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Teaching Science through the Science Technology and Society (STS) lens in Zimbabwean High Schools: Opportunities and Constraints.

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ABSTRACT

This paper is an extract from a bigger study that investigated use of Science Technology and Society (STS) approaches in teaching General Science in eight secondary schools in Harare, Zimbabwe. Data were collected from 28 Science teachers and 88 lower secondary school level students through interviews, questionnaires, observations and documents. The findings indicate that no deliberate effort has been made to infuse STS in the teaching methods course of teacher training programmes; schools are largely under resourced and the harsh economic environment prevailing in the country has made it difficult for schools to acquire equipment and contain the exodus of trained personnel. The General Science syllabus has also not been reviewed in a very long time so that it can be responsive to current needs. Opportunities for implementation of STS include the existence of professional associations, a well established teacher education system, school clubs, partnerships between business and the education sector and information and communication technologies (ICTs). The study recommends that STS be infused in the teaching methods course of all teacher training Programmes and that the science syllabus be reviewed regularly so that it responds to current needs. Relevant authorities need inject more resources towards in-service programmes and come up with legislation on in-service programmes e.g. promotion or salary hikes for those who develop themselves through workshops.
INTRODUCTION
In his commencement address to the graduating class of 1990, at Arkansas College David Orr said
...many things on which your future health and prosperity depend are in dire jeopardy... it is worth noting that this is not the work of ignorant people. It is rather the work of people with BAs, BSs, LLBs, MBAs, and PHDs... (www.context.org/ICLIB/IC27/orr.htm).

Though not restricted to the United States of America (USA), Orr’s sentiments were based on his observations in the USA of developments, in the name of Science and Technology, which tended to disregard the health of the environment. He talks of what might be called the educated illiterates and argues that education does not guarantee wisdom or decency. There is an argument that people’s behavior largely depends on how the education system has prepared them to think about the world. He and other scholars blame the social ills society faces on an education that is too theoretical and deficient in values. He advocates for education that empowers people to live in harmony with the environment. In science education, such an approach has been regarded as the science technology and society (STS) approach to the teaching/learning of Science (Spencer 1859 in Paul (1998), Zisk 1994, Aikenhead 1994, 1998, Bergerman and Reed 1995, Orr 1996). STS thus grew out of the need to develop science curricular that foster a sense of personal and social responsibility. There is an argument that science education should go beyond knowledge and awareness creation, but raise consciousness that can be translated into action and positive social transformation.

In response to global trends in curriculum reform and in a bid to reorient school curricular towards the economic and socio-political needs of an independent Zimbabwe, Government mandated the Curriculum Development Unit (CDU) to introduce scientific socialism within the school system (CDU 1987). The thrust of the Government was on science and technology education as a tool for economic development, self-reliance, and a form of national investment. This was done by developing Science syllabuses that are
geared to the practical application of science through technology. Government aimed at achieving scientific and technological literacy for all, (Hodzi and Chagwedera 1990, Udwin and Chidhume 1983, Mutumbuka 1981). The quest was to make science education more accessible and practical, less abstract and of greater relevance to the needs of Zimbabwe. The Ministry of Education and Culture as stated by the Science syllabus document made an indirect provision for STS by stating that;

The syllabus aims to equip pupils with scientific skills which will be of long-term value in an increasingly technological world. A pupil-centered practical approach to the subject is advocated to encourage scientific thinking and the application of the acquired knowledge (Ministry of Education and Culture, 1993; 2).

Basically the Science curriculum was designed with an STS orientation. However despite these impressive developments, government through what has generally been popularised as the Nziramasanga Commission of inquiry reports that

... Zimbabwe has invested heavily in improving access to and enhancing the quality of science education...available evidence on the level of achievement in science and technology suggest that scientific literacy and technological operacy are still distant goals (Government of Zimbabwe 1999; 36).

This may be interpreted to mean that the levels of scientific and technological literacy in Zimbabwe are still very low set against some predetermined criteria thus internationally recognized. This investigation thus sought to identify gaps between theory and practice and suggest solutions to major problems that relate to the conceptualization and implementation by teachers of an STS curriculum. The study also sought to gather data on theoretical knowledge, in a bid to provide rationale upon which the science curriculum could be reviewed to be responsive to social,
psychological and philosophical thrusts that are in line with modern trends in curriculum development and innovation. The ultimate goal was to work towards improving science education, not just in the selected schools, but in Zimbabwe and probably beyond. Although much has been written about the challenges bedeviling science education in Zimbabwe, very little has been said about the opportunities that exist to take it to greater heights. This paper aims to close this gap by enumerating research based opportunities that exist for the provision of a quality and relevant science education to many at a relatively low cost.

Conceptualising the Study

Academics have not really agreed on what it means to be scientifically literate. However for purposes of this discussion the definition given by the National Association of Science Teachers Handbook (NSTA 1982) will be adopted. They define scientifically and technologically literate individuals as those who understand how science, technology and society influence one another and are able to use this knowledge in their everyday decision making. The scientifically literate person has a substantial knowledge base of facts, concepts and conceptual networks and process skills that enable that individual to think logically. The individual both appreciates the value of science and technology and understand their limitations. It is generally believed that science education should develop these and other competencies to enable learners to cope in an increasingly technological world.

One aspect of literacy includes an understanding of the roles of science in society from both local and global perspectives. Considerations of such societal issues lead to questions like:

*Is it wise to invest in bio-fuels?*

*Is it ethical to practice birth control?*

*Should we invest in nuclear energy?*
Such issues evoke debate and bring to the fore morality, values and ethics as an added dimension of science education. It is generally believed that through the study of such science-related social issues learners will appreciate that scientific advances bring convenience as well as problems (Lopez 2000, Rahman 1995). Education is therefore expected to empower people to confront the challenges posed by the advance of science and technology.

Scholars inclined to this school of thought advocate for STS that is the teaching of science in the context of human experience (McCann, 1997; Lopez; 2000; Zisk, 1994). According to Zisk (1994: 7) “STS programmes begin with a real world problem and attempt to resolve it by proposing explanations, finding resources, seeking advice, experimenting, reaching consensus, dealing with diverse ideas and observations, and using information to support ones’ explanations.” It means focusing upon current issues and attempts at their resolution as the best way of preparing students for current and future citizenship roles. It calls for the development of a broad-based science curriculum embedded in the socio-political and cultural contexts in which it operates. This entails student engagement with different viewpoints on issues concerning the impact of science and technology on everyday life. Students thus would understand the relevance of scientific discoveries instead of simply focusing on learning scientific facts and theories that seem so distant from their realities. This is considered important to make science accessible and meaningful to all and most significantly engaging them in real world issues (Wikiprojectscience 2008). Emphasis is on responsible citizenship because science concepts and process skills are regarded as useful tools in dealing with real world problems.

Ham and Yager in McCann (1997; 2) put it that “…taking into account the fact that students today will soon be operating as adults in a society that is even more technologically oriented than at present, they will be participating as citizens in important science-related societal decisions”. The objective then is to make science education dynamic and changeable to meet the challenges of a rapidly changing world. It is expected that students will resultantly
become scientifically and technologically literate and so be better at making personal, social; and civic decisions. Through participating directly in activities like street cleaning science education can help train citizens to be aware of their social responsibilities. The argument being that what is included or excluded in the school science curriculum teaches students that they are a part or apart from the natural world (Orr 1990). In support of this view, Haggis (1991; 39) ascertains that

It is now widely recognised that the most effective and relevant learning takes place through the process of solving problems that occur in or are immediately connected to the life of the learner rather than in contrived classroom situations. There is a fundamental need for “doing” to become part of learning ... otherwise the learning will not be brought into effective action.

Consequently teaching has to be practical and anchored in the local context. Using problems that affect the community, teachers endeavor to show the practical value of scientific knowledge in determining causes of specific phenomena for example land degradation, water pollution and climate change. STS thus allows students to find science classes relevant to their lives.

The goals of STS include forging an interdisciplinary approach to science education where there is a seamless integration of economic, ethical, social, and political aspects of scientific and technological developments in the science curriculum as well as engaging students in examining a variety of real world issues and grounding scientific knowledge in such realities. In today’s world such issues may include the impact of society on global warming and climate change, genetic engineering and nuclear testing. STS also aims at enabling students to formulate a critical understanding of the interface between science, technology and society; and to develop students’ capacities and confidence in making informed choices, to take responsible action and to addressing issues arising from the impact of science on their daily lives (Wikiprojectscience 2008). STS thus
advocates for a science education that is interdisciplinary, practical, humanistic, value-laden, responsive and relevant to personal, societal and environmental concerns. The idea is to provide real-world connection for the student between the classroom and society. Thus the bottom line in STS is the involvement of learners in experiences and issues that are directly related to their lives. Apart from imparting scientific knowledge and process skills science education is also expected to impart values such as respect, tolerance, self-reliance, justice and responsibility to enable learners to make sound choices and live in harmony with nature and other human beings.

Ajeyalami (1990) argues that science and technology have contributed to make life comfortable for people. Ironically some of the world’s worst problems of humanity have either been brought about or aggravated by science and technology, the most significant being the investment which contemporary society has made in weapons of mass destruction (Rahman 1995). There is numerous science/technological disasters that have occurred around the world, Zimbabwe included. Noteworthy events in Zimbabwe include the Hwange Colliery Mine disaster and the Millennium Tower disasters. On the global front, one cannot discuss science-related disasters without mentioning the Chernobyl Nuclear disaster, Bhopal Chemical disaster, Hiroshima and Nagasaki bombings and more recently the threats posed on human lives by global warming and climate change. These and other technological disasters which are man-made and should be preventable have caused immense human suffering. Each of these tragedies was possible because scientific knowledge has been used without much consideration of its social implications... Having seen the havoc that had been wrought by the misuse of science and technology and the threat posed to humankind by it, some scientists began to question what education could do to ensure that mankind and the planet earth can survive. The events of the Second World War in particular awakened many scientists to this social responsibility, and the STS movement is a direct result of such efforts; an outcry for wiser use of science and technology so that humans can live in harmony with nature. Consequently this demands improved science education programmes that empower students to
become active and responsible citizens by responding to issues that impact on their lives (McCann 1997). In short STS will create a scientifically literate citizenry who are equipped to confront the challenges posed by the advance of science and technology and able to recognise which applications are beneficial and which are potentially harmful. Duran and Nowaldly (2000) argue that the more people understand about the world around them the better citizens of the earth they can be. Science literacy helps one better understand the effects of cutting down of trees on global warming and climate change. The challenge then becomes to make science education changeable and dynamic to meet the challenges of a rapidly evolving scientific and technological age.

In as much as the content of the science programmes is important, the way science is taught becomes crucial as well. STS redefines the role of the teacher from the expert lecturer to be that of facilitator who guides students on how to learn. In essence an STS curriculum is characterised by more learning for understanding and less rote learning, more varied, interactive, and activity based learning and less passive learning; more relation to the natural and social context and to pupils’ life and experiences and less transmission of abstract theory. More attention is paid to practical skills and problem solving for example raising questions, designing investigations and observing (de Feiter, Vonk and Akker 1995). Instead of using abstractions from text books teachers are encouraged to treat problems that are relevant to students. As often as is possible teachers must use everyday objects to illustrate abstract concepts; local brews such as ‘mahewu’ illustrate fermentation, while lemon juice illustrates acid. Emphasis is thus on learning from experience not on teaching.

The role of the teacher extends beyond the four walls of the classroom to important activities such as pioneering innovations and encouraging their development and adoption, sharing insights with colleagues and working with researchers to develop new curricular. The argument is that an approach confined to the classroom, more abstract and with more limited, purely academic objectives may
serve a minority, and may lead to passive assent, and even disengagement. Haggis (1991; 39) puts it that:

It is now widely recognised that the most effective and most relevant learning takes place through the process of solving problems that occur in or are immediately connected to the life of the learner rather than in contrived classroom situations. There is a fundamental need for ‘doing’ to become part of learning...otherwise the learning will not be brought into effective action.

Science education therefore should be relevant, appropriate and practical. Thus particular attention should be given to activities centered on problem solving, decision making and designing. This then calls for a shift in teaching methodologies from the traditional modes that mainly center on chalk and talk to more interactive and child centered approaches such as debates, fieldwork, projects and site visits.

The NSTA Handbook (1992-1993) summarises the characteristics of STS programmes as follows:

- Student identification of problems with local interest and impact;
- Use of local resources to locate information that can be used in problem resolution;
- Active involvement of students in seeking information that can be applied to solve real life problems;
- A focus upon the impact of science and technology on individual students;
- Extension of learning going beyond the class period, the classroom, the school;
- A view that science is more than concepts which exist for students to master;
- An emphasis upon process skills which students can use in their own problem resolution;
An emphasis upon career awareness especially careers related to science and technology;

Opportunities for students to experience citizenship roles as they attempt to resolve issues they have identified;

Identification of ways that science and technology are likely to impact the future;

Some autonomy in the learning process.

Recommended methodologies include simulations, cooperative and collaborative action, independent projects, case studies, surveys, written and oral presentations, student-centered class discussion, problem solving, controversies, debating and using the media and other community resources. Evaluation tools to use could include essay examinations, performance based assessment and portfolios (Aikenhead, 1994).

Using the above features as a guide to identify an STS curriculum this investigation thus sought to make a SWOT (Strengths, Weaknesses, Threats and Opportunities) analysis of STS implementation in real classroom situations by attempting to answer the following questions:

How is STS conceptualised by both science educators and students?

To what extent does the General Science curriculum relate to modern trends in curriculum development in general and to STS in particular?

What kinds of structures are in place to ensure effective implementation of STS?

What kinds of problems are associated with the implementation of an STS curriculum and has there been a conscious effort by relevant stakeholders to solve such problems?
Research Design and Methodology
This study took a mix of qualitative and quantitative approaches. The debate on whether the two approaches are complementary and compatible is beyond the scope of this paper. This particular approach was adopted based on the belief that qualitative research is appropriate to answer certain kinds of questions and quantitative is right for others. A qualitative approach was justified basing on the premise that schools are social organisations that exist within particular socio-cultural contexts. There is a strong argument among qualitative researchers that human behavior is significantly influenced by the setting in which it occurs; thus one must study that behavior in situations. The physical settings e.g., pay, and the internalised notions of norms, traditions, roles, and values are crucial contextual variables. Research therefore must be conducted in the setting where all the contextual variables are operating (Marshall and Rossman 1980). A quantitative approach was incorporated because it was critical to answer questions like how many, what percentage of and to what extend teachers use particular teaching methods. Quantitative data was collected to provide baseline data on the kinds of teaching and evaluation methods used by science teachers. However it was imperative to investigate why teachers used/did not use particular teaching methods. This then called for adoption of a qualitative approach to the study.

The methodology opted for in this study is the comparative multicase study. This involves the study of two or more cases and then compares and contrasts them (Bogdan and Biklen 1992). “Case studies are the preferred strategy when ‘how” and “why” questions are being posed. When the investigator has little control over events, or when the focus is on a contemporary issue with some real-life context…” (Hitchcock and Hughes, 1995; 322). The study was generally descriptive; data were collected from existing situations without making a conscious effort to manipulate the environment. The goal was to seek explanations and to understand relationships between variables, for instance to explain why teachers used particular teaching approaches and not others.
Population and sample
A stratified random sample of eight secondary schools was drawn from all secondary schools in Harare Province. The sample was stratified to ensure that all categories of schools found in Harare are evenly represented. The sample comprised: one government school former group A, three former group B, one school in a farm holding settlement, one church school, two privately owned school, one low fee-paying, and one high fee-paying. Teachers participated on the basis of their class allocation and the study focused on those teaching at the lower secondary school level. Questionnaires were distributed to all teachers who taught ZJC General Science in all the schools and lesson observations were conducted with one teacher per school in five of the schools. Twenty-eight (28) science teachers and eighty-eight (88) form two students responded to questionnaires. At every school one class was selected to participate in the study and half the class was randomly selected to respond to questionnaires.

Data Gathering Techniques
The data gathering process spanned a period of approximately three months. It incorporated four data collection techniques; semi-structured questionnaire, classroom observation, documental analysis and clinical interview.

Questionnaires
The questionnaire provided baseline data for the study. A self-administered, semi structured questionnaire was completed by twenty eight General Science teachers. Closed questions were used because they provide answers that are standard and hence can be compared from person to person. Open ended questions were used to allow for respondents to express their personal views. The questionnaire was used to gather data on syllabus analysis, the preferred teaching and assessment methods, support structures and resources provisions for teaching science, extension activities, and implementation challenges teachers face, staff development issues, funding of science activities and their conceptualisation of STS in general. Eight-eight students also completed a semi structured self-administered questionnaire that sought to triangulate the teachers’
questionnaire as well as solicit for students’ views with regards to the way science is being taught. To increase the validity of the responses student questionnaires were completed in the absence of their teacher. Students were also given the assurance that their teachers would not have access to their responses. Students whose first language (L1) is not English were also allowed to respond to open ended questions in their mother language in the event that they find English limiting.

Classroom Observation

An observation schedule designed by the researcher was used to collect data. It comprised both a free-form method of collecting data and a checklist. This was done to allow for the researcher to collect data on both expected and unexpected dimensions of the topic. A tape recorder was used in some of the lessons to help capture lesson proceedings fully. The researcher’s behaviour ranged from complete observer, by sitting quietly at the back of the room to participate observer, especially during practical sessions. In order to create a free environment for both the teacher and the students involved in the observation, the researcher visited the class prior to the observation at least twice just to familiarise with both the teacher and students without recording anything. Lesson observations were done in five of the schools. At least three recorded and two informal observations were done per teacher. Only one teacher per school was observed. Classroom observations provided an opportunity to assess the reality of what takes place in classrooms. It gave the researcher an opportunity to observe first hand, the kinds of structures schools have in place to support implementation of STS as well as the challenges teachers face in their endeavour to implement an STS curriculum.
coded and categorised onto themes which reflected the purpose of the research. From the themes and codes came narrative descriptions constructed by identifying dialogue that provided support for themes. Quotes were collected from interview data as well as responses to open ended questions in questionnaires. This was done to allow the data to speak for itself, hence improve validity of findings Data was then interpreted in view of the NSTA’s ideals of STS programmes as well as the general purpose of the study. Quantitative data was analysed statistically using Microsoft excel. Where necessary the visual presentation was achieved through the use of graphs.

Profiling the Participants

The schools

School A
Is a Government secondary school, former group B. The school has, trained Science teachers, adequate laboratory space, trained laboratory assistants and a library with largely irrelevant books.

School B
This is a government school former group A. The school has a computer laboratory, science laboratory with largely old and malfunctioning equipment, trained laboratory assistants, a spacious library with largely irrelevant books. All teachers have no teaching qualifications.

School C
This school is owned and managed by a private board of trustees and is located in one of Harare’s posh suburbs. The school has adequate, state of the art and well equipped Computer and Science laboratories plus trained laboratory assistants. There is a spacious library, reading rooms, and a variety of updated and relevant books. All teachers are certified graduates.
School D
Is a privately owned school initially meant to cater for disabled children from disadvantaged families. The school has adequate laboratory space but inadequate equipment, a library with relevant books and professionally trained Science teachers.

School E
This is a government secondary school established after independence to absorb mainly African children who were accorded easy and automatic access to secondary school education. The school boasts of trained laboratory personnel, spacious laboratories, though poorly equipped and a spacious library with largely irrelevant books. Some teachers are trained while others are not.

School F
This is a multi-racial church school mainly serving high-income earners. The school has a computer laboratory, well equipped science laboratories, trained laboratory personnel and all teachers are certified graduates.

