Science education reform and the impact on the school environment in transitional societies

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Abstract

This paper discusses science education reform in two transitional societies. The research used an interpretive case study methodology with quantitative and qualitative data to examine how teachers' knowledge, perceptions and experiences impact on the school-learning environment. The societies in transition are Rwanda and Kosovo adversely affected by major social, political, economic, and ethnic upheaval. Rwanda and Kosovo have adopted the following goals - implementation of a durable educational policy, eradication of illiteracy, and capacity building in science and technology. The study made use of questionnaires, interviews, photographs, classroom observations, narratives, personal reflexivity, and historical document analysis. Document analysis indicated that there is a need for greater access to secondary education. Interviews and science lesson observations indicate that it is necessary to develop a curriculum that is contextually relevant and redefine science teacher training programmes. Findings indicated that the school-learning environment will improve through gradual evolutionary reform and requires coordination among all stakeholders in the education reform process: the teachers, the curriculum developers, the examination board and the governing structures.
Objectives of the study

The objective of this study is to describe, discuss and analyse information on the status of science education and school environments in Rwanda and Kosovo, from the perspective of primary and secondary science teachers and the first author’s observations and analysis. The study analyses the constraints in the implementation of educational policies and a relevant science education in a climate of social, political, cultural, ethnic and economic uncertainty. Political and economic forces have meant that the world is redefining relationships globally, and many parts of the world are experiencing conflicts and ethnic violence leading to transitional societies in each and every continent. These changes have contributed towards an increase in displaced and refugee populations giving a new meaning and dimension to emergency education, development education, comparative education and international education research.

This study is guided by two major research questions:

1. What are the major influences for science education reform and school environments in Rwanda and Kosovo?

2. What recommendations can be made to improve learning environments and provide a relevant science education in these transitional societies?

Significance

Very few studies have examined the Rwandan educational system in Central Africa. The ones that have been carried out are World Bank reports for the purpose of continuity in financial aid. This study pioneered the use of an instrument in a non-western country, where English and French are the languages of instruction, but not the students’ or teachers’ first languages. The study analyses and documents the constraints faced by the Ministry of Education in Rwanda in the implementation of a relevant education program during the emergency period after the war, the period of transition and the current period of integration and reconciliation.

Kosovo is a society recovering from war, a decade of isolation and coping with the current international presence of the United Nations Mission in Kosovo (UNMIK) and foreign military. This study provides information on the status of the science education reform process and identifies the urgent needs and key issues of the education system of societies in crisis. Currently there is an emergency situation in Kosovo and elections have been held recently to elect local leaders. In a long-standing political crisis, the education system will hopefully move from interim, to transitional, to an integrated one (Davies, 1999).

It is expected that the study will contribute to the knowledge about implementation of educational policies and reform in a climate of uncertainty, so as to inform educators, teachers and curriculum developers. As a result of informing authorities of outcomes, it is hoped that the results may be used to re-align objectives of curriculum programs and teacher education programs to ones that are more relevant and suited to the needs of each society. Finally, the study provides some data on the numerous and complex factors that account for the current status of education reform, the challenges and constraints in each society and the parallel trends in Rwanda and Kosovo.
Context of the study

Personal background of the first author

Of particular interest to the study was the first author's personal experience in her challenge to understand the reform process in science in Rwanda, a country with a shattered economic, social and political fabric where she had worked for two years as a school principal. She has lived and worked in four different developing countries of the world and brought with her the experiences of having lived in these countries. She spent 9 weeks gathering data in Rwanda for the purpose of this study and 3 weeks in Kosovo. During this period, she spent many hours in discussion with her interpreters, a Congolese refugee teacher who was a survivor of the 1994 genocide and a young Albanian university student who had experienced the war firsthand.

Some Background Variables to the Research in Rwanda

As one of the world's poorest countries, Rwanda is faced with two major challenges - ensuring recovery, rehabilitation and reconciliation after the genocide of 1994, and overcoming the problems associated with poverty and the massive need for sustainable development. The major background variables to the study are as follows:

Figure 1: Map of Rwanda and its neighbours
Social Indicators: The war and genocide in 1994 killed as many as one million people and almost half of a population of 7.7 million people was displaced. It paralysed the country's socio-economic infrastructure and disrupted cultural values. Nearly 53% of the population is illiterate and the secondary school enrolment rate is 20%.

Population and Ethnicity: The population of Rwanda is 94% rural. Three ethnic groups make up the population: the Hutu (90%); the Tutsi (9%); the Twa (1%), a pygmyoid people. The official languages are Kinyarwanda (a Bantu language) and French. 75% of the population is Christian, 9% Muslim and 17% follow traditional religions.

Gender: Women constitute 54% of the total population and 34% of the households are female-headed. The government and the United Nations Development Programme (UNDP) is ensuring that women are fully involved in the development process and are being enskilled through income generating and capacity building activities. It is a known fact that the poorer households are female or child-headed.

The Ministry of Education in Rwanda: The current government in Rwanda regards science as a national project for the achievement of national development. The Ministry of Education is focussing on the expansion of equitable access to education, the improvement of the relevance and the quality of education and the development of capacities for the effective delivery of education. It is within this context that education is expected to play an important role in social reconciliation, reconstruction and economic development. Rwanda has now adopted the following national goals - eradication of illiteracy, universal primary education, teacher training, national capacity building in science and technology and reinforcing the teaching of mathematics and sciences. The Ministry of Education in Rwanda came up with a comprehensive plan for the complete restructuring and re-organising of the education system with the help of the UNDP and UNESCO in 1998 and is trying to implement the plan of action and strategies laid out in the policy document.

Some background variables to the study of Kosovo

In contrast, the former Yugoslavia had a very well developed education system in place. Former Yugoslavia was heterogeneous in terms of development, historical background, nationality and religion. Significant reforms of the school system were carried out during the 1970s and 1980s.

History: The Socialist Federal Republic of Yugoslavia was a nation of south-central Europe and was divided into six republics. Today the republics of Slovenia, Macedonia, Croatia and Bosnia exist as independent states. In view of the national and cultural diversity of the federation, the question of ethnic origin has always played a major role in contemporary Yugoslav society. The civil war has affected the proportions of ethnic groups in all of former Yugoslavia. Kosovo was established as an autonomous province in 1968 and the Albanian language became the second official language in Kosovo.
Education: Modernisation and democratisation of the primary school system continued in the period 1975-91 following the trends of decentralisation and modernisation. Primary education has been compulsory in Yugoslavia since 1952, for all children from 7 to 15 years. There were 19 universities in former Yugoslavia and the quality of their work was of a very high level. The Pristina University had about 10,000 students being instructed in Albanian. In many fields of science and technology results of worldwide significance were attained.

The conflict: In 1989, the autonomy of Kosovo was abolished by Serbia, which caused a huge revolt of the Albanian people in Kosovo. It led to a boycott of the official school system and the Kosovars ran a parallel system of education.

Social Indicators: Kosovo's social structure has been altered by the war. 15,000 people have been killed or have disappeared. 46% of the population is still internally displaced. Kosovo has the youngest population in Europe, half the population under the age of 19. Widespread unemployment is rampant and is as high as 80%. Kosovo is densely populated.
and a poor region with a population of 2.2 million, 90% Albanian, 7% Serbian, and 3% other nationalities, it also has the highest birth rate and highest infant mortality rate.

The effects of war: Due to the devastation of homes there is enormous pressure on the urban centres. Infrastructure and services have been heavily damaged or remain dysfunctional. All social, cultural and economic spheres have been totally or partially devastated. Professionals suffer from a long period of oppression, isolation, they need to improve and update their skills.

Illiteracy and women: The multiple problems in post-war Kosovo have a negative effect on the role and position of women and there is a serious absence of women in the process of post war reconstruction of Kosovar society. There has also been a decline in the numbers of women in the schooling system at all levels.

Minorities: During the last three decades minorities were guaranteed the use of their native language in local proceedings and primary school. Today, the pre-war minority population of Serbs, Bosnians, Turks, Gora and Roma remain often isolated and fearful in enclaves since the end of the conflict. Continuing acts of inter-ethnic violence continue and lead to frustration at all levels.

The Future Status: The undetermined future status of Kosovo poses grave problems with respect to identity, property registration, passports, trade relations, public utilities, security and the taxation system makes it a society in an emergency situation that is still in the crisis stage. Even today 2 years after the war, Kosovo is still part of Yugoslavia, but is totally administered by the United Nations.

Theoretical Underpinnings

Science Education and National Development

Caillods et al (1996) conclude that investing in science education is a necessary condition for economic growth. The World Conference on Science in Budapest in Hungary in July 1999 addressed the issues of science education for development, science education in schools and science education for the future. One task was to promote the professional development of teachers and educators and address the lack of appropriately prepared science teachers in their countries. Another task was to develop new curricula, teaching methodologies and resources in response to the changing educational needs of societies (Lewin, 1993).

Many developing countries invest heavily in science education to strive for socio-economic development. The science for development model put forward by Drori (1998) works on the assumption that a government envisions science education as a systematic programme for national development with a scientifically and technically skilled labour force that enables industrialization and in turn economic progress. The leaders in Rwanda have acknowledged national capacity building in science and technology and is trying to ensure that an education in science will facilitate development, environmental sustainability and enable the young to change, transform and work collectively to create a better future.

Field of Learning Environments

Rutter and his colleagues (1979) estimate that students spend in excess of 15,000 hours in the classroom during their school life, therefore, the environment that students are exposed to becomes extremely important. The influence of the learning environment on the process of education has received a great deal of attention from educational researchers during the
last three decades (Fraser, 1994, 1998). Much research has been carried out into the relationship between student achievement and the quality of the classroom-learning environment. Consistent and overwhelming evidence from these studies suggests that the classroom environment strongly influences student achievement (Fraser, in press). Contemporary research on learning environments partly owes inspiration to Lewin's (1936) seminal work in non-educational settings, which recognised that both the environment and its interaction with characteristics of the individual are potent determinants of human behaviour.

Research specifically on classroom learning environments took off about 30 years ago with the work of Walberg (Anderson and Walberg, 1968) and Moos (1974) which spawned many, diverse research programs around the world (Fraser, 1998). During this time, several approaches have been used in conducting research in the field of learning environments. Although earlier work often used questionnaires to assess learning environments, the productive combination of qualitative and quantitative methods (Tobin & Fraser, 1998) and use of interpretative research (Erickson, 1998; Tobin, 1998) is increasing rapidly in the field today. This interpretative study draws on and contributes to the field of learning environments to investigate the school and classroom environments created as a result of the implementation of a school improvement program.

