"You learn by doing." (S1002, instrument 2)

Only one student (S1001) was consistent in her responses.

> "We don't do it ourselves. Some students do but, mostly the teacher does it. The teacher asks someone else to help her." (S1001, interview)

> "At school our teachers do many experiments with us. We particularly do many experiments in chemistry to help us understand our work better and to see what happens, not only read about it." (S1001, instrument 2)

Probably the instructions were not explicit enough, so these students did not know what was expected of them. The expectation was for the students to say whether they did practical work at their school and state how it was done (whether teacher demonstrations, group or individual activities).

When comparing Sefika high school students' responses to the interview and instrument 2 it was difficult to find any consistency in the responses in terms of how practical activities were done, except when they mentioned the issue of a lack of apparatus.

> "We are not familiar with practical work because of lack of apparatus....." (S2005, interview)

> "At my school we are not very familiar with practical work because of lack of apparatus........" (S2005, instrument 2)

What one can conclude is that there was little practical work done at this school.

Abdool Moosa high school students showed some consistency in their responses. On both the interview and instrument 2 they mentioned the fact that practical activities were demonstrated by the teacher.

> ".........We have done practicals but not us as pupils, our teachers have done practicals...the experiments for us." (S30031, interview)

> "Up to matric level all experiments were carried out by teachers." (S30031, instrument 2)

Students at Matsieng gave consistent responses. According to their account on the second part of the interview and instrument 2, they did not do practical work because of a lack of apparatus.

> "Ah...we don't usually do practical work, we don't have equipment." (S4005, interview)

> "Mostly it depends on the teacher who is teaching that subject. We didn't do much in chemistry. Our problem was that we didn't have much apparatus so far." (S4005 instrument 2)

The issue of science laboratory micro-scale equipment and biology practical activities comes out again in this table (Table B) and has already been addressed in section 5.3.
Instrument 2 was therefore, not found valid.

The last instrument to be validated is instrument 3.

5.3.2 Validating instrument 3

The same procedure as in section 5.3.1 is used to validate instrument 3, that is bringing together responses from instrument 1 and 3 from the 98 students who participated in the study. Table B (see Appendix B) displays students' responses to the 2 instruments mentioned.

Again, most of the students coded with book familiarity in instrument 1 were coded with teacher demonstrations in instrument 3 which further confirms the relationship between book familiarity (1B) and teacher demonstrations (2A). The interesting thing about the responses is that students did not leave blanks as they did with instrument 1. In this instrument the respondents only had to tick, for them it was an easy task to do. This strengthens the argument of unwillingness to work on instrument 1 on the part of some of the respondents because it was more demanding than instrument 3. Instrument 3 was testing passive knowledge as students merely had to recognise names of equipment rather than recall uses.

The next step is to establish how valid is this instrument (instruments 3) by looking at frequency of the consistent combinations in relation to instrument 1.

Below is a table of all the combinations obtained from instrument 1 and 3. The combinations in bold are the ones that are considered consistent.

Table 5.3 Combination of codes obtained from instrument 1 and 3

Combinations		**Frequency**
Specific remembered experience (instrument 1)	**Passive experience (instrument 3)**	
1A	**1B**	**3**
1A	2A	11
1A	2	3
1A	3	3
1B	**1B**	**8**
1B	**2A**	**35**
1B	2	6
B	3	9
2	**2A**	**4**
2	**2**	**1**
2	**3**	**10**
3	2A	1
3	**3**	**4**

A careful look at table 5.3 shows a common trend with the combinations, except for two sets of combinations. In all the other combinations, the codes in the second column are higher than in the first column. This is exactly the same situation as in table 5.2 Possible reasons for the lower codes in first column (instrument 1) have already been mentioned in section 5.3.1. In both columns (for instrument 1 and 3) are codes showing students' specific practical experience. One should remember that instrument 3 was testing passive knowledge. Students had a simple task to do, that of just ticking. Probably that is why they did not leave blanks. As a result they obtained higher codes than with instrument 1, may be for same the reason that it (instrument 1) was more demanding than instrument 3.

A closer look at the all the combinations (see Appendix B table B) shows that over 51 students had code 2A (teacher demonstration). What is interesting with Matsieng high schools students is that instead of only two students claiming teacher demonstrations, as it was the case in section 5.3.1, six of them now had code 2A. This show some inconsistency in their responses. Maybe the format of the instrument somehow influenced students' responses. It should be remembered that in instrument 3 students had to just tick. It is possible that students just ticked without giving it a thought or may be they did give it a thought but decided to exaggerate.

