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PROMOTING LEARNING IN SCIENCE :

**A CASE STUDY OF THE
APPROPRIATENESS AND IMPLICATIONS OF
GROUP WORK**

**SUBMITTED IN PARTIAL FULFILMENT
OF THE REQUIREMENTS FOR THE DEGREE
OF MASTER OF EDUCATION IN SCIENCE
OF RHODES UNIVERSITY**

BY

KENNETH MLUNGISI NGCOZA

SUPERVISORS

DR JAAP KUIPER AND MRS GILL BOLTT

DECEMBER 1998

ABSTRACT

This research project, using a qualitative case study methodology, reports on the appropriateness and implications of using group work in promoting cooperative learning in science. In this study, group work is seen as providing a social support mechanism for learning through interactive "hands-on" activities, designed to give learners opportunities to discuss and share ideas so that they can grasp science concepts.

The Science Olympiad Project class composed of approximately thirty-six (36) learners formed the case study for this unit. The Science Olympiad Project is a project concerned with the promotion of science in the primary schools in Grahamstown. From this group, twenty-two (22) learners (12 girls and 10 boys) were interviewed and kept journals. The Science Olympiad facilitator (a science teacher from one of the schools involved in the project) and two teachers who attended the science classes and whose learners are part of the project were interviewed. Semi-structured interviews, journals kept by the learners and the researcher (who was a participant observer and a co-facilitator), observations and discussions constituted sources of data for the research project.

The analysis of data indicated that the learners found science during the Science Olympiad Project classes interesting and challenging. There were many benefits reported by the learners including the use of group work, the effect of "hands-on" activities, their attitudes and perceptions towards science and the role of excursions. Teachers found the learner-centred approaches adopted helped to encourage the learners to be actively involved in their own learning. One concern raised by the teachers was what would happen to those learners who have been identified as enthusiastic in science when they go to secondary schools. The implications of the results to improve and sustain the project are discussed.

ACKNOWLEDGEMENTS

The success of any research endeavour is always dependent on the contributions of many groups and individuals. This research project is no exception and I would like to gratefully acknowledge some important contributors:

- My M.Ed. in Science Education co-ordinators, Mrs Gill Boltt and Dr Jaap Kuiper for their guidance and critical analysis on designing data collection instruments and writing a research report.
- My M.Ed. colleagues, especially Kwanele and Fred, for their support during this research process.
- Judy, the librarian from the Education Department, Rhodes University, for her assistance in the library.
- Mrs Joy Hayes, for her time and effort in proof reading my research report.
- Mr Ngesi, who started the Science Olympiad Project, and the learners and teachers who were interviewed.
- Finally, it is customary and, in this case, very appropriate to record my thanks to my wife Nobuntu, who has been supportive in many ways throughout this period and is also my best critic.

To all these people, I owe my thanks for their time and effort.

CHAPTER ONE

INTRODUCTION

I am inclined to agree with Ntho and Perlman (1997: 4) when they say that teaching methods used in teaching science to learners have a great influence on their perception of science. For example, the perception that science is boring and difficult results largely from poor presentation of the subject. On the other hand, science teaching can only be made meaningful and exciting when the learners are actively involved in the process and when real-life experiences are taken into consideration. Driver et al. (1985: 291) argue that children even when they are young, have ideas about things and these ideas play a role in their learning experience.

Traditionally, science has been perceived as a fixed body of (absolute) knowledge to be transmitted by the teacher. In this approach, emphasis is on content and rote learning at the expense of understanding. Hence, learners become passive recipients of such knowledge. Watters and Ginns (1996: 53) argue that content-driven approaches fail to engage learners in effective learning. Contrary to this notion of science, in the new curriculum (curriculum 2005) science is regarded as a human undertaking (Government's document for Natural Sciences, 1996). The notion of life-long learning purported by the Outcomes Based Education (OBE), therefore, provides a much more "open" understanding of the "learner", the "teacher" and "science".

Teachers are no longer seen as the all-knowing transmitters of facts. Their role is to create an appropriate environment conducive to learning. Learners become active participants in the learning process (van Harmelen, 1997: 8). To use the Vygotskian term, teachers need to determine the learners' "zone of proximal development" and assist them in navigating across it (Wheatley, 1991: 17). This of course demands that teachers need to abandon the "dispenser of knowledge role" and recognise that learners can construct knowledge in their own ways. For instance, within a constructivist view, individuals construct knowledge through social interactions. Meaning is given in terms of prior knowledge of students (Tobin et al., 1990; Driver et al., 1985). Knowledge

of students' ideas therefore enables us to choose activities which help to provoke students to reconsider their ideas.

Driver and Erikson (1983: 47-55) are in favour of a multifaceted approach in science teaching and learning since they argue that "students possess many commonsense beliefs about phenomenon which are not in accord with the way these phenomenon are interpreted in school science". Furthermore, Etchberger and Shaw (1992), suggest that teachers must constantly be aware of what knowledge base each individual learner has and should always strive to make science relevant to the learners' everyday lives. According to Smit (1997: 426-427), the concept of "relevance" in school science has been used as a vehicle to explain transformation in goals and approaches in science education. Hence the focus of classroom activities should shift from the teacher to a learner-centred approach, recognising that learners do contribute to their own knowledge and to the learning environment (Watters and Ginns, 1996: 58). Teachers not only need to develop a knowledge base for teaching science, but also need to use their understanding of science content, curriculum and learners when making decisions regarding their classroom teaching (Peterson and Treagust, 1995: 291).

Rote learning might help learners to pass the examinations, as has been the case in the past, but it will never help them learn science meaningfully. With reference to this, Bodner (1990) points out that some teachers have a tendency to equate activity with learning, which he refers to as "naïve constructivism". Furthermore, since OBE is encapsulated in social constructivism, language is perceived as playing a pivotal role in science education. Through language, learners are able to interact through dialogues, sharing new ideas and knowledge. Hence, through discussions, learners get an opportunity to learn from each other. Doyle and Mallett (1994) believe that through collaborative learning, learners get an opportunity to share each other's questions and answers in a mutually supportive way.

The intention of the Science Olympiad Project is to encourage grade 7 learners to develop an interest and understanding of science. By involving other science teachers it is hoped that they would share their expertise, and also that the experience gained during the project would help them review their teaching and learning practices. Therefore, during

the Science Olympiad classes the facilitator and the researcher will attempt to maintain contact with modern ideas in the teaching and learning of science (e.g. activity-based, constructivism, hands-on and minds-on, co-operative learning etc.). Activities that are planned or designed in the science project are such that they help the learners to understand scientific concepts and develop problem-solving skills. The spin-off effect of this approach is that learners stop being passive recipients of knowledge and become active participants who are capable of making meaning out of whatever they learn. Also as part of the Science Olympiad Project, excursions are undertaken to demonstrate that learning does not only take place in the classroom.

In this research endeavour, the researcher will therefore investigate the appropriateness and implications of group work as a teaching and learning strategy in relation to Outcomes Based Education (OBE). Johnson et al. (1986) argue that learners learn better when they are in groups. Furthermore, learners can be encouraged to participate actively, to ask questions freely in their language, to share ideas and to solve problems collaboratively when group work is employed, provided it is properly implemented. Group work therefore gives learners an opportunity to learn from each other through task-orientated activities. This promotes learning and social skills rather than the accomplishment of tasks, as traditional approaches to teaching and learning tended to emphasise.

CHAPTER TWO

THE RESEARCH CONTEXT

The Primary Science Programme (PSP) is concerned with the promotion of innovative science programmes in the primary schools in Grahamstown. The target group is grades 5, 6 and 7 science teachers. Workshops that are activity-based are run for teachers, with the hope that they will apply the skills acquired in their classrooms. Unfortunately, presently there is no follow-up classroom support offered. Giving support and guidance to teachers in the classrooms is one of the tasks Subject Advisors are supposed to be doing; but the way this has been done in the past has stigmatised the whole exercise, which resulted in teachers resisting any visits to their classrooms even by their own school principals, making it impossible for teacher appraisal and development to occur. The Department of Education is presently faced with the dilemma of altering attitudes to classroom visits.

I, however, do attend these science workshops in my capacity as a science Subject Advisor, so that I can learn with and from the teachers, share my expertise, and, most importantly, establish a good rapport with them in order to develop a relationship of trust and respect (Pelington and Stoker, 1998: 369). In the past there has been very little interaction between departmental officials and teachers, and these workshops serve as a breakthrough.

Attending these workshops has been an eye-opener and an empowering experience for me. I have already observed that there are teachers who are enthusiastic about the new curriculum and are thus willing to change and be agents of change (Prawat, 1992). There are, however, some teachers who are opposed to the new curriculum and see it as a threat, and would rather remain in their comfort zones. But what is positive about this latter category is that they openly express their feelings. Interestingly, this category is mostly composed of teachers who have been in the teaching profession for years, who possibly might have preferred to be given their "severance packages". Their level of motivation seems to be very low resulting in negative attitudes. There are also those teachers who are reserved and would rather not air their views and feelings.

Furthermore, to encourage participation and involvement by learners, PSP also co-ordinates the Science Olympiad for standard five (grade 7) learners. Learners involved in the project have to write a test based on certain sections in the syllabus, which are made known to the teachers. The nature of the questions encourages problem-solving skills rather than recall. This implies that classes should be conducted in such a way that rote-learning is discouraged and learners are encouraged to play a leading role in the construction and meaning-making of knowledge. The learners have to compete regionally and then nationally and are awarded certificates as an incentive.

Concerned with the lack of participation by the Grahamstown Primary schools, Mr Andile Ngesi, a science teacher at Archie Mbolekwa, approached me to assist him with the teaching of science to learners selected from various schools in Grahamstown, so that our schools could be part and parcel of this programme. At least six learners per school had to be chosen. This of course, is a drop in the ocean, but should be seen as a pilot project aimed at encouraging teachers to be engaged in their various schools.

Archie Mbolekwa Primary School is used as a venue for these science classes. These science classes usually take place twice a week for an hour in the afternoons. The facilitator (with the help of the researcher sometimes) teaches this group of grade 7 learners. In the past, during these science classes, emphasis was placed on the teaching of the sections prescribed, doing experiments, revising question papers, and allowing the learners to work in groups. The approach was changed in 1997 and in 1998, and an approach was adopted which encouraged learners to be engaged in "hands-on" activities. During such activities, emphasis is on understanding science concepts. Science is made relevant to the learners' everyday lives by adopting an integrated approach to science teaching and learning. Therefore, a constructivist approach is advocated and hands-on practical work is seen as vital, developing a view of science as a human activity in everyday situations (Rowell and Guilbert, 1996).

Science teachers teaching at schools which are involved in the project are encouraged to come and be participant observers. This requires commitment and dedication on their part, which according to the Bateson Report (1995) is often lacking in many teachers.

The aim of this is to encourage science teachers to adopt learner-centred approaches and also to give them an opportunity to share their expertise for teachers are important human resources.

The success of this project has been demonstrated by a learner from Good Shepherd school who represented our region at the National Science Olympiad. Her science teacher was always co-operative and even went to the trouble of transporting her learners to Archie Mbolekwa, where the classes took place. This demonstrates that, in terms of learner interest and achievement, success has come to those teachers who have made the effort to institute change.

CHAPTER THREE

RESEARCH DESIGN

3.1 THE PHILOSOPHY UNDERLYING THE RESEARCH DESIGN

This research project is located within a qualitative paradigm since the transactional and the dialectical nature of inquiry requires a dialogue between the researcher and the respondents, which is essential in transformation. Within this paradigm, the researcher will embark on a case study approach (Wiersma, 1986; Cohen and Manion, 1994), which can help improve the situation through active intervention (Hitchcock and Hughes, 1995:27). Furthermore, in a case study, emphasis is on practice, participation, collaboration, reflection and interpretation (Eisner and Peshkin, 1990: 29, 317-323). By adopting a participatory case study, research model, motivational factors could be addressed successfully (de Laat and Watters, 1995: 461). Also a case study acknowledges that educational research has a myriad of influences.

Semi-structured interviews were the main qualitative data sources for the case study. According to Kvale (1996: 125), an interview is a form of human interaction in which knowledge evolves through a dialogue and the interviewer through further questions steers the course of the interview. Field notes were taken during the lesson observations and were referred to in the interviews. Data collection instruments also included journals written by the learners. Through the journals, learners were accorded an opportunity to reflect on the learning process. Hand and Peterson (1997: 77) suggest that multiple sources of data (triangulation) are necessary to confirm findings, enabling plausible explanations to be constructed. Also corroboration of data was achieved by the researcher who as a participant researcher in the study maintained field notes, progressive observations and notes on informal discussions between teachers, learners and himself (de Laat and Watters, 1995: 456).

3.2 THE RESEARCH PURPOSE: AIMS AND OBJECTIVES

The aim of this research project is to investigate the appropriateness and implications of group work in the teaching and learning of science in relation to Outcomes Based Education (OBE). The researcher will therefore endeavour to answer the following research questions:

Does an active involvement of learners in “hands-on” activities improve their perceptions and attitudes towards science ?

Does group work help to promote learning in science ?

As a vehicle in doing this research project, a module on measurement (see appendix A), which was designed by the researcher in 1997, was implemented to promote group work skills amongst the learners since they are from various schools. This module was implemented to a group of grade 7 (standard 5) learners, in preparing them for the Science Olympiad examinations, which they will write towards the end of this year. However, the researcher is interested in the process of preparing these learners for the Science Olympiad rather than on how well they do in this examination. This information could however be used to some extent in judging the impact of this project on the learners, but there could be other factors that could possibly impinge on their progress. These would be outside the scope of this research endeavour. However, some indications of these factors will be given.

The facilitator also prepared some modules on energy, electromagnetism, acids and bases, and the biology section. Also, as part of this programme, learners were taken to the museum to be more exposed in the field of science study.

3.3 METHODS

3.3.1 DATA COLLECTION METHODS

This research endeavour is essentially qualitative. To attempt to provide answers to the research questions, the researcher used a number of data collection instruments (Cohen and Manion, 1994; Hand and Peterson, 1995). According to Hand and Peterson (1995: 77), "triangulation is an important method for qualitative research since multiple sources of data are used enabling plausible explanations to be constructed". This also enabled the researcher to compare and contrast information, which in turn helped to make data more reliable and valid. The interview and observation schedules were designed, discussed and criticised by the supervisors, pilot tested and modified, before being applied.

The interview schedules for teachers (see appendix B) consisted of open-ended questions (de Laat and Watters, 1995: 456) designed to probe each teacher's science background, ascertain his or her beliefs about science teaching, explore his or her current science teaching practices, and also to find out whether the Science Olympiad Project had impacted on his or her practices. Furthermore, a semi-structured approach was adopted: that is, a set of basic questions was posed to each interviewee, but further discussions and comments were encouraged and taken up as the interview progressed (Kuiper et. al, 1998; Sanders and Pinhey, 1990; Burroughs, 1975), allowing for clarifications and in-depth probing of responses (Driver et al., 1996).

Secondly, an observation schedule (see appendix C) was used by the teachers (especially those teachers whose learners are involved in the Science Olympiad Project) who were invited to come and observe the presentations being made. This was done with the hope of stimulating these science teachers to reconsider the way they teach science at their own schools and to encourage their learners to take part in the Science Olympiad. This was also intended to serve as an evaluation guide for the researcher and the facilitator, as it is difficult to teach and observe at the same time (Kuiper, 1998, personal communication). Information obtained from discussions and suggestions made by the teachers were recorded and formed part of the data.

The observation schedule was pilot tested at a teachers' workshop on co-operative

learning, which was run for teachers by facilitators from Port Elizabeth Teachers' Centre. Valuable input was given by the facilitators to help improve the schedule. The workshop was an eye-opener for me since I was going to model group work in the form of co-operative learning.

The learners' interviews (see appendix D) investigated how the learners were selected, whether they enjoyed working in groups during the Science Olympiad Project, and what impact on their understanding of science the project had had. Learners were also asked to keep journals, something which is new in most of our schools. In their journals learners were asked to reflect on the learning process, mentioning things they learnt, what they liked or disliked and whether they enjoyed working in groups or not etc. Besides getting information from the journals, it was hoped that the learners would improve their writing skills, which is a major problem for most students (Hetcht, 1997, personal communication).

The researcher and the facilitator also wrote journals, reflecting on the strengths and weaknesses of the programme, and how improvements could be made. Discussions held with the facilitator during the planning sessions, before and after the implementation of the modules, were recorded as part of data for this research project. Furthermore, data were analysed for evidence of the impact of "hands-on" activities and the effectiveness of group work in promoting learning in science.

3.3.2 SAMPLES

The Science Olympiad Project class was composed of grade 7 learners from six primary schools (mostly "black" schools with the exception of one school having both "black" and "coloured" learners). Each of these schools was represented by at least 6 learners, who were chosen by their science teachers using their own criteria. The class group, which formed the case study, was intended to be constituted of thirty-six (36) learners, but there were more. From this group, twenty-two (22) learners (12 girls and 10 boys), whose ages ranged from 12 to 15 years were interviewed (with permission sought from their school principals and their science teachers).

Learners from four primary schools involved in the project were randomly selected, taking

into consideration their sexes. Group interviews were employed except for two learners who were interviewed individually for the purposes of experiencing the effect of an individual interview on respondents of this age group. The class group participating in this study was asked to keep journals and information from those journals was used in the data analysis to get a much broader picture of the learners' experiences, feelings and attitudes (reflections).

All the grade 7 (standard 5) science teachers from the schools involved in this project were invited to come and be participant observers during the science classes. Two teachers from these school who attended the science classes and the facilitator were interviewed. The researcher's sample therefore was constituted of twenty-five (25) respondents or informants.

CHAPTER FOUR

DATA ANALYSIS PROCEDURE

4.1 DESCRIPTION OF HOW THE INTERVIEWS WERE IMPLEMENTED

During the course of the science classes, discussions and debates were held with the science teachers and the facilitator. Issues raised during such discussions were recorded in the field notes. Appointments for interviews with science teachers and the facilitator were made during the science classes. Both teachers were interviewed at their schools during their free periods and the facilitator was interviewed in my office. The interview with the facilitator was in the form of reflections.

During the interviews, since a semi-structured approach was adopted, follow-up and probing questions were asked. The interviews were made informal as far as possible so that my respondents could feel free to share information with the researcher. Also, responses were hand-written as the interview progressed.

The learners' interviews were conducted at their schools. To make the learners feel relaxed; they were interviewed as a group. During these interviews some learners were shy and had to be probed to answer. Although questions were asked in English, they were also interpreted in Xhosa to ensure that they all understood the questions. They were also allowed to respond in both languages. Some learners dominated the discussions. With the individual interviews, the two learners were confident and attempted to answer in English. They were also able to make recommendations for the improvement of the project unlike when they were in a group.

4.2 RESULTS FROM THE INTERVIEWS

4.2.1 TEACHERS' INTERVIEWS

For the purposes of this research endeavour, two primary school science teachers, who have been attending the Science Olympiad Project classes, were interviewed. One of the teachers has been in the teaching profession for more than twenty years, but is new to the teaching of science. In fact she said that she had not specialised in science. The other teacher is new to the teaching profession and has specialised in science teaching, but needed experience in this field of study.

How many grade 7 classes do you have in your school and what criterion did you use to choose the learners to represent your school in the Science Olympiad Project?

One teacher said that at his school they have five grade 7 classes of about thirty-four (34) learners. He considered this number a manageable number for science lessons. Regarding the selection of six learners who were involved in the Science Olympiad Project, he said that selection was based on the learners' performance in class and also based on the continuous assessment of the learners. He felt that the number involved in the project was too small given the positive impact of the project and he would have preferred to have more learners involved. The other teacher said that she has one grade 7 class of about forty learners. She said that the criterion used to select the learners to be involved in the project was based on the learners' interest and enthusiasm in science. She explained that she chose this strategy because the learners had to attend science classes in the afternoons, which required commitment on their part. She also mentioned that she could not stick to the stipulated number and more learners attended the science classes. They both commented that they liked the idea that during the Science Olympiad Project, learners were exposed to science while doing extra-curricula activities. This exposure, they felt, stretches the learners' minds and makes them lateral and critical thinkers.

During the Science Olympiad Project classes, how did you find group work as a teaching and learning strategy?

Both teachers said that they found group work useful during the Science Olympiad classes. They observed that learners were freely communicating with one another in a language suitable to them. When the learners needed help they would then call upon the facilitator or the teachers for help. They also mentioned that they liked the idea of being participant observers during the science classes. Furthermore, they commented that the use of a variety of teaching and learning strategies prevented lessons from becoming boring and ensured that learners with different abilities were reached. However, they said that the venue was not big enough for the large groups of learners. This they felt could impact negatively on the students' learning. Because of the resources available, they said that the class set-up was conducive to teaching and learning. They also mentioned they liked the idea of mixing the learners from the different schools, taking into consideration the gender issue.

