with change in ICT-based learning environments: newly qualified Rwandan teachers' reflections

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Abstract

The overarching aim of this study is to investigate how newly qualified Rwandan teachers can contribute to the creation of theoretical and practical knowledge for professional development with information and communication technology (ICT). Questionnaires, focus groups and interviews were used for data collection. The findings show that novice teachers are motivated to acquire ICT and that they succeed in situations where school administrators grant easy access to computers. The novice teachers expressed a strong desire to be trusted and be allowed time to use computers and related skills in their learning and teaching. These views are discussed in terms of learning conditions created in schools so that participants become active, responsible and committed practitioners. We assume that such attitudes can be a model for their future roles in fostering change in social practice. For example, this study shows that gender equity becomes an aspect of change in an ICT-learning environment, which creates new opportunities for continuous education. To achieve this, as revealed by the findings, there is a need to develop school-based curricula, appropriate pedagogy and teacher professional development in the area of ICT literacy, which allows the teachers to develop a critical mind to the new tools.

Keywords

change, conditions, ICT, learning, newly qualified teachers, tools.

Background

The Rwandan educational system continues to register different reforms in order to respond to the needs of the country. Before the massacres and genocide of 1994, access to education was discriminatory on the basis of an ethnic and regional quota. During the period following these atrocities, the Government of Rwanda (GoR) aimed, first, at transforming the educational sector into a tool for peace, unity and reconciliation and, second, at

developing sufficient and competent human resources for the social and economic development of the country. Later on, the GoR expected that an investment in human resources should contribute to the alleviation of poverty (Hayman 2005).

In order to reach these core objectives, school curricula have been revised. Since 1997, the GoR has tried to put more effort on the teaching and learning of science and technology in schools. The rate of qualified teachers increased in primary education from 53.2% in 1999/2000 to 88.2% in 2003/2004. However, the proportions stand around 50% at secondary level between 2000 and 2004. Since the presidential elections of 2003, the GoR has decided to expend the free basic education provision from 6 to 9 years, though this policy continues to add pressure on the quality of education

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(Hayman 2005). The education follows the system of 6 years primary; 3 years lower secondary (which also is due to be fee-free), 3 years upper secondary; 2–6 years tertiary and the postgraduate programme.

Gender equity in primary schools has been achieved even before 1994. At secondary level girls represent 47.7% (Teacher Training Centres) though male teachers at this level represent more than 90%. However, during the academic year 2004/2005, girls continue to be under-represented at the public higher educational institutions (24.6%).

Rwanda *Vision 2020* identifies the strengthening of teacher development in an information and communication technology (ICT)-rich environment as one of the top government priorities for the achievement of national socio-economic development goals (MINECOFIN 2001). In order to accommodate as much as possible in-service teacher training and education, the standpoint of the GoR is that it is essential to foster continuous professional development through ICT and distance education. For example, Kigali Institute of Education has launched a distance learning programme in order to upgrade the skills of under-qualified teachers (Hayman 2005). A 5-year policy and plan (2001–2005, Government of Rwanda 2001) on ICT was established. One of the subplans of this document was related to the deployment of ICT in schools in terms of developing and implementing a detailed plan for equipping schools with computers, so that the student–computer ratio in each should be at least 10-to-1 at the end of the 5-year period.

It would seem as though these actions were very ambitious in that it was expected that most of the computers to be deployed in schools could be funded from donations. The reality concerning the deployment of computers in schools was very different from that which was written in the plan. Most schools in Rwanda, especially those in the remote countryside, do not have electricity let alone computers and telephone lines. Hayman (2005) criticizes policies based on assumptions, and on foreign experience rather than on the context of the country. With respect to the development of ICT in the educational system, higher educational institutions in Rwanda were required to make computer studies and basic computing an integral and a compulsory subject within teacher education programmes. This is still an ambition to be attended to progressively.

Student teachers and newly qualified teachers with ICT

The initial enthusiasm about the introduction of ICT in schools leads one to believe that the powerful learning environment will change and improve school practices. As referred to earlier, however, the optimism about the expected effects often goes along with some exaggeration. According to Säljö (2004, p. 490), two major implications may be identified: first, research should ‘attempt to integrate into the discussion findings on learners’ conceptions of technology and approaches to learning, and their epistemological beliefs more in general.’ The second implication is that instructional designers and producers of software should obtain detailed information and perform cognitive modeling about learners’ activities, so that their products suit their learners’ needs.

As technologies continue to develop, they change human interaction and actions. Through this, students’ ways of learning are also modified in line with what is regarded as relevant forms of learning in educational institutions. As a consequence of this modification, learning is less a matter of reproducing what is already known and more a matter of creating something new and useful (Säljö 2004). Thus, technologies transform learning not in a linear sense, but in a spiral process. But as Jedeskog and Nissen’s (2004) findings have shown in a Swedish context, students continue to concentrate on the functionalities of ICT instead of focusing on knowledge building or on the content.

Educational policies on ICT often point out that schools should be equipped with adequate resources that teachers are supposed to utilize in order to enhance and improve the quality of students’ learning. Different research findings have shown that access to ICT, in terms of resources and time is still limited (Galanouli & McNair 2001). Older teachers seem to be reluctant towards the incorporation of ICT in schools, while student teachers and some newly qualified teachers are the most confident users of ICT (Galanouli & McNair 2001; Madden *et al.* 2005; Sime & Priestley 2005; Andersson 2006). In a recent Swedish study on newly qualified teachers, Andersson (2006, p. 679) identified three groups of ICT users with approximately one-third of the participants belonging to each group. The participants of the first group, ‘called experienced ICT users, show certainty when they talk, and they see, in several

situations, ICT as an irreplaceable tool when they are faced with difficult challenges'. The same is valid for the second group, curious ICT users, who use the technique but to a lesser degree. In contrast, the third group, the resistant users, comprises those who are not interested in using the technique, in spite of a certain degree of ICT education. The study suggests there is a need for further investigations, in order to find out the arguments for resisting the use of the new technique. Drawing on other studies, reluctance is explained as resistance to change or as lack of training and time, and even as a result of technophobia. Galanouli and McNair's (2001) findings show that some older teachers in a UK context become anxious when dealing with advancements of ICT. All the studies mentioned in this paragraph report that teachers would like to receive further training in the use of ICT in their teaching. Fullan (1993, p. 46) draws on Sarason and explains the necessity of the teachers' concern in this way:

You cannot have students as continuous learners and effective collaborators, without teachers having these same characteristics (Sarason 1990). [. . .] It is simply not possible to realize the moral purpose of the teaching – making a difference in the lives of students – without similar developments in teachers. [. . .] Teachers must succeed if students are to succeed, and students must succeed if society is to succeed.

In ICT-rich environments, teachers in modern societies need to be change agents, those who can cope with change and make it possible. The argument is that technologies do not change societies *per se*, but people transform their societies using technologies as a tool. In educational settings, teachers should be able to create conditions that allow students to make sense of the world and be successful through the interplay between humans and machines.

The extent to which teachers use ICT varies in relation to space and time. In Sweden for example, Andersson (2006) mentions occasions where ICT is used as a forum to exchange knowledge between teachers or a platform where *experienced* and *curious ICT users* search for new forms and content of teaching. In the context of Sime and Priestley (2005) argue that an online forum constitutes a space of sharing and validating ideas between student teachers. They conclude that this implies negotiating and co-constructing meaning that will stay memorable for the group when reflecting. Sime and Priestley assert that in their school placements, student teachers experi-

ence opportunities to integrate ICT in their teaching subjects and, at other times, they teach ICT as a separate subject to support pupils and staff.

This discussion brings to the fore two important stages depicting the development of digital competence in schools, as pointed out by Moore (2002): teaching ICT and teaching with ICT. The initial stage consists of acquiring the capability to use ICT effectively and to have control over its resources. As referred to earlier, this stage is often coupled with or preceded by optimistic talk about expectations of ICT with a sometimes exaggerated stance. The second stage is aimed at transforming students' learning and allows students to learn with ICT. This stage enables students to become active and reflective learners. According to Sime and Priestley (2005), although newly qualified teachers have knowledge and skills to deal with ICT in classroom settings, they face a problem in challenging routine and existing school practices. These authors thus maintain that physical, human and cultural factors must be adequate in order for ICT to be effectively integrated into schools. Andersson's (2006) study shows that newly qualified teachers can be driving forces when they work with more experienced teachers in an ICT-supported learning environment. Andersson asserts that emphasis should be put on investigating how novice teachers may become change agents for integrating new techniques into teaching culture.

ICT-based learning environments in Africa

ICT has become an important tool for teaching and learning and has therefore attracted a great deal of investments in the African countries. Some researchers have investigated the ways in which learning take place in ICT-based environments in African classrooms. For example, de Jager and Nassimbeni (1998), in their evaluation of computer literacy training for South African students, report that students are not only attracted by ICT but that the technique has significantly enhanced their information and awareness of its implications in different areas. However, the researchers maintain that information literacy training has little effect on the participants' writing abilities in essays or assignments.

In contrast, McLean's (2001) study on an effective method of providing computer-aided instruction resource material in histology confirms the inherent

value of computing as a useful tool for learning. She ascertains that, despite their different educational and socio-economic backgrounds, students become acquainted with different varieties of computer-based education without marginalization of any group. This is coupled with an advantage of adapting the system to the student's own pace, which promotes self-directed learning, independent study and self-assessment quizzes that contain similar questions to what they handle in a block test. McClean points out that creating interactive educational material does not require the presence of expert designers, but that standard software and being familiar with a word processing program are adequate tools to help a teacher use web page design facilities.

In their project on the incorporation of an online course in first year journalism at the Technikon Pretoria, Axmann *et al.* (2002) advocate that the major problem faced is students' lack of basic skills in computer literacy and lack of access to Internet facilities and personal computers. In many African countries, ICT training consists of basic computer skills, that is, word processing and computer operating systems such as MS-DOS and Windows (81%) while a few participants (19%) have some experience of spreadsheet or database packages (de Jager & Nassimbeni 1998).

In the evaluative research carried out between 1998 and 2000 by the World Links Programme in 12 developing countries, Kozma *et al.* (2004, p. 378) conclude that 'when technological infrastructure is developed in conjunction with appropriate teacher training, significant educational change can be achieved in developing countries.' Jansen (2003) adds that new technologies have changed how teaching takes place and what is taught in terms of new interactions emerging between people and cultural content on the Web. However, Kozma *et al.* (2004) identify some barriers in the implementation of ICT in developing countries such as lack of time for teachers in order to integrate ICT in their lessons, lack of appropriate computer hardware, software and teacher training. In other countries the use of ICT was not included in the curriculum or the Internet connection was not reliable.

From a gender perspective, ICT is one of many strategies identified in order to improve the access and retention of girls in schools in the Middle East and Northern Africa (Rihani & Prather 1994). Wamala (2005, p. 100) reports, in a study about women's accessibility to ICT in Swaziland, that 'social understanding and

construction of the feminine is a hindrance on an African Woman's desire to explore her full potential.' However, these views are challenged by a number of women who have embarked in careers that were previously dominated by men. Yet, Wamala concludes that it will take time before women reach general acceptance in ICT workplaces.

Harley *et al.* (2000, p. 296) point out that 'In South Africa, as in other countries, "control first" is the most important maxim traditionally drummed into every novice teacher as part of her informal induction into school life.' In addition to that, documents regarding their duties stipulate that novice teachers should rather play a role of leadership. However, Harley *et al.* (2000) argue that 'there is little in policy to suggest what might constitute appropriate forms of control or leadership.' Our study draws from that statement and also from the research question generated by Andersson's (2006) findings about how newly qualified teachers may become agents of change in ICT-based learning environments. We would like to investigate how novice teachers can contribute to the creation of theoretical and practical knowledge for professional development with ICT as a pedagogical tool in developing countries, especially in Rwanda.

The GoR, in its Vision 2020, prioritizes the strengthening of teacher development in an ICT-rich environment for enhancing the national goals. However, reference made to a Namibian context, we strongly agree with O'Sullivan (2004, p. 599) that an outline in policy documents has to be followed up in order to take into consideration 'realities at "classrooms level" ' and to explore as well reasons for non-implementation.

The first purpose of this study is therefore to gain information about necessary conditions through which newly qualified teachers can learn with ICT in Rwandan schools. The second purpose is to gain knowledge about newly qualified teachers' needs, their ability with regard to ICT, and their reflections on in-service teacher training and education with ICT as a tool. Thus, the objectives of the study are to:

- examine newly qualified teachers' skills in ICT;
- examine these teachers' needs for in-service training with ICT as pedagogical support;
- examine the ICT-related environments in their respective schools and what learning conditions are at hand and;

Table 1. The infrastructure of ICT in selected secondary schools.

Selected school	No. of computers	Internet connection	Floppy disk drives	CD drives	Computer/student ratio
School 1	36	24	35	35	1:20
School 2	27	16	27	13	1:20
School 3	15	15	12	1	1:49

- identify cultural values driven from the infusion of ICT in schools.

Method

Participants and settings

Data were collected in 2004. The target group consisted of newly qualified teachers working in secondary schools in Rwanda. The total number of participants was 18; 12 women and six men, and their average age was 31 years. They represented the arts, social and human sciences and secretarial streams, with either a secondary school certificate (10) or with 'baccalaureate', equivalent to 2 or 3 years of studies in a higher educational institution (4), or with a bachelor's degree (4).

Three schools were selected in suburban areas of three of the main towns in Rwanda. The selection was based on the criterion that the school had at least one computer lab connected to the Internet. They were boarding schools for girls although one of them counted 15 boys among its students. The ratio of computers connected to the Internet available to teachers was approximately 1:2 in each school. Equipment and the ratio of computers to students are shown in Table 1.

As shown in Table 1, the selected schools were relatively well equipped and with these physical conditions it was possible to conduct the study.

Procedures

The data collection combined questionnaires, focus groups and in-depth interviews. First, questionnaires were used in order to capture a general picture of newly qualified teachers' needs when learning with ICT as a tool. In Silverman's (2001, p. 241) terms, 'Simple counting techniques can offer a means to survey the whole corpus of data ordinarily lost in intensive, qualitative research.' The number of 18 newly qualified teachers was selected for this purpose and all of the

teachers responded to the questionnaire. The questionnaires were structured as measurement scales and were available in both English and French versions, so that each participant could receive a copy in the language she or he was conversant with.

Second, focus groups were used for follow-up to the data collection from the questionnaires. Three focus groups were organized, one in each school. All participants from the schools were invited to attend the discussion but only three of them were available from School 1, and three from School 3, while in School 2 four participants joined the discussion. In the three schools, participants in the focus groups preferred to conduct discussions in Kinyarwanda, the native language in which all of them were conversant.

Third, in-depth interviews were conducted with the purpose of deepening the understanding of important issues arising from the questionnaires and focus groups. Three participants, one from each of the schools, were interviewed. In this case, Morgan (1997) suggests targeting individuals who fit the characteristics rather than conducting interviews with all informants. Two interviewees preferred to respond in Kinyarwanda, while the third one asked to be interviewed in English. In order to elicit utterances of participants' critical reflections upon their experience of the ICT-supported environment, the topics of the focus groups and in-depth interviews reflected the 'what' and 'how' questions as suggested by Holstein and Gubrium (2004).

All the focus groups and in-depth interviews were audio recorded and fully transcribed. As for the transcripts in Kinyarwanda, the sections with relevance for the purpose of the study were selected and translated into English. In the analyses, they were scanned qualitatively to look for common themes. The focus groups and in-depth interview data were organized in matrices indicating codes, themes and key findings to support the qualitative analyses. Quantitative data arising from the questionnaires were recorded on a summary sheet and used as a guide for constructing interview questions.

Findings

Participants' skills in ICT

Data reported in this section were drawn from questionnaires collected from 18 newly qualified teachers (women: $n = 12$; men: $n = 6$). Responses to the issues about participants' ICT skills show that they agreed or strongly agreed that they were able to use the operating system Microsoft Windows (women 10/12 and men 5/6), and word processing (women 5/12 and men 6/6) and spreadsheet programs (women 3/12 and men 6/6) in their activities of teaching and learning. The responses also show that some of the participants were able to use Internet (women 3/12 and men 4/6) and email (women 4/12 and men 4/6) in their activities of teaching and learning. Two of them (women only) were able to use Microsoft PowerPoint but none of them was able to use Microsoft FrontPage and Microsoft Access. Women participants went to the computer lab slightly more frequently than men did (average days/week: women 2.6 against 2.3 for men). In addition to the school computer lab, a few participants indicated that they visited cyber cafés outside the school (women 3/12 and men 3/6) and one woman participant reported that she owned a private computer.

Peer teaching and ICT literacy in schools

From the focus groups and in-depth interviews, we can in various ways note that incorporation of ICT in Rwandan schools is a prioritized process. For example, the participants pointed out that two to five teachers were selected for the acquisition of computer literacy at each school. When they came back to their schools, after their training, they started to train their colleagues, that is, they conducted peer teaching. The participants analysed this training critically. First, they said that schools put more effort into computer literacy than into learning and teaching with ICT. For example, a participant argued: 'Some teachers who have gone for training, we don't know if they went there for computer literacy or for ICT literacy . . . I think the only thing they know is how to use a computer.' Second, the participants reported that the quality of peer teaching was not satisfactory. One participant complained: 'Our training in ICT is somewhat superficial. We need well planned and ongoing training which is not superficial.' Another participant from a different school explained: 'Maybe

they [teacher-trainers] train learners. These ones go and come back to teach us. That is the programme. So we get second-hand information.' They argued that teacher-trainers were not skilled enough in what they delivered, especially not in pedagogy.

Third, the participants said that the time allocated for the peer teaching was insufficient and inappropriate. They argued that the peer teaching was mostly based on delivering training in specific programs. In this regard, one of them explained: 'Most likely, [teacher-trainers] know how to use Word and Excel while beyond these programs there are other, more sophisticated, things. Therefore, we just get an introduction about it and never go beyond.' Furthermore, they reported that they were overwhelmed by their teaching load. Also, they highlighted that the peer teaching was organized after teaching hours when they felt very tired. The participants reported that other people from outside the schools attended computer literacy courses as well and they used the same computer labs as teachers and their students. They argued that the training of those people also rested on the shoulders of the teacher-trainers. Although this initiative was appreciated by the participants, it was also criticized because they reported that it narrowed their access to the computers. One participant summed up the point in these words: 'But there is a plan that they [teacher-trainers] must also train other people from outside the school. Therefore, we do not have enough space . . . They have so many students. They cannot be available because they are only two.' The participants said that, in their three schools, students were initiated to computer literacy, especially from those who were in the fourth year, regardless of their stream. One of them explained: 'It was decided that all students from upper secondary must learn how to use it [computer].' However, they stressed that these initiatives contributed to the addition of extra courses run by the teacher-trainers as the computer literacy courses were part of extra curricula studies.