Conceptual framework for the study

In the context of Rwanda and Kosovo, the study was an enquiry into complex societies. A case study like research of all kinds has a conceptual structure organized around a small number of research questions. These may be information questions, questions on issues or revolving round themes. Issues in Rwanda were complex and invited attention to varied experiences and also drew attention to related common disciplines of knowledge such as science education, historical research and education reform.

A Case Study Approach

Merriam, 1998 argues that there are four essential properties that distinguish case studies. Case studies are particularistic, in other words concerned about how a particular group confronts a problem. They are descriptive, that is complete and literal descriptions are provided of the units being studied. They are heuristic in that they illuminate the readers’ understanding of the case and are inductive where reasoning is relied on to interpret the data grounded in a context.

Each of these four characteristics satisfies the needs of the study. First this paper aims to study the science education reform process in Rwanda and Kosovo. Second this paper aims to provide a detailed description of the process of science education reform in Rwanda & Kosovo. Third, this study is heuristic because it aims to make the reader understand the complexity of education reform in Rwanda; and finally the study is inductive because the data are interpreted by taking into account the complex realities of Rwanda & Kosovo.

Patton (1990), states that one can usefully mix methods without being limited by allegiance to a single paradigm. He calls such an approach the paradigm of choices and suggests that, even within a single study, researchers can usefully view the same data from different perspectives and can interpret data in more than one way (Patton, 1990). In other words, qualitative data can be collected and used in conjunction with quantitative data. The rigor in the study stems from matching research methods to the research questions within the contextual frame of reference. In this interpretive case study, quantitative data were collected through the survey questionnaire in Rwanda, but the data relating to the historical
aspects, curriculum implementation and study of socio-cultural factors were primarily qualitative.

This research was bounded in space (the transitional societies of Rwanda and Kosovo), time (the post-genocide and post-conflict period), population (teachers and students), focus (context, curriculum, school environment), and scale (primary and lower secondary schools). In addition, this research focuses on the socio-cultural context of the post-genocide period, thus becoming "more than an intensive, holistic description and analysis of a social phenomenon. Concerns with the socio-political and cultural contexts are what set this study apart" (Merriam, 1988, p. 23).

This case study was both qualitative and quantitative. Research into socio-cultural, ethnic, gender and economic aspects makes an important contribution to the field of science education as, firstly, the sample usually provides greater variation in teaching methods, student attitudes, school and classroom environments. Secondly, familiar educational practices, beliefs and attitudes can be exposed and made 'strange'. As the study progressed, the study began to involve a more interpretative approach that included the combination of multiple research methods. The critical theory perspective implies that reality is shaped over time by social, political, cultural, ethnic and gender factors (Guba & Lincoln, 1994). This case is true of Rwanda, and Kosovo where all these factors have shaped the destiny of these transitional societies.

Research Design and Procedures

The culturally sensitive nature of the present study led to a multi-method approach to allow triangulation of the methods and cross validation of the data. The data collected using the different methodologies complemented each other and together formed a more coherent and complete picture (Denzin & Lincoln, 2000). Quantitative and qualitative methods were used to identify constraints in the implementation of education policies in Rwanda & Kosovo. The approaches were combined in order to provide an in-depth general picture.

The quantitative approach conceptualised reality in terms of selected variables and the relationship between them, rested on measurement and the pre-structuring of data. The qualitative approach dealt more with the case in hand and was sensitive to the context, the process and the lived experience. In this study, a survey questionnaire was administered to teachers and students in Rwanda and interviews, classroom observations, study of historical documents and personal reflections were the qualitative methods used in the two transitional societies. The present study commenced from a case study mode and moved to a more interpretative and ethnographic mode combining multiple research methods.

Quantitative Data

A quantitative probe was used to provide an overview of the science education reform in Rwanda. The researcher developed separate questionnaires for students and teachers. The English version of the questionnaire was translated into French by a bilingual teacher and then back translated by an independent third party. The back translation ensured that the French version maintained the original meanings and concepts in the original English version.

The Teacher questionnaire

English and French versions of the combined questionnaire were administered to 125 English and French teachers in twelve different schools in rural, semi-urban and urban
Rwanda. The teacher questionnaire was made up of four parts, three of which have been documented in this paper.

Part A of the questionnaire contained 10 questions designed to elicit basic background information from the participants.

Part B included 17 statements on stated development-related functions of science education, these questions were a modified version of a similar questionnaire used by Vlaardingerbroek, (1998) in Botswana.

Part C was a modified version of the School-Level Environment Questionnaire (SLEQ) developed by Fisher & Fraser (1990) was used to assess four dimensions of the school environment: affiliation which assesses the advice, encouragement, and acceptance teachers receive from their colleagues; staff freedom which assesses teacher freedom to set rules and guidelines and ensure rule compliance; resource adequacy which assesses adequacy of facilities, support and equipment and work pressure which assesses the extent to which pressure dominates the school environment.

The student questionnaire

The student questionnaire contained 70 items. It was administered to 500 French and English students in 12 different schools from class 6 to class 12 in Rwanda. Results of the student questionnaire used in Rwanda have not been included in this study.

The schools

In all 12 schools were used in this case study in Rwanda. The schools were government and private, single sex and co-educational schools. They were urban, semi-urban and rural schools and displayed a conflicting mixture in terms of resource adequacy, infrastructure, governance, teaching staff and student make-up. In Kosovo, 4 schools, 25 Albanian and English teachers, 10 student teachers, 15 Education personnel from International organisations and the Department of Education and Science.

Qualitative Data:

These were gathered using multiple methods including interviews, classroom observations, teachers’ stories, document analysis and the researcher’s narrative.

Historical documents

Historical data were generated based on a study of documents from the Ministry of Education and World Bank covering a period of 23 years from 1977 to 2000 in Rwanda. The policy documents and reports helped look for facts and specific events related to education policy and reform of the past two decades. In Kosovo, a document extensively used to give a historical perspective gave details on the education system in the former republics of Yugoslavia for more than two decades during the 1970s and the 1980s provided historical insights into the education system. Interpretation of historical documents took on special importance because events had occurred and it was important to describe, analyse and interpret them.
Interviews

Interviews with teachers, students at secondary level, senior education personnel and head teachers provided a better understanding of the system in existence. In each society more than a dozen education personnel were interviewed. The interviews ranged from unstructured to semi-structured, depending largely on the situation. The interviews covered a number of areas including feelings about science teaching, the curriculum, examinations, professional development activities and their feelings about the future of the education system in Rwanda. Questions were open-ended, allowing the interviewer the opportunity to determine the limits of the respondent's knowledge and understanding and allowing probing in order to clarify misunderstandings (Cohen & Manion, 1994). Interviews provided a rich source of insights into cultural aspects.

Classroom Observations

Non-participant observation of five theoretical and practical science lessons in four different schools gave deep insight into teaching practices and methodology in Rwanda. All the teachers were known to the first researcher and were willing to be involved in the study. Her personal perceptions and reflections, gave credibility to the reality of a situation that she had personally experienced as head teacher in Rwanda for two years. In Kosovo, 3 classes were observed, two in a primary school and one in a secondary information technology classroom. The approach to classroom observations was that of a non-participant and structured observations were made using a checklist of pre-specified behaviours. As the observations were made in normal classroom settings, it was possible to sample both likely and unlikely classroom occurrences.

Results

The results are presented below in four different sections: analysis of descriptive data, analysis of questionnaire of data, information gathered from historical and documentary data, information gathered from interviews and classroom observations.

Descriptive Data

Analysis of the items dealing with teacher and student age gave teacher and student profiles that indicated that the majority of the teachers in Rwanda were below 30 years of age. A sizeable proportion of teachers have been killed in the genocide. Immediately after the war the percentage of qualified teachers fell from 60% to 33%. It is estimated that more than 400 teachers were killed in Kosovo during the years of unrest and subsequent conflict. The average age of teachers in Kosovo is 40 years. The student profile in Rwanda also showed that 17% of high school students were in the age group of 20 to 25 years and this can be attributed to the war and displacement of the population.

Analysis of items dealing with the qualifications showed that only 18% of the teachers had a bachelor's degree and 3% a master's degree. A high percentage of teachers in both transitional societies are poorly qualified and have limited content knowledge. In Kosovo, statistics from the Department of Science and Education in the United Nations Mission in Kosovo indicated that 17% of the teachers were unqualified, only 26% had a bachelor's degree, 46% had a higher diploma in education and 11% had a diploma in education. Few science teachers in Rwanda and Kosovo have undergone professional training in the last decade with respect to classroom practice or practical science skills. See figure 3 and 4.
Regarding years of employment of Rwandan teachers, 41% had less than 5 years of employment, and 56% of the teachers had had no in-service professional development in the last 10 years. These observations are consistent with a recent government report that shows that Rwandan teachers have often to teach between 60 to 80 students per class and most of the teachers have only completed secondary education.

**The New Curriculum Documents**

Between April and May 1996, a Commission was appointed by the Ministry of Education in Rwanda, led by a curriculum design specialist from Canada, to harmonize the primary and secondary curriculum in all subjects and to produce a new curriculum document. Each
subject had a group of seven members, also known as the Commission of Teachers, which consisted of four members who were teachers from government schools or from the University of Rwanda, two secretaries to record the discussions in French and in English and a subject chairman (Ministry of Education, 1996). The commission developed a draft curriculum and the final published documents were published and presented to schools in September 1998 (Ministry of Education, 1998).

The Department of Education and Science in Pristina, Kosovo; published the new Kosovo Curriculum framework - a discussion white paper in September 2001. This document was published in English, Albanian and Serbian. The new framework offers teachers and educators concrete guidelines that assist them in creatively dealing with different techniques, learning issues and situations. It assists teachers to organise the teaching process for the benefit of students and helps schools and education administrators in the organization, management and evaluation of school activities and school environment (Kosovo Curriculum Framework, 2001)

**Developmental-Related aspects of the Science Curriculum**

An education in science should enhance each developing country's capacity to find ways to provide crucial essential services that are environmentally sound, socially equitable and economically affordable. Agriculture, population control, food production and nutrition, environmental management, health and sanitation are a few of the areas where a wider understanding of science will lead to more informed decision making and social development of the community at large (Ware, 1992). The development related functions have been shown in Table 1.

<table>
<thead>
<tr>
<th>Development-Related Topic</th>
<th>Subject Areas</th>
<th>Year Included in</th>
</tr>
</thead>
<tbody>
<tr>
<td>Health</td>
<td>Human body, hygiene, first aid, AIDS, STDs and drug abuse</td>
<td>Upper primary, lower and upper secondary</td>
</tr>
<tr>
<td>Water</td>
<td>Water pollution, conservation and purification, water borne diseases</td>
<td>Upper primary and lower secondary</td>
</tr>
<tr>
<td>Sanitation</td>
<td>Building a pit latrine, disease, prevent mosquito infestation, cleanliness and sewage disposal</td>
<td>Upper primary and secondary</td>
</tr>
<tr>
<td>Environment</td>
<td>Fuels, deforestation, conservation, soil and soil erosion, trees, plants,</td>
<td>Upper primary,</td>
</tr>
</tbody>
</table>
There have been many meetings and workshops with regards to the curriculum in Kosovo and a new curriculum was expected during the 2000-2001 academic year. Landmine awareness is being incorporated in all schools in Kosovo through the Non Governmental Organisation, Save the Children Fund and the UNICEF. Other topics related to health, disease, sanitation and population control are included in family and health education in Kosovo. Kosovo has the highest birth rate and infant mortality rate, the largest percentage of young people in the whole of Europe and most Kosovars have big families; however the region does not have the problem with HIV/AIDS that Rwanda has. The development related functions of science cannot be adequately and effectively taught to students in Rwanda and Kosovo due to the lack of textbooks and resources, the poor content knowledge of teachers and inadequate teacher professional development.

In 1998, a questionnaire was administered to teachers and students in Botswana to measure the extent that developmental functions of science education had been incorporated into the newly reformed curriculum (Vlaardingerbroek, 1998). As part of the present study, a revised version of the questionnaire was administered to a sample of teachers and students in Rwanda. Cronbach's alpha co-efficient was calculated at 0.82 for the teachers' instrument and 0.67 for the students' questionnaire indicating that all items measured the same construct and acceptance of the modified version of the instrument used in Rwanda.

Analysis of the data established the extent to which science teachers and students perceived that the development-related functions of science education had been incorporated into the new curriculum. For example, 87% of teachers and 94% of students perceived environmental awareness had been included in the new science curriculum. The teachers perceived that the new curriculum prepared students for further study in the areas identified in Table 7 and students similarly perceived that they were taught the development related topics as indicated in Figure 5. The next section discusses agriculture as a subject in the lower secondary science curriculum.
In spite of the immense difficulties and constraints in curriculum implementation, the new curriculum documents in Rwanda and Kosovo gave tremendous hope for the future of education. This hope is endorsed by the program director of an international volunteer organisation that provided volunteer science teachers to Rwanda:

It is important that young students in these transitional societies display a shared sense of the need for change. Change has to be brought about in the education system, but this change has to fit reality. There is a need for huge manpower resources and skills in the education sector. It is important to put education into context, think about the out of school youth and the rural poor. The new curriculum should put education into context and must be progressive.

The new science curriculum has been a start, a way forward and signifies hope for Rwanda and Kosovo, but it must meet the highly varied needs of Rwandan and Kosovar students. The curriculum can mean nothing in practice if it is not examined for its appropriateness of the existing situation in a society (McKenney, 2001). The attempts to improve science curriculum quality in Rwanda will depend on the realistic initial appraisals of the goals and objectives of the new curriculum and the Ministry’s understanding of the reality of classroom practice. Currently, the new science curriculum has introduced subject innovations and approaches but further research will be required to identify if existing curricular intentions are implemented in systems with under and unqualified teachers and a lack of finances (Lewin, 1985).
The School-Level Environment Questionnaire

A modified version of the School-Level Environment Questionnaire (SLEQ) was administered to 125 teachers in Rwanda. Principal components factor analysis followed by varimax rotation resulted in the acceptance of a revised version of the instrument. The *a priori* factor structure of the final version showed nearly all items having a factor loading of at least .30 on their *a priori* scale and no other scale.

To establish that each scale has satisfactory internal consistency, or that each item in a scale assesses a common construct, Cronbach's alpha coefficient was calculated. The internal consistency of each of the four scales ranged from 0.53 to 0.66 with mean correlation ranging from .10 to .21 for the four scales affiliation, staff freedom, resource adequacy and work pressure (see Table 2). There was some overlap between the mean correlations but generally each scale measured a unique aspect of the school environment.

Table 2: Internal Consistency Reliability (Cronbach Alpha Coefficient), and Discriminant Validity (Mean Correlation With Other Scales) for the School Level Environment Questionnaire (n=125)

<table>
<thead>
<tr>
<th>SLEQ scale</th>
<th>No. of Items</th>
<th>Alpha Reliability (internal consistency)</th>
<th>Mean Correlation (discriminant validity)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Affiliation</td>
<td>5</td>
<td>.66</td>
<td>.21</td>
</tr>
<tr>
<td>Staff Freedom</td>
<td>5</td>
<td>.53</td>
<td>.10</td>
</tr>
<tr>
<td>Resource Adequacy</td>
<td>6</td>
<td>.65</td>
<td>.16</td>
</tr>
<tr>
<td>Work Pressure</td>
<td>4</td>
<td>.61</td>
<td>.10</td>
</tr>
</tbody>
</table>

The average item mean and the standard deviation for each scale are shown Table 3. Responses indicate that teachers perceive a limited amount of work pressure, a lack of resources, affiliation between staff members and a great deal of staff freedom. However the results from the SLEQ survey were not often in congruence with the classroom observations made by the first author. The level of work pressure often varied from type of school and was often high in the private schools where teacher salaries were also higher. Most schools in Rwanda lack resources and in some instances have equipped laboratories donated by aid organisations that are often not used or used ineffectively. Textbooks are in acute shortage in the whole country and are not yet published in Rwanda.

Table 3 Mean and Standard Deviation with respect to the scales for the teacher sample (n=125)

<table>
<thead>
<tr>
<th>Scale</th>
<th>Mean</th>
<th>Standard Deviation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Affiliation</td>
<td>4.04</td>
<td>0.60</td>
</tr>
<tr>
<td>Staff Freedom</td>
<td>3.66</td>
<td>0.73</td>
</tr>
</tbody>
</table>
The Affiliation scale had a mean score of 4.04, which indicated that the teachers in the study sample were often encouraged and felt accepted by colleagues. This finding showed that the teachers in Rwanda were indeed cohesive, at least in terms of helping each other and were often able to work as a group. As most of the teachers in Rwanda have experienced sorrow, death and trauma, they displayed a unique mechanism of support. Inspite of their low salaries, they willingly contributed to any fund to help a colleague in need. Thus the affiliation dimension of the school environment in Rwanda showed that teachers in the sample felt they could rely on their colleagues for assistance if the need arose.

The Work Pressure scale of the school environment had a mean score of 2.78, which indicated that teachers did not feel a great deal of work pressure. This dimension can be explained in the Rwandan context. Most Rwandans are extremely hard working and work both at home and at school. At home and in their small farm plots they are used to physical labour. Compared to teachers in western societies, the teachers in the study sample did not spend time making or arranging classroom displays, as most schools did not have the resources to make displays. They were not overloaded with work and did not have to spend time making or arranging classroom displays.
The level of work pressure also varied from school to school. Private schools that paid higher salaries often had higher expectations of their teachers, including working longer hours and performing some extra duties. I had also observed that in most government high school teachers worked only a four-day week, teachers were expected to use the free day to research or gather information for their subject. Planning expectations were not high and teachers were allowed the freedom in the classroom as long as content was completed and the students were well behaved and disciplined in the classroom.

The Staff Freedom scale with a mean of 3.66 indicated that teachers in the study sample experienced considerable staff freedom. Teachers are allowed enough freedom to carry out their tasks independently as long as their classes are disciplined, the course content is completed, examinations are held and examinations marks are submitted on time. The teachers were provided the freedom to design their own scheme of work. Although teachers often experienced pressure at examination time when examination papers had to be set and marked. When students copied notes from the board, teachers did not feel the need to check their work for accuracy. The teachers in most schools very rarely had staff meetings and often class work did not provide opportunities for individual student needs. Thus teachers in Rwanda carried out their work, did not have a great deal of supervision and hence felt they had considerable freedom to do their work.

The scale mean score of 2.99 for Resource Adequacy seemed unusual because most schools in the study had only the basic amount of resources. Most of the schools in Rwanda have very poor infrastructure and do not have teaching and material resources. However, teachers in Rwanda had never experienced working with a high amount of resources were used to working in difficult circumstances and with few resources. The result of this dimension revealed that if teachers had chalk, a chalkboard, a few supplies, pens, pencils, and a few textbooks, they felt this was enough for them to carry out their tasks.

Qualitative Data:

By weaving questionnaire data with observations and interviews with participants it was possible to provide a more complete picture of the reform process and explain differences and similarities in the questionnaire scores.

Mining Data from Historical and Curriculum Documents:

Historical and cross-cultural studies are areas where documents are crucial to an investigation. The documents sought existed independent of a research agenda and were therefore non-reactive and did not affect the research process. They were a product of the context in which they were produced and therefore grounded in the real world. Analysis of historical data gave contextual richness and helped grind the enquiry in the milieu of the writer. Documents of all types formed the fourth major source of data in this study. Documents helped the researcher uncover meaning, develop understanding and discover insights relevant to the research problem. Historical data brought to light that the reform process in Rwanda had been ongoing and had always been funded by the World Bank, but this process has often been marred by the political, ethnic and socio-cultural agenda of the leaders in power. In Kosovo the parallel system of education was established in 1991 and functioned under extremely difficult circumstance for 9 years.

Emerging Themes from Interview Analysis

Data collected from the interviews with teachers, students and education personnel brought out emerging themes that highlighted the constraints that are being faced by the two societies: Interviews with teachers indicated that they are poorly paid in both transitional
societies leading to poor morale. Teachers’ interview analyses and subsequent quotes gave a human dimension to the complexity of the reform process and the constraints faced by the practitioners. Teaching is not viewed positively as a profession because teachers are not able to improve their qualifications due to a lack of financial means and lack of teacher training programmes.

**Infrastructure:**

There was structural damage to many schools in Rwanda. In some cases severe, some schools were in extremely bad physical condition and needed to be repaired. Repair had been carried out with aid from international organisations. The study highlighted the acute need for significant improvement in water and sanitation facilities in most schools. Many schools had no toilets or latrines within the school and many had pit latrines outdoors. This structural damage caused teachers to teach in difficult circumstances and the learning process is difficult for many students especially in rural schools. In Kosovo the complexity of the problem arose due to the climatic conditions. The sub-zero temperatures in winter indicated a clear need for heating. In Rwanda, the heavy rains and periods of drought pose different problems altogether.

A school principal in a small, rural Christian boarding school in Rwanda is struggling to improve infrastructure in his school and although not very optimistic, hopes for the best under difficult circumstances,

> I just have the minimal basics in terms of structure. I need more latrines, water and desks for the school. We desperately need resources of every kind. Resources mean funds and these are slow in coming.

The school principal of one of the biggest Gymnasiums or secondary schools in Kosovo had this to say to the first author:

> The school was completely destroyed during the conflict but has been rehabilitated. This is the first emergency year after the war and I have to cope with the large number of students. Unfortunately we do not have any library and our laboratories are non-functional.

**Curriculum:**

In Rwanda the curriculum was a combination of one that had been borrowed from other countries and was administered in Kinyarwanda in Rwanda. The curriculum is content-laden, teacher centred, requiring rote learning, copying of teacher’s notes from the board and memorisation of factual knowledge in exams and tests. The curriculum does not encourage development of knowledge, skills and attitudes. Often the content is outdated and does not reflect current pedagogical best practice. The Ministry of Education in Rwanda implemented a new curriculum for the primary and secondary schools in September 1998. The new curriculum framework in Kosovo has tried to preserve valuable features and practices of the Kosovar education system, while adding and adapting valuable education experiences that have occurred in progressive systems during the last few decades (Kosovo Curriculum Framework, 2001).
A highly qualified science teacher in an elitist urban school tries to make sense of the detail in the curriculum in Rwanda:

The course content of the science subjects is too detailed and there are too many topics to be covered and time is usually not on our side, there is too much to cover within a short period of time. I cannot understand why it is necessary to include so many subjects and have so much content.

A biology teacher in a secondary school in Kosovo had this to say about practical science:

This is the first time in 10 years that we have a proper school building, we ran schools in any place that was available. It was not possible to do practicals and students only did theoretical science. Even now we have a laboratory but we teachers need to improve our own skills first. Since this is the first year after the emergency we have not yet started practical science.

Human resources:

Young teachers were often not provided with ongoing pedagogical training and practical internship. Teachers have often been teaching out of areas for which they were qualified and there was a specific lack of teachers for maths, sciences and languages. In Rwanda after the genocide the proportion of qualified teachers fell from 60% to 33%. With regards to higher and secondary education there were very few qualified graduate teaching staff. The majority of the teachers for pre-school education had no specific training for the task. In Rwanda, teachers have often to teach between 60 to 80 students per class and most of the teachers have only completed secondary education. The Institute of Education in Rwanda is training about 120 young student science teachers who will graduate with an undergraduate degree in 2001 and be ready to teach secondary school science. It remains to be seen how many of these young graduates will be motivated enough to stay in the teaching profession.

Teachers in Kosovo have had no inservice training for 10 years. There is a real need in both societies to encourage young students to take up teaching. Young teachers were often not provided with pedagogical training and practical internship. Teachers have been teaching out of areas for which they were qualified and there was a specific lack of teachers for maths, sciences and languages. Teachers are in need of new skills in order to make decisions about what constitutes best practice in the classroom.

A smiling female high school principal of a rural catholic, girls school expressed her feelings:

I am usually an optimistic person and have been in the education system before and after the genocide. Many teachers have been killed and have also gone into exile. There is acute poverty and I see that people are desperate. The teacher salaries are low and often not delivered by the ministry on time. We need teachers to teach and books to implement the program.

A dynamic bilingual female primary school principal of a primary school in Kosovo had this to say of the difficulties faced by teachers:
I have seen the changes at all times during the last 10 years. It has been difficult and oppressive but the people of Kosovo must move ahead. Teachers are poorly paid and sometimes not paid on time. This makes it hard and they often do other jobs to earn more money. They also need training to improve their skills and computer training.

Bilingualism:

This is an issue in both societies, in Rwanda the need for competency in English and French and in Kosovo, Albanian and English. Lack of competent language teachers is a major constraint and there is need to establish a sufficiently large group of competent language teachers and improve material on language teaching. In Kosovo, the British Council is providing in-service training to English language teachers Bilingualism is an issue in Rwanda, the government has recognised the need for competency in English and French. Lack of competent language teachers is a major constraint in both transitional societies and there is need to establish a sufficiently large group of competent language teachers and improve material on language teaching.

Material resources:

Most school are lacking basic equipment and books in both societies. The lack of equipment, including technological equipment continues to be of great concern. School facilities are in a bad state with inadequate and missing equipment and often this is unevenly distributed throughout the national territory. There are severe regional disparities in terms of access and distribution of educational resources. Most schools in Rwanda and Kosovo have been rehabilitated but water and sanitation problems exist in both societies.

Finances:

In Rwanda, it is the UN agencies, international governmental, bilateral and non-governmental agencies that are funding economic, health and educational projects. It is important in the context of transitional societies that these agencies view long-term sustainable goals in education as a determinant for funding. 12% of the government's ordinary budget was allocated for education in Rwanda in 1998. Apart from external sources the Ministry looks at internal sources of funding like parental contribution, communal budgets, assistance from religious institutions and contributions to parental association. Kosovo had a system whereby parental contribution and contributions from society and diaspora helped keep the parallel system in place for ten years. Today both these societies desperately need the finances from external sources to build a strong educational base.

Governance:

The Ministry of Education in Rwanda is responsible for the management of all levels of education, pre-school, primary, secondary and higher secondary and is divided into two administrative authorities: central and local. As the central administration, it is responsible for organizing, monitoring and evaluating all educational and extracurricular activities in the country. The local administration is characterized by a double system of inspection at the district and commune levels. The head teachers are also an important factor in the local administration of education. However in spite of the existence of district inspectorates, nearly all decisions are taken by the central administration thereby creating a bottleneck for regional and local services.