School G
This school was established due to joint efforts between Government, donors and parents in a farm holding settlement 30km outside the city centre. One teacher is a trained Science teacher and the other one is trained to teach mathematics. This is the only school without proper classrooms, laboratories and library although they have a few pieces of equipment and books kept by the science teachers in a makeshift staff room.

School H
The school is a government school, former group B. The school has trained laboratory personnel, adequate laboratory space but inadequate equipment, and a spacious library with mostly irrelevant books. All teachers have professional training.
The teachers
The sample comprised of twenty eight teachers of a generally sound academic background, with 22 having attained at least passes at advanced level. The majority (20) of the teachers have professional qualifications ranging from certificates in science education to masters degrees. Of the trained teachers quite a number (16) have been teaching for periods in excess of five years.

The students
All the schools involved in the study do not group their students according to ability. The sample was heterogeneous comprising 88 students of mixed ability, socio-economic status, ethnicity, race and gender.

Results Presentation, Analysis and Discussion
The study was conducted two decades after Government adopted its policy of scientific socialism that sought to spearhead economic development through science education. At the time of the study the Science Syllabus had been operational for more than ten years, a situation which militates against the essence of an STS curriculum that advocates for a dynamic and changeable science education that addresses the challenges of a rapidly evolving scientific and technological age. Despite changes on paper and greater political rhetoric about coming up with a more relevant and practical science education that places greater emphasis on science and technology currently used in Zimbabwe, the curriculum remained largely academic and strongly influenced by the colonial system. The changes thus remained cosmetic and the Zimbabwean experience might be likened to what has generally been referred to as “innovation without change”.

Opportunities however exist for educators to capitalise on the STS concept and give students a quality and relevant science education that will help them become better and responsible citizens. Opportunities identified in the selected case studies will be discussed below.
Professional Associations
There are properly structured Science teachers’ professional associations such as the National Science Teachers Association and the Science Education In-service Teacher Training (SEITT) programme, which offer opportunities for science educators to network and build capacity to improve science education so that it could be more relevant, responsive to the needs of Zimbabwe and in line with modern trends in science instruction. STS is about focusing on current issues and events hence call for continuous staff development. The argument is that knowledge is not static but keeps on changing; hence learning should be a continuous process.

Sadly such fora are not being exploited to the full. An interview with a committee member of the National Science Teachers Association (Harare Region) who happens to be HOD, school E reveals that the economic environment currently prevailing in the country has hit the associations hard.

*There is no money to sponsor such activities... We used to be very active...we used to meet and share ideas on the teaching of different topics and we also used to make models such as the heart and lungs using manila paper and electricity cables...but in the past year or two we haven’t done anything...*

Answering to why schools cannot sustain these associations he said:

*The problem we have in Zimbabwe is that we are so much used to donor assistance. Once the donor pulls out the project dies...I think it would be better to have these projects funded locally. The relevant authorities must also allow us to seek local sponsorship...lets just stop this habit of looking to the West for assistance.*

Professional associations do exist but are under threat from donor syndrome. Teachers could possibly sustain these professional associations if the initiative to establish the fora is locally driven. Other respondents felt that there should be some incentive to lure
them into participating in professional development activities. Asked why they do not participate in workshops one respondent simply put it that “there is no incentive” (teacher school G). One way to improve teachers’ participation in professional development associations could be through provision of incentives such as promotion or award of certificates.

Science Clubs
One aspect of STS is an extension of learning going beyond the class period, the classroom and the school (NSTA 1992-1993). One way to extend science beyond the class period is through establishment of science clubs. These provide opportunities for students and teachers to meet and carry out Science related activities such as community outreach. Science clubs also create autonomy in the learning process as students may be free to design projects of their choice. Students are free to identify projects or their choice with local interest and impact. All schools in the study have a viable science club. Activities vary from school to school including making simple electronic devices to giving care and support to HIV/AIDS patients. In School G the club extends its reach to the local community by campaigning for and supporting HIV/AIDS patients under the home-based care programme. Former students continue to be members. The club therefore provides links between the school and the community and opportunities for both to learn from each other. This club also provides for opportunities for students to experience citizenship roles as they attempt to resolve issues affecting their communities as recommended by the NSTA Handbook (1992-1993).

In another school (school B) the club is an electronics club and part of the club’s activities includes construction of simple electronic devices such as door alarms. Students thus are being actively engaged in seeking and applying information that can be used to solve real problems. This is in line with the NSTA (1992-1993) Guidelines that seek to promote autonomy in the learning process as well as use of local resources to locate information that could be used in problem resolution. Such activities also develop skills that students can use in solving their on problems at home and may be
later on in life. If properly managed Science clubs thus can be a source of inspiration for students to develop interest in science related community issues, hence help improve their scientific literacy and provides opportunities for positive social transformation and responsible citizenship. The more people understand about the world around them the better citizens of the earth they can be (Duran and Nowadly, 2000).

Unfortunately some teachers lack interest in these activities. Responding to whether the school has a science club or not one teacher in school E had to first consult her Head of Department (HOD) “nhai pane science club here pano?”, meaning ‘do we have a science club in the school?’ More so certain schools restrict membership to senior classes and the youngsters miss out on this opportunity. “yes we have a science club but it’s restricted to A level students”, HOD a\school B.

Partnerships between Business and the Education Sector
One partnership which has benefited science education in general and STS in particular is the Business Education Partnership of Zimbabwe (BEPAZ) through programmes like Science Teacher Placement in Industry (STPI) and School on the Shop Floor. The programmes are meant to expose teachers and students respectively to the world of work in general and to new technology in particular. This is in support of the STS view that science education should be linked to the world of work and that local resources could be harnessed to enrich science education (NSTA 1992-1993).Activities involved include industrial visits and work experience linked either to subject studies or core courses. Such programmes provide opportunities for tying the education system more closely to the economy and serve the needs of industry more effectively. Unfortunately the majority of teachers (86%) have never participated in STPI and quite a significant proportion (56%) is not aware of the shop floor programme as demonstrated by the following responses;

Is it a science programme... and what does it involve? (Teacher, school B);
I haven't heard about it (Teacher, school C);

I am not aware of the programme...maybe it's limited to A Level (teacher school A)

The programme exists but science students are not involved. The involved students go every Friday... I'm not sure why the science students do not participate...never thought about it anyway (HOD school C)

Though other factors cannot be ruled out the above responses are an indication of ignorance, lack of interest and an unwillingness to find out more about available structures educators can capitalise on to take science teaching beyond the classroom as envisioned by STS.

Added to that Junior students are left out because they are regarded as immature and not ready to enter the job market. One then questions the logic of introducing career guidance at the end of the secondary school course. Teachers must endeavour to introduce career guidance earlier.

An analysis of students' responses suggests career guidance is a grey area. Despite 65% of the students indicating that they would like to study science at college or university, only 50% indicated they would love to pursue a science-related career. This discrepancy points to the fact that students miss the link between the subjects they study and the careers they wish to pursue.

Laboratories
All schools serve for G boast of spacious laboratories and trained laboratory personnel. This provides opportunities for students to experiment individually and in small groups hence creating autonomy in the learning process as well as develop process skills (NSTA 1992-1993). Data from lesson observations however reveals that all but very few experiments are restricted to teacher
demonstrations where students are reduced to mere spectators. Teachers cite the following reasons;

_We cannot allow them to handle equipment at this stage because they are not yet mature. They break equipment and the cost of replacing it is prohibitive...just imagine the cost of making chemicals available for thirty six students...we cannot afford this so we restrict our practicals to teacher demonstrations...they will only do practicals at A Level (HOD, school B)_

Unfortunately not all students proceed to do Science at A Level; some terminate at the Ordinary level. Science educators thus need to seriously reconsider this unfortunate stance because this creates an environment where students leave school without having acquired the relevant skills and attitudes to help them cope in an increasingly scientific and technological world as demanded by STS.

Teachers in group B government schools are restricted by non availability of equipment and large classes which make it difficult to supervise individual experiments. "as you can see we don’t have equipment to allow for individual experiments...yes equipment can be improvised but our classes are large so individual supervision is very difficult" (teacher school E). In some schools equipment is there but is old and obsolete. "...well this lab is full of equipment but it's too old and...the bulky of what we have in here is not working (teacher school A). So in as much as there are laboratories and trained laboratory personnel in the schools these are not being utilised to the full because of safety concerns, large classes as well as unavailability of chemicals which emanate from prohibitive costs.

Information and Communication Technologies
Information and communication technologies (ICTs) including the computer and the internet are useful strategies to employ in the teaching/learning of science because they shift emphasis from the teacher to the learner and help extend teaching/learning beyond the
classroom as per STS recommendations. The NSTA (1992-1993) recommends some autonomy in the learning process and active involvement of students in seeking information that can be applied to solve real life problems. ICTs, especially the computer and the internet provide for such opportunities. Sadly all respondents do not use the computer and rarely use videos and other ICTs in their teaching. Reasons for not using these facilities varied among the schools and the individual teachers. In some schools the facilities are not available. In others computers are regarded as a preserve for computer studies.

"The computers are meant for computer students and can only be accessed during computer lessons" (teacher school B).

The computers are meant for computers students...but access to the computer labs is not restricted (HOD school C).

Some science teachers in the sampled schools have access to computers but argue there is no software and generally do not see the place of the computer in their teaching.

Yeah... access to the lab is not restricted but you see we don't have the software...besides I am happy with the way I am teaching now and don't think using the computer is really important... What I'm doing is enough (teacher school C). This study did not ascertain teachers’ levels of competence in using ICTs in the teaching and learning of Science, so generally incompetence and ignorance could be some of the reasons teachers do not use ICTs. There is also a general lack of innovativeness on the part of the teachers. As a result implementation of STS is negatively impinged on, unnecessarily.
Zimbabwe has a formalised and coordinated teacher education system. Teacher education could make a contribution to the advancement of STS by infusing STS content into the methods courses of all teacher training programmes. The challenge for teacher education is to design programmes which transform the role of the teacher from the lecturer/expert and giver of knowledge to that of facilitator who guides students on how to learn. Results from the study may suggest that STS is not a compulsory component in teacher training programmes.

Only 18% of the teachers received formal training in STS and indicated they received the training as part of their teacher training programmes. The greater proportions of the teachers do not have training in STS despite the fact that they passed through the formal training system. The teacher education system is one possible avenue that could be used to advance STS science teaching.

**Barriers to Teaching Science through STS**

*Lack of training/awareness in STS*

One major constraint to the implementation of STS is lack of training and awareness in STS discourse. Only 25% of the respondents were aware of STS and out of these, just 18% were trained in STS science teaching. This lack of awareness/training negatively impacted on the
adoption of STS methodologies and might explain why in certain schools junior students are not allowed to experiment and participate in career awareness initiatives. When asked about the school’s participation in the shop floor programme, the HOD from one of the schools’ response was, *the programme exists but science students are not involved... I’m not sure why the science students do not participate... ugh... never thought about anyway* (HOD, school C). This is one typical response that highlights how ignorance/lack of training is negatively impacting on the implementation of STS.

**Language of Instruction**

Lesson observations revealed that both students and teachers alike struggle with the language of instruction except for a few whose first language is English. The following excerpts from students’ questionnaire responses might help illuminate the gravity of the problem:

*I wish about my teacher she makes someone against their life;*

*I think he has to remain doing some attitude because it helps many students, e.g. to tell students that a teacher did write test for but you write with yourself.*

Although teachers are allowed to code switch they feel obliged to teach in English, a second language because eventually students will write their exams in English. The goal is to prepare students for exams and further study contrary to intentions of STS of preparing students for life. The language problem is a reality and there is need to devise strategies for improving students’ proficiency in the language of instruction or better still create an environment where the local language becomes the language of instruction. STS borrows a lot from constructivist and social constructivist theories which underscore the idea that learning is a social process mediated through language. So it is only fair that science be offered in local languages.
**Heavy Teaching Loads and Large Classes**

Both class size and the number of lessons conducted by each teacher per week have implications on the teaching methods teachers use. In the public schools teachers not only have heavy teaching loads but large classes as well. Large classes limit teachers to use more of the teacher centered methods because giving students individual attention becomes a challenge. Implementation of STS under these circumstances becomes a mammoth task and unless this area is addressed STS might just remain a concept in Zimbabwe's public schools.

**Lack of Resources**

Resources for teaching/learning of science in public schools are inadequate. Material resource inputs like textbooks, laboratory equipment, training and retraining of human resources needs attention. Other schools do not have resources to fund field visits and the hiring of experts. Other teachers feel that the time allocated for science on the school time table is inadequate. Responding to why they do not use debate as a teaching method one teacher says;

*The time allocated to science does not permit us to use such methods...debates are very helpful because the teacher also learns a lot from the students...it helps reduce teacher talk...* (Teacher school A). In as much as teachers appreciate the use of child-centered, interactive methodologies such methods may not be used because teachers are under pressure to finish the syllabus so that students are ready for exams. Compounded with this the science education sector has been hard hit by the mass exodus of qualified personnel in search of greener pastures. All these challenges pose serious threats to the implementation of STS.

**Syllabus and Examinations**

Results from the study indicate that science teaching is syllabus driven and examinations oriented. There is therefore need to change the format of evaluation from a purely objective to a more subjective form that reflects the diversity of science education. The Science syllabus needs to be reviewed more often so that it can be responsive
to current trends in science and technology. Issues that can be added to the syllabus include cell phone technology, the internet and e-mail, as well as renewable energy technologies.

Uninformed Conservatism and Lack of Innovativeness

By its very nature STS demands significant changes in the role and expertise demanded of the teacher because it departs from the "usual" way of how teachers conduct their work, how they view themselves and the students they teach and the whole teaching/learning interactions. Although teachers appreciate the usefulness of using child centered approaches some teachers passively and actively resist the role changes because they blindly follow tradition and there is a fear of losing control of the teaching/learning situation respectively. One teacher felt that certain teaching methods like drama militate against his beliefs and ethical conduct and limits content offered. Other teachers felt that certain teaching methods tend to restrict the content covered. "inini zvangu zvinondirestricsta data rangu". Loosely translated it means "as for me it restricts my content...you may have videos but without the relevant data" (teacher school C). There is a fear of students’ missing out on content if some of these not so conventional teaching methods are used. Others lack interest in out of class activities and are not innovative enough to try out new things. Responding to why the teacher does not take out her class on field trips, the response was "funds are available but I haven’t really thought it’s useful to do so". Teachers have resources such as computers, personnel, and the natural environment but do not and sometimes never explore them partly due to ignorance and partly due to lack of motivation and innovativeness.

Students on the other hand have illuminated weaknesses in the methods adopted by their teachers as exemplified by the following responses;
...it would be nicer if our lessons were more like discussions, where everyone's' views and opinions can be heard...

...listen to our suggestions in class...

She should slow down in teaching and explaining...communicate with slow learners

He should'nt be harsh with us when we fail to comprehend because he will confuse us even more...people must not be punished for failing.

Generally students' sentiments that strongly came out may be grouped into the following major themes/categories;

- We would like to go out more often...
- Make us watch more videos
- We want to share science ideas with students from other schools/classes through debates and seminars
- We want to know more about computers
- Give us the opportunity to experiment on our own so that we can feel the excitement
- Our teachers must be a bit friendly and patient with us and please give us respect.

A quick rundown at the students' responses combined with data from teachers responses and lesson observations indicate that teachers use more of the teacher centered methods contrary to STS that advocates child driven teaching.

Heavy Dependency on Text Books

Teachers mainly depend on text books as the major source of information because the text books are readily accessible. Not a single teacher uses sources such as magazines, journals and the internet. They rely only on text books and this defeats the purpose of
STS teaching which stipulates use of current and varied sources to locate information about particular issues. The most popular text books (Focus on Science and Step Ahead Science) are old, outdated and deficient in social issues.

CONCLUSION

STS provides an opportunity to provide practical, relevant and quality science education to many at relatively low costs. However despite its usefulness and potential benefit the concept of STS is still not well understood, has not been massively sold to science educators and has not been widely applied in the teaching and learning of science at the lower secondary school level. The study revealed that giving students a practical and relevant science education of high quality goes beyond resource provisions. Human and material resources lie idle because teachers are not aware of their benefits. Even though some teachers were trained in STS methodology they continue to passively and actively resist the role changes because there are concerns with losing class control and preparing students for examinations. Despite the existence of such constraints opportunities however do exist for effective implementation of STS and these include the existence of professional associations, well established teacher education systems, school clubs, partnerships between businesses and the education sector, and ICTs. Science education can also benefit from the existence of locally relevant resources. Human resources that can be tapped on include personnel from fields such as medicine, electrical and electronic, environmental management and food processing. Respected and renowned people who have made it in the field of science can also be invited to give talks or teach particular topics. This can act as a motivator and may help demystify science as a preserve of a privileged few. Material resources include the natural and built environment including school food and botanical gardens, factories, hospitals and rubbish dumps. Such facilities can be used as avenues to take science outside the classroom and the class period as demanded by STS. Waste material like tins, glass and plastic bottles can replace conventional lab apparatus. All these activities help improve the relevance of science by linking what happens in the
classroom to what happens in real life, the essence of STS. With relevant training, a desire to innovate, willingness to change the status quo and the right attitudes opportunities abound for science educators to improve on the quality and relevance of junior secondary school science education through the STS approaches.

**Recommendations**
The study was limited to only eight secondary schools in Harare so findings may not necessarily apply in other settings. However the study suggests a few recommendations that could benefit science education, not just in the sampled schools but probably beyond. Further research using a much bigger is however recommended to allow results to be generalised to Zimbabwe.

**Teacher Education**
The challenge for teacher education is to design programmes which transform the role of the teacher from the lecturer/expert and giver of knowledge to that of facilitator, who guides students on how to learn. Respondents with training in STS indicated they received the training as part of their teacher training programme. It then becomes imperative to infuse STS content into the methods courses of all pre-service teacher training programmes.

**In-service training**
Respondents who participated in staff development initiatives demonstrated an appreciation of how such fora improves the way taught. This therefore calls for a need to invest in teachers' professional development through the training and re-training of science teachers. Staff development should be seen as a continuous process. Responsible authorities should come up with incentive schemes to encourage teachers to participate in staff development initiatives.

**Resources provisions**
Resource provision tended to affect strategies teachers use to teach science. There is an urgent need to provide material resources in government schools including computers and internet facilities, lab
equipment and text books in order to make STS implementation a reality. Private schools are well resourced and instead of government fighting bitter wars with these schools, may be negotiations for resource sharing should be tabled. I Botswana public and private schools merged and pooled their resources together and this helped raise the standards of education in that country.

**Conditions of service**
Closely related to resources provision are the working conditions of teachers. Heavy teaching loads, large classes, poor remuneration all prompt science teachers to leave the profession in search of greener pastures. Unless and until such issues are addressed qualified teachers will continue leaving the profession.

**Syllabus review**
The general science syllabus needs to be reviewed so that it can be responsive to current trends in science and technology. Issues that could be added to the syllabus include cell phone technology, global warming and climate change as well as renewable and cleaner energy technologies.

**Evaluation and assessment**
Examinations tended to influence how teachers in the sample school taught. This then calls for a shift in the assessment modes used. A summative mode of evaluation militates against STS teaching. The study thus recommends continuous assessment.

**End notes**
During the colonial period in Zimbabwe schools and the curricular they offered were divided along racial lines. Group A schools were meant to serve Whites, Coloureds and Asians while group B schools were meant to serve the natives. After attaining political independence in 1980 all forms of racial segregation were abolished in the education sector. Government schools are thus categorised as either former group A or B.
REFERENCES


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