What the researcher is trying to establish here is the reliability of some of the students' responses to instrument 3 and the combinations that result out of this. Just like with instiument 2, combinations like (1A, 2A), (1B, 2) and (1B, 3) (see table 5.3) one could argue that they could as well be (1B, 2A for reasons pointed out above. Also, the interview responses (both teacher and student) reveal that most students had more teacher demonstrations than group or individual activities.

5.4 Concluding remarks

This chapter discussed data presented in chapter 4. The main task in this chapter was to validate the primary instrument (instrument 1) which, in turn, was used in validating the other two instruments (instrument 2 and 3). Validation of these instruments is the core of this study.

Instrument 1, with the help of data obtained from teacher and student interview sessions, was found to be valid though it could only identify everyday familiarity, book familiarity, some laboratory familiarity, and good laboratory familiarity, and not teacher demonstrations. Students' interview responses were match against teachers' and some consistency was established (see table 5.1).

Instruments 2 and 3 were found not to be good match to instrument 1. Hence they were not found valid. The fact that the percentage of consistent combinations in both cases was relatively low deemed the two instruments not valid (see tables 5.2 and 5.3). Furthermore, for instrument 2, data from second part of the interview session (on perceived experience) was compared with one from instrument 2 (on perceived experience as well) and little consistency was established there.

One may argue that instrument 2 was measuring something different from the other two instruments. Instrument 2 measured perceived practical experience of the students, while the other two instruments (instrument 1 and 3) looked at remembered and passive practical experience, respectively. A match between the three instruments was supposed to have been established if there was consistency in the students' responses to all the instruments.

Students may have exaggerated about their practical experience (perceived experience). Probably this is why codes obtained from instrument 2 were higher than those in instrument 1. Another factor that could have contributed is that students may not have been clear what was expected of them when giving an account of their practical experience in instrument 2. Hence the inconsistency in their responses.

As for instrument 3, anybody could have placed a tick wherever they liked without giving it a thought, or may be they did give it a thought but, decided to exaggerate. Again for reasons mentioned above, they could as well give a false impression of the real situation in as far as their practical experience is concerned.

On the other hand, with instrument 1 it was rather difficult for the students to write anything to impress or give a false impression. With instrument 1 students had to give names of the apparatus, say whether they have used them, and give their uses. So this did not allow for cheating and guess work from the students. It was either you knew the piece of apparatus and its use, or you didn't. Instrument 1 was more demanding than the other two instrument.

The next chapter will summarise all the data, present some findings in this study as well as giving recommendations.

CHAPTER 6

SUMMARY, CONCLUSION AND RECOMMENDATIONS

6.1 Introduction

This chapter begins with a brief summary of the whole study, including research questions and comments, how the study was carried out, and its findings. The findings and conclusions resulting from this study will also be discussed. Limitations of the study and recommendations will also be looked into.

6.2 Summary of the study

Four schools participated in the study, with a total of 98 students and 8 physical science teachers also involved. To capture a variety of experience across the diverse schools in South Africa, schools were selected from three different historical communities, White, Indian and Black. The purpose of this study was to validate instruments (three instruments) used to establish chemistry practical experience of high school students. This was achieved by means of both teacher and student interview sessions. Instrument 1(the primary instrument) was validated using responses from the interview sessions, and in turn, instrument 1 attempted to validate the other two instruments. This study was guided by research questions cited below.

6.3 Research questions and comments

Basically there are two research questions, with question (A) having two sub-questions and question (B) none. Question A and its sub-questions will be answered together. Below are the research questions followed by answers.

A. How valid are existing instruments in determining learners' high school chemistry practical experience?

(i) To what extent does the information obtained from these instruments tally with their actual experience?

(ii) How well do the various instruments agree with each other with regard to high school chemistry students' practical experience?

B. How do these instruments discriminate between the different practical experiences that high school chemistry students might have?

6.3.1 Findings

Question A: How valid are existing instruments in determining learners' high school chemistry practical experience?

Instrument 1 measured students' specific practical experience and could only account for everyday familiarity, book familiarity, some laboratory familiarity, and good laboratory familiarity, but could not identify teacher demonstrations. Subsequent to responses to instrument 1 and during the interviews it was discovered that instrument 1 did not pick up teacher demonstrations.

Specific practical experience was measured through students' ability to describe the functions of common pieces of apparatus they have actually used themselves in school practical work. The validity of instrument 1 was suspect because it could not pick up teacher demonstrations. A data gathering instrument ