

Supporting Higher Education through Electronic Meeting Support in Tanzania

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Abstract

To learn, a person has to be able to communicate effectively with others about the knowledge to be learned. Communication processes in class rooms can be supported by Group Support Systems (GSS), that enable students to communicate anonymously and in parallel. GSS experiences suggest that the technology increases observed learning, self-reported learning, on-task participation, and satisfaction with the learning experience. This paper discusses case studies from higher education in Tanzania. The particular benefit of GSS in this environment was threefold: First, it encouraged meaningful interaction among students and between students and teachers. Local culture normally hinders this. Second, it allowed all participants to freely discuss sensitive topics. Finally, it exposed students to collaborative technologies that are expected to play a pivotal role in (global) collaborative development activities.

1. Introduction

Teaching at universities and Higher Vocational Education institutions is currently facing a number of challenging developments. Students have to adhere to tight study programs in order to graduate within fixed time limits. Organizations employing graduates have for years been calling for educational programs to be more closely coordinated with the skills they require. Finally, the budgets of universities and Higher Vocational Education institutions are under almost constant pressure [11].

In response to these developments, educators and educational institutions are in search of teaching methods, techniques, and technologies that make teaching more efficient and effective. As a result, various forms of Information Technology (IT) are often deployed. The potential uses of IT in education range from providing analytical tools and eliminating distance barriers to replacement of repetitive tasks [13]. It is expected that IT supported education will involve lower costs for travel and

classrooms, provide greater convenience, security, and flexibility, and will bestow the ability to ignore time and geographic differences. Learning overall is expected to become faster, more interesting and qualitatively better while the student/teacher ratio can increase [19].

In terms of teaching methods, *collaborative learning* in face-to-face settings has been shown to be a highly effective learning strategy [1]. In contrast to more traditional forms of education where the primary interaction between teacher and students is where the teacher speaks and the students listen, collaborative learning emphasizes group or cooperative efforts among students and faculty, and often focuses on the interaction between students themselves. Students actively discuss and debate on a whole range of subjects and problems in order to come up with explanations, suggestions, and solutions for them. This process helps students to conceptualize, construct, and internalize procedures and knowledge [23]. Also, sharing information helps students to deepen understanding. It is in this learning environment that various types of IT support are emerging rapidly, see e.g. [6, 10].

In general, bringing electronic support into the classroom aims to facilitate the information flows between students and instructors, and among students [14]. This paper focuses on one particular collaborative application that can be used within various forms of education to provide effective support for learning processes: Group Support Systems (GSS). GSS enable teachers and students to share and capture information and knowledge efficiently and effectively. We have applied GSS in a number of case situations in Tanzanian higher education to explore how this technology can support learning processes. In the remainder of this paper we will first discuss education in Tanzania and the role of GSS in education in more detail. In the next two sections, the case experiences in Tanzania will be presented and discussed. We conclude the paper with a summary of our findings, the limitations of our study, and directions for future research.

2. Background

In this section we first elaborate on education in Tanzania in general and the state of university education in particular. Next we elaborate on the technology that we introduced to a number of Tanzanian university classrooms

2.1. Education in Tanzania

Education in Tanzania has gone through many changes as time went by. The history of education in Tanzania can be separated in three periods:

- *Before colonialism*: education passed on through local traditional methods.
- *After imposition of colonialism* (end 19th century): traditional education was replaced by a formal system based on western education.
- *Past independence adjustments 1961-1967*: elimination of racial distinctions, the modification of the curriculum and the expansion of schools. It was not until 1971, however, that the first national secondary school exams were written, marked and analyzed entirely in Tanzania.

Today, educating children and students in Tanzania is a big challenge [2]. While close to 70% of children obtain at least some primary education (50% of children complete primary school), only about 5% enroll at the secondary level (less than 3% of children complete secondary school). This is caused mainly by the following three aspects:

- The relatively high school tuition rate for secondary level, while primary schools are free, is a problem for many rural families.
- Language poses additional barriers because primary school instruction is in Kiswahili and secondary level instruction is in English.
- During the early days of Nyerere's presidency he set aside 14% of the national budget for education. Now, governmental spending on education declined to less than 4% of the total budget. Educational facilities are lacking, morale is low and there is a shortage of qualified, committed teachers. Private schools, which had been nationalised in the wake of the Arusha Declaration in 1967, have again started operating due to the existing situation and help to bridge the enormous gap between the country's educational need and scarce resources, but their geographical distribution is uneven.

Overall, the Tanzanian educational system consists of the following levels:

1. Primary school.
2. High school. Based on a final examination at the end of primary education, a number of pupils are selected for secondary education. Secondary education is divided in two levels, O-level (form 1 to 4) and A-level (form 5 and 6, compulsory before attending higher education).

3. University. In order to enroll at the University, A-levels have to be completed successfully.

The University of Dar es Salaam was born out of the decision taken in March 24th, 1970 by the East African governments to split the then University of East Africa into three independent universities - for Kenya, Uganda and Tanzania. The University of Dar es Salaam consists of several faculties, institutes and two colleges. It offers BSc and MSc programs. It is currently not possible to obtain a PhD degree from the University of Dar es Salaam. Few Tanzanians pursue a PhD abroad due to financial restrictions.

The University has developed the institutional "UDSM-2000" Transformation Program. Under this program, the University aims at the expansion of programs and student enrollment from some 3500 students in 1995 to some 8000 student in the year 2000. By the year 2008 targeted undergraduate enrollment will be approximately 13,000 students. The overall targeted enrollment for postgraduates is 2,000 students by the year 2008, with an interim level of approximately 1300 students by the year 2000. One of the key items of the transformation program is the use of computer technology to support educational processes.

Computer literacy in Tanzanian society is very low [16] and unfortunately little is known about computer education in Tanzania. Concerning a neighbouring East-African country, we found an interesting study by [15] who intensively observed secondary school classes at six Kenyan schools. The observations revealed a number of features of the teaching-learning process, summarised below. Although these observations refer to secondary education in Kenya, based on discussions with various university teachers and our own observations we believe that they largely also apply to higher education in Tanzania:

1. *In most lessons the approach was teacher-centred.*
2. *Most lessons were focused on providing facts, and very little on "learning how to learn".*
3. *In the majority of lessons, there was little peer learning. Sometimes peer learning was actively discouraged with exhortations such as "do your own work"!*
4. *Virtually no teaching aids, except from the blackboard or textbook, were ever used. E.g. in none of the history or geography lessons observed was a map ever used or drawn on the blackboard.*
5. *The most common teaching strategies were lectures accompanied by note-giving, question and answer sessions, demonstrations and explanations by the teacher. In many lessons, key and vital steps in the explanation or demonstration were missed out.*
6. *Many teachers did not set a high premium on evaluating the learning taking place during their lessons. There were few instances of homework being given, and even fewer cases of homework previously given being corrected.*

7. *In most subjects the content was approached in a manner which isolated the skills and knowledge from real life. There was little drawing on the experience and environment of the students.*
8. *In the majority of lessons students sat totally passively receiving the "words of wisdom" from the teacher.*
9. *There were very few instances of teachers using a sequenced problem-solving approach to the learning of new concepts or attributes. Students were rarely asked to give their views or to challenge a problem.*
10. *Efficient use of time available to the teacher was rare.*
11. *While the preceding findings paint a grim picture of teaching learning in the schools, it must be pointed out that there were some shining examples of teachers who really brought their classes alive and who made learning an exciting experience.*

Makau further describes the introduction of computers for various subjects, e.g. geography, maths (calculating games), biology (dissecting a "virtual frog"), to bring a change to the teacher-student interaction and make the learning process more vivid. Interesting observations were:

- Teachers were critical on pedagogically poor software.
- Computer assisted instruction seemed to make learning more interesting for most pupils. For instance, students attended lessons punctually partly with the hope of operating the computer. They also observed that solving problems with the computer can be "exciting, interesting and fun, very easy and helpful".
- Teachers would like to see computer-assisted lessons "where teachers and students don't just gaze at the screen and simply punch keys to move on, but where students listen, talk, discuss, write something down, ask and answer questions, and get assignments".

These observations provide some first insights in the challenges that East African education is facing nowadays, and the role that IT applications such as GSS may play in making educational processes more effective.

2.2. Group Support Systems

Group Support Systems (GSS) are employed to make creative group meetings more productive and effective. A GSS can be defined as a system consisting of computer software, computer hardware, meeting procedures, and facilitation that support groups engaged in intellectual collaborative work [8,12].

Researchers and practitioners claim that GSS meetings are often more efficient and effective than "normal" meetings, and that participants are more satisfied with such meetings. Research usually subscribes these claims, see e.g. [18,22]. The following characteristics of GSS appear to bring about these positive experiences:

- *Anonymity.* Submissions cannot be traced to individual participants. This prevents dominant meeting behavior. Moreover, it encourages a more critical attitude which has shown to result in better ideas.
- *Parallel communication.* Participants submit ideas simultaneously, which results in higher productivity.
- *Group memory.* All electronic contributions are saved automatically. When the GSS meeting is adjourned, the minutes with the generated ideas and decisions made can be printed out immediately.

GSS can be applied in many different areas, e.g.: the development and evaluation of policies, the identification of organizational problem areas, the execution of SWOT analyses, the development of new product concepts, expert consultations, and the development of company strategies. One particular application area, Education, will be discussed in more detail below.

2.3. GSS and Education

GSS remain one of the few examples of IT originally developed within universities and which subsequently became a commercial success. Considering its background it is not surprising that students came into contact with GSS at an early stage. Initially, students were introduced to GSS as guinea pigs in numerous experiments directed towards examining different aspects of electronic conferencing in more detail [9]. But the systems rapidly also came to be used to support teaching. The most common form of this was the support of "traditional" discussions about questions and opinions in response to a particular case study which the students had to read in preparation for or during the lecture. GSS were also set up in a number of university laboratories to support project work. Examples of these are the Learning Theater at the University of Maryland and the electronic meeting rooms at the University of Arizona.

The first experiences with using GSS in educational situations were thus gained fairly rapidly. From a student perspective these experiences were mainly positive. GSS were found to be more interesting, enjoyable, satisfying, efficient, and motivating [e.g. 14,21,26], lead to more even participation among participants [13], and help students to generate higher levels of critical thinking abilities [1] when compared with non-GSS learning experiences.

There are a variety of successful examples of using GSS to support learning processes. A number of areas in which studies have shown that there is an added value in the application of GSS to educational processes are [1,3,23,26]:

- *Education in group planning and decision making.* During courses on collaborative technology, a GSS was used to familiarize students with system characteristics, issues surrounding the application of such systems, and research opportunities.

- *Supporting case studies in an executive program.* GSS allow executives to interact electronically and speed up the process of case discussion. Also, the executives become familiar with the use of GSS to help address their own organizational decision making problems.
- *Supporting a nursing management course.* During a year, a GSS was used to support the in-class discussions of issues with respect to the topic of the course. For example, case management: define case management, identify critical components of a case management system, discuss differences between contemporary case management models, discuss benefits and problems associated to the case management role.
- *Survey and questionnaire administration.* GSS software has been used to administer questionnaires and summarize results as well as give students an opportunity to provide anonymous feedback on courses.
- *A 'virtual continuous learning space'.* GSS were used during a joint course, in which two sites were linked up, using video, audio, and data. The environment supported both *in-class* learning activities (lectures by instructors, discussions and question/answer activities between instructors and students, and among students, electronic sessions for issue analysis and discussion) and *out-class* learning (project work by dispersed student groups).
- *Gaming support for participative design.* A GSS game was played by groups of 6 students, representing a governmental department going through a reengineering process. Each group member played one department employee working in a specific subdepartment. By sharing information through the GSS, the group had to work through problem understanding, alternative generation, and alternative elaboration phases.

Overall, GSS experiences in learning environments are very encouraging. In a variety of settings and applications, positive aspects of using GSS are reported. For example, Leidner and Jarvenpaa [13] observed that computer supported learning invited students to do exploratory analyses of the course subjects, and stimulated the acquisition of computer skills. In another study, Briggs et al. [4] reported that compared to 'traditional' students, GSS supported students participated more in lecture sessions, generated significantly higher quality and quantity answers, and were more interested in the lectures. With respect to the dispersed class room setting described in [1], it was found that for the in-class activities, the students perceived that they had learned more, and they found the ability to cooperate with remote instructors and students very enriching and satisfying. In general, there are strong indications from a substantial number of studies that suggest that in educational settings, GSS increase [21,26]:

1. Observed learning.
2. Self-reported learning.

3. On-task participation.
4. Satisfaction with classroom experience.

It should be noted that these results are mainly based on studies in Euro-American developed countries, the environment where GSS were developed. GSS researchers argue that national culture may influence differences in GSS usage by groups [18,24,25,27]. Little is known about the use of GSS (in education) in African developing countries [16,24,25]. Yet, studies such as [16] clearly show that the socio-cultural environment indeed influences the way in which GSS are employed in Tanzania. Hence, the question remains: *To what extent can GSS have added value in higher education in Tanzania?* The remainder of this paper will illustrate some early experiences.

3. Case studies in Tanzania

In 1998 and 1999, we employed GSS in a number of class room situations in Tanzania. In each situation, we collected data from various sources to analyze the way in which GSS were used and perceived by the students. We handed out questionnaires after each class. Also, we carried out semi-structured interviews with a number of students, sometimes immediately after class, sometimes up to one week later. During the classes we both made observations and kept notes that we compared and elaborated after each class.

Below, we describe three case situations. For each case we highlight the setting in terms of course context, objective of the GSS session, and the way the session process took place. We will also elaborate our observations and findings in each case.

3.1. Case 1: University of Dar es Salaam

3.1.1. Setting. For 3 hours, 14 students majoring in computer science participated in a GSS classroom exercise at the University of Dar es Salaam. The meeting objective was to discuss problems that hinder a quick and wide spread use of computers in Tanzania, and to suggest possible solutions for these problems.

The session started with a 15 minute warm-up exercise to get the students acquainted with the GSS application GroupSystems. Next, the students were asked to identify and select the most critical problems regarding computer adoption in Tanzania. The students were subsequently asked to identify and select the best strategies to handle these problem. In each activity, GroupSystems' Categorizer and Vote modules were used for identification and selection activities respectively. The problem identification and strategy selection activities each took about 45 minutes, during which 22 distinct problems with supporting comments and 42 solutions were suggested. An example of solution strategies with some supporting comments is depicted in

table 1 (the number between the brackets signify a unique identification for each contribution which can be used to refer to earlier contributions).

Table 1. Example of students' contributions.

<p>1. Impose basic computer knowledge at elementary schools How can this improve the financial situation of the people? {#48} This should be for the development of the country in future. {#74} Provide education about computers from primary schools {#30} Teach the use of computers from low level e.g. from primary level {#36}</p>
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After the identification of problems, the students' contributions were first grouped into a number of categories, including *financial, human resource, illiteracy, new technological development, government policies, and promotion*. These categories were moved into the vote module where students used a multiple selection technique to identify what they felt were the greatest problems. Similarly, generated solutions were first categorized and then ranked in the Vote module. The class was concluded with an oral discussion of the results of the electronic discussion.

3.1.2. Findings. During the electronic discussion, all participants appeared to be contributing equally. However, during the oral discussion very few students participated. In fact, only one student dominated the group by expressing his views. This student seemed to steer the group a bit because generally the other students were very shy to air their views in public.

The group as a whole was very focused on the goal of the session. Oral communication between different participants was minimal, except at the beginning of the session when students helped each other to operate the system. The students were very serious during the entire class. At no point was the possibility for anonymous communication with the meeting technology used to make off-topic remarks or even flaming. Compared to our experiences with other student groups, the contributions were serious, well thought out, and of high quality. Feedback suggested that the students used each other's comments as a source of inspiration, as a stimulus for their own thinking.

The computer literacy in the group was high, which could be expected from computer science students. Nevertheless, a lot of technical and facilitation issues were asked before, during and after the meeting as the students appeared eager to learn more about electronic meeting technologies. In contrast, the students' typing skills were limited which negatively affected the productivity of idea generation.

From questionnaires and post-session interviews with some of the participants the following issues were noted:

- Participants were very enthusiastic about the use of GSS to support their discussion.
- The discussion was very open, which is not surprising given the nature of the discussion topic. It was not a topic that raises conflict easily.
- The group was very focused on the subject but also on the meeting technology. They wanted to learn more about the system as it was part of their optional course on groupware.

The scores from a satisfaction questionnaire (scale 1-5, 5 being most positive, based on [5]) confirm the positive attitude from the students towards the class room experience. Table 2 shows that in general the students were very satisfied with the GSS process and session outcomes.

3.2 Case 2: NSWTI

3.2.1. Setting. This case concerned a class at the National Social Welfare Training Institute (NSWTI). Ten students majoring in social welfare subjects participated. The objective of the session was to explore the causes for the substantial increase in sexual offences in Tanzania and to suggest ways to handle this social problem. The session was planned to take two hours.

The session started with a 25 minute introduction and warm-up exercise to get the students acquainted with the electronic nature of the meeting. Next, the students performed a problem analysis of the situation. This was divided into two topics: causes and motivation. Students identified causes for the increase in sexual offences in Tanzania. They also contributed possible explanations for the increasing rate of rape of women by grown up men. For this activity, the Categorizer module was used with two baskets for each category. After 20 minutes into this activity, 32 causes and 39 motivations had been generated. Mostly, the contributions were short, focussed with minor English language problems, such as typographical errors. The second part of the session addressed problem solving

Table 2. Satisfaction scores in the UDSM case.

<i>Question</i>	<i>Mean</i>	<i>STD</i>
Interest Accommodation		
Today, my interests were (not accommodated – accommodate)	4.1	0.6
Thinking about what I needed from this meeting (I did not get it - I got it)	4.1	0.6
The outcome of today's activities (does not meet – meets) my personal needs	4.1	0.9
Product Value		
The work we accomplished today was (not worth - worth) the effort	3.9	1.1
The results of this meeting are worth the resources it cost to produce them (disagree – agree)	3.8	1.2
The value of the meeting's outcomes justifies our efforts (disagree - agree)	4.1	1.1
Process Satisfaction		
The meeting methods we used today (did not meet – met) my expectations	4.2	1.2
Today's meeting process was (inadequate – adequate) to meet our goals	3.8	0.8
How satisfied were you with the work process we used today? (dissatisfied – satisfied)	4.4	0.8
Product satisfaction		
The outcome of today's activities (does not meet – meets) the meeting's objectives	4.3	0.6
The outcome of today's meeting is (unsatisfactory – satisfactory)	3.9	0.9
The results of today's meeting are (inadequate – adequate)	4.1	0.8

Table 4. Satisfaction scores in the NWSTI case.

<i>Question</i>	<i>Mean</i>	<i>STD</i>
Interest Accommodation		
Today, my interests were (not accommodated – accommodate)	4.6	0.9
Thinking about what I needed from this meeting (I did not get it - I got it)	4.4	0.8
The outcome of today's activities (does not meet – meets) my personal needs	4.5	0.9
Product Value		
The work we accomplished today was (not worth – worth) the effort	4.3	1.3
The results of this meeting are worth the resources it cost to produce them (disagree – agree)	4.2	0.8
The value of the meeting's outcomes justifies our efforts (disagree - agree)	4.5	0.6
Process Satisfaction		
The meeting methods we used today (did not meet – met) my expectations	4.7	0.6
Today's meeting process was (inadequate – adequate) to meet our goals	4.1	0.7
How satisfied were you with the work process we used today? (dissatisfied – satisfied)	4.6	0.5
Product satisfaction		
The outcome of today's activities (does not meet – meets) the meeting's objectives	4.6	0.7
The outcome of today's meeting is (unsatisfactory – satisfactory)	4.4	0.7
The results of today's meeting are (inadequate – adequate)	4.6	0.6

Table 6. Satisfaction scores in the CBE case.

<i>Question</i>	<i>Mean</i>	<i>STD</i>
Interest Accommodation		
Today, my interests were (not accommodated – accommodate)	4.4	0.7
Thinking about what I needed from this meeting (I did not get it - I got it)	4.3	0.7
The outcome of today's activities (does not meet – meets) my personal needs	4.2	0.7
Product Value		
The work we accomplished today was (not worth – worth) the effort	4.3	1.0
The results of this meeting are worth the resources it cost to produce them (disagree – agree)	3.9	1.0
The value of the meeting's outcomes justifies our efforts (disagree - agree)	4.4	0.6
Process Satisfaction		
The meeting methods we used today (did not meet - met) my expectations	4.7	0.6
Today's meeting process was (inadequate - adequate) to meet our goals	3.9	0.8
How satisfied were you with the work process we used today? (dissatisfied – satisfied)	4.4	0.5
Product satisfaction		
The outcome of today's activities (does not meet – meets) the meeting's objectives	4.2	0.7
The outcome of today's meeting is (unsatisfactory – satisfactory)	4.5	0.6
The results of today's meeting are (inadequate – adequate)	4.1	0.6

strategies. For this activity the Categorizer and Vote (Agree/Disagree) modules were used. In 30 minutes, the students generated 43 problem solving strategies. Some of the generated strategies are depicted in table 3.