Currently municipalities are being trained in Kosovo, so that they enjoy a high degree of autonomy with regard to maintenance of schools and planning for the schools. They receive
a lump sum budget and have to decide over priorities. They are also being consulted about school directors. A lack of status of the society and proper leadership has resulted in the UN making and taking most decisions in Kosova often not in consultation with local educational personnel.

The Director of secondary education in the Ministry of Education in Rwanda, a young woman shared this vision for increasing capacity of secondary schools

The Ministry of Education is trying to sensitize parents to build communal schools in all villages and communes and the ministry will then try to support these schools by providing desks, chairs and teachers' salaries but the governance of the school will have to be through the Parents Associations.

Classroom Observations

Class observations indicated that all teachers taught science under difficult circumstances in Rwanda and Kosovo but students never questioned the teacher's knowledge, the teaching methods, the content knowledge and had respect for the ability of the teacher. The curriculum is overloaded and often the level was much higher than required for the students. Textbooks in which curriculum was presented formed the basis of the exams. Content of material to be taught in order to cover the syllabus was one of the biggest constraints to curriculum delivery. It is also imperative to reduce the number of subjects that are being taught at both the primary and secondary levels. There is constant pressure to maintain high achievement scores, improve position of schools in national examinations and a constant need to improve student test results. Success was identified with goal achievement and performance in school. Students exam results were most important, so that students could go for higher education and hence the competitive nature of the curriculum. This encouraged teachers to concentrating on developing the academic ability and allowed limited opportunities for discussions or questions.

Discussion and Conclusions

This study highlights the constraints faced by transitional societies like Rwanda and Kosovo in the implementation of a relevant science education program. Transitions due to war, the breakdown of communism and internal conflicts are changing patterns of globalisation, diversifying local cultures and causing massive movements of people have had fundamental implications for education and training systems in many parts of the world. This is especially true of Rwanda and Kosovo. Rwanda had a civil war from 1990-94, the genocide in 1994 and is involved in a conflict with neighbouring Congo since August 1998. After internal unrest for 10 years from 1989 to 1999 in Kosovo and the war in mid-1999, the region has once again encountered tensions in 2001 with the Albanian rebels in Macedonia.

The common background variables in transitional societies that is moving towards long term sustainable development like Rwanda and Kosovo are an unstable political situation, a complex social context, a range of ethnicities, the inherent culture of the population, the non-urban agrarian make-up of society and a devastated economy.

The following four recommendations have been put forward take into account the results from the study and the various historical, social, cultural, political and practical factors affecting teachers, students and school environments in Rwanda.
Recommendation 1: Provide increased opportunities for and access to secondary education

Changing economic structure and employment patterns have affected Rwandan and Kosovar society. Unemployment, especially long term, is emerging as a major determinant of poverty and thus the increased demand for further education. Even after the efforts at rehabilitation the dropout rates remain high and the prospects of access to secondary education remain limited. The challenge is meeting the need for secondary and higher education. It is a future catastrophe for any country if only 20% of its primary school leavers are able to continue onwards to secondary education.

Recommendation 2: Provide a contextualized science curriculum

The challenge lies in improving the quality of education in mathematics, sciences, technology and English language so that the curriculum is presented in a relevant context. For example topics might include training in rural subsistence-based activities, mine awareness, health, water and sanitation, to equipping young people with a skill base applicable to modern and industrial technological contexts and the development of skills conducive to environmental preservation, disease prevention and self-employment.

Recommendation 3: Provide a living wage for teachers and opportunities for in-service training. Recommendation 4: Provide a living wage for teachers and the means for professional development

Teachers form the backbone of the education system in Rwanda and it is important that they receive adequate training and motivation. The challenge in Rwanda is re-organising teacher training structures, redefining teacher training programmes, creating higher pedagogical institutes, increasing content knowledge of teachers, and improving remuneration and incentive packages. Indeed evidence from the study has shown that Rwandan teachers are not motivated enough to stay in the teaching field due to low wages and their poor economic conditions. It is important that the government in Rwanda acknowledges this and improve the conditions of teachers.

Recommendation 4: Introduce Five-year Plans to provide Systematic Guidance to the Country's Education Reform Process.

Each component of the system (the teachers, the Curriculum Development Centre, the Examinations Board and the Inspectorate) has responsibilities in the science education reform process and has their own challenge. Science education reform will achieve its goals through systemic evolutionary reform and must involve co-ordination and problem solving among all components. This co-ordination between the teachers, the Curriculum Development Centre, the Examinations Board and the Inspectorate requires political commitment, organizational skills, long-term financial assistance and patience. For any educational plan of action to succeed, the plan must evolve over a period of at least 6-10 years. As a result of funding from the World Bank, the International Monetary Fund and the United Nations Development Programme, the Ministry of Education has developed plans, but these plans need to be evaluated annually or every alternate year in order to assess if targets and goals are being achieved.

The present study is a first in two respects. Firstly it has successfully combined quantitative and qualitative multiple methods to study science education reform in the post-colonial, transitional societies of Rwanda and Kosovo. The findings of the study focussed on teachers, students and educational personnel. Secondly this study is the first study of school environments in transitional societies. To successfully take advantage of the new emerging,
realities in Rwanda and Kosovo will depend on the quality of educational and human resources in the two transitional societies. Ultimately, it will be the Rwandans who must decide Rwanda’s future role and status within the Central and East African region and the whole world at large. The degree of success in this regard will depend on the intellectual abilities of Rwandans and Kosovars to critically understand, adapt and reshape their society through education.