Fourth, the newly qualified teachers explained that there was no school-based curriculum on ICT. One of them argued: 'The school as a school, they value ICT ignorantly. The problem is that they don't know what they are supposed to have as ICT.' Another participant from a different school said: 'The problem of ICT is implementation. We talk about it in words, but in schools, ICT is not yet in practice.' The participants voiced that the concept of ICT was not clear to them and

therefore they confirmed that they did not know what should be learned in ICT and how to go about it.

Finally, the participants raised at length the lack of practice and follow-up of their peer training. For example, one of them said: 'There is no follow-up and no practice of the teacher training in computer literacy. Hence, the little knowledge gained during the training is quickly forgotten.'

Conditions for access to ICT facilities

Teachers' access to computers varies from one school to another. However, two major conditions in relation to access to computers in schools can be drawn from the focus groups and in-depth interviews. Access to existent computers in each school is strongly influenced by the behaviour of the school administrators as the following paragraphs indicate:

Centralization and teachers under control – frustration

In two schools, access to computers was a problem. One of the participants stressed the situation as follows:

The computer lab is still a new arrival. The school managers cannot allow that we use it at any time, any how, to do whatever and in unknown ways. You must ask for an authorization for getting access . . . I think that when all teachers are perfectly computer literate, then the school managers will probably authorize them to use the computer lab. By that time, they will do some exercises and other things they need in line with their teaching in the same way as they go in the library to search for books.

Teachers under this kind of control seemed to be frustrated because of the lack of trust from the top management of the school. One of them commented: 'The school managers don't trust teachers' ability; they are afraid of what could be damaged because maintenance is expensive.' Some participants reported that one way to improve the access to ICT might be an increase in number of computers and computer labs. Most participants complained repeatedly about the frequent lack of Internet connection. Some others argued that they preferred to go to private cyber cafés outside the schools and pay their own money to get access. This problem, as it was seen during the visits to the schools, was exacerbated by a lack of electricity for many hours. Moreover, all participants mentioned a great need of maintenance services in their schools.

In both of these schools, it was reported that sometimes the management of the computer lab was either in the hands of the director or another person. For example, some participants repeated again and again: 'The top management of the school does not trust the ability of teachers so that it can give them a free hand to use the computer lab.' On the other hand, all participants reported that the teachers organized themselves in two groups of peer teaching when they acquired computer literacy. In their school, one teacher was in charge of the computer lab. One newly qualified teacher complained: 'unfortunately as a teacher I don't get the service. They say "this time you will come and get it." When you go there, the man [the teacher in charge of the computer lab] is not there. When he is there, he is doing other things. That one is a problem: programme implementation.' All schools do not work like this. In the following paragraphs, it is clear that in the third school, teachers have a free hand in using computers.

Decentralization and trust in teachers – self-confidence and ownership

The above findings were strengthened during the focus groups and in-depth interviews when we again saw that teachers were granted more easy access to ICT facilities in some schools than in others. The management of the computer labs was pointed out as the central holder of the access. For example, in one of the three schools, participants underlined – and they were visibly proud to mention it – that shared responsibilities were at the heart of their school management. A participant reported: 'What is unique in this school is the decentralization of the school management and self-confidence in teachers' use of the computer lab.' Another teacher commented: 'We feel that the computers belong to us and that we must take care of them.' Asked what should be changed in that school so that ICT might be effectively implemented, she explained:

If the management of the computer lab was in the hands of the director, I would suggest that this should change. I was employed in a school where nothing could be done when the director was not there. This is not the case here . . . I appreciate it. Things should not lie in the hands of one person. We should share responsibilities so that our work may be done more effectively.

Similarly, other participants from this school affirmed that four people were appointed to manage the computer lab, and the director was not one of them. 'This is good',

one of the participants commented: 'because they [teachers in charge of the computer lab] are available. If one of them is not there, one of the others is'.