Table 3. Example of students' contributions.

- | |
|---|
| <ol style="list-style-type: none"> 1. The laws should be implemented strictly so that men may fear to break it. 2. Educate the society on the impacts of sexual offences such as rape; defilement, sodomy and others, as a means to arrest such behaviours. 3. Institutions such as churches, schools, etc. should train members in the society about the effect of sexual offences. 4. Sex education should be formalised; be introduced in school syllabi from the nursery through primary and secondary education up to higher learning institution. |
|---|

As in the first case, the group organized generated ideas before voting on them. For example, the problems were categorized under (a) social-economic issues, such as increase in poverty, leniency in law enforcement, low level of illiteracy, changes in cultural values through new mass media such televisions, movies, and internet, and (b) social-cultural norms such as alcoholism, drug abuse, women dressing, and men's chauvinism. The solutions that were generated comprised of a variety of policy and educational issues which is reflected in the example in table 4. The results of the session were subsequently used in the training program and lectures at NWSIT as input for further discussions.

3.2.2. Findings. It appeared that the students' computer and typing skills were very limited. During the session most students received some support from us and each other. Nevertheless, the way they were eager to learn how to operate the system suggested that they did not feel threatened by the use of computers in their class session. The limited computer and typing skills was illustrated by the relatively low productivity. For example, during the warm up exercise the students generated on average only two ideas per student. However, post-session feedback from the students suggested another reason for the seemingly low productivity: the students expressed that they needed some time to think because they wanted to be focused and careful in answering the brainstorming questions.

Another interesting observation during the session concerned gender-dependent behavior. During the first part of the meeting it could be noticed that there were two distinct groups of participants: the males and females. This difference manifested itself in the way participants entered the meeting room and the sitting arrangement. The males entered the room first and all of them set close to each other. The male group approached the questions at the beginning

with giggling and without generating very serious contributions. However, this behavior changed during the course of the session when the students became more focused and started approaching the topic as a single group. At this point, participation appeared to be evenly spread over all participants. Feedback suggested that this was related to the anonymous nature of the communication. They could generate ideas without calling names, pointing fingers. It became clear they did not need to be shy to discuss this topic and its related sensitive issues.

During the session there was very little oral discussion besides some short discussions between adjacent students. Public comments were rare. This appeared not to be caused by a reluctance to cooperate. Rather this seemed to be caused (1) by the difference way in which the male and female students participated, and (2) by the sensitivity of the session topic. Nevertheless, the students expressed after class that this had been a very interesting and thought-provoking exchange of ideas. They were especially pleased with the fact that they could build their own arguments and get inspiration from each other's contributions. The teacher was pleasantly surprised by the amount and quality of contributions and discussions. Many students indicated that it would have been difficult if not impossible to have a similar discussion without the GSS facilities.

After the session, the same satisfaction questionnaires were distributed as in the UDSM case. The scores from the questionnaire are depicted in table 4. The overall results, with a mean score of more than 4.0 for all questions, show that students were very satisfied with class experiences.

3.3 Case 3: College of Business Education

3.3.1. Setting. The third case is different in nature than the previous two. The previous two cases concerned the use of GSS to support a class room activity. In the third case, GSS was used to support an discussion among both students and teachers with respect to the organizational development of the College of Business Education (CBE) at UDSM. Two sessions were organized to enable participants to make suggestions and recommendations that should yield a more efficient and effective College.

The composition of the participant groups differed per session. The first session was dominated by teachers (10 teachers and 2 students). The Director of studies, representing the Principal, also attended the first session. The second session included only (20) students. The sessions were especially popular with the students. In the second session, students appeared to 'invade' the meeting room. This was caused by the fact that almost all computer courses are taught theoretically. Thus, the session would give a lot of students their first hands-on computer experience.

Both sessions proceeded in the same manner. First the participants were introduced to GSS followed by a warm-up

exercise. Next, the activities of the main agenda were carried out. In both sessions, the Categorizer and Vote module were used for problem discussion and selection of best strategies, respectively. Issues that were contributed and discussed were grouped under: *Marketing, Training Programs, Resources, and Qualifications of Human Resources and Trainees*. A combined selection of the Voting results regarding the selection of the most promising courses of action is depicted in table 5. The scores represent the average on a scale of 1 to 5, 5 being the most positive.

Table 5. Example of voting results at CBE.

Contribution	Score
CBE should now concentrate on both long and short term courses. It should be emphasized however that computerization will have to be taken more seriously than has been hitherto the case.	4.45
The college should make efforts on registering its courses to concerned bodies such as NBAA and NBMM in order to give quality of its diplomas.	4.42
CBE should strengthen her unique courses like the Office Management, Metrology, etc.	4.40
CBE should improve the computer teaching system.	4.36
CBE should concentrate in marketing programmes and should try to convince other organizations to sponsor students	4.17
Trainers' qualification: Trainers should be based on professionalism.	4.00

3.3.2. Findings. In the first session, the participants had some experience with computers. Still most had to be trained on the basic functions of the keyboard. Also, the typing speed was low. This group averaged about 20 contributions in 30 minutes. In the second session, the participants were more experienced. Hardly any assistance was needed to use computers. The second group also achieved a higher productivity: about 30 ideas in 30 minutes (although the number of available computers was the same during both sessions). The participants in the second group appeared more focused on the meeting than their colleagues in the first group. The second group's ideas were more objective and more on-task. Especially the students in both groups were very inquisitive about issues such as the operation of the laptops, the meeting technology, and the costs of the various technologies.

It was easy to witness that the participants in both sessions felt comfortable offering their views electronically. In the first session, the presence of the Director was unnoticed. Also the students in this session were very relaxed. All participants agreed that the anonymity feature in GroupSystems made them feel more comfortable to express themselves. In the first session it was stated that because of the anonymity, there was less domination. This feeling

appeared to results in very limited oral communication between the participants in both sessions. The only oral communication that took place concerned some assistance by neighboring participants.

The most striking observation which was confirmed by feedback from the participants after the sessions took place, was that they experienced an equal opportunity to participate in the meeting. This was the main reason that the students seemed to enjoy the use of GSS. They found the topic a burning issue and were very motivated to contribute their ideas. In a normal situation, it would have been very difficult for them to enter into such an open dialogue with their teachers and administrators.

At the end of both sessions, we collected satisfaction scores using the same questionnaire as in the previous two cases. Although only about 60 percent of the questionnaires were returned, the feedback from participants during interview suggests that the scores are representative for the feelings of the group as a whole. The combined results are shown in table 6. In general, the participants appeared to very satisfied, especially regarding the accommodation of their own interests and the meeting process.

4. DISCUSSION

Below we present some insights that emerged after analyzing the three case situations. We have organized these insights into two categories: *process*, concerning the way in which the sessions were carried out, and *results*, concerning the tangible and perceptual outcomes of the sessions.

4.1 Process

There are three main insights regarding the process of the classroom experience. *First*, it was obvious that the electronic meeting technology allowed students to freely express their thoughts. They could contribute whatever they wanted in any wording they wanted. In all cases, the feedback from the students indicated that they very much appreciated this. The anonymity feature of the meeting software was key to make them participate enthusiastically in the discussions. Especially when sensitive issues were addressed or when teachers or directors were participating in the discussion as well, the anonymity feature was perceived as a sine qua non for open discussions.

Second, it appeared and was also perceived as such by the students that the participation in the discussion was more equally distributed than in traditional classes. In normal classroom processes, few students participate in class discussions, which was for example illustrated in the UDSM case. In all cases, the participation in the electronic discussions appeared to be evenly spread over the students. Especially the teachers perceived this as a great advantage of using GSS in classroom exercises.

Finally, the nature of the educational process changed during the electronic class room sessions. In a traditional Tanzanian class room, the teacher is presenting information to the students. He or she offers personal knowledge and views on an issue for the students to digest. Discussions between teacher and student are often limited compared to, for example, American or Dutch standards. The introduction of meeting technology appeared to change this: Instead of the teacher taking central stage in the discussion of a topic, the students themselves were in the spotlight. The students determined the course and content of the discussion. They were triggered to actively participate and express their own thoughts, learn their fellow-students' thoughts and subsequently use this to further sharpen and formulate their own thoughts. The teacher could steer the course of the discussion a bit, but could not dictate beforehand what would be discussed and what would not. This resulted in a class room process that was perceived as fascinating by both students and teachers.

4.2 Results

With respect to the results of the sessions in the three case studies, we identified three main insights as well. *First*, it was apparent that the productivity (in terms of contributions per person per hour) in the sessions was somewhat low compared to Western environments that we have experience with. This appeared to be mainly due to limited computer and keyboard skills. Students' behavior during the sessions and post-session feedback indicated that few had experience operating a computer. Even fewer students had typing proficiency. Nevertheless, lack of skills did not seem to prevent the students embracing the technology. In each case, the students understood the technology within half an hour. Although the pace in the sessions may have been comparatively slow at times, at no point was the technology abandoned and replaced by oral communication.

Second, as was evident from the results of the satisfaction questionnaires, the students liked the classroom experiences very much. Each of the satisfaction indicators received high scores. Also the teachers involved appeared to be very satisfied with the way in which the class room exercises were supported. They found it a stimulating experience for their students. However, one has to be cautious interpreting the positive scores from the questionnaires. During prior research in Tanzania, we found that participants were often reluctant to provide negative feedback [24]. Giving positive feedback is normally perceived to be polite. Therefore, we stressed and explained each time before handing out questionnaires or doing interviews, that we were interested in their real experiences and opinions. In addition, we extended our satisfaction data by looking at an additional measure for satisfaction which is "repeated use" [20]. From this perspective, we found support for the high satisfaction scores

as in all case situations invitations were extended and followed up for more class room support. Still, the tendency for politeness has to be taken into consideration when interpreting the questionnaire findings.

Finally, the third case situation clearly showed that the applicability of the meeting technology goes beyond just class room discussions. GSS may also be employed to support discussions about the organizational design of the educational institute itself. In fact, it may be argued that a GSS within an educational institute may offer support in four different areas [17]. First, it may be used to support educational processes, as we demonstrated in this paper. Second, it may be used to support administrative reform as we demonstrated in the third case. Third, it may be used to support research activities, for example the formulation of hypotheses, the analysis of qualitative research data, or the writing of a research report. Finally, it may be employed as a service to society where the institute provides (financially funded) GSS services to other organizations.

5. CONCLUSIONS

To be able to learn, a person has to be able to communicate sufficiently and effectively with another person about the knowledge to be learned. In this study, we have investigated the application of GSS in electronic class room situation to support such communication. The case studies illustrate the potential of this technology. It appears that GSS may enable a more interactive environment in which all students actively participate in discussions with each other and with their teacher. The results of the study further suggest that students are highly satisfied with this type of learning environment and are highly motivated to perform in class. An additional advantage is that through the use of GSS, students automatically learn how to handle and become acquainted with computers in general and this type of groupware in particular.

An important issue regarding the further applicability of GSS in educational environments in Tanzania concerns the costs involved in setting up a meeting facility. In this research, we used the facilities from the University of Dar es Salaam, which were provided to the teachers at no cost. The costs of hardware and software, however, can be an insurmountable obstacle for educational institutes in developing countries. Outside funding would probably be required. Moreover, the use of technology alone is no solution! To effectively apply GSS in learning environments, teachers need to be trained in its possibilities and applications. Among other things this means that new teaching formats will have to be introduced to make optimal use of the potential of GSS. The case studies illustrated that the nature of the class room process is changing considerably, as is the role of the teacher. It cannot be expected that all teachers are willing to embrace this change.

The limitations of this study are twofold. *First*, the case situations only concerned single class room experiences. It was not possible to support all classes in a certain subject with GSS. It may be argued that supporting a whole course would have resulted in different findings. The perceptions of groups that repeatedly use electronic meeting technology change over time [7]. *Second*, within the time frame of our research it was not possible to assess whether the application of GSS had a (positive) effect on the students' level of learning. To this end, for example comparative measures have to be collected from classes that cover similar topics but did not use GSS.

In response to these limitations, our future research efforts extend along two dimensions. First, we are looking for possibilities to support complete courses using GSS technology. Second, we are developing procedures and measurements to assess the effect of GSS applications on long-term learning. A first pilot project that is investigating these issues is currently underway.

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