How do your learners that are involved in the Science Olympiad Project function in your science classes?

The teachers interviewed said that they found that the learners who were involved in the project were more advanced than those who were not attending. Consequently they had to give these learners more challenging work. However, they said that since they use group work as a teaching and learning strategy at their schools as well, they made use of these learners in helping others in their groups. One teacher also mentioned that one of the shortcomings of group work he had noticed in his classes was that some learners have a tendency of not doing their work with the hope that it will be done by others. The other teacher said that to curb the problem cited above she assigns roles to the learners when they are working in groups and they also have to change these around.

Has the Science Olympiad Project helped to improve your learners' attitudes and perceptions towards science?

They both said that ever since their learners had been involved in the project their attitudes, interest and curiosity in science had improved dramatically. One teacher commented that he has been getting a positive feedback from some of the learners who had been involved in the project in the past and are now in the former model C schools. They are coping at these schools and have been helped by the project. The other teacher said that she is concerned about what happens at some of the secondary schools regarding encouragement of those learners who have been identified as having an interest in and enthusiasm for science. "Are these learners encouraged to take part in extra-curricula activities such as the science expo so as to be enriched in science?" She feels that this is a concern which needs to be addressed.

What did you learn from the Science Olympiad Project programmes?

Both teachers commented that they enjoyed the way science is taught during the Science Olympiad Project classes. They observed that "hands-on" activities encouraged learners to be involved actively in the learning process. They also felt that the activities were planned in such a way that they encouraged problem-solving and thinking amongst the learners. Both said that this has had a positive impact on their teaching and learning strategies as well. One teacher said that although she lacks equipment at her school she tries her level best to improvise so that the learners are able to do "hands-on" activities. They both said that they found the interaction with other teachers or educators as well as the learners from other schools an empowering and stimulating experience.

Regarding the Science Olympiad Project curriculum, one teacher said that he appreciated the idea of the integrated teaching and learning approach adopted during the science classes. She felt, however, that not enough time was given to the biology section. Maybe, as a solution to this problem, a biology facilitator should join the

project. This would hopefully lessen the burden on the present facilitator. However, both teachers commented that a museum visit as part of the curriculum was a wonderful idea. This, they said, was a learning experience for both the teachers and learners. They commented that the presentation on fishes broadened the learners' thinking and raised their awareness, values and attitudes about the environment, particularly water pollution. The presentation on food chains helped to clarify misconceptions and stimulated both teachers and learners. The methods used during both presentations, they said, were eye-openers. They realised that learners come into the classroom with their own content-based understanding of many concepts. Hence building on the learners' everyday experiences makes learning more meaningful.

One teacher felt that some of his learners were experiencing problems as far as language was concerned. As a solution to this dilemma, he said that at his school teachers are encouraged to use English when teaching, which is the recommended medium of instruction anyway. He mentioned that they are also engaged in a campaign to collect old newspapers so that their learners can read them. The other teacher said that her learners were at an advantage since they can speak English, Xhosa and Afrikaans. Since the learners have to answer questions in English, she expressed the opinion that there is a need for learners to be taught in English. From her experience she mentioned that teachers themselves have a tendency to revert to Xhosa when teaching. She also recommended that journals were useful in improving the learners' writing skills and confidence in the language. Therefore, she recommended that teachers should encourage all their learners to write journals, and not only during the Science Olympiad Project as is the case at the moment. Furthermore, she suggested that the culture of communicating in English should to be encouraged in the classrooms and outside teaching and learning time.

These teachers recommended that there is a need to encourage other science teachers to become involved in the project. They said that some teachers always claim to have

commitments in the afternoons. They feel that learners have a great potential and need to be stimulated. For quality teaching and learning as educators we have to run the

extra mile. From the new knowledge and findings, which came out during these science classes, one teacher suggested that teaching and learning modules could be designed and these resources shared amongst other science teachers. This, he suggested, would help to discourage the total reliance on textbooks.

One teacher mentioned that the project has had a ripple effect in the entire school where she teaches. When her school principal congratulates those who were in the project and have been successful, grade 6 learners become interested in being part of this project. This therefore permeates through the entire school.

4.2.2 LEARNERS' INTERVIEWS AND JOURNALS

The learners were interviewed as a group, except for two learners who were interviewed individually. Although all the learners were asked to keep journals, data was extracted only from the journals of those learners who were interviewed. In this way, correlation of what was written in their journals and what they said during the interviews was made.

Why were you chosen to represent your school in the Science Olympiad Project?

Some learners interviewed said that they were chosen to represent their schools in the Science Olympiad Project based on their performance in their science classes at their schools. Some said that they were chosen because of their interest, enthusiasm, and understanding of science, and not because of their marks. All the learners who were interviewed said that they feel proud to be part of this exciting program, and feel they have been exposed to more in the field of science. They said that they feel much more confident in the science subject than they did in past years. It was heartening to hear that some learners had a vision of pursuing the field of science as a study in future and some said that they would like to be involved in similar projects when they are in secondary school. This a challenge to secondary school science teachers.

Did you enjoy doing the "hands-on" activities during the Science Olympiad Project classes ?

All the learners said that they enjoyed the "hands-on" activities they were doing during the project. They said that through the practical "hands-on" activities they did during the science lessons they were able to understand science concepts and they did not have to memorise these. As far as they are concerned, through practical activities, learning science becomes interesting and fun since learners can see things for themselves.

Did you enjoy or not working in a group during the Science Olympiad Project classes?

They said that they enjoyed working in groups during the Science Olympiad science classes as they were able to share their experiences, knowledge and ideas. Although they were from different schools they worked collaboratively as a team. Some mentioned that initially they were shy but as the time went on they communicated freely with their peers and their teachers. Through working in groups they said that they were able to be involved in discussions and learn from one another. They also mentioned that it was unusual to have four teachers moving from one group to another, helping those who needed assistance. Some learners pointed out that sometimes other learners did not participate in their group. This correlates to what was said by one of the teachers interviewed. They mentioned that, during the Science Olympiad classes, they were always engaged in problem solving skills rather than writing long notes or listening to the facilitator teaching.

These learners explained that at their schools they do not have afternoon classes. The fact that they had to attend science classes in the afternoons was not perceived as a burden. Through working extra time they were able to acquire knowledge and skills rather than sitting lazily at their homes. They were also able to understand things they did not grasp in their science classes at their schools. However, they mentioned that sometimes they

were discouraged not to find a teacher at the venue. Some also

mentioned that their parents were excited that were involved in the project because it meant that they were kept occupied.

Did the visit to the museum help you during the Science Olympiad Project?

The learners stated that they found the visit to the museum useful as certain scientific concepts such as how fishes mate and breed, and their habitats; the characteristics of mammals; and food chains were clarified. They mentioned that the presentation on food chains helped them in answering some questions during the Science Olympiad test. This exposure, they said, helped them to view science differently.

Some learners said that the journals have helped them to improve writing skills. One learner commented that this has also helped her in writing English compositions. As a recommendation, some learners suggested that they should be doing more experiments during the science classes. They also mentioned that they would like to go on more excursions and to visit a game reserve to see the living animals which they had encountered at the museum. Also they mentioned that the learners who are involved in the project should be encouraged to attend regularly. Some learners mentioned that the biology section should also be given enough time. Also they needed to learn more about acids and bases.

4.2.3 FACILITATOR'S INTERVIEW

How many grade 7 classes do you have in your school and what criterion did you use to choose the learners to represent your school in the Science Olympiad Project ?

The facilitator said that at his school he has five grade 7 science classes of approximately

forty learners per class. Regarding the selection of learners to be involved in project, he said that learners were asked to volunteer. The initial number

of learners involved was six as stipulated, but later on more learners were interested and the number increased to ten.

Considering the interest amongst the learners who are involved in the project, he feels that it would help having more of his learners involved. During the Science Olympiad classes he felt that learners were exposed to, and allowed to explore, science more meaningfully than in the normal classroom situation. However, he mentioned that during his science classes he uses the approaches adopted during the project and also does some of the work covered there. During his science classes he said that those learners who are involved in the project show more interest in science compared to those who are not involved. He also felt that the fact that learners are drawn from different schools could have a positive impact on them.

During the Science Olympiad Project classes, how did you find group work as a teaching and learning strategy?

Regarding group work as a teaching and learning strategy, he explained that some learners rely on others for the work to be done. The teachers and the learners who were interviewed also made this comment. As a solution to this, group members are assigned roles and one of the responsibilities of a group leader is to ensure that everybody participates. In this way leadership skills are developed.

Has the Science Olympiad Project helped to improve your learners' attitudes and perceptions towards science?

Dealing with learners from different schools has extended friendship, trust and mutual

respect between him and the learners. Furthermore, he said that the learners from his school who are involved in the project are more enthusiastic about science and some of them have said that they would like to pursue this field of study. This, he said, is very encouraging and motivating. Also worth mentioning is that, through this experience, he

was able to assess how learners from other schools are taught science. He feels that some teachers still adhere to the traditional "chalk and talk" methods when teaching science, totally rely on textbooks, and emphasise rote learning. This he feels impacts negatively on the learners' problem solving skills, curiosity and enthusiasm. He suggested that textbooks should be used as reference sources only.

How has your involvement in the Science Olympiad Project impacted on your teaching and learning strategies?

The idea of inviting science teachers to attend the science classes in the afternoons was to ensure that they also became confident, and shared their expertise in the subject. Some teachers did attend. He mentioned that some teachers are reluctant to work in the afternoons and planning "hands-on" activities is perceived as a burden by some. Some teachers are only concerned with finishing the syllabus and any extra-curricula or enrichment work is perceived as unimportant. Such stereotypes and resistance to change are detrimental to the learners' understanding of science.

He feels that interaction with other teachers and learners is a learning experience. In view of this, he suggested that there is a need for subject teachers, for instance, in the Natural Sciences to meet to share ideas and enhance each other's teaching and learning strategies. He commented that he feels it is ridiculous for teachers teaching the same subject to quarrel over what will be set. He feels that there is a need for setting standard common examination papers. He feels that the way one sets questions is influenced by the way one teaches. For instance, if one teaches in the traditional methods, questions will tend to be mostly recall.

During the Science Olympiad classes he said that attempts were made to implement integrated teaching and learning approaches. New ideas were learnt such as cutting a bar magnet at the centre.

What improvements can be made to sustain the project?

To bring about improvements in the project he suggested that there is a need to run a workshop for grade 7 teachers on the importance of the Science Olympiad. He further suggested that science teachers should write their own teaching and learning materials to encourage "hands-on", self-discovery and problem-solving activities, in accordance with the objectives of Outcomes Based Education (OBE).

CHAPTER FIVE

A CRITICAL REFLECTION ON THE RESEARCH PROCESS

Our experiences, no matter how difficult at times, are our lessons. We are to observe the lessons and hopefully grow stronger. But there is one critical point that some of us miss, namely, that, our experiences are not only for us, but also for those who cross our path. In this case, all the readers of this research report fall into this category. Doing this research has been a journey worth travelling. Constraints throughout this journey have been perceived of as challenges. I have been always mindful of the fact that my glory consists not in never falling, but in rising whenever I fall.

If I cannot comment on my experience of designing this research proposal I will have not done justice to myself. Designing and presenting a research proposal to the entire M.Ed. class and to my supervisors was a challenging exercise for me. It was challenging in that during the presentation I had to account for and give reasons for various aspects of my work such as the research methodology. My research topic and research questions were critically analysed and torn apart. Although before the presentation I used to have "butterflies in my stomach", after the presentation I emerged an enlightened and empowered man. From this exercise, amongst other things I learnt to be focused, one of the most difficult things I have experienced throughout this research process. Regarding this, my supervisors' advice will always remain indelibly in my mind: "do not bite off more than you can chew".

Worth mentioning is that empowerment in this research process was not only acquired through the presentations mentioned above. During these presentations, some of my M.Ed. colleagues resisted our critical criticisms, defending the positions they were adopting in their research projects. This never discouraged me in making my critical analysis because this is a skill I had to acquire. Through critiquing other colleagues' research proposals presentations, I had an opportunity to re-examine my own research project. It was also heartening and motivating to see some colleagues' progress. It was

also unfortunate that we only interacted during these sessions.

Quite interestingly, almost all the M.Ed. in Science Education students made claims that our researches were within the post modernism paradigm, guided and informed by a qualitative research. During the presentations, however, there was a tendency to revert to the positivistic perspectives. It was like a question of "old French wine" in new bottles. Now if we did not get an opportunity to make these presentations, how would we know if we were on the "right" track? The shift from a positivistic approach to the post modernism paradigm was not an easy task for most of us. I also learnt that the type of questions asked determine the quality or type of data received.

For this research endeavour, interview and observation schedules were designed. These instruments were then referred to my supervisors for modification purposes, which was a fruitful and worthwhile exercise. Unfortunately, I did not have time to discuss these instruments with my M.Ed. colleagues even before referring them to my supervisors. This would have helped me in critically thinking about what I wanted to achieve in this research project, something which our supervisors reiterated. However, I had an opportunity to pilot test the observation schedule during a teacher's workshop conducted by the Port Elizabeth Teacher's Centre. The interview schedule was pilot tested on one teacher and I chose not to pilot test the interview schedule for learners since at their age level they would not be able to assist me with the modifications. Through the pilot testing I was able to refine and modify my instruments so that they were ready to be implemented. Every step in this process has been a learning experience for me.

The fact that these research instruments were designed concurrently with the science lessons in progress, enabled me to phrase, structure and restructure my questions to become as focused as possible. Also during the science lessons at times I was a participant observer and at times a facilitator and this put me at an advantage as far as the taking of field notes was concerned. However, this could also have problems since the facilitator, the teachers and the learners who were interviewed could think that they should only give positive responses to please the researcher with whom they were familiar. This could lead to bias and invalid data. The interaction with the facilitator, the science teachers and the

learners also gave me an opportunity to think carefully about my research aims and objectives. Deciding exactly what I wanted to investigate was not an easy task for me. At heart, my being involved in the project was not merely for research purposes, but for the promotion of science amongst learners. Also I was stimulated by the fact that I had in my mind that there is a need to improve and sustain the project. How to achieve this I did not know before I was engaged in this research project. I found enjoyment out of this research endeavour through being involved in the promotion of science in this project and not merely involved for research purposes.

The success of my case study was dependent on the science classes taking place and teachers attending such classes. At times the science classes had to be cancelled due to other school activities. This caused me to panic because our supervisors encouraged us to try and stick to our plans. Also, according to my plans, I had hoped to interview all the grade 7 science teachers, but only two science teachers managed to attend. A third teacher availed herself of the opportunity to go to the museum with the Science Olympiad class, while the other teachers never bothered to involve themselves. Where did things go wrong? Introspection rather than pointing fingers is crucial here. But what consoled me was the thought that, in this research endeavour, I was concerned with quality rather than quantity.

For the Science Olympiad Project class, we had planned to design teaching and learning modules together with the facilitator. This did not happen and we relied on the facilitator presenting what he had prepared. Having some well-thought out and prepared teaching and learning materials could be a motivating factor for the teachers. Planning together with the facilitator was an essential ingredient to the success of the project.

During the science classes, little attention was given to group dynamics. Emphasis was rather on learners working together, asking questions, discussing and helping one another in their small groups.

As part of the Science Olympiad programme, learners were taken to the Albany Museum for lesson presentations on fishes and on food chains. A problem which arose was that since the learners were from different schools some arrived late to the museum because of transport problems. However, the museum educators were kind enough to make provision for such problems. It became apparent that without support from teachers, organising learners from different schools could be problematic. Also, some teachers accompanied their learners and some did not. This means that there is a need to devise some mechanism to encourage teachers to become involved in this project since the learners stand a good chance of benefiting from it.

The teachers who attended the science classes were participant observers, helping learners with problem solving in their various groups. Also, during the science classes we had an opportunity to discuss problems and their solutions. This helped in developing confidence amongst the teachers.

Interviews with learners were done at their schools and permission was sought from the school principal and/or from their science teachers. Group interviews were conducted with the learners except for two learners who were individually interviewed. During the interviews, questions were asked in English and sometimes were further explained in Xhosa when the learners did not understand the question. Since a semi-structured approach was adopted, probing and follow-up questions were asked. Some learners were shy during the interviews and some dominated the discussions. However, the learners who were interviewed individually could freely express themselves and proved to be confident. Unlike when they were interviewed as a group, when they did not understand they asked for clarifications.

Some learners had written extensively in their journals. I realised, however, that they needed some guidelines as to how to go about writing their journals. It also came to my knowledge that some teachers do not encourage their learners to write journals. In their journals, the learners had commented mostly about their experiences at the museum. This alone tells us something about the importance and impact of an environment on teaching

and learning.

The two teachers interviewed showed considerable enthusiasm about the project. During the interviews they expressed their opinions freely and perceived the project as very empowering. The interview with the facilitator was conducted in my office. He showed great enthusiasm about the project. During the interview we also had an opportunity to reflect on the project, looking at our strengths and weaknesses.

Responses to interviews were hand-written. When I wrote these responses, at times I felt that I was a bit too slow to write all the information shared. In this case a tape-recorder could have been a solution. However, from my experience this has its own shortcomings as the respondents are likely to feel reserved and not talk freely.

From the experience acquired from the other researches done I felt more confident in critically analysing the data. There were also improvements as far as language problems were concerned. Initially I had problems in previewing and using the literature I had read for this research. After the draft report was written I consulted with my research supervisors, who helped me to look at my research with a more critical eye.

I have found typing my research report time-consuming and strenuous. However, typing my research myself I found useful in that I was able to make changes there and then as I was typing the document. As a second language speaker, referring my research report to somebody else for critiquing and proof reading helped me a lot.

In my research proposal I had mentioned that discourse analysis would be done in this research project. This was not done and I feel I need to learn more about this research technique. Also, I had hoped to utilise internet facilities to enrich my research and this did not happen. However, computer skills were learnt in the process of doing this research.

CHAPTER SIX

CONCLUSION AND RECOMMENDATIONS

School science has been for the most part decontextualised and deprived of the human interactions which constitute a science culture (Aikenhead, 1997; Kuiper, 1998). Aikenhead (1997: 419) argues that scientific knowledge is socially constructed and is influenced by society and culture, hence he suggests that science should be seen as a human/social activity laden with values and beliefs. Kuiper (1998: 12) argues that learners come into the classroom with their content-based understanding of many scientific concepts, which requires learning to be contextualised within the learners' familiar environment. Furthermore, the nature and quality of opportunities for learning in the classroom are dependent on choices made by the teacher in selecting materials and creating activities (Rowell and Ginns, 1996: 187).

The intent of this research study, therefore, was to investigate the appropriateness and implications of using group work in promoting learning in science. "Hands-on" activities were used as a vehicle in this study. With the advent of the new curriculum has come an emphasis placed on learners working effectively in groups. Group work is not just putting learners into groups for the completion of given tasks; learners should be able to learn from one another. This, however, requires teachers to review their teaching and learning strategies, so that such strategies can impact effectively and positively on their learners, remembering Bodner's warning (1990: 27): "we can teach; and teach well, without having the students learn". Too much emphasis on "chalk and talk" often leads to the poor behaviour that results from boredom. The kind of science teaching which learners experienced is the most important factor in forming their attitudes towards science.

Analysis of the qualitative data provided some revealing insights into the influences and impact of the Science Olympiad Project. The implementation of the project was to some

extent effective in that the learners acknowledged in the interviews and in their journals

a greater interest and enjoyment of science, and an acceptance of group work in which ideas were shared and valued. The learners liked sharing ideas and having their ideas listened to in their small groups.

The study found that having the learners work collaboratively in small groups (Johnson et al., 1986; Tippins et al., 1995; Nason et al., 1996; Penlington and Stoker, 1997; Wilmot and Euvrard, 1998) enhanced the construction of knowledge. However, although some learners favoured group learning, it is evident from the interviews that some were cautious or reluctant participants during the science sessions. For some learners the group dynamic was a problem (Hand and Peterson, 1995: 82), though not a major problem. The group interactions combined with learner-centred learning were particularly useful in developing behaviours such as teamwork, sharing of information and valuing each other's individual or group effort.

All the learners who were interviewed said that they enjoyed doing science experiments since they did not have to memorize the science concepts. Through the "hands-on" activities, which they did during the Science Olympiad Project, they mentioned that they had developed a love for science, and some of them hope to pursue this field of study in future. But in our education system, we are faced with the dilemma of a lack of continuity between primary and secondary science education. The literature review suggest that at the end of primary school students believe that science will become more exciting at secondary school because of the specialized knowledge of teachers, the sophisticated resources available and the prospect of a more challenging curriculum (Speering and Rennie, 1996: 286). However, the reality of secondary school science appears not to meet these expectations. In fact, from my experience as a science teacher, secondary school teachers blame the primary teachers for not properly preparing the learners.

The study has shown that learners can develop a broader view of science through social constructivist teaching and learning than the representations that they acquire through traditional didactic approaches. Through being involved in the project the learners were

able to view science as exploring, investigating, problem solving, and fun. However, a longer term in this study is required to explore whether learners will develop knowledge which is a reflection of social constructivist teaching and learning (Hand and Peterson, 1995: 87).

The study also indicates that excursions as part of the curriculum have a positive impact on both the teachers' and learners' attitudes towards science. Particularly in this research project, this has been evidenced by the feedback given by both teachers and learners about the museum visitation, which was part of the project. All the learners interviewed said that the presentation on food chains helped them to answer some biology questions in the Science Olympiad question paper. The question of values was shown by their awareness of the dangers of water pollution which was highlighted during the presentation on the endangered fish species in the Eastern Cape.

Language, the primary function of which, according to Vygotsky (1986: 6) is communication and social discourse, has been identified as one of the possible barriers in this study. This was also revealed during the interviews with the learners, since some questions had to be repeated in Xhosa before some learners could understand them (Ngcoza, 1997). This was also confirmed by the other groups of learners who expressed the opinion that at their school they are encouraged to communicate in English during teaching time and even during break time. With reference to language, Webb and Ilsley (1997: 481) suggest that successful teaching of science and mathematics can be constrained by the fact that some teachers lack proficiency in English, which is the recommended medium of instruction. Furthermore, these factors are exacerbated by the fact that learning takes place in a second language and teachers have a tendency of reverting to the mother tongue.

From this research study, an unexpected but very valuable outcome emerged. It is evident from this study that the teachers who were interviewed perceived the Science Olympiad lessons as being useful in promoting interest and enthusiasm in science. These teachers expressed the opinion that the project has impacted positively on their teaching and

learning strategies as well; consequently they employ the techniques used during the project at their schools. For instance they said that they use "hands-on" activities, which encourage learners to interact, discuss, and engage in problem solving. This is commendable, but we cannot take it at face value, and therefore this needs to be investigated.

It was heartening to hear from these teachers that they perceive constraints such as lack of resources as challenges, which have encouraged them to learn about improvisation, and to consult other teachers. There were no indications of blame being put on extrinsic factors as inhibitors of effective teaching practice (de Laat and Watters, 1995: 455), instead they were motivated and determined to do the best with the little they have at their schools. Their enthusiasm and willingness to come to the afternoon science classes evidences this. The facilitator, the science teachers and the learners all expressed the opinion that they perceived coming to the science afternoon classes as a commitment and sacrifice, and not as a burden. They all realized that commitment and dedication are prerequisites for success. This attitude is often lacking in most teachers and learners; and this concern was expressed by the teachers who were interviewed.

The research literature indicates that there is possible link between the teachers' views of scientific knowledge and their classroom practice (Prawat, 1992; Prawat, 1996). For example, Prawat (1992) argues that teachers are perceived as agents of change, but they can also resist change by using traditional methods of teaching and learning. Prawat (1996: 92) suggests that traditional transmission models of teaching and learning should be rejected in favour of a new view aimed at developing "learning communities". According to this perspective, referred to as social constructivism (Gergen, 1985; Solomon, 1994; Atwater, 1996; Kuiper, 1998), teachers create a climate or environment where learners are able to explore ideas. In this case, the teacher's practice is based on a vision of what it means to teach for understanding. This requires the active engagement of learners in the learning process. Watters and Ginns (1996: 53) point out that content-driven approaches fail to engage learners in effective learning.

The integrated and cross-curricula approaches adopted during the Science Olympiad Project classes were found to be empowering by the science teachers. However, one teacher said that there was a need for enough time to be given to the Biology section as well. Some learners also expressed this concern. Furthermore, this teacher recommended that to lessen the pressure on the present facilitator, a second facilitator specializing in the Biology section could be useful.

As a recommendation, there is a need for designing teaching and learning modules for the Science Olympiad. Also learners need to be given projects, whether individually or in groups. This can help to improve their research skills. Lack of projects has been one of the weaknesses of the project this year. With these projects, learners can be referred to the library, the museum, J.L.B. Smith Institute and other educational institutes. Also, time constraints forced the facilitator and the researcher to put an emphasis on revising past examination papers in preparing the learners for the Science Olympiad examinations. Also, the Biology section was not given enough time.

The need to encourage all grade 7 science teachers to attend the Science Olympiad classes was expressed by both the facilitator and the science teachers. This needs to be clearly communicated to the science teachers. Involving grade 6 science teachers could also help in the preparation of the learners. To empower those teachers, science workshops on the topics to be covered for the Science Olympiad work could be run so that teachers do not feel threatened when their learners who are involved in the project ask for help. This is crucial since teachers are seen as central in the development of school science programmes (Rowell and Ginns, 1996: 187). Rowell and Ginns further argue that some teachers perceive science as an extra burden because of the time required to prepare "hands-on" activities. Furthermore, general reluctance to teach science has been attributed to the teachers' level of confidence and competence. Teachers need to feel excited about teaching science (de Laat and Watters, 1995: 462).

How the level of teachers' confidence and competence in science can be enhanced is a research study which needs to be pursued in future. Hand and Peterson (1995: 75-82)

suggest that knowledge and practical competence should be extended beyond the level to which it is to be taught in primary school. Furthermore, pre-service teachers need to experience, as learners, a social constructivist approach to learning if they are to consider teaching using these approaches. This would ensure that there is a shift towards co-operative group work compared with the teacher-centred approach to teaching and learning.

Implicit in the success of the project is that the process adopted constructivist learning principles (Gergen, 1985; Bodner, 1986; Etchberger and Shaw, 1992; Matthews, 1992; Solomon, 1994; Prawat, 1996) and encouraged the development of reflective practice (de Laat and Watters, 1995: 455). Evidence from the study is that the Science Olympiad Project has been an inspiration to those teachers who have been attending the science classes, and have thus developed skills to promote the teaching and learning of science in their schools (Venville et al., 1998: 214). It is my view that three major contextual factors contributed to the particular success of the project, viz., commitment and dedication on the part of teachers and learners, willingness to work together, and having a shared vision for the promotion of science in the primary schools. In the light of this, each and every educator must strive to be an effective change agent (Watters and Ginns, 1996; Prawat, 1992).

The fact that the researcher was a participant observer could create a possible limitation as the learners and the teachers could believe that they should respond in a more positive manner in both the interviews and journals (Peterson and Treagust, 1995: 294). However, these findings have a number of important implications for teaching and learning of science in primary schools and for future researches. For instance, given the current climate of curriculum reform, it is important that one considers the willingness of teachers to participate in change processes and thus strategies for enhancing teaching and learning practices (de Laat and Watters, 1995; Prawat, 1992).

Also a study in the transition between primary and secondary schools needs to be

investigated with the purpose of eliminating the way the transition impacts on the students. Presently we are faced with a dilemma of a discontinuity, which results in a decrease in the number of students enrolling for science subjects at secondary schools. Likewise a research study on how to improve teachers' attitudes in science is needed since, despite the fact that workshops have been run for teachers, there seems to be very little improvement in schools in terms of putting into practice what has been acquired during such workshops. Such studies could also help with how science can be demystified.

Worth mentioning is that giving classroom support and guidance is one of the tasks Subject Advisors are supposed to be doing. However, the way this was done in the past ("top down approach and evaluative") has stigmatized the whole exercise. This has resulted in teachers resisting any visits to their classrooms, by even by their school principals. This makes it impossible for teacher appraisal. By being a participant observer and co-facilitator in the Science Olympiad Project, I hope that this research will serve as a breakthrough to some of the problems mentioned above.

It should be borne in mind that when one becomes a teacher one takes on the awesome responsibility of the future of the country and its population. Therefore, in the new educational dispensation in South Africa, educators, especially teachers, are faced with the challenging task of bringing about change, which is necessary for improvements in teaching and learning in their classrooms. As teachers are perceived as agents of change (Prawat, 1992), they need to expend effort and work outside classroom time to facilitate quality teaching and learning (Bateson Report, 1995: 72).

In conclusion, I have found this research project very demanding, but worthwhile and an eye-opener. I hope that teachers, learners and other educationists will be able to draw from the results obtained in this study in order to be effective in the current transformation in our education.

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WHAT ARE MUSEUMS FOR?

**A CASE STUDY ON THE BENEFITS OF
USING THE MUSEUM'S SCIENCE PROGRAMMES**

**SUBMITTED IN PARTIAL FULFILMENT
OF THE REQUIREMENTS FOR THE DEGREE
OF MASTER OF EDUCATION IN SCIENCE
AT RHODES UNIVERSITY**

BY

KENNETH MLUNGISI NGCOZA

SUPERVISORS

DR JAAP KUIPER AND MRS GILL BOLTT

DECEMBER 1998

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Appendix A: Teachers' Interview Schedule

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ABSTRACT

This research project, using a case study methodology, reports on the museum's interactive science programmes. The Science Olympiad class formed the case study for this unit. Semi-structured interviews, journals, observations, field notes and discussions were used as data collection instruments.

The analysis of data from these instruments indicated that learners perceived the science programmes as interesting and found it to be fun learning science through "hands-on" activities. Teachers perceived the activities to be "learner-centred" which encouraged learners to be actively involved in the learning process. However, there was uncertainty as to how to assess how the learners can demonstrate what they have learnt at the museum. In this context, it was recommended that the impact of the science programmes on the learners' attitudes and perceptions of science could only be assessed over a longer period. Also, the learners' prior knowledge was regarded as crucial in ensuring the effectiveness of the museum's science programmes.

ACKNOWLEDGEMENTS

The success of any research process is always dependent on many people and individuals. This research endeavour is therefore no exception and I would like to sincerely thank the following contributors:

- * My M.Ed. in Science Education supervisors, Mrs Gill Bolt and Dr Jaap Kuiper for their support and for their constructive criticism throughout this research process.
- * Dr Jim Cambray, Dr Sarah Gess, Mrs Marijke Cosser and Mr Cecil Nonqane for their time and effort in making presentations to a group of learners who are in the Science Olympiad Project.
- * Mrs Judy Cornwell, the librarian from the Education Department library for her assistance in the library.
- * Mrs Val Scott, for proof reading my research report document.
- * The science teachers and learners who gave of their time to be interviewed.

To all these people I owe grateful thanks for their time and effort.

Chapter One

Introduction

Although science is a specialised field, it has many relationships with other subjects. The problem with science education in the past was that it ignored the cross-curricula nature of science, making the subject very rigid and uninteresting. Tobin et al. (1990: 410) argue that traditional methods of teaching science are based on the knowledge transferred from teachers and textbooks to students. Furthermore, rather than focusing on the extent to which students understood concepts, emphasis was placed on rote learning and regurgitation of facts. However, it is encouraging that in the new curriculum in South Africa, mention is made of values, culture (Kuiper 1998; Aikenhead, 1997), history of science etc., hence science education is no longer a restricted field.

Rowell and Guilbert (1996) call for contextualisation of science in classrooms and development of science as a human activity in everyday situations. By relating science to real life, they believe it helps to dispel the view that science is only what happens in the laboratories. Also, the cross-curricula approach to the teaching and learning of science helps both teachers and learners to utilise skills acquired in other subject areas to make the study of science more interesting and enjoyable. In support of this view, Prof. Irwin argues that science cannot be taught in isolation from other subjects and, most importantly, from the rest of life, hence he suggests that environmental education, with its emphasis on thinking and conceptual development, is important in science education.

In view of the above arguments, I similarly believe that science teaching benefits more by relating it to real-life situations. The most important aspect about science that we need to remember is that science is about life and about many things that we see, touch and feel in our environment. It does not make sense to only show children pictures drawn in textbooks of things that are available in the environment (for example museum's collections), which they could learn more about by actually seeing and touching.

Holleman (1987: 19) raised the following questions: "do museums impart knowledge and

values, do they teach skills?" In response to these questions, Kannemeyer (1987: 55-56) argues that there is no justification for museums to adhere to the traditional "chalk and talk" methods of learning. He suggests that museum education should be learner-centred, which means that the task of a museum educator should be that of a facilitator with learners actively involved in the learning process.

Bloom (1992: 17) believes therefore that we must learn how to assess the power of museum education and seriously investigate the way people (especially learners) learn in a museum. By involving learners in doing science rather than learning about science can help to influence their perceptions towards this subject. However, whether there is a special place for the kind of learning that takes place in museums or not, depends on the teachers' perceptions of museum education. Teachers are perceived as agents of change (Prawat, 1992; Prawat, 1996).

Science educators have cautioned us that knowledge about scientific facts and skills in the use of scientific methods are of little value if there is no desire to use them. Science teachers need to develop in their scholars an attitude toward science that will convert knowledge and skills into action and willingness to use scientific procedures and methods. There is a need therefore to create an environment conducive to the acquisition of a positive attitude toward science.

The purpose of this research project is to investigate the benefits of using the museum's science programmes. That is, do learners' attitudes and perceptions of science improve through the museum's interactive science programmes? How do these science programmes in turn impact on the teachers' teaching and learning strategies? Holleman (1987: 2) suggests that there is a need to assess the long term effectiveness of what is taught at the museum so that learning can contribute to the professionalism of the museum educators and to the status of the museums as educational institutions. In this context, the museum educators and facilitators (curators) will be interviewed on the science programmes they run for schools which will help to establish the museum's vision and mission pertaining to education.



Chapter Two

The Research Context

The Albany Museum's Education Department aims to foster an awareness of the need to love, know about and care for our fragile eco-cultures. By providing interesting and informative programmes, trained facilitators familiarise themselves with the wonders of the natural and human world and learn about ways to preserve its balance, peace and beauty (Cosser 1998 pers. comm.).

Finson and Enochs (1997: 594) argue that informal education is an umbrella term, which includes among other things, field trips one of which is the popular museum visitation.

A visit to a museum can change the learners' perceptions about science (Beiers and McRobbie, 1992) since they are accorded an opportunity to ask questions and to pursue new-found interests on their own (Bloom 1992). For example, current research indicates that museum-style, object-based learning is particularly effective in countering erroneous beliefs about the physical universe and these theories are very difficult to eradicate in the classroom setting (Bloom 1992: 17-18). Furthermore, a museum offers direct, one-to-one personal experience and the chance to experience real objects. Bloom (1992) points out that no one can fail a museum visit.

In museums, objects form the strong base from which inductive learning processes emanate which are also viewed as aspects of discovery learning. Therefore, the dynamic nature of museum resources has a great potential for learning, which is in line with the new curriculum 2005.

Since museums strive to make learning enjoyable for their visitors, their experience can serve as models for formal education as well. Ntho and Perlman (1997) believe that there are three keys to science teaching and learning, viz., motivation, interest and enthusiasm. However, these must begin with the teacher. In view of this, the museum's interactive learning resources and approaches can be useful and instrumental in promoting the above mentioned keys. Active learning also gives teachers an opportunity to create a relaxed, but stimulating environment.

Museums therefore, have an important role to play in this new curriculum in education.

By working closely with schools, they can provide professional development opportunities to educators. Since science is taught in "hands-on" and "minds-on" ways; the Albany Museum educators believe that:

" Tell a child and she forgets;
Show a child and she remembers;
Involve a child and she learns".

Teachers construct beliefs regarding the nature of knowledge, how students learn and what strategies may best be applied in a given teaching-learning environment. Therefore, within a constructivist framework, individuals define learning as the construction of knowledge; hence learning becomes an interpretative process involving constructions of individuals and social collaboration (Tobin et al., 1990: 4110-411). Tilgner (1990: 427) suggests that teachers need to find out what students already know from previous experience.

For the purposes of this research, about thirty-six-(36) grade 7 learners who are involved in the Science Olympiad Project were taken to the museum where arrangements were made for two science presentations, namely, fishes and food chains. When these presentations were conducted, the researcher and the science teachers were present.

Chapter Three

The Research Design

3.1 The philosophy underlying the research project

In this research project, the researcher was informed and guided by the qualitative research paradigm. The methodologies utilised in this research project derive from the premise that curriculum and school programs are socially constructed, hence the reconstruction and translation of ideas into classroom learning need to be linked to the prior knowledge of learners (Rowell and Guilbert, 1996: 189).

The researcher embarked on a qualitative case study. According to Wiersma (1986: 8), a case study gives an opportunity for one aspect of a problem to be studied in some depth within a limited time scale. Furthermore, Eisner and Peshkin (1990: 29) argue that a case study puts an emphasis upon “practice, participation, reflection and interpretation”.

For the purposes of this study, the group of grade 7 learners who are involved in the Science Olympiad Project formed a case study group for this research project.

3.2 The research purpose: aims and objectives

The aim of this research project is to investigate whether the museum's interactive science activities help to improve the teachers' teaching methods and the learners' perceptions and attitudes of science. The researcher will endeavour to answer the following questions:

- 1. Do the museum's science “hands-on” activities help to improve the learners' perceptions and attitudes of science?**
- 2. Do the primary science teachers find the museum's science programmes helpful as a support for designing OBE based teaching and learning?**

3.3 Methods

3.3.1 Data collection methods

The case study adopted an essentially qualitative approach to follow closely the learners' interests in science. In particular, the impact of "hands-on" activities and the teaching and learning strategies employed were examined so that their importance in shaping learners' attitudes and perceptions towards science could be assessed. In order to enhance trustworthiness (de Laat and Watters, 1995), data were collected from four sources, namely, interviews, journals kept by learners and the researcher, field notes made during presentation observations by the researcher and discussions between the researcher, teachers and the museum's facilitators (curators) and educators.

The main data collection instrument was interviews. The interview schedules were designed, discussed and criticised by the supervisors, pilot tested and modified before being applied. Data was collected through interviews with the teachers (see appendix A), learners (see appendix B) and the museum's facilitators (curators) and educator (see appendix C). In the interviews, a semi-structured approach was adopted in order to allow for follow-up and probing questions (Burroughs, 1975; Sanders and Pinhey, 1983; Rennie, 1996; Kuiper et al., 1998).

Group interviews were conducted with the learners. All interviews were hand-written during the interviews except for one with the museum facilitator (curator) who was busy during the time of the interviews, which was done through the Internet. The sources of data employed in this study ensured that some triangulation of data could be achieved (Cohen and Manion, 1994; Peterson and Treagust, 1995), in order to determine validity of results enabling plausible explanations to be constructed (Hand and Peterson, 1995).

3.3.2 Samples

The Science Olympiad class composed of approximately thirty-six (36) grade 7 learners from six primary schools in Grahamstown formed the case study for this unit. From this group, sixteen (16) learners (8 girls and 8 boys) were selected from two schools and were interviewed. The learners' ages ranged from 13 to 15 years. Data from the learners' journals was extracted and also used.

Three teachers were interviewed. Two of these teachers were invited to attend during the

museum's science presentations and the other teacher had recently taken her learners to the museum during their science Focus Week. The third teacher interviewed was intended to reduce biases of data since the other two teachers familiar with the researcher may believe that they had to give only positive responses. Two museum facilitators (curators) who made the presentations and one museum educator who assisted during the presentations were interviewed. This implies that the researcher's sample was constituted of twenty-one (22) respondents or informants.

Chapter Four

Data Analysis

4.1 Descriptions of how the research instruments were implemented.

Two museum curators and the museum educator were approached and requested to prepare science presentations on fishes and food chains for the Science Olympiad learners.

For the purposes of this research endeavour, two teachers, teaching science at the schools involved in the Science Olympiad Project, were invited to attend the museum science presentations. An appointment to interview these teachers was made after the presentations. These teachers were therefore interviewed on the bases of what they experienced and observed at the museum during the two presentations made. One of these teachers was interviewed at his school during his free period and the other teacher was interviewed at her home. The other teacher interviewed had recently taken her learners to the museum during the Focus Week. An appointment to interview this teacher was made telephonically and she was interviewed at her school during her free period.

From the experience acquired through doing other interviews, the approach was slightly different in that rather than following the interview schedule rigidly, the respondents were allowed to openly discuss their views about the museum's science educational programmes. Since a semi-structured interview approach was adopted, the researcher was able to ask follow-up and probing questions. During the interviews, responses were hand-written.

All my respondents were so enthusiastic about taking their learners to the museum as a result one of them directed the interview. She even went to the extent of explaining how she fits the museum's programme into her own school programme. Time management and planning were mentioned as crucial in this process since there has to be continuity between what is done in school and what is done at the museum. Because of this open-ended discussion, some questions contained in my interview schedule were answered even before they were asked. In this case I had to be flexible and alert, and such questions were omitted.

The interviews with the museum educator and curators were conducted at the museum.

One interview with the one curator was conducted through Internet since during the time of the interview he was not available. This was a learning experience for me.

Regarding the interviews with the learners, permission to conduct these interviews was sought from the school principals as well as their science teachers. The interviews were conducted at the schools. Since all these learners were all in grade 7, with ages ranging from 13 to 15 years, they were interviewed as a group so that they could help one another with responses. The two groups that were interviewed were from two different schools.

In one group there were eleven (11) learners, composed of six (6) girls and five (5) boys. The second group consisted of five (5) learners, composed of two (2) girls and three (3) boys. Also learners were asked to keep journals prior to visitation to the museum. Data from the journals was extracted and used.

During the interviews, questions were asked in English and at times further explained in Xhosa when the learners did not understand. However, all the responses were handwritten and recorded in English. Initially one of the groups was a bit shy and I had to ask ice-breaking questions.

The researcher kept a research journal and field notes were written during the observations and discussions were recorded as part of the data.

4.2 Results of the interviews

4.2.1 Teachers' interview schedule

Do you make use of "hands-on" activities when teaching science at your school and how do your learners find learning science in this way?

The teachers interviewed said that they use "hands-on" activities when teaching science at their schools. Furthermore, they mentioned that their learners enjoy science when they do "hands-on" activities since they become actively involved in the learning process. These activities, they said, are done in groups. They all perceived group work as a useful teaching and learning strategy, not only because some classes have large numbers, but through working collaboratively in groups, learners are given an opportunity to interact, discuss in a language suitable and understandable to them. In the process, they said, learners are given opportunity to share ideas and knowledge.

One teacher said that she is able to use 'hands-on' activities at her school, through utilising equipment they had obtained from the Primary Science Project (PSP). She explained however that due to the shortage of equipment, learners do not all get the opportunity to handle the apparatus and thus quarrel over the limited resources, since they enjoy handling and using the apparatus. As a solution to this problem she mentioned that she does improvisation and also makes use of the Albany Museum.

One teacher said that at her school they have been hard-hit by vandalism and most of their science equipment has been stolen. She mentioned that she sees the need to do "hands-on" activities and she has to borrow equipment from other schools. She expressed the opinion that she has been getting good co-operation from science teachers at the other schools.

Is it worthwhile or not to take learners to the museum?

The teachers interviewed perceived the museum resources as a blessing since they have limited resources at their schools. They all expressed the view that taking learners to the museum is very useful and worthwhile. Through the museum's activities they felt that the learners' horizons were broadened, exposing them to the larger world. Hence they see the museum environment and experience as indispensable.

They also said that the museum is not only useful to learners, but to teachers as well. The presentations made at the museum have thus helped them to reconstruct the way they teach at their schools, allowing the learners to learn science by doing rather than theoretically. The teachers interviewed said that they found the museum's collections very useful teaching and learning aids since the learners get "hands-on" experience. The learners learn with understanding through the collections since they can see, feel and touch them and learning therefore becomes enjoyable.

They said that during some museum presentations, videos are shown and in those videos, the learners' background knowledge is taken into consideration. They also mentioned that they liked the idea of focusing on one aspect when the learners are at the museum, e.g., the mammal gallery. In addition, one teacher felt that it was a good idea to prepare learners before their visit to the museum so that during the presentation the facilitators are able to build on the learner's ideas.

These teachers said that by going to a museum, a number of skills are learnt, viz., reading, writing, communication, creativity and research skills. They see a museum visit as not only concerned with the mastering of content, but also concerned with clearing of preconceptions and misconceptions and with a broader understanding of knowledge. What they liked most, they said, was the integrated and cross-curricula approaches to teaching and learning adopted during the presentations. For instance one teacher interviewed said that the presentation on fishes helped to make the learners aware of the dangers of pollution, in particular, water pollution. This was also helpful in incorporating environmental education into learning something, which is often lacking in the schools.

Did the museum's science presentations help to improve your teaching and learning strategies?

The teachers interviewed said that from the presentations they learnt that activities need to be carefully planned so that they can encourage learners to be engaged in their learning. They mentioned that they liked the idea that at the museum a variety of teaching and learning strategies such as video and slide shows, "hands-on" activities and collections are used. All these strategies they said helped to reinforce the understanding of scientific concepts amongst the learners as well as the teachers. One teacher said that she liked the activity on the "fishing quiz" for revision purposes and she said that she was going to try it at her school.

During the presentations they said that the facilitators asked probing and "scaffolding" questions and they also encouraged the learners to ask questions. This approach they said was helpful in ensuring that the learners were always involved in the learning process. They emphasised that the teacher's presence was important during these presentations. Learners enjoy seeing that their teacher is learning with them. Also, when teachers are there they felt that they could assist with discipline or ask questions for their learners or that they could ask questions on the things they themselves do not understand. A museum visit therefore should be a learning experience for the learners, teachers as well as the museum educators.

The teachers interviewed said they feel that the activities planned at the museum are relevant to what is purported by the new curriculum 2005. They feel that during these presentations, the museum educators facilitate the learning process and learners are encouraged to interact and be actively involved in their learning. They said that the learners' background information was always taken into consideration during the presentations.

Did the learners experience any language problems during the presentations?

One of the teachers said that her learners did not experience language problems since in her school English is strictly the medium of instruction and learners are encouraged to communicate in it. The other two teachers felt that some of their learners found it difficult to communicate in English because of the environment from where they come, but expressed the opinion that this problem is catered for at the museum since there are two educationists, one Xhosa speaking and the other English speaking. Otherwise they are always there with their learners to offer any assistance that may be needed.

Do you discuss a museum visit afterwards at your school?

After a museum visit the teachers interviewed said that learners are given an opportunity to reflect as a class about the visit. This they felt that this encouraged discussion skills and in the process a teacher gets an idea of any learning that has taken place. Of course, learning is not remembering of facts about what was learnt, but learners should be able to discuss key concepts and be able to link ideas together. One of the teachers interviewed expressed the view that some teachers are more concerned with finishing the syllabus at the expense of the learners' understanding; hence such teachers do not value what is offered at the museum.

To reinforce the writing skills, one teacher said that after a museum visit, the learners are asked to write thank you letters to the museum educators. Furthermore, she said these letters become part of the learners' Journals and are thus taken into consideration for continuous assessment purposes. The museum environment, therefore, they said serves many purposes and contributes to the enrichment of the learners' Journals. Furthermore, they felt that it stimulates learners to become responsible for their own learning, something that is lacking amongst many of them.

4.2.2 The learners' interview schedule and data from their Journals

Do you like or fear science?

The learners interviewed said that they all enjoyed science and they would like to further pursue studying this subject in future. Some learners perceived science as promoting and encouraging thinking skills. Some learners mentioned that they liked science because they learn about nature, about animals and about the earth etc. Most of them mentioned that they found science more challenging and exciting through the "hands-on" activities they do in science than is the case with other subjects.

From the one group interviewed, it was mentioned that they liked the way science was taught at their school since their teacher explains it very well and they do various "hands-on" activities, which makes science easy to understand and also interesting. From the activities they said they were able to understand science concepts, and not just memorise them. They also mentioned that at their schools they work in groups. They said that it was useful and helpful to work in this way, as they were able to discuss matters with their peers and ask questions of one another; questions they would otherwise be afraid to ask their teacher. One of the barriers they faced when asking questions of their teacher they said was the language.

From the other group interviewed, they mentioned that when they were in grade 6, they did science experiments and this year they did not do much of these since their science teacher was on sick leave. They said that they prefer to do "hands-on" activities as they find it interesting to learn science concepts this way.

Do you like visiting the museum and what did you learn during the science presentations?

All the learners who were interviewed said they liked going to the museum because they learn about fishes, birds, animals etc. They mentioned that they were able to see, feel and touch the specimens at the museum and, they said, this made learning more

exciting. On the day they were at the museum they mentioned that they learnt about the endangered Eastern Cape Rocky fish. They said they learnt about its habitat and how it mates and breeds. One of the learners mentioned in her journal that before the presentation she did not care much about fishes but that had changed and was now worried about this endangered species. All the learners interviewed said that they enjoyed the activity on the "fishing quiz" and through the activity they were able to revise what they were shown in the slides. Also through the activity they were able to interact with one another getting to know each other better. This proves that social skills can be enhanced through activities.

Obviously the presentation made a positive impact on the learners and was successful in sensitising them about environmental issues. As a result their attitudes and values were likely to improve. One learner mentioned in his journal that he was fascinated to learn about fishes from the Eastern Cape. This means that learning becomes meaningful when learning is within the context and made relevant to the learners' everyday lives and this calls for the contextualisation of the curriculum in schools. These learners mentioned that they also learnt about the conservation of water, how to keep water clean (water pollution), and lastly, how to conserve energy (Blue Planet Gallery).

During the presentation on food chains the learners mentioned that they were given some background information on mammals, birds and other animals. As an activity they were allowed to work in small groups, making their own pyramids using the different collections. They said that they enjoyed the activity since they were actively involved. During the presentation on insects, they said they liked the idea of being shown the different insects and the relevant examples that were made, for example, insects living on cabbages. They felt that the time was too short and their group was being large, did not afford them the opportunity to participate during this session. However, as the lesson progressed, they were asked questions by the facilitator to ensure that they understood and as a result of that they felt relaxed. One of the most positive feedback given by the learners was that, from the knowledge acquired during the presentation on foodchains made at the museum, they were able to answer some questions in the Science Olympiad examination question paper.

During both presentations, the learners who were interviewed said in their journals that they liked the idea that they were given time to ask questions and also that questions were asked as the presentation progressed, as well as after it. Also they said that they were unaware that they could take insects to the museum for research purposes.

The learners interviewed said that the museum environment was conducive to learning and was quite different from their school environment. Also, some felt that they enjoyed the surprises at the museum, so they did not mind being given some background information of what will be discussed there. Some preferred to be prepared for better understanding purposes. They found the use of the different teaching strategies useful in making learning fun instead of boring. Of greatest importance, besides this being fun, they expressed that they enjoyed being taught in such a relaxed, non-threatening manner, without fear of being tested.

One group mentioned that they arrived late at the museum on this day due to taxi problems. However, they said they were given the opportunity to do all the activities which were done by others, and were thankful to the museum educators for their flexibility. After a visit to the museum, they mentioned that they did not get time to discuss the museum visit and said that they would like to visit more often so that things they did not understand at school could be made clearer. They also mentioned that museum educators could visit their schools to teach them about animals.

Did you experience any language problems during the science presentations at the museum?

Those learners interviewed mentioned that they did not experience any language problems during the science presentations. When asked how they became so conversant with the language they said this was the result of regular reading of newspapers, magazines, library books and of watching TV. Some mentioned that at their school they communicate in English even with their peers, during and outside teaching time. One of the two groups interviewed was not proficient in English, although they claimed that they did not experience any language problems.

4.2.3 Interviews with the museum facilitators and educator.

The interview with one of the museum facilitators (curator), who made a presentation on the Eastern Cape Rocky fish, was done through the Internet. The other facilitator (curator) was interviewed in her office. Since both the facilitators are not educationists, questions regarding the museum education's vision, its involvement in the curriculum 2005 and how the vision is communicated to the schools, were only asked of the museum educator, who also helped during the presentations.

In an interview with the museum educator she explained that as part of its function to conserve both natural and cultural heritage, the Albany Museum Education Department aims "to foster an awareness of the need to love, know about and care for, our fragile eco-cultures, by providing interesting and informative programmes; and trained facilitators familiarise learners with the wonders of the natural and human world and learn about ways to preserve its balance, peace and beauty". The museum educator emphasised that it is their conviction and belief that a sense of wonderment with learners was crucial so that they find learning at the museum to be fun.

One facilitator explained that his presentation was a slide show on his actual research and awareness programmes, followed with an interactive "fishing quiz". Through this "hands-on" activity the learners were able to grasp what was presented. The different strategies were adopted, he said, to get the ideas across to the learners, and was some kind of 'repetition' using different strategies. The activities were designed and planned to encourage the learners to participate actively in the construction of knowledge. During the game the enthusiasm could easily be seen compared to more static lecture approach using the slides. To break this boredom, questions were asked as the presentation progressed.

The facilitator further mentioned that his presentation was about conserving biodiversity. Through these presentations, learners are able to learn various skills. Regarding the relevance of his presentation, he mentioned that although he is a researcher, it is his interest to communicate his findings to the public. He therefore perceived doing this for scholars as a suitable vehicle for this information to get to the

parents. Interacting with scholars therefore was found to be an exciting experience by the museum educator and the curators. He said that learners always find it interesting to learn about things relevant to their everyday lives.

What do you think of the Science Olympiad Project learners' background knowledge?

One facilitator interviewed felt that during his presentation, the learners' background knowledge regarding the topic under discussion was poor. He suggested that teachers need to do some ground work before taking learners to the museum. He felt however, that the learners were enthusiastic as well as receptive and could learn through their varied teaching and learning strategies. The other facilitator felt that the learners' background knowledge was varied. However, she felt that it was sufficient for them to be able to follow the presentation made.

Did you find it difficult to build on the learners' ideas and was language a problem or not?

One facilitator said that he found the learners were keen to learn, especially with the "hands-on" interactive approaches that were employed. During the presentation, the learners were asked (sometimes probing) questions and encouraged to ask questions to make sure that they understood what they were taught. The other facilitator said that she would have liked to see more interactions during her presentation. They both said that language might have been an inhibitor for some learners, but others coped very well. Some learners however, were quite comfortable in asking questions.

Both the museum educator and the facilitators said that it is encouraging when questions are asked since then one can see whether the learners understood or not. They therefore mentioned that it is encouraging to see that some teachers are trying to shift away from the "traditional" approaches whereby it is only the teachers who bombard learners with questions. The museum educator mentioned that during the presentation the relaxed, fun-filled, learning experience that was provided encouraged some learners to feel free to ask questions.

To try and address the language problem, the facilitators interviewed recommended that teachers need to be part of these presentations since they are in a position to see if there are language or understanding problems. One facilitator mentioned that from his experience, it was found that some teachers have a tendency of handing over to the presenter and not becoming part of the learning experience. If teachers are there, they both suggested that teachers could also ask questions as one of the learners or give some guidance in which direction the lesson should go. However, the facilitators said that excellent visuals and collections helped to break these problems.

What relevance has your science programmes have in OBE?

The museum was perceived by both the museum educator and the curators as a great source of information waiting to be enjoyed by all learners. They said that in their science programmes, utilising the museum's artefacts, the learners are engaged in practical activities. During these activities they said the learners are given the opportunity to work in groups, discuss and share ideas. However, they said that they rely on questions asked during the presentations to assess if the learners understood. They recommended that teachers should encourage their learners to write journals, to keep portfolios and also to do projects. Through these forms of assessment they are able to get feedback from the learners, as they are not formally assessing their programmes.

Furthermore, there are also many objects which they have to show and it is always good for learners to "break free" of the everyday school classroom and experience a "lesson with a difference" at the Albany Museum. They felt that the actual objects were helpful in that learners do not only depend on pictures in the textbooks. The "hands-on" activities encourage learners to be actively involved in the learning process, sharing ideas with their peers and developing responsibility for their learning. The exhibits (interactive) are useful in promoting the learning of scientific concepts. For instance, putting animals into a context, that is, how they interact with the environment, raises environmental awareness and the learners are thus able to think holistically. They also learn to be observant by looking at the animals in more detail and thinking about its physical structure etc.

Chapter Five

A Critical Reflection on the Research Process

Description of my experience of strengthens and weaknesses of the methods used and what was learnt from this research process.

First and foremost, I wish to comment that I found doing a research proposal for this research project a challenging experience for me. The positive criticisms from both my supervisors and colleagues I found to be an eye-opener. My supervisors encouraged me to be focused as much as possible but as a novice researcher, I found it not an easy task to accomplish. This has been one of my weaknesses in this M.Ed. course and I am not too sure if this has anything to do with the way that I was taught at school. Our supervisors advised us time and again that, the secret was to ask, "what do I want to achieve through doing this research?"

Worth noting is that the interaction with the other M.Ed. colleagues and the presentations on the research proposals made were helpful in that I was able to think carefully about my research project. To be given an opportunity to critique a colleague's presentation was a worthwhile exercise. At times some of us made claims about the paradigm in which we intended operating and during the presentation found it to be contradicting ourselves. At times some of my colleagues resisted change, furiously defending their positions. It is human nature to fear to be criticised. However, I have learnt from this research process that it pays to listen to somebody else and it is empowering and encouraging critical thinking skills to critique somebody else's work. I am grateful for the skills that I have acquired during this research project.

Given the Albany Museum's financial constraints, what was worrying me was whether it was worthwhile or not to do a research on the museum. Although our supervisors reiterated that the purpose of doing this research was meant to familiarise ourselves with the research process, I was always optimistic that whatever research I do should be of help in the current transforming education system in South Africa. I hope my aspirations were not too high.

Guided and informed by my research proposal, I designed my data collection instruments, mainly the interview schedules. Designing these was not an easy task either. It was so unfortunate that I did not get an opportunity to design these collaboratively with my M.Ed. colleagues. For one reason or another we became too individualistic and as result of this I took a long time to complete these instruments. However, after these were completed, they were referred to my supervisors for critiquing and it was then that I had the opportunity to discuss my instruments with one of my M.Ed. colleagues, which helped me with the modifications. Unfortunately, after being modified and due to time constraints, I did not get the opportunity to pilot test my instruments.

The research topic I had chosen, researching on the benefits of the museum's science programmes, is a topic that requires to be studied over a long period of time. However, as advised by my supervisors, I chose to do a case study rather than an action research.

Our supervisors informed us that the latter is difficult to finish. So my case study involved taking a class of the Science Olympiad learners to the museum for two different presentations. I have used the word presentation in this text to differentiate it from the classroom lessons. By being involved in the Science Olympiad Project helped me a great deal, since I arranged for this class to visit the museum, rather than negotiating with a school to be involved in my research project. Also, the benefit of this was that learners were familiar to me since I am also involved in their teaching. During one of the presentations a video camera was used and this helped me in assessing how the learners responded during the science presentations.

Establishing good relations with the museum staff has been one of my strengths in this research project. At the Albany Museum, the Education Department forms the bridge between the curators/researchers and the schools and despite this, I personally approached one curator to make a presentation on fishes and I never specified the subject. An arrangement was also made with the museum educationists to be present on this day. I hope I did not bypass the museum educationists in this case. However, I feel that I did not give him enough time to make his preparations and this was a weakness on my part as a researcher. For the second presentation, another curator (an entomologist) was approached by the museum educator to prepare a presentation on food chains.

Worth mentioning is that in the Science Olympiad Project, our curriculum is not syllabus orientated as such, but much broader so going to the museum was part of the project's educational programmes. Some teachers are so bogged down to the syllabus that they deprive learners the opportunity of exploring and discovering for themselves. The learners were taken to the museum in the afternoon so as to not to interfere with their school programme. However, it was problematic for the learners coming from different schools to be on time at the museum.

For my research purposes, teachers teaching at the schools where these learners are enrolled were invited to attend with their learners. In fact these teachers were also invited to attend the sessions where these learners are taught, but only a few managed to attend and on the day of the science presentation at the museum, only two teachers attended. My mistake was not to some remind teachers again on the day before. Finding out why teachers are reluctant to work after school hours is a research project on its own.

Regarding interviews with the teachers, appointments were made telephonically. Two teachers were interviewed at their schools during her free period. During one of these interviews, the other teachers who came in and out of the staff room time and again interrupted us. This proved to be a most unsuitable venue for an interview. However, the teacher who was interviewed proved to be excited about using the museum so much so that she directed the interview and hence the interview schedule was not rigidly followed. Kvale (1996) believes that an interviewer has to take control of an interview, and that did not happen on this day. Also, I realised that my interview schedule was long and I had to be flexible and not ask questions already addressed. In the process, a lot of information was shared and at times I felt hand-writing the responses was too slow and a tape-recorder would have been useful during this interview. Also, my timing was not good enough because there was little time for the debriefing session and the teacher interviewed had to go to another class after the end of the period.

The other teacher was interviewed at her home during her leisure time. This interview was kept very informal, deviating from the schedule and allowing for discussions to take place.

It was exciting to hear the teacher relating her experience and her learners' experience pertaining to their visit to the Thomas Baines Nature Reserve.

During the interviews with the teachers more probing questions could have been useful to find more information on the usefulness of the museum's science programmes, especially in helping teachers to design outcomes based education teaching and learning. I feel that more in-depth information was needed to answer this research question. Furthermore, all the teachers interviewed indicated that they were battling for resources at their schools, hence they took their learners to the museum. What I did not establish was if they had sufficient resources at their schools, would they still take their learners to the museum. This question would help to establish whether these teachers realise that the museum has also human resources.

Also I would have liked the teachers to critically reflect on the museum's science programmes rather than merely only looking at positive aspects. This lack of critical thinking could be attributed to the teachers' cultural background and the kind of education they had gone through in their school days. For instance, in the past teachers were not required to question or challenge anything and were used to top-down approach. This has impacted negatively on many teachers. This vicious cycle in our education can be improved by taking teachers from the marginalised positions to the centre of education and also through professional development.

On my part as a researcher I should have used more probing questions to solve this dilemma. Also it would have been useful data to establish from the teachers interviewed what their learners had really benefited from the museum's science programmes.

The learners were interviewed at their schools, with the permission of their principals and their science teachers. For these group interviews, I had planned to interview a maximum of eight (8) learners per group, but with one of the groups interviewed, the science teacher sent eleven (11) to be interviewed. With this large group, I found that they were initially shy during the interview. I had to explain most questions in Xhosa to make sure that they all understood. They were also allowed to respond in Xhosa. As the interview progressed, some learners dominated the discussions, which proved that interviewing a large group of learners was not ideal. I should have been firm and restricted the number to eight as

planned. This was a weakness on my part as a researcher.

Writing the responses in English, which were given in Xhosa, was a laborious but challenging exercise for me since I am also a second language speaker. I had to be careful not to distort what the learners had said. I think that is where the question of discourse analysis comes in although I am still not sure how to apply this research technique. This was also time-consuming, but worthwhile because I had to get quality data from my respondents.

With the other group which was composed of both "black" and "coloured" learners, taught by "coloured" teachers, I was able to communicate in English with the learners and did not experience any language problems. During the interview, the learners freely shared their views. Interviewing this small group of learners proved to be successful and I think individual interviews with these learners, given their ages, would be threatening.

In both groups interviewed, probing and follow-up questions were asked and all the learners interviewed were not threatened since I am co-facilitator during Science Olympiad classes. However, what I observed with some of the learners is that they were not accustomed to debating or discussing. Also, given their age group, they were not critical about issues and I would have loved to get more critical reflections on the museum's science programmes, which would help the museum educators in improving their science programmes.

Worth noting is that, although the learners were not interviewed immediately after the visit to the museum, they could remember most of the things they were taught during both presentations which shows that the museum's science programmes can have a positive impact on learners' understanding of science. When I read through the learners' journals, there was consistency in what they said they had learnt at the museum and what they had written in their journals. Compared to what the learners' knowledge was at the beginning of the year, they could now express themselves freely in English. It is evident from this study that journals can have a positive influence on the learners' language proficiency.

One facilitator who was busy during the time of the interview, was interviewed through Internet. In view of this, I perceive computer literacy as essential in doing a research project. However, as a result of the interview schedule not being pilot tested, when the museum facilitator (curator) was interviewed, he suggested that questions pertaining to the museum's education vision and how such vision is communicated to the schools should be referred to the museum's educators.

If I had pilot tested the interview schedule; I would have picked up which questions were relevant to be asked of the curators. However, this weakness in my research process helped me to get to know the museum's researchers' (curators') perceptions pertaining to the museum's education.

I have enjoyed doing the interviews during this research process and I have found them to be much better than questionnaires, since through the interaction with my respondents, I was able to rephrase the questions and interpret the questions in Xhosa. There was mutual trust between my respondents and myself and they freely aired their views and feelings.

My biggest weakness was to keep postponing my research write-up; as a result I was behind schedule. Initially I had planned to write a chapter at a time and consult with my supervisors. This did not happen and consequently I had to work under-pressure and "burn the candle" the whole night at times.

During my research write-up, I experienced language problems and I was not too sure where and how to use the literature. This was a consequence of the problem of previewing I experienced last year.

As a second language speaker, referring my research draft to someone for proof-reading helped me structure my report and with syntax errors I might have not noticed. When I referred my research report to my supervisors, they encouraged me to think critically about what I set out to find in this research endeavour and also about my research critical reflections. This was an empowering exercise.

If I were to do this research project again, I would take my supervisors' advice to keep a research diary and would make sure that I stick to my planned schedule. These were some of my weaknesses in my research project. Otherwise, doing this research project has been worthwhile and an eye-opener for me. With the experience gained during this research project, I will be able to take on any challenge in future research endeavours.

Chapter Six

Conclusion and Recommendations

Hooper-Greenhill (1997: 1) argues that if we think of knowledge as being external to the learner and the learning process being the acquisition of that body of knowledge (behaviourist view), then the task of the teacher or a museum educator is to transmit such knowledge to the learner. The learner is thus seen as a cognitively passive receiver of such knowledge transmitted by the teacher or museum educator. Worth mentioning is that, prevailing classroom practices emphasise rote learning and content coverage at the expense of learning with understanding (Tobin et al., 1990: 411).

If museums are intended to complement and supplement teaching and learning in the classrooms, how do they hope to accomplish this? Duggan (1996: 68) argues that museums communicate information, ideas, values and attitudes. However, Hein (1995: 25) suggests that in order to know how a museum is organised to facilitate learning, we need to address both what is to be learned and how it is to be learned. Furthermore, Tishman (1997) believes that helping people learn more effectively in museums means having a sound conception of what learning is.

The kind of learning that takes place in a museum is referred to as being “informal” (Finson and Enochs, 1997; Bloom, 1992) and is not formally assessed. Learning therefore includes the ideas of personal growth, lifelong development and the broadening of the vision of the world (Studart, 1997: 26). Furthermore, learning is perceived as an active process characterised by a constant interaction and exchange between the individual and the physical and social environment. In view of this, the role of the museum educator is supposed to be that of facilitation of active learning through handling of objects, and through discussions linked to concrete experiences (Duggan, 1996: 68). Furthermore, communication is understood as being cultural and a process concerned with the negotiated production rather than the imposition of meaning. Hence, learning in a museum is primarily concerned with engaging learners in actively exploring ideas (rather than receiving them) (Russell, 1994; Studart, 1997). Bloom (1992: 17) points out that

very little research has been undertaken on the "informal" learning that takes place in museums. However, literature review on the museum education reveals that children prefer interactive exhibits, which offer opportunities for whole body movement.

The intent of this research study, therefore, was to investigate the impact of the museum's "hands-on" activities on the learners' perceptions and attitudes towards science. It was also in the interest of the researcher to establish whether the museum's (interactive) science programmes helped to improve the teachers' teaching and learning strategies. It was also interesting to ascertain the museum educators' and curators' perceptions regarding their interventionist role in the science education in schools.

From this research study, the analysis of the qualitative data provided some revealing insights into the influences and impact of the museum's science programmes. As an observer during the science presentations, the nature of activities that were planned encouraged a learner to interact and be actively involved in the learning process. Knowledge was therefore created through social interactions with the teachers, curators, museum educators and learners. Furthermore, the presentations made addressed the question of attitudes, culture and values, something that is often neglected in our education system. Therefore, examples of factors considered important for (social) constructivist teaching and learning were evident. However, more time could have been provided for discussions and reflections during the presentations to make them more interactive.

The learners who were interviewed and kept journals acknowledged that they liked the "hands-on" activities they did at the museum. The museum's artefacts also helped them to understand certain scientific concepts and found that learning science was fun. It has also been confirmed by the studies that interactive exhibits are appealing to the learners since they become actively involved in the learning process (Finson and Enochs, 1997, Falk and Dierking, 1997). It is also evident from this study that learners learn science better when they do it rather than being told the scientific concepts. The museum's collections have proved to be outstanding in this regard. Also given the different galleries at the museum

makes the museum's environment conducive to learning. However, as a recommendation, it would have been useful for learners to be given projects to do at the museum so that they can enhance their research skills. That is, the science programmes should not be a one off thing. However, giving projects to learners would require more participation by class teachers. Hence, commitment and dedication on the part of teachers is crucial. Furthermore, by engaging learners in projects, the museum would also be in a better position to assess the impact of its science programmes, something, which is currently lacking. There is a need for learners to be able to demonstrate that learning has taken place when they are at the museum.

The study also indicates that the teachers who were interviewed perceived the museum's science programmes as a learning experience for them. The variety of teaching and learning strategies used, the integrated approaches adopted and the collections were mentioned as motivational and empowering. This was evidenced by the fact that these teachers willingly attended the science presentations in the afternoon. But whether or not these teachers utilise the skills acquired needs further investigation. In view of this, Peterman (1997: 4) argues that educators' beliefs and practices are resistant to change (Prawat, 1992) and are not always complementary. Therefore it is recommended that teachers need to wear a new set of lenses if they are committed to be agents of change.

From the museum's curators and educators, learners' prior knowledge is perceived as being crucial in the learning process. It emerged from this study, that the learners' background knowledge was not solid, but the curators and educators utilising the different teaching and learning strategies, could build on the learners' ideas. The time constraints were however mentioned as a barrier. In this context, Russell (1994: 21) argues that adequate preparation and follow-up is essential if a museum visit is to provide a learning experience. Evidence from these studies shows that some teachers do not prepare their learners prior to a museum visit or discuss the museum visitation. Holleman (1987: 7) has also confirmed this.

Given the age group of the learners interviewed, the familiarity of the researcher with the

teachers, museum educators and the museum curators (researchers), it is hoped that the validity of the research findings is not affected by bias on the part of the researcher. However, I hope the teachers, museum educators and the curators will be able to draw from the results of this research to improve their teaching and learning strategies and their science programmes respectively.

In conclusion, doing this research project has been a journey worth travelling. The experiences gained during this journey have helped me to travel with a different view, in particular, viewing teaching and learning with a new mindset.

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WHY CAN'T WE GO TO THE MUSEUM?

STUDY OF THE ALBANY MUSEUM AS A RESOURCE CENTRE

STIMULANTS AND INHIBITORS

**SUBMITTED IN PARTIAL FULFILMENT OF
THE REQUIREMENTS FOR THE
DEGREE OF MASTERS OF EDUCATION
IN SCIENCE EDUCATION OF
RHODES UNIVERSITY**

BY

KENNETH MLUNGISI NGCOZA

SUPERVISORS

DR JAAP KUIPER AND MRS GILL BOLTT

DECEMBER 1998

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ABSTRACT

Too often, when people talk or think of resources, they think mainly of physical or material resources, especially equipment. This mindset blindfolds lateral thinking. Resources could be you and me. Furthermore, it should be borne in mind that physical resources may be available in abundance, but if there are no human resources, the former is useless. Likewise, an understanding and insight into how and where to look for scarce resources is pivotal in education.

With the advent of the new curriculum 2005 in South Africa, the focus of teaching and learning activities shifts from a teacher to learner-centred approach and in this context huge variations exist in the availability of resources for science education, both human and physical. In the light of this, this study investigates the potential of the Albany Museum as a resource centre. Employing a survey, the researcher will investigate teachers' and principals' perceptions regarding the utilisation of such resources. Pros and cons will be considered through a critical examination of possible stimulants and inhibitors. The perspective of the museum's staff is also an essential ingredient of this study.

ACKNOWLEDGEMENTS

The success of any research endeavour is always dependent on the contributions of many groups and individuals. This research project is no exception and I would therefore like to gratefully acknowledge some important contributors:

- * My M.Ed. in Science Education supervisors, Mrs Gill Bolt and Dr Jaap Kuiper for being supportive in various ways throughout the course.
- * My M.Ed. in Science Education colleagues for their supportive and constructive criticism during the course.
- * Mr Holleman, Dr Jim Cambray, Dr Sarah Gess, Mrs Shoba and Mrs Cosser for their support at the Albany Museum.
- * Miss Louisa Verwey, the librarian from the Albany Museum, for her assistance in the Albany Museum library.
- * Mrs Judy Cornwell, the librarian from the Education Department, for her assistance in the library.
- * The school principals and teachers who gave of their time to be interviewed, and completed questionnaires.
- * Mrs Joy Hayes for her time and effort in proof-reading my research report.
- * My neighbours, Mr and Mrs Aziz Fakir, for offering me the use of their car which helped me considerably when I was doing my research.
- * Finally, it is customary, and in this case very appropriate, to record my thanks to my wife Nobuntu, who has been very supportive and has sacrificed much, becoming in effect a single parent to our beloved son, Mbasa, at times when I was busy with my research, and who is always my best critic.

To all these people, I owe my thanks for their time and effort.

Chapter One

Introduction

Museums are dynamic and accountable institutions, which both shape and manifest (reflect) the consciousness (world-view), identifying and understanding communities and individuals in relation to their historical, cultural and natural environments. This is done through collections, conservation, research, education and outreach programmes, which are intended to be responsive to the needs of the society (Voigt and Briedenhahn, 1997).

Holleman (1987:32) argues that education is the function of museums and is one of the marketing tools to justify museums' existence. Bloom (1992:17) believes, therefore, that we must learn how to assess the power of museum education and seriously investigate how people (especially learners) learn in a museum. This he suggests should be done both to document the impact of museums and to show how they can be even more effective. In view of this, Duggan (1996:68) suggests that museums' education policies and programmes need to be consistent with the current changes in education, which purport life-long learning as a process. Furthermore, he suggests that museum education should move beyond the narrow focus of the material world and take cognisance of the complexities of the world we inhabit.

In my capacity as a Science Subject Advisor, I work with and serve science teachers and learners in the Grahamstown District. It is my vision therefore to promote science teaching and learning in the Grahamstown schools. I believe it is crucial that science teachers become aware of, and understand the context within which the Albany Museum operates, as its educational activities are intended to complement teaching and learning in the schools.

Taking learners on excursions such as field-trips, visits to industries, nature reserves and museums is in line with the curriculum 2005, whose philosophy is called Outcomes Based Education (OBE), which is a new curriculum in South Africa. According to Kudlas (1994:32), this curriculum needs to be embraced and implemented. Using the Kuhnian language, there is, therefore, a need for a paradigm shift in how teachers view teaching and learning. According to Falk and Dierking (1997: 211), a fundamental shift in our notions of learning during field trips is required, as current models of learning suggest that field trips result in salient and indelible memories. However, Jackson and Hann (1994:11) suggest that visits to a museum should be justified in terms of curriculum relevance and learning outcomes. One of the major strengths of OBE is that it purports life-long learning for all citizens of South Africa. This however does not happen on its own. This requires educationalists, especially teachers, who are, according to Prawat (1992), perceived as important agents of change, and need to be open-minded, critical and reflective thinkers.

In support of this assertion, Koballa and Price (1985) argue that we need to study teachers' attitudes because it is teachers who help students develop positive attitudes toward science. Furthermore, Duggan (1997: 68) suggests that commitment to learner-centred education means putting learners first; recognising and building on their knowledge, skills, abilities and experience; responding to their needs; taking into account different ways in which they learn; and demonstrating respect for their language, culture and personal circumstances.

Our society is becoming increasingly dependent on science and technology. As this dependence grows it becomes increasingly important for science educators to understand what attitudes exist toward their discipline. However, one of the greatest problems in our education is that teacher education institutions do not adequately prepare teachers for the task ahead. Student teachers are, for instance, lectured to, yet they are expected to teach in an interactive way.

They are also not exposed to institutions such as museums so that by the time they enter the teaching profession they are well-equipped (Booi 1998 pers. comm.). This is a vicious cycle we are faced with in our education. Theorising about OBE will take us nowhere; we need a cadre of pro-active teachers in our schools who are capable of utilising all available resources, both human and physical.

In this research endeavour therefore, the researcher will investigate possible stimulants and inhibitors pertaining to the use of the Albany Museum as a resource centre, suggest some possible ways of overcoming those inhibitors, investigate the attempts being made at the museum towards finding solutions to these aforementioned problems. Both administrative and educational innovations will be explored.

Chapter Two

The research context

The Albany Museum is a provincial museum funded by the Department of Arts, Culture and Sport in the Eastern Cape, and is an associated institute of Rhodes University. Although the museum consists of a family of six buildings, for the purposes of this research, the researcher will focus only on the Natural Sciences Museum.

The Natural Sciences Museum building (see appendix A) is situated in Somerset Street, near Rhodes University. It is constituted of the following (science) departments:

- * Botany -Selmar Schonland Herbarium (Plants)
- * Range and Forage Institute (Agricultural Research Council).
- * Earth Sciences (Palaeontology, geology).
- * Entomology (Insects).
- * Freshwater Ichthyology (Fishes).
- * Freshwater Invertebrates (Insects, crustaceans, snails, worms).
- * Vertebrates (Birds, mammals, reptiles and amphibians).
- * The Education and Outreach Department.

Bloom (1992:18) believes that as education is an integral part of the function of museums, it is important for us to know what is unique about education in museums. Jackson and Hann (1994:12) argue that the uniqueness and strength of the museum experience lies in the direct encounter with real objects.

Museums are, first of all, places where objects of historical, cultural, artistic and scientific importance, referred to as collections (specimens of birds, fishes, insects, animals etc.), are preserved. These objects are available for study by researchers employed in museums and also by researchers coming in from elsewhere.

These collections are in themselves a source of knowledge, such as books in a library. They can therefore be used for teaching. Textbooks, for example, offer pictures of objects and organisms, but teachers and scholars, if they have never seen the objects or organisms, have difficulty in relating the pictures to reality. In contrast, seeing and touching objects and organisms concretises the learning experience.

Hall (1991:13) believes that museums are perfectly poised to build bridges of understanding, awareness and appreciation by providing flesh to the bones of education by means of curriculum extension and enrichment. Furthermore, Jackson and Hann (1994:13-14) believe that opportunities to handle and experiment with exhibits are strong motivators as the vast stores of knowledge and experience contained in collections and displays can help to evoke a sense of excitement. Cambray (1990) suggests that collections housed in museums can be used in a broad spectrum of systematic, ecological and bio-geographical research and teaching programmes. Hence, through the expertise of museum staff and collections, conservation can be promoted. Thus the museum has an important role in environmental conservation.

The curators of collections are also researchers and, as such, are specialists in the fields covered by their collections and are therefore able to interpret the objects to scholars both directly and also indirectly by interpreting them to teachers, through museum education. The researchers are also a source of knowledge not yet available in books. These researchers keep up with new work in their own fields, but their function is to make new discoveries, which adds new knowledge. For example, in countries like India, where insect collections are not available, pest insects cannot be identified and must be sent to the Natural History Museum in London for identification (Gess 1997 pers. comm.).

One of the responsibilities of museum education officers is to teach people that a museum actually is an essential institution since it preserves objects both natural and man-made

for use not only now but also in the future.

Therefore, the museum setting is concerned primarily with engaging the visiting public in exploring ideas rather than passively receiving them. Russell (1994: 19-20) argues that the constructivist view emphasises active and imaginative understanding that enables the world to be seen as an active reconstruction. Thus "hands-on" activities are not an end but a means to an end.

The education department forms some kind of a bridge between schools and museum's researchers. The museum has no specified curriculum, but deals with a broader knowledge. Its education has no age or geographical area restriction. It is open to everybody. Unlike schools, a museum education is not restricted to teaching a limited group of scholars; it is available to all students from all educational institutions. It is also not restricted to the collections or lessons or tours within the museum buildings, but excursions or field trips are organised for learners as part of its outreach programmes. Falk and Dierking (1997: 212) argue that learning in museum is not linear but complex. They argue that learning during a field trip must involve the use of memories to solve real-world problems.

The Albany Museum has extended its accessibility to the community by being involved in the Grahamstown Foundation's Science Festival ("Scifest") programmes, whose main focus is the promotion of science. The spin-off effect for the "Scifest" is the promotion of public awareness and appreciation of science and technology.

Chapter Three

The research design

3.1 The philosophy underlying the research project

This research project is located within a qualitative paradigm. In this kind of research, according to Wolcott (1990: 25), progressive problem setting and focus, fieldwork and analysis move forward in a complementary fashion and the writing proceeds as an integral part of the fully orchestrated research process. According to Tesch (1990:4, 43), in a qualitative research, the analysis is the process of making sense of narrative data, and not concerned with variables and their measurement. Furthermore, according to Kicheloe (1991:144-145), qualitative research views experience holistically.

The researcher will embark on a small-scale survey. A survey is a data-collection method that asks questions of a sample of respondents using either a questionnaire or an interview. Furthermore, the questionnaires and interview schedules that were designed were in the form of a semi-structured interview, to allow for follow-up or probing questions (Sanders and Pinhey, 1974; Cohen and Manion, 1994; Kvale, 1996; Kuiper et al., 1998). According to Walker (1985:117), an interview opens areas of dialogue. Regarding the sequence of questions, the "funnel" approach will be employed; that is, the schedule will commence with broad questions and progressively be narrowed down (Oppenheim, 1992:110).

These data collection instruments were designed and discussed with the researcher's supervisors for modification purposes. The questionnaires were further referred to the Albany Museum's educators or researchers for critiquing since they are authorities on museum education. By involving the museum educators or researchers, data collected, and the interpretation thereof, can become more meaningful and it would be easier to avoid misinterpretation (Kuiper et al. 1998). Both the questionnaires and interview schedules were pilot tested to ensure that any ambiguities were minimised as far as possible, and to obviate obscure responses being obtained, especially in questionnaires (Sanders and Pinhey, 1974:128).

Therefore, in this research endeavour, the research output will come from various sources, viz., teachers' and principals' questionnaires, interviews with the museum's educators and Director in order to get a much more broader picture of the stimulants and inhibitors as well as the museum's management policies. Data was also collected through discussions and personal communications, especially with the college lecturers who are also doing the M.Ed. course at Rhodes University.

3.2 The research purpose: aims and objectives

First, it is worth mentioning that teaching and learning does not take place only inside the classroom. In this regard, museums can be utilised as an extension to what takes place in the classroom. Museums have both human resources (curators or researchers and education officers) and physical resources such as the collections, which are always available. Furthermore, collections can be borrowed to be used as teaching aids in the classroom.

However, from my experience as a Science co-ordinator based at the Albany Museum and later as an Education Officer, I realised that some schools did not utilise the museum as a resource centre. This is a concern that needs to be addressed so that teachers can be made to see the new curriculum in a positive and constructive light. According to Duggan (1996:69), museum education can and should prepare learners to be active participants in the process of change rather than merely passive spectators to the action of others.

The aim of this research endeavour, therefore, is to ascertain the possible reasons why some schools use the museum and why others do not by addressing the following questions:

- 1. What stimulates science teachers to make use of the museum as a resource centre?**
- 2. What inhibits science teachers from making use of the museum as a resource centre?**

3. How can science teachers be encouraged to make use of the museum as a resource centre?

Although the main focus of this research will be on the teachers' perceptions and attitudes, Hall (1991:10) suggests that museums now have to take a long hard look at themselves.

Hence it is imperative for them to broaden their reach to embrace the whole community if they are to fulfil their real purpose. It would be in the interest of the researcher therefore to know what attempts are made at the museum to keep teachers informed about its programmes. How these teachers respond to these programmes will be a valuable data for this research report. At the heart of this research endeavour, is an attempt to find solutions to this dilemma, with the hope of stimulating more teachers to utilise the museum's resources (both human and physical).

3.3 Methods

3.3.1 Data collection methods

The main body of the data comes from questionnaires and interviews with school principals, teachers, museum educators and the museum's Director. For principals and teachers, interview questionnaires were designed and then used as a semi-structured interview. A set of basic questions was posed to each interviewee, whereas further discussions and comments were taken up as the interview progressed and were recorded as part of the data, as suggested by (Kuiper et al., 1998). In-depth interviewing encourages people to reconstruct their experience actively within their context of their lives (Seidman, 1991: 8). Furthermore, interviews are adaptable (Wiersma, 1986: 91), hence allowing depth to be achieved by providing the interviewer the opportunity to probe and expand on the respondents' responses (Hitchcock and Hughes, 1995: 153-157). In this way, some kind of balance between the interviewer and the interviewee can develop, which can provide room for negotiation and discussion.

To obtain qualitative data, these questionnaires were used in three different ways: some questionnaires were administered, some were self-completed, and some were used as bases

LITERATURE REVIEW

IS SOCIAL CONSTRUCTIVISM AND
MUSEUM EDUCATION A MARRIAGE OF
CONVENIENCE OR A MARRIAGE
MADE IN HEAVEN?

SUBMITTED IN PARTIAL FULFILMENT
OF THE REQUIREMENTS FOR THE
DEGREE OF MASTERS OF EDUCATION
IN SCIENCE AT RHODES UNIVERSITY

BY

KENNETH MLUNGISI NGCOZA

SUPERVISORS

DR JAAP KUIPER AND MRS GILL BOLTT

DECEMBER 1998

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ABSTRACT

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ABSTRACT

Curriculum is perceived as central to the education process. Since theory informs practice, understanding the theories, which underpin our epistemology, can encourage us to look at our world with new conceptual lenses. In this paper I outline the theoretical underpinnings of social constructivism and museum education, suggest the implications for both these in "formal" and "informal" education respectively. Furthermore, the links between these two are drawn.

ACKNOWLEDGEMENTS

There were many hands, hearts and minds involved in the creation of this paper. I would like to sincerely thank the following people for their support:

- * My M.Ed. in Science Education supervisors Mrs Gill Bolt and Dr Jaap Kuiper for their constructive criticisms and tireless support throughout the course.
- * Mrs Judy Cornwell for her support in the Education Department at the library.
- * Miss Louisa Verwey for her support in the museum library.
- * Mrs Val Scott, for proof reading my literature review paper.

To all these people I owe grateful thanks for their time and effort.

1. Introduction

Curriculum is perceived as central to the education process. Broadly defined, curriculum refers to teaching, learning activities and experiences provided, for example, by the school and other institutions such as science centres and museums. The kind of curriculum offered in schools is referred to as being “formal” whereas the kind of curriculum offered in institutions such as science centres and museums is referred to as being “informal”. These curricula are believed to be complementing one another, and both have implications for teachers and museum educators respectively.

Worth noting is that the apartheid curriculum policies mirrored the traditional approaches to teaching and learning. Teachers had therefore to follow a rigid, linear and prescriptive curriculum. Any deviation from such curriculum was perceived as defiance to authority. Furthermore, teachers had to master the subject matter. To be an authority on the subject meant to master the textbook from cover to cover, to provide the knowledge teachers were to dispense (Tilgner, 1990) without questioning any of the content contained in it. When I was at school we used to refer to these teachers who demonstrated to “know” the textbook, as “coughing” teachers. This expression meant that the teacher had memorized the textbook off by heart. We were, however, impressed with these teachers because they pretended to be authorities in their subjects, yet not.

Furthermore, teachers were seen to be authorities who were active “instructors” and transmitters of “absolute” knowledge. Emphasis was therefore on rote learning of facts and algorithms rather than conceptual understanding (Tobin et al., 1990). Learners together with the content were viewed as relatively fixed entities which were static and non-interactive (Prawat, 1992).

Learning was thus perceived as being successful if learners were able to regurgitate the knowledge or information transmitted by their teachers. These teacher-centred approaches resulted in compartmentalized knowledge, exam-orientated teaching. Furthermore, examinations acted as gatekeepers to the future and hence learners competed for grades.

I remember when I was at school we used to spend most of the time writing notes (even mathematics notes) which we had to memorize in order to pass the examinations. There was very little learning taking place. Most traditional assessment indicators communicated very little about the quality of students' specific accomplishments. This is no exaggeration; I have experienced this process myself. This had serious repercussions for learners. Learners, who were regarded as intellectually immature, became passive recipients of the accumulated knowledge (behaviourist view) and this can be depressing to students.

In this vein, Bodner (1986) argues that the traditional paradigm is best characterized as a "transmission" approach to teaching and an "absorptionist" approach to learning. Furthermore, Bodner argues that the theory underpinning this perspective is based on the assumption that knowledge can be transferred intact from the mind of the teacher to the mind of the learner (regarded as an "empty vessel"). Bodner, therefore, brings to our attention that teaching and learning are not synonymous. Furthermore, he asserts that we can teach adequately without the students necessarily learning and I fully agree with him. However, Bodner does not clearly state how teaching and learning can be improved.

On the other hand, informal sectors such as museums emulated the positivistic and behaviouristic traditional approaches to teaching and learning. Museum educators relied on the exhibits designed by the curators as sources of knowledge. Learners had to learn the information provided on the exhibits in a parrot-like fashion. This was exacerbated by the fact that some museums employed teachers who were trained in the traditional methods. Also, emphasis was on general tours, especially when there was nothing to do in some schools, which resulted in museum visitation being intended for fun rather than learning.

However, some museums attempted to free themselves of the absolute rigidity of following the exhibits by utilizing interactive exhibits and programs encouraging "hands-on" activities. But what has been lacking from these museums has been the evaluation and assessment of its programs; that is, how could they ensure that learning was taking place? In view of this, Duggan (1996: 69) suggests that the museum's vision should encompass a broad understanding of museum education which includes events or activities which can be planned and organized with clearly defined teaching and learning objectives.

In South Africa today, the education system is currently undergoing a paradigm shift (using Kuhnian language). This shift is from the traditional approaches to teaching and learning to the new curriculum 2005. The traditional epistemological paradigm is now being turned upside down and the transformation is from content-based (subject) education to skills-based (outcome) education. This results in a move from teacher-centred to learner-centred approaches with an emphasis on outcomes rather than on objectives. An outcome is perceived as proof that learning has taken place. Therefore the emphasis is on what a learner can do. This new curriculum is referred to as "outcomes based education" (OBE). The theory, which underpins this new curriculum, is social constructivism. This perspective is intended to make teaching and learning more interesting, enjoyable, challenging and meaningful. Also the move away from behaviourist and content-based curricula towards constructivist, contextualised and process-based curricula has opened the door for cultural considerations in development of curricula (Kuiper, 1998: 11).

Regarding teachers and other educators, the focus is on the change from being the dispenser of knowledge towards being providers of learning situations. This however requires educationists (both in formal and informal sectors) to revisit their teaching and learning strategies which emphasize rote-learning, to more interactive methods which encourage active participation by learners. The constructivist movement therefore acknowledges that learners come into the classroom with their own content-based understanding and learning needs to be contextualised within the learners' familiar environment in order to effectively deal with the learners' ideas.

The focus of this paper is on social constructivism and museum education. Earlier on it was mentioned that museum education is intended to complement what is happening in the classrooms. Given the range of teaching and learning strategies employed in museums, it will be investigated if its education fits into the new curriculum 2005.

2. Literature Review

2.1 The Social Constructivist Perspective

Constructivism favours a more interactive and dynamic approach to curriculum and thus the curriculum should not be viewed as a road map (Prawat, 1992) with content presented as a finished product. This requires improvisation of learning materials (Kuiper, 1997) and the educational reform emphasizes the importance of logistic support for material centred learning (Tobin et al. 1990). Furthermore, Urevbu (1984) suggests that curricula methodologies and teaching materials should be drawn from the life of the community and from the environment.

In the constructivist teaching and learning scenarios, the traditional telling-listening ("chalk and talk") relationship between the teacher and the learner is replaced by one that is complex and interactive (Prawat, 1992). Commitment to learner-centred education means putting learners first, recognizing and building on their knowledge, skills, abilities and experience, responding to their needs and taking into account the different ways in which they learn. With emphasis on the learner, we see that learning is an active process occurring within and influenced by the learner as much as the facilitator (Yager, 1991).

From this perspective, learning outcomes (which are perceived as a demonstration that learning has taken place) are important rather than objectives, and outcomes do not depend on what the teacher presents.

Furthermore, the constructivist perspective purports that knowledge is constructed in the mind of the learner (Bodner, 1986), that is, the learner is capable of making meaning of what knowledge is. Therefore, learners construct understanding and they do not simply mirror and reflect what they are told by the teacher or what they read. Learners come into the classroom with their own context-based understanding of many concepts and skills (Kuiper, 1998). Hence, learning needs to be contextualised with the learners' familiar environment in order to effectively deal with learners' ideas. Kuiper (1997) warns however that for young children it is useful to first elicit their ideas and then challenge these in concrete situations.

Also the learners' prior or preconceived knowledge base is pivotal (Beiers and McRobbie, 1992; Solomon, 1994; Kuiper, 1997) and should be used as a starting point (Clough and Clark, 1994). Kuiper points out that the learners' ideas should not be considered "wrong" when compared with the accepted views of science, but only different. Furthermore, Driver et al. (1985) argue that knowledge of students' ideas enables teachers to choose teaching and learning activities which are likely to be interpreted by students in the way intended; thus teaching becomes better adapted to the students. These activities can be undertaken in groups so that learners are accorded the opportunity of sharing knowledge and ideas.

Furthermore, in this perspective, teachers are viewed as creators of learning situations or environment, as individuals who are expected to "construct" their practice based on a vision of what it means to teach for understanding (Prawat, 1996). This means that there is a shift from the transmission of scientific content to the development of understanding of science concepts, with science learned in a contextualized way (Matthews, 1992; Kuiper, 1998). This shift requires a two-directional flow of information between the teacher and the learner. Through the dialectical interaction, teachers will also be able to reflect on their actions and practices, hence learn to vary their teaching and learning strategies to suit learners' needs. In the process the teacher acts as a facilitator, a co-learner and a "scaffolder". Therefore, the teacher, with a dynamic view of subject matter, i.e., recognizing that knowledge, is dynamic not static, departs from the teacher-centred scenarios emphasizing instead the importance of student reasoning (Prawat, 1992) and encouraging problem-solving skills.

According to this perspective, all learning is an active process of constructing meaning (Clough and Clark, 1994). The learners thus internalize their experience (Driver et al., 1985; Driver et al., 1996). Learners thus apply knowledge rather than recite it (Kuiper, 1997) and are encouraged to recognize the science that surrounds them and develop understanding of key concepts, principles and models. Thus, relevant science can be perceived as learning science in the context of the learners' environment, making it more to their experience in their communities (Smit, 1998). However this requires restructuring of the curriculum. Beiers and McRobbie (1992) point out that learners' prior knowledge, which they bring to the learning situation, is crucial.

According to Yager (1991), rote learning and repeated practices are not likely to generate real understanding and useful knowledge. In this vein, Gergen (1985) argues that the social

constructivism inquiry is principally concerned with explicating the process by which people describe, explain or account for the world in which they live. Social constructivism therefore affords the opportunity to construct knowledge through processes which are socially, culturally and politically based (Kuiper, 1998: 12). Furthermore, this perspective opens the door to different perspectives, experiences and values, allowing learners to construct a culturally and personally meaningful understanding of science. Also understanding is negotiated rather than imposed.

This perspective employs language to achieve its goals. Therefore, demonstrating respect for the learners' language, culture and personal circumstance is crucial in social constructivism. This is crucial since society and culture influences science. Science therefore is seen as a social activity laden with values and beliefs (Aikenhead, 1997). Both teachers and students with a social constructivist perspective can therefore evaluate scientific knowledge claims in a socio-cultural context (Atwater, 1996). Furthermore, multicultural science education continues to be influenced by class, culture, ethnicity, gender and different lifestyles. It is therefore necessary to begin to understand how these influence the teaching and learning of science. In addition to this, during teaching and learning scenarios, a sense of value and ownership needs to be encouraged with ethical issues considered and putting learners at the centre of things (Doyle and Mallett, 1994).

Sprod (1997) argues that social construction of knowledge encourages discussion in the classroom. Social constructivism is therefore concerned with the contributions of social interactions and learning is perceived as a social act more akin to socialization than instruction (Ritchie, 1998). Students therefore need to be encouraged to engage in group discussions (Solomon, 1994; Prawat, 1996; Sprod, 1997). In student-student interactions, meaningful conversation is important if learning is going to take place in student groups (Yager, 1991; Atwater, 1996).

Furthermore, in this perspective, knowledge is not something that people possess somewhere in their heads but rather something people do together (Gergen, 1985; Yager, 1991; Prawat, 1996; Ritchie, 1998). Furthermore, students are accorded the opportunity of sharing ideas and collaborative learning involves activities such as small groups negotiating the meaning of a problem (Doyle and Mallett, 1994; Tippins et al., 1995). When negotiating meaning, learners explain, clarify, elaborate, question, evaluate and argue (Etchberger and Shaw,

1994). Also through discussions, students are accorded an opportunity to share ideas in a mutually supportive way.

However, Sprod (1997) points out some institutional curbs such as curriculum pressures, assessment techniques, lack of teacher expertise and lack of consideration of theories for the classroom complexities. For instance, since the focus of classroom activities shifts from the teacher to the learner-centred approach, "hands-on" practical activities are vital and these require materials and thorough planning.

According to Atwater (1996), communication is perceived as a central theme in social constructivism. Learning is dependent on language and communication (Yager, 1991). The communication discussed in this perspective should be a two-way process which requires engagement of learners in the learning process. Language therefore, is perceived as vital in social constructivism and is a central theme in multicultural education (Atwater, 1996). Vygotsky's theory (1986) sees social interactions as a vehicle for learning and therefore, learners are able to solve problems cooperatively (Penlington and Stoker, 1998).

Furthermore, Atwater (1996) argues that socialization in any cultural setting not only teaches a child what language to speak and what non-verbal communication behaviours are appropriate, but also how to learn. Therefore, central to social constructivism is social interactions with language being a fundamental concern. Multiculturalism plays an important role in education since it has to do with teaching and learning strategies, gender issues, language etc and not necessarily different cultures as this is a misconception by many (Latragna 1998 pers. comm.). Cooperative learning, where learners get an opportunity to work in groups, is pivotal. This is seen as an ideal vehicle through which construction of knowledge takes place. This is important since the process of understanding is the result of an active, cooperative enterprise of persons in relationship (Gergen, 1985).

In the social constructivism perspective, the teacher's role has to change from that of the disseminator or transmitter of knowledge to that of a facilitator (Atwater, 1996) and also toward a provider of situations and information. Teachers therefore need to think of the

curriculum as a matrix or network of big ideas (Ritchie, 1998). Tobin et al. (1990) points out the importance of how teachers set up classroom activities to facilitate learning and they need to work alongside students to help them explore and make sense of the network of ideas within and across disciplines of science. Furthermore, through interaction with peers and students, teachers construct beliefs about the nature of knowledge, how students learn and what strategies may best be applied in a given teaching and learning environment.

On the other hand, students move from a receiver of knowledge to a gatherer, processor and constructor of knowledge (Etchberger and Shaw, 1992; Bodner, 1986). In this perspective, teaching and learning strategies require the active participation of students and encourage them to assume a greater responsibility for their own learning (Ritchie, 1998). Knowledge is not constructed passively and hence constructivist science teachers promote group learning (Yager, 1991). Matthews (1992) argues that social constructivism places stress on learner engagement in learning, stressing dialogue, conversation and arguments. Which means that learners are no longer passive recipients of knowledge as was the case in the traditional approaches. Learners are encouraged to construct and deconstruct knowledge, which is a two-way mediation process between the teacher and students. Learners become involved in the production rather than reproduction of knowledge. In particular, the constructivist perspective aims at the autonomy of the learner with emphasis on understanding.

As far as the multiculturalism perspective is concerned, Atwater (1996) argues that the classroom should provide a varied contextualisation of science appropriate to the variety of daily-life experience of learners. This is theoretically supported by the social constructivist interpretation of learning.

It should be borne in mind that learners are not repositories for adult knowledge, but are organisms which are constantly trying to make sense of and to understand their experiences (Etchberger and Shaw, 1994). Literature review has revealed that active students learn more than passive ones (Bodner, 1986) and the intellectual involvement of participants increases with "hands-on" involvement. Learners therefore develop positive attitudes towards science and learning science becomes an enjoyable experience (Beiers and McRobbie, 1992). Through interaction with students and teachers, science knowledge is expanded (Atwater, 1996). Students' cultural realities, including concepts of self and social roles, are constructed through social interactions. Furthermore, Mayoh and Knutton (1997) argue that science educators

should pay greater attention to the potential interactions between “formal” and “informal” science learning.

Assessment is the major tenant of social constructivism. In this perspective, learning, teaching and assessment are inextricably linked. Without learning assessment has relatively little value, and without assessment, the effectiveness of learning and the accountability of teaching cannot be determined. Learning therefore requires effort and assessment of such effort. However, the way we teach inevitably determines the way we assess our students. With the variety of assessment strategies propagated in the new curriculum 2005, emphasis is on understanding and the ability to apply knowledge and skills. Development of problem-solving skills is encouraged rather than memorizing a given quantity of science information. Emphasis is also on practical skills, learners' attitudes and values.

2.2 Museum Education

Education is perceived as the integral function of museums (Holleman, 1987; Bloom, 1992) and the kind of education that takes place in a museum is often referred to as ‘informal’ (Bloom, 1992; Studart, 1991; Finson and Enochs, 1997). In an “informal” education setting, learners can follow their own interests and their knowledge is not “formally” assessed. Furthermore, in this context, learning fundamentally includes the ideas of personal growth, lifelong development and the broadening of the vision of the world (Studart, 1991). However, both Holleman and Bloom suggest that it is important to investigate how learners learn in a museum. In support of this view, Tishman (1997) suggests that museum educators need to have a sound conception of what learning is, that is, how it happens and how it can be helped to happen.

Furthermore, Hall (1991) sees museums as being perfectly poised to build bridges of understanding, awareness and appreciation by providing flesh to education by means of curriculum extension. Therefore, she asserts that museum activities are intended to

complement and supplement what is happening in the classrooms. Worth noting is that museum education has no specified curriculum, but deals with a broader knowledge. Furthermore, the uniqueness and strength of museum experiences lie in the direct encounter with real objects, for instance learning by using the museum's collections and exhibits. Also all ages are accommodated. One can conclude that museum education has the potential for cross-curricula and integrated teaching and learning. But does this really happen in museums?

Russell (1994) argues that the way that a museum is organized carries implicit assumptions about the manner in which visitors (learners) learn. He points out that the ancestral style of museums reflect a *positivistic* (my italics) view of the world. The learning environment in this case is driven by the museum educator's or curator's view of the structure of the subject as contrasted with the need of the learner. In this *behaviourist* (my italics) view, content dictates what is to be learned (Hein, 1995; Studart, 1997). Therefore, the museum educator or curator is seen as an active instructor and the transmitter of knowledge that cannot be challenged.

Hein (1995) further points out that in such museums, it is common for exhibits to present material in a single orderly manner deemed by the exhibit designers to be best suited for visitors (learners). In such cases, the museum educator takes a more didactic stance, informed by a more positivistic epistemology. In some cases, this is exacerbated by the fact that some museums employ teachers from schools who have been trained in traditional methods.

Hooper-Greenhill (1997) lends support to this argument, pointing out that a positivist epistemology understands knowledge as external to the learner. Furthermore, he argues that the behaviourist learning theory understands learning as the acquisition of facts and information in an incremental way. A positivistic view of knowledge as objective, external and transmissible, with the educator as the knower and the learner as passive and uninformed prevailed. Learning consisted of accumulation of facts and information provided by the exhibits.

Furthermore, a realist and positivistic epistemology and behaviourist learning theory underpin

the transmission model. The transmission model can be applied to the process of exhibition production in museums; where an exhibition originator, frequently a curator, working on their own, selects the objects and writes the text, and then passes all this fixed unity to the designer, later the educator is expected to find ways of making the exhibition relevant to visitors. At no stage is the target audience considered or planned for; it is the exhibition for the general public (Hooper-Greenhill, 1997: 2).

In view of this, Hein (1995) argues that our beliefs about the nature of knowledge, our epistemology profoundly influences our approach to education. Peterman (1997) points out that our beliefs and practices are sometimes resistant to change; yet there is a need for educators to abandon traditional textbook-driven curricula, and utilize object-based museum artifacts. For instance, Russell (1994) argues that the view of science is about understanding objects and phenomena.

However, in recent years the museum world has begun to accept that visitors (learners) can be seen as individuals with their own particular needs, preferred learning styles, social and cultural agendas (Hooper-Greenhill, 1997: 1). Therefore visitors are conceptualized as active in the construction of their own knowledge. This shift from positivism and behaviourism can be seen as a process. Some museums have attempted to free themselves of this absolute rigidity to teaching and learning by employing good interactive exhibits designed so that visitors can experience and explore real phenomena (Feher, 1993: 242). Hein (1995) points out that constructivist museum exhibits can allow learners to make their own connections with the material world; with the focus on the learner and not on the material to be learned.

Object-based learning is therefore a term used by museologists to describe inductive learning approach to museum artifacts and as such object-orientated learning may be viewed as an aspect of discovery learning. It is believed that this might invigorate teaching and learning (Peterman, 1997: 4). In view of this, Kannemeyer (1987) argues that there is no justification for museums to adhere to the traditional "chalk and talk" methods of learning. Furthermore, learners should not be expected to receive, memorize and repeat information in a parrot-like fashion. Museum education needs to be learner-centred. This means that "putting learners first, recognizing and building on their knowledge, skills, abilities and experience, responding to their needs, taking into account the different ways in which they learn and demonstrating respect for their language and culture" (Duggan, 1996: 68). It is therefore the task of the

museum educator to be a facilitator who guides but does not direct. She or he should be more concerned to raise questions than to provide tailor-made answers and through discussions linked to concrete experiences.

Hooper-Greenhill (1997) further suggests that social and cultural contexts for learning need to be taken into consideration. As a result of the influences of the theoretical views of the role of experience and social context of museums on the learners' learning, the prevalent approach adopted by learner-orientated museum exhibitions is participative and interactive in nature (Studart, 1991). The main purpose of such exhibitions is to stimulate curiosity and to encourage exploration and social interactions amongst learners. Also through the museum artifacts, learners get an opportunity to make connections with concepts and objects (Hein, 1995). Furthermore, children's galleries offer a novel, unthreatening and relaxed environment for children to interact and share learning experiences.

Feher (1993) argues that there is a need for museum educators to acknowledge that learners bring with them preconceived ideas about the way the world functions. Learners will bring with them their own theories about how things happen. Therefore, the job of the museum educator should be to engage, to make contact with existing ideas in order to further the development of understanding and awareness. Worth noting is that the learners' ideas are sometimes in direct contrast with accepted scientific views. Also, the pre-existing ideas strongly influence how learners learn.

Preconceptions play a decisive role in the way visitors (learners) perceive and interpret the exhibits. Therefore, the task of exhibits should be to help learners reorganize their ideas and construct new understandings. Furthermore, Falk and Dierking (1997) argue that the ability to learn is strongly dependent upon the ability of an individual to frame prior experiences within the context of the physical environment.

Given the paradigm shift in our education system in South Africa, museums need to address both what is to be learned and how it is to be learned (Russell, 1994; Duggan, 1996). Russell

(1994) suggests that museum education should be concerned with engaging learners in actively exploring ideas (rather than passively receiving them). He points out that a constructivist view emphasizes the active and imaginative dimensions of learning and discovery.

Furthermore, the proponents of constructivism argue that learners construct knowledge as they learn, they do not simply add new facts to what is known (Hein, 1995). Russell (1994) asserts that children prefer interactive exhibits, which offer opportunities for whole body movement. In "hands-on" learning experiences, although understanding is physically and perceptually supported by material experience, Russell warns that "hands-on" is not an end in itself, but a means to an end. The very expression "hands-on" is tangible recognition of the power and importance of "concrete operational" learning, that is, learning in which understanding is physically and perceptually supported by material experiences. However, an invitation to manipulate materials should therefore engage thinking since the common goal of museum education learning is conceptual understanding.

Since learning is culturally mediated, using language to communicate understanding and to share meanings can be a powerful means of supporting new learning (Russell, 1994). Interactive exhibits can do this by affording visitors a personal experience with phenomena. However, Feher (1993) suggests that a network of exhibits is needed which enables visitors to make more and better connections among related concepts and experiences. Exhibits must interrelate and dovetail, presenting a topic in multiple forms, allowing the visitors' experiences to be extended and their ideas to be confronted, challenged and reinforced.

According to Studart (1997), museums have an unprecedented opportunity to create physical settings that can enhance learning. Immersing the learner within a context that enables him or her to see how things are connected, to understand visually, aurally and even through smell and touch what something looks like, is a tremendous educational tool. The essence of the museum experience is therefore the ability of an individual to see real things, and within real and meaningful physical contexts. In this vein, Hein (1995) argues that constructivist museum exhibits have no fixed entry and exit points, but allow the visitor to make his or her own connections with the material and encourage diverse ways of learning.

In view of this argument, Duggan (1996) suggests that museum education policies and

outreach programs need to be consistent with the current changes in the education system, which purport life-long learning as a process. The challenge therefore requires museums to move beyond the narrow focus of the material world. Will (1992) suggests that museums should not only be concerned with mastering content (knowledge), but also concerned with understanding and a change of attitude towards the subject being taught. He further argues that through presenting "real objects" and putting these into context, a learner is allowed to enter the world where these objects are used. In support of this, Bloom (1992) argues that a museum visit can inspire visitors to ask questions and to pursue newfound interests on their own.

Hooper-Greenhill (1997) therefore suggests that learners in a museum should be seen, as individuals with their own particular needs, preferred learning styles and social and cultural agendas. They therefore make sense in their own way. Furthermore, a constructivist epistemology understands knowledge as constructed by the learner in interaction with the social environment (whereas the behaviourist learning theory understands learning as the acquisition of facts and information in an incremental way). He therefore points out that if we think of knowledge as being external to the learner and the learning as being acquisition of this body of knowledge, then the task of the museum educator is to transmit knowledge to the learner (who is cognitively passive as the receiver of such knowledge). He therefore suggests that the role of the museum educator should be the facilitation of active learning through the handling of objects and through discussions linked to concrete experiences. In support of this, Durant (1992) asserts that collection-based view of science dwells on the practical aspect in the learning process.

3. How do these link?

Pertaining to "formal" education, the new curriculum 2005 whose philosophy is Outcomes-based education (OBE) and is encapsulated in social constructivism, the curriculum is no longer syllabus-orientated as was the case in the traditional paradigms. Instead, there are learning areas, which are grouped into themes, which allow for cross-curricula and integrated approaches to teaching and learning. Therefore, knowledge is no longer compartmentalized and put into discrete pigeon-holes. Emphasis is no longer on the content but on the outcomes, that is, what the learners can do. This curriculum is therefore intended to promote lifelong

learning, which is a process that continues throughout a person's entire life (Duggan, 1996: 68).

On the other hand, museum education has no specified curriculum, but deals with broader knowledge, and complementing school curriculum. This dynamic view of knowledge allows for cross-curricula and integrated teaching and learning. This is further enhanced by the availability of resources such as exhibits and collections, as well as human resources.

In the social constructivist curriculum, contextualisation of knowledge to the learners' everyday lives is promoted. Likewise, in museum education, for instance, science is made relevant to the learners' everyday lives through using the collections. Learners are able to see, touch and feel these collections.

Social constructivism and museum education has implications for the roles of teachers and museum educators as well as for learners. Both teachers and museum educators have their roles as facilitators rather than transmitters of knowledge. They therefore become providers of learning situations or environments. This demands that they have to think carefully which participative and interactive "hands-on" activities to plan for learners. There is a need for them to guide and to raise questions to arouse the learners' curiosity and enthusiasm. As facilitators teachers and museum educators become co-learners, and at times as "scaffolders" in the learning process. There is therefore a shift from teacher/educator-centred approaches to learner-centred approaches and the facilitation process is a two-way traffic. In both cases learners are perceived as being able to construct their own knowledge and thus their preconceived or prior knowledge is used as a starting point. Also learners are required to be actively involved in the learning process. Learners become responsible partners in documenting their learning, with creativity and self-reflection promoted.

A variety of teaching and learning strategies to enthuse the learners is propagated. For instance, social constructivism purports the use of cooperative teaching and learning strategies. Therefore, through group activities learners are encouraged to work collaboratively sharing knowledge and skills. Likewise, during museum education, through its object-orientated materials, learners are given opportunity to discover things on their own.

This they do individually or in the groups. During group work discussions are encouraged. Both the acquisition and development of skills is encouraged. Since the construction of knowledge is communicated through language, both in museum education and social constructivism language is regarded as pivotal.

Social constructivism purports gradualism when students learn, recognizing the different ways in which they learn. Teachers do not have to rush to finish the syllabus at the expense of the learners' understanding. The underlying factor is that emphasis is on quality (understanding) rather than on quantity. Similarly, in museum education, learners can revisit the exhibits as they wish, making sure that they understand the concepts. The focus of museum education is conceptual understanding. Learners can therefore learn at their own pace in a relaxed manner and without fear of being tested.

In both social constructivism and museum education, culture, attitudes and values are regarded as vital. Therefore, the different learning styles of learners and the language they speak are taken seriously. Attitudes towards the environment are enhanced through cross-curricula and integrated teaching and learning approaches as well as involvement in projects. Museum education also plays an important role in raising environmental awareness amongst learners.

Social constructivism purports the use of a variety of assessment strategies such as journals, portfolios etc. However, museum education has no formal assessment, but assessment strategies such as journals and portfolios can be utilized to track down the learners' personal development and growth. These strategies are useful in that the learners are holistically developed.

Conclusion

Clearly from the links drawn between social constructivism and museum education, these have been found not to be at two extreme ends, but rather are inextricably linked. The marriage between these two cannot be divorced. In the new education reform in South Africa, in order for museums to be successful in complementing and supplementing what is happening in the classrooms, there is a need for them to adopt the social constructivist perspective. Therefore, in both social constructivism and museum education, teacher and museum educator empowerment is crucial. Both teachers and museum educators are required to wear a new set of lenses. These educationists have a major role to play in this education dispensation and Prawat (1992) rightfully refers to them as agents of change.

In conclusion, for change to be effective and fruitful, both “formal” and “informal” education should be explored. Tobin et al. (1990) argues that teachers need to confront constraints and effect reforms to enhance student learning. The classroom environment should therefore promote focused learning through multifaceted teaching together with learning strategies. Furthermore, teachers need to explore certain situations, which shape what takes place in their classrooms (Nichols et al., 1997). Also, educationists need to carefully re-examine the ways in which prior experiences, social factors, and research conventions shape their conceptualization of effective teaching and learning (Driver et al., 1985).

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1. Introduction

Curriculum is perceived as central to the education process. Broadly defined, curriculum refers to teaching, learning activities and experiences provided, for example, by the school and other institutions such as science centres and museums. The kind of curriculum offered in schools is referred to as being “formal” whereas the kind of curriculum offered in institutions such as science centres and museums is referred to as being “informal”. These curricula are believed to be complementing one another, and both have implications for teachers and museum educators respectively.

Worth noting is that the apartheid curriculum policies mirrored the traditional approaches to teaching and learning. Teachers had therefore to follow a rigid, linear and prescriptive curriculum. Any deviation from such curriculum was perceived as defiance to authority. Furthermore, teachers had to master the subject matter. To be an authority on the subject meant to master the textbook from cover to cover, to provide the knowledge teachers were to dispense (Tilgner, 1990) without questioning any of the content contained in it. When I was at school we used to refer to these teachers who demonstrated to “know” the textbook, as “coughing” teachers. This expression meant that the teacher had memorized the textbook off by heart. We were, however, impressed with these teachers because they pretended to be authorities in their subjects, yet not.

Furthermore, teachers were seen to be authorities who were active “instructors” and transmitters of “absolute” knowledge. Emphasis was therefore on rote learning of facts and algorithms rather than conceptual understanding (Tobin et al., 1990). Learners together with the content were viewed as relatively fixed entities which were static and non-interactive (Prawat, 1992).

Learning was thus perceived as being successful if learners were able to regurgitate the knowledge or information transmitted by their teachers. These teacher-centred approaches resulted in compartmentalized knowledge, exam-orientated teaching. Furthermore, examinations acted as gatekeepers to the future and hence learners

competed for grades.

I remember when I was at school we used to spend most of the time writing notes (even mathematics notes) which we had to memorize in order to pass the examinations. There was very little learning taking place. Most traditional assessment indicators communicated very little about the quality of students' specific accomplishments. This is no exaggeration; I have experienced this process myself. This had serious repercussions for learners. Learners, who were regarded as intellectually immature, became passive recipients of the accumulated knowledge (behaviourist view) and this can be depressing to students.

In this vein, Bodner (1986) argues that the traditional paradigm is best characterized as a "transmission" approach to teaching and an "absorptionist" approach to learning. Furthermore, Bodner argues that the theory underpinning this perspective is based on the assumption that knowledge can be transferred intact from the mind of the teacher to the mind of the learner (regarded as an "empty vessel"). Bodner, therefore, brings to our attention that teaching and learning are not synonymous. Furthermore, he asserts that we can teach adequately without the students necessarily learning and I fully agree with him. However, Bodner does not clearly state how teaching and learning can be improved.

On the other hand, informal sectors such as museums emulated the positivistic and behaviouristic traditional approaches to teaching and learning. Museum educators relied on the exhibits designed by the curators as sources of knowledge. Learners had to learn the information provided on the exhibits in a parrot-like fashion. This was exacerbated by the fact that some museums employed teachers who were trained in the traditional methods. Also, emphasis was on general tours, especially when there was nothing to do in some schools, which resulted in museum visitation being intended for fun rather than learning.

However, some museums attempted to free themselves of the absolute rigidity of

following the exhibits by utilizing interactive exhibits and programs encouraging “hands-on” activities. But what has been lacking from these museums has been the evaluation and assessment of its programs; that is, how could they ensure that learning was taking place? In view of this, Duggan (1996: 69) suggests that the museum’s vision should encompass a broad understanding of museum education which includes events or activities which can be planned and organized with clearly defined teaching and learning objectives.

In South Africa today, the education system is currently undergoing a paradigm shift (using Kuhnian language). This shift is from the traditional approaches to teaching and learning to the new curriculum 2005. The traditional epistemological paradigm is now being turned upside down and the transformation is from content-based (subject) education to skills-based (outcome) education. This results in a move from teacher-centred to learner-centred approaches with an emphasis on outcomes rather than on objectives. An outcome is perceived as proof that learning has taken place. Therefore the emphasis is on what a learner can do. This new curriculum is referred to as “outcomes based education” (OBE). The theory, which underpins this new curriculum, is social constructivism. This perspective is intended to make teaching and learning more interesting, enjoyable, challenging and meaningful. Also the move away from behaviourist and content-based curricula towards constructivist, contextualised and process-based curricula has opened the door¹ for cultural considerations in development of curricula (Kuiper, 1998: 11).

Regarding teachers and other educators, the focus is on the change from being the dispenser of knowledge towards being providers of learning situations. This however requires educationists (both in formal and informal sectors) to revisit their teaching and learning strategies which emphasize rote-learning, to more interactive methods which encourage active participation by learners. The constructivist movement therefore acknowledges that learners come into the classroom with their own content-based understanding and learning needs to be contextualised within the learners’ familiar environment in order to effectively deal with the learners’ ideas.

The focus of this paper is on social constructivism and museum education. Earlier on it was mentioned that museum education is intended to complement what is happening in the classrooms. Given the range of teaching and learning strategies employed in museums, it will be investigated if its education fits into the new curriculum 2005.

2. Literature Review

2.1 The Social Constructivist Perspective

Constructivism favours a more interactive and dynamic approach to curriculum and thus the curriculum should not be viewed as a road map (Prawat, 1992) with content presented as a finished product. This requires improvisation of learning materials (Kuiper, 1997) and the educational reform emphasizes the importance of logistic support for material centred learning (Tobin et al. 1990). Furthermore, Urevbu (1984) suggests that curricula methodologies and teaching materials should be drawn from the life of the community and from the environment.

In the constructivist teaching and learning scenarios, the traditional telling-listening ("chalk and talk") relationship between the teacher and the learner is replaced by one that is complex and interactive (Prawat, 1992). Commitment to learner-centred education means putting learners first, recognizing and building on their knowledge, skills, abilities and experience, responding to their needs and taking into account the different ways in which they learn. With emphasis on the learner, we see that learning is an active process occurring within and influenced by the learner as much as the facilitator (Yager, 1991).

From this perspective, learning outcomes (which are perceived as a demonstration that learning has taken place) are important rather than objectives, and outcomes do not depend on what the teacher presents.

Furthermore, the constructivist perspective purports that knowledge is constructed in the mind of the learner (Bodner, 1986), that is, the learner is capable of making meaning of what knowledge is. Therefore, learners construct understanding and they do not simply mirror and reflect what they are told by the teacher or what they read. Learners come into the classroom with their own context-based understanding of many concepts and skills (Kuiper, 1998). Hence, learning needs to be contextualised with the learners' familiar environment in order to effectively deal with learners' ideas. Kuiper (1997) warns however that for young children it is useful to first elicit their ideas and then challenge these in concrete situations.

Also the learners' prior or preconceived knowledge base is pivotal (Beiers and McRobbie, 1992; Solomon, 1994; Kuiper, 1997) and should be used as a starting point (Clough and Clark, 1994). Kuiper points out that the learners' ideas should not be considered "wrong" when compared with the accepted views of science, but only different. Furthermore, Driver et al. (1985) argue that knowledge of students' ideas enables teachers to choose teaching and learning activities which are likely to be interpreted by students in the way intended; thus teaching becomes better adapted to the students. These activities can be undertaken in groups so that learners are accorded the opportunity of sharing knowledge and ideas.

Furthermore, in this perspective, teachers are viewed as creators of learning situations or environment, as individuals who are expected to "construct" their practice based on a vision of what it means to teach for understanding (Prawat, 1996). This means that there is a shift from the transmission of scientific content to the development of understanding of science concepts, with science learned in a contextualized way (Matthews, 1992; Kuiper, 1998). This shift requires a two-directional flow of information between the teacher and the learner. Through the dialectical interaction, teachers will also be able to reflect on their actions and

practices, hence learn to vary their teaching and learning strategies to suit learners' needs. In the process the teacher acts as a facilitator, a co-learner and a "scaffolder". Therefore, the teacher, with a dynamic view of subject matter, i.e., recognizing that knowledge, is dynamic not static, departs from the teacher-centred scenarios emphasizing instead the importance of student reasoning (Prawat, 1992) and encouraging problem-solving skills.