Conditions for learning in ICT environments

Learning to teach ICT and to teach with ICT

Throughout their discussions in the focus groups and in-depth interviews, the participants raised some conditions which they considered to be the most desirable for creating an ICT environment conducive for their learning in their respective workplaces. First of all, they reported that teacher-trainers should be trained and retrained in ICT literacy, and also in pedagogy. In this connection, some participants argued that a policy for in-service training of teachers should be established in schools. One of them explained: 'If we get a chance to be trained in ICT, it will help us to increase the quality of our teaching and learning.' The participants pointed out that the training they wished to receive was the kind that would open doors to job mobility.

All participants asserted at length that well-planned and ongoing teacher-training in ICT is a prerequisite for students' success in ICT. For example, a participant underlined: 'Teachers are like parents; they take care of their students. They want their students to be more educated than they [teachers] are. If they were trained, they would train their students as well.' Hence, it becomes evident that the participants are strongly aware of that using ICT in an appropriate way depends to a great extent on whether the teachers can handle the new technique.

Learning for creativity and problem solving

Two-thirds of the participants voiced a strong desire to be taught how they could become creative. One participant said: 'We should not rely on information we have been given. We should learn to be creative. Maybe exchange ideas with others.' Another participant illustrated this argument with an example of a problem she encountered: 'For example, early this morning, I was looking for a dictionary, but I couldn't find who had removed it. I went to the library and didn't find it. Then I said in my mind, if I were skilled enough in ICT, I would go and look for the vocabulary on the Internet.' The former participant who raised this issue explained why it was important to be creative. He said that he was able to send an email, to attach a file and to search informa-

tion on the Internet. He concluded: 'I do all this because I am creative. I have taught myself everything.' Asked if he used his creativity to improve his teaching, he replied with a disappointed tone of voice: 'I don't do it with my students because I know that this programme of taking students to the computer lab and teaching them our views does not exist.' The point raised by this participant is that creative learning should be an integral part of the school programme. The computer skills of this novice teacher served his own needs but he was not encouraged to integrate them in changing his traditional classroom practice.

'Let there be follow-up'

Most participants argued that the best time for them to commit themselves to in-service training would be when they did not feel tired, especially during holidays and weekends. They suggested that the teaching load for those who attend in-service training should be reduced, 'otherwise', one of them argued, 'it would be very difficult.' Most participants reported that the planning and the training itself would not be enough if the follow-up was overlooked. One of them put it in this way: 'Let there be a follow-up session. What is the programme about? Has it reached the people it was supposed to reach?' Getting a time to use the new technique is therefore one of the conditions for an effective use of ICT in schools.

Conclusions and discussion

Necessary conditions when implementing ICT

ICT incorporation in Rwandan schools, as reported by the participants, is a new phenomenon that the whole school community is trying to cope with. Seemingly, many efforts are being made in terms of establishing ICT infrastructures, and training teachers, students and outsiders. In aiming towards successful development, for instance an increased number of experienced and curious ICT users who see ICT as a useful tool when facing challenges, we are able to identify four major conclusions that can be drawn from the findings of this study:

- Unconditional support of the school administrators is a necessary condition for effective integration and implementation of ICT in schools.

- Newly qualified teachers and the school community in general are determined and motivated to acquire ICT literacy as a tool for teaching and learning.
- ICT users need to be considered trustworthy and be allowed time to use computers and related skills in their learning and teaching.
- Schools would seem, from the participants' discussions, not to know exactly what should be learned in ICT. First, the content delivered in peer teaching is exclusively about Microsoft Word and Excel. Second, school-based curricula do not exist in areas like the acquisition of ICT literacy and teacher professional development. Third teacher-trainers do not have enough skills in ICT literacy and related pedagogy.

The fact that the participants emphasize the need for more education in ICT agrees with what has been found internationally regarding teachers' usage of ICT (Sarason 1990; Fullan 1993; Carter & Burger 1994; Kozma *et al.* 2004; Andersson 2006). For example, in Australia, where Carter & Burger (1994) studied newly qualified teachers, it has been suggested that additional education is required about the relation between ICT, the curriculum, teaching and learning. In an evaluative research in developing countries including Africa, and in studies in a European context, Kozma *et al.* (2004), Clarebout and Elen (2000) and Nordstrom (2000) claim that success in using ICT depends on teachers' competence in handling the new technique. Furthermore, Legrand's (1993) findings converge with ours where he asserts that the lack of motivation and decision making from administrators can make change problematic particularly in public organizations. In our study, we have noticed that some school directors who centralize to some extent the use of computers tend to limit teachers' access and therefore the latter become frustrated. This impedes teachers' commitment, motivation and creativity in terms of ICT implementation in a classroom practice.

Added educational achievements

Drawing on the findings of this study, there are indications of added educational achievements when appropriate conditions for the ICT infrastructure are present:

- ICT might serve as a pedagogical tool fostering the principles of problem solving (e.g. searching vocabulary on the Internet), creativity and critical thinking (e.g. not rely on information given only).
- ICT might help to develop positive values of democracy and promote a culture of peace in a country like Rwanda, which experienced a civil war, genocide and massacres. First, the participants were committed to learn by good example and from each other. In their peer teaching they wish to voice and exchange ideas. Second, access to information from different sources will support critical reflection.
- Finally, ICT might help to promote gender equity. The findings reveal that both male and female newly qualified teachers have the same ability to use a computer. Thus, ICT literacy may transcend gender boundaries and allow more women continued education.

The preliminary insights gained from these added achievements deserve further investigations in order to explore related newly qualified teachers' practice in ICT-based learning environments, and in the particular context of Rwanda.

Coping with change

The effective use of ICT as a tool for learning involves a change of attitude towards greater accountability and optimism in order to bring about change in school social practice. It is interesting to note how the participants were motivated to acquire ICT skills, so that they might improve their teaching and make a difference to their students' lives (Fullan 1993). One way of coping with change in schools is to build efforts on positive values existing in schools. If teachers, for instance, are creative or learn together through peer teaching, appropriate conditions can be strengthened not only through a chance to learn in a creative environment and through peers, but also through opportunities to demonstrate the outcomes of their creativity and their peer teaching during joint reflections and problem solving. ICT contains many hints and represents a huge information source that can be better handled collectively. The key to peer teaching is that teachers learn from one another and develop a culture of continuous inquiry in social practice.

Newly qualified teachers' determination and motivation to acquire ICT skills is not enough as such. Two examples illustrate this issue: The first is from the participant who was looking for the dictionary and did not

find it. She thought that ICT could help her to sort out the problem. The second example is from the participant who learned how to search for information on the Internet on his own and who also suggested that teachers should be taught how to be creative. The first participant puts the theoretical knowledge forward as a condition to find vocabulary items on the Internet. The second advocates both theoretical knowledge and inner creative ability, and learning through practical activity. It seems that both theoretical knowledge and practical knowledge are interdependent and should, preferably, go hand in hand in the context of learning with ICT as a pedagogical support. However, collaborative efforts and creativity must be sustained by external expertise as both participants put it. This point is in concordance with what Svensson *et al.* (2000) call reflective learning.

Säljö (2002) points out that ICT can challenge people's traditional hierarchies of knowledge in schools and in other places. Democratic values are powerful in the process of complex change. Some participants had a sense of ownership of the school ICT infrastructure because the school director trusted them and they felt self-confident as a result. In some schools, newly qualified teachers were happy and self-confident because their voices were heard. Therefore, ICT as a tool of learning can help to develop positive values of democracy, for example, access to information, voicing one's opinion, listening to each other and gender equity.

Learning in ICT environments is like a journey and the newly qualified teachers provided new insights about how to make use of the new technique. Of course a lot needs to be done in terms of theoretical and practical knowledge construction, especially in developing countries such as Rwanda. Therefore, we suggest that further investigations should be undertaken in developing countries, in order to scrutinize the development of collaborative knowledge in computer-mediated social practices.

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