According to this perspective, all learning is an active process of constructing meaning (Clough and Clark, 1994). The learners thus internalize their experience (Driver et al., 1985; Driver et al., 1996). Learners thus apply knowledge rather than recite it (Kuiper, 1997) and are encouraged to recognize the science that surrounds them and develop understanding of key concepts, principles and models. Thus, relevant science can be perceived as learning science in the context of the learners' environment, making it more to their experience in their communities (Smit, 1998). However this requires restructuring of the curriculum. Beiers and McRobbie (1992) point out that learners' prior knowledge, which they bring to the learning situation, is crucial.

According to Yager (1991), rote learning and repeated practices are not likely to generate real understanding and useful knowledge. In this vein, Gergen (1985) argues that the social constructivism inquiry is principally concerned with explicating the process by which people describe, explain or account for the world in which they live. Social constructivism therefore affords the opportunity to construct knowledge through processes which are socially, culturally and politically based (Kuiper, 1998: 12). Furthermore, this perspective opens the door to different perspectives, experiences and values, allowing learners to construct a culturally and personally meaningful understanding of science. Also understanding is negotiated rather than imposed.

This perspective employs language to achieve its goals. Therefore, demonstrating respect for the learners' language, culture and personal circumstance is crucial in social constructivism. This is crucial since society and culture influences science.

Science therefore is seen as a social activity laden with values and beliefs (Aikenhead, 1997). Both teachers and students with a social constructivist perspective can therefore evaluate scientific knowledge claims in a socio-cultural context (Atwater, 1996). Furthermore, multicultural science education continues to be influenced by class, culture, ethnicity, gender and different lifestyles. It is therefore necessary to begin to understand how these influence the teaching and learning of science. In addition to this, during teaching and learning scenarios, a sense of value and ownership needs to be encouraged with ethical issues considered and putting learners at the centre of things (Doyle and Mallett, 1994).

Sprod (1997) argues that social construction of knowledge encourages discussion in the classroom. Social constructivism is therefore concerned with the contributions of social interactions and learning is perceived as a social act more akin to socialization than instruction (Ritchie, 1998). Students therefore need to be encouraged to engage in group discussions (Solomon, 1994; Prawat, 1996; Sprod, 1997). In student-student interactions, meaningful conversation is important if learning is going to take place in student groups (Yager, 1991; Atwater, 1996).

Furthermore, in this perspective, knowledge is not something that people possess somewhere in their heads but rather something people do together (Gergen, 1985; Yager, 1991; Prawat, 1996; Ritchie, 1998). Furthermore, students are accorded the opportunity of sharing ideas and collaborative learning involves activities such as small groups negotiating the meaning of a problem (Doyle and Mallett, 1994; Tippins et al., 1995). When negotiating meaning, learners explain, clarify, elaborate, question, evaluate and argue (Etchberger and Shaw, 1994). Also through discussions, students are accorded an opportunity to share ideas in a mutually supportive way.

However, Sprod (1997) points out some institutional curbs such as curriculum pressures, assessment techniques, lack of teacher expertise and lack of consideration of theories for the classroom complexities. For instance, since the focus of classroom activities shifts from the teacher to the learner-centred approach, "hands-on" practical activities are vital and these require materials and thorough planning.

According to Atwater (1996), communication is perceived as a central theme in social constructivism. Learning is dependent on language and communication (Yager, 1991). The communication discussed in this perspective should be a two-way process which requires engagement of learners in the learning process. Language therefore, is perceived as vital in social constructivism and is a central theme in multicultural education (Atwater, 1996). Vygotsky's theory (1986) sees social interactions as a vehicle for learning and therefore, learners are able to solve problems cooperatively (Penlington and Stoker, 1998).

Furthermore, Atwater (1996) argues that socialization in any cultural setting not only teaches a child what language to speak and what non-verbal communication behaviours are appropriate, but also how to learn. Therefore, central to social constructivism is social interactions with language being a fundamental concern. Multiculturalism plays an important role in education since it has to do with teaching and learning strategies, gender issues, language etc and not necessarily different cultures as this is a misconception by many (Latragna 1998 pers. comm.). Cooperative learning, where learners get an opportunity to work in groups, is pivotal. This is seen as an ideal vehicle through which construction of knowledge takes place. This is important since the process of understanding is the result of an active, cooperative enterprise of persons in relationship (Gergen, 1985).

In the social constructivism perspective, the teacher's role has to change from that of the disseminator or transmitter of knowledge to that of a facilitator (Atwater, 1996) and also toward a provider of situations and information. Teachers therefore need to think of the curriculum as a matrix or network of big ideas (Ritchie, 1998). Tobin et al. (1990) points out the importance of how teachers set up classroom activities to facilitate learning and they need to work alongside students to help them explore and make sense of the network of ideas within and across disciplines of science. Furthermore, through interaction with peers and students, teachers construct beliefs

about the nature of knowledge, how students learn and what strategies may best be applied in a given teaching and learning environment.

On the other hand, students move from a receiver of knowledge to a gatherer, processor and constructor of knowledge (Etchberger and Shaw, 1992; Bodner, 1986). In this perspective, teaching and learning strategies require the active participation of students and encourage them to assume a greater responsibility for their own learning (Ritchie, 1998). Knowledge is not constructed passively and hence constructivist science teachers promote group learning (Yager, 1991). Matthews (1992) argues that social constructivism places stress on learner engagement in learning, stressing dialogue, conversation and arguments. Which means that learners are no longer passive recipients of knowledge as was the case in the traditional approaches. Learners are encouraged to construct and deconstruct knowledge, which is a two-way mediation process between the teacher and students. Learners become involved in the production rather than reproduction of knowledge. In particular, the constructivist perspective aims at the autonomy of the learner with emphasis on understanding.

As far as the multiculturalism perspective is concerned, Atwater (1996) argues that the classroom should provide a varied contextualisation of science appropriate to the variety of daily-life experience of learners. This is theoretically supported by the social constructivist interpretation of learning.

It should be borne in mind that learners are not repositories for adult knowledge, but are organisms which are constantly trying to make sense of and to understand their experiences (Etchberger and Shaw, 1994). Literature review has revealed that active students learn more than passive ones (Bodner, 1986) and the intellectual involvement of participants increases with "hands-on" involvement. Learners therefore develop positive attitudes towards science and learning science becomes an enjoyable experience (Beiers and McRobbie, 1992). Through interaction with students and teachers, science knowledge is expanded (Atwater, 1996). Students' cultural realities, including concepts of self and social roles, are constructed through social interactions. Furthermore, Mayoh and Knutton (1997) argue that science educators should pay greater attention

to the potential interactions between “formal” and “informal” science learning.

Assessment is the major tenant of social constructivism. In this perspective, learning, teaching and assessment are inextricably linked. Without learning assessment has relatively little value, and without assessment, the effectiveness of learning and the accountability of teaching cannot be determined. Learning therefore requires effort and assessment of such effort. However, the way we teach inevitably determines the way we assess our students. With the variety of assessment strategies propagated in the new curriculum 2005, emphasis is on understanding and the ability to apply knowledge and skills. Development of problem-solving skills is encouraged rather than memorizing a given quantity of science information. Emphasis is also on practical skills, learners’ attitudes and values.

2.2 Museum Education

Education is perceived as the integral function of museums (Holleman, 1987; Bloom, 1992) and the kind of education that takes place in a museum is often referred to as “informal” (Bloom, 1992; Studart, 1991; Finson and Enochs, 1997). In an “informal” education setting, learners can follow their own interests and their knowledge is not “formally” assessed. Furthermore, in this context, learning fundamentally includes the ideas of personal growth, lifelong development and the broadening of the vision of the world (Studart, 1991). However, both Holleman and Bloom suggest that it is important to investigate how learners learn in a museum. In support of this view, Tishman (1997) suggests that museum educators need to have a sound conception of what learning is, that is, how it happens and how it can be helped to happen.

Furthermore, Hall (1991) sees museums as being perfectly poised to build bridges of understanding, awareness and appreciation by providing flesh to education by means of curriculum extension. Therefore, she asserts that museum activities are intended to complement and supplement what is happening in the classrooms. Worth noting is that museum education has no specified curriculum, but deals with a broader knowledge. Furthermore, the uniqueness and strength of museum experiences lie in the direct

encounter with real objects, for instance learning by using the museum's collections and exhibits. Also all ages are accommodated. One can conclude that museum education has the potential for cross-curricula and integrated teaching and learning. But does this really happen in museums?

Russell (1994) argues that the way that a museum is organized carries implicit assumptions about the manner in which visitors (learners) learn. He points out that the ancestral style of museums reflect a *positivistic* (my italics) view of the world. The learning environment in this case is driven by the museum educator's or curator's view of the structure of the subject as contrasted with the need of the learner. In this *behaviourist* (my italics) view, content dictates what is to be learned (Hein, 1995; Studart, 1997). Therefore, the museum educator or curator is seen as an active instructor and the transmitter of knowledge that cannot be challenged.

Hein (1995) further points out that in such museums, it is common for exhibits to present material in a single orderly manner deemed by the exhibit designers to be best suited for visitors (learners). In such cases, the museum educator takes a more didactic stance, informed by a more positivistic epistemology. In some cases, this is exacerbated by the fact that some museums employ teachers from schools who have been trained in traditional methods.

Hooper-Greenhill (1997) lends support to this argument, pointing out that a positivist epistemology understands knowledge as external to the learner. Furthermore, he argues that the behaviourist learning theory understands learning as the acquisition of facts and information in an incremental way. A positivistic view of knowledge as objective, external and transmissible, with the educator as the knower and the learner as passive and uninformed prevailed. Learning consisted of accumulation of facts and information provided by the exhibits.

Furthermore, a realist and positivistic epistemology and behaviourist learning theory

underpin the transmission model. The transmission model can be applied to the process of exhibition production in museums; where an exhibition originator, frequently a curator, working on their own, selects the objects and writes the text, and then passes all this fixed unity to the designer, later the educator is expected to find ways of making the exhibition relevant to visitors. At no stage is the target audience considered or planned for; it is the exhibition for the general public (Hooper-Greenhill, 1997: 2).

In view of this, Hein (1995) argues that our beliefs about the nature of knowledge, our epistemology profoundly influences our approach to education. Peterman (1997) points out that our beliefs and practices are sometimes resistant to change; yet there is a need for educators to abandon traditional textbook-driven curricula, and utilize object-based museum artifacts. For instance, Russell (1994) argues that the view of science is about understanding objects and phenomena.

However, in recent years the museum world has begun to accept that visitors (learners) can be seen as individuals with their own particular needs, preferred learning styles, social and cultural agendas (Hooper-Greenhill, 1997: 1). Therefore visitors are conceptualized as active in the construction of their own knowledge. This shift from positivism and behaviourism can be seen as a process. Some museums have attempted to free themselves of this absolute rigidity to teaching and learning by employing good interactive exhibits designed so that visitors can experience and explore real phenomena (Feher, 1993: 242). Hein (1995) points out that constructivist museum exhibits can allow learners to make their own connections with the material world; with the focus on the learner and not on the material to be learned.

Object-based learning is therefore a term used by museologists to describe inductive learning approach to museum artifacts and as such object-orientated learning may be viewed as an aspect of discovery learning. It is believed that this might invigorate teaching and learning (Peterman, 1997: 4). In view of this, Kannemeyer (1987) argues that there is no justification for museums to adhere to the traditional "chalk and talk" methods of learning. Furthermore, learners should not be expected to receive, memorize and repeat information in a parrot-like fashion. Museum education needs to be learner-

centred. This means that “putting learners first, recognizing and building on their knowledge, skills, abilities and experience, responding to their needs, taking into account the different ways in which they learn and demonstrating respect for their language and culture” (Duggan, 1996: 68). It is therefore the task of the museum educator to be a facilitator who guides but does not direct. She or he should be more concerned to raise questions than to provide tailor-made answers and through discussions linked to concrete experiences.

Hooper-Greenhill (1997) further suggests that social and cultural contexts for learning need to be taken into consideration. As a result of the influences of the theoretical views of the role of experience and social context of museums on the learners’ learning, the prevalent approach adopted by learner-orientated museum exhibitions is participative and interactive in nature (Studart, 1991). The main purpose of such exhibitions is to stimulate curiosity and to encourage exploration and social interactions amongst learners. Also through the museum artifacts, learners get an opportunity to make connections with concepts and objects (Hein, 1995). Furthermore, children’s galleries offer a novel, unthreatening and relaxed environment for children to interact and share learning experiences.

Feher (1993) argues that there is a need for museum educators to acknowledge that learners bring with them preconceived ideas about the way the world functions. Learners will bring with them their own theories about how things happen. Therefore, the job of the museum educator should be to engage, to make contact with existing ideas in order to further the development of understanding and awareness. Worth noting is that the learners’ ideas are sometimes in direct contrast with accepted scientific views. Also, the pre-existing ideas strongly influence how learners learn.

Preconceptions play a decisive role in the way visitors (learners) perceive and interpret the exhibits. Therefore, the task of exhibits should be to help learners reorganize their ideas and construct new understandings. Furthermore, Falk and Dierking (1997) argue that the ability to learn is strongly dependent upon the ability of an individual to frame prior experiences within the context of the physical environment.

Given the paradigm shift in our education system in South Africa, museums need to address both what is to be learned and how it is to be learned (Russell, 1994; Duggan, 1996). Russell (1994) suggests that museum education should be concerned with engaging learners in actively exploring ideas (rather than passively receiving them). He points out that a constructivist view emphasizes the active and imaginative dimensions of learning and discovery.

Furthermore, the proponents of constructivism argue that learners construct knowledge as they learn, they do not simply add new facts to what is known (Hein, 1995). Russell (1994) asserts that children prefer interactive exhibits, which offer opportunities for whole body movement. In "hands-on" learning experiences, although understanding is physically and perceptually supported by material experience, Russell warns that "hands-on" is not an end in itself, but a means to an end. The very expression "hands-on" is tangible recognition of the power and importance of "concrete operational" learning, that is, learning in which understanding is physically and perceptually supported by material experiences. However, an invitation to manipulate materials should therefore engage thinking since the common goal of museum education learning is conceptual understanding.

Since learning is culturally mediated, using language to communicate understanding and to share meanings can be a powerful means of supporting new learning (Russell, 1994). Interactive exhibits can do this by affording visitors a personal experience with phenomena. However, Feher (1993) suggests that a network of exhibits is needed which enables visitors to make more and better connections among related concepts and experiences. Exhibits must interrelate and dovetail, presenting a topic in multiple forms, allowing the visitors' experiences to be extended and their ideas to be confronted, challenged and reinforced.

According to Studart (1997), museums have an unprecedented opportunity to create physical settings that can enhance learning. Immersing the learner within a context that enables him or her to see how things are connected, to understand visually, aurally and even through smell and touch what something looks like, is a tremendous educational tool. The essence of the museum experience is therefore the ability of an individual to see real things, and within real and meaningful physical contexts. In this vein, Hein (1995) argues that constructivist museum exhibits have no fixed entry and exit points, but allow the visitor to make his or her own connections with the material and encourage diverse ways of learning.

In view of this argument, Duggan (1996) suggests that museum education policies and outreach programs need to be consistent with the current changes in the education system, which purport life-long learning as a process. The challenge therefore requires museums to move beyond the narrow focus of the material world. Will (1992) suggests that museums should not only be concerned with mastering content (knowledge), but also concerned with understanding and a change of attitude towards the subject being taught. He further argues that through presenting "real objects" and putting these into context, a learner is allowed

to enter the world where these objects are used. In support of this, Bloom (1992) argues that a museum visit can inspire visitors to ask questions and to pursue newfound interests on their own.

Hooper-Greenhill (1997) therefore suggests that learners in a museum should be seen, as individuals with their own particular needs, preferred learning styles and social and cultural agendas. They therefore make sense in their own way. Furthermore, a constructivist epistemology understands knowledge as constructed by the learner in interaction with the social environment (whereas the behaviourist learning theory understands learning as the acquisition of facts and information in an incremental way). He therefore points out that if we think of knowledge as being external to the learner and the learning as being acquisition of this body of knowledge, then the task of the museum educator is to transmit knowledge to the learner (who is cognitively passive as the receiver of such knowledge). He therefore suggests that the role of the museum educator should be the facilitation of active learning through the handling of

objects and through discussions linked to concrete experiences. In support of this, Durant (1992) asserts that collection-based view of science dwells on the practical aspect in the learning process.

3. How do these link?

Pertaining to “formal” education, the new curriculum 2005 whose philosophy is Outcomes-based education (OBE) and is encapsulated in social constructivism, the curriculum is no longer syllabus-orientated as was the case in the traditional paradigms. Instead, there are learning areas, which are grouped into themes, which allow for cross-curricula and integrated approaches to teaching and learning. Therefore, knowledge is no longer compartmentalized and put into discrete pigeon-holes. Emphasis is no longer on the content but on the outcomes, that is, what the learners can do. This curriculum is therefore intended to promote lifelong learning, which is a process that continues throughout a person’s entire life (Duggan, 1996: 68).

On the other hand, museum education has no specified curriculum, but deals with broader knowledge, and complementing school curriculum. This dynamic view of knowledge allows for cross-curricula and integrated teaching and learning. This is further enhanced by the availability of resources such as exhibits and collections, as well as human resources.

In the social constructivist curriculum, contextualisation of knowledge to the learners’ everyday lives is promoted. Likewise, in museum education, for instance, science is made relevant to the learners’ everyday lives through using the collections. Learners are able to see, touch and feel these collections.

Social constructivism and museum education has implications for the roles of teachers and museum educators as well as for learners. Both teachers and museum educators have their roles as facilitators rather than transmitters of knowledge. They therefore become providers of learning situations or environments. This demands that they have to think carefully which participative and interactive “hands-on” activities to plan for

learners. There is a need for them to guide and to raise questions to arouse the learners' curiosity and enthusiasm. As facilitators teachers and museum educators become co-learners, and at times as "scaffolders" in the learning process. There is therefore a shift from teacher/educator-centred approaches to learner-centred approaches and the facilitation process is a two-way traffic. In both cases learners are perceived as being able to construct their own knowledge and thus their preconceived or prior knowledge is used as a starting point. Also learners are required to be actively involved in the learning process. Learners become responsible partners in documenting their learning, with creativity and self-reflection promoted.

A variety of teaching and learning strategies to enthuse the learners is propagated. For instance, social constructivism purports the use of cooperative teaching and learning strategies. Therefore, through group activities learners are encouraged to work collaboratively sharing knowledge and skills. Likewise, during museum education, through its object-orientated materials, learners are given opportunity to discover things on their own. This they do individually or in the groups. During group work discussions are encouraged. Both the acquisition and development of skills is encouraged. Since the construction of knowledge is communicated through language, both in museum education and social constructivism language is regarded as pivotal.

Social constructivism purports gradualism when students learn, recognizing the different ways in which they learn. Teachers do not have to rush to finish the syllabus at the expense of the learners' understanding. The underlying factor is that emphasis is on quality (understanding) rather than on quantity. Similarly, in museum education, learners can revisit the exhibits as they wish, making sure that they understand the concepts. The focus of museum education is conceptual understanding. Learners can therefore learn at their own pace in a relaxed manner and without fear of being tested.

In both social constructivism and museum education, culture, attitudes and values are regarded as vital. Therefore, the different learning styles of learners and the language they speak are taken seriously. Attitudes towards the environment are enhanced through cross-curricula and integrated teaching and learning approaches as well as

involvement in projects. Museum education also plays an important role in raising environmental awareness amongst learners.

Social constructivism purports the use of a variety of assessment strategies such as journals, portfolios etc. However, museum education has no formal assessment, but assessment strategies such as journals and portfolios can be utilized to track down the learners' personal development and growth. These strategies are useful in that the learners are holistically developed.

4. Conclusion

Clearly from the links drawn between social constructivism and museum education, these have been found not to be at two extreme ends, but rather are inextricably linked. The marriage between these two cannot be divorced. In the new education reform in South Africa, in order for museums to be successful in complementing and supplementing what is happening in the classrooms, there is a need for them to adopt the social constructivist perspective. Therefore, in both social constructivism and museum education, teacher and museum educator empowerment is crucial. Both teachers and museum educators are required to wear a new set of lenses. These educationists have a major role to play in this education dispensation and Prawat (1992) rightfully refers to them as agents of change.

In conclusion, for change to be effective and fruitful, both "formal" and "informal" education should be explored. Tobin et al. (1990) argues that teachers need to confront constraints and effect reforms to enhance student learning. The classroom environment

should therefore promote focused learning through multifaceted teaching together with learning strategies. Furthermore, teachers need to explore certain situations, which shape what takes place in their classrooms (Nichols et al., 1997). Also, educationists need to carefully re-examine the ways in which prior experiences, social factors, and research conventions shape their conceptualization of effective teaching and learning (Driver et al., 1985).

5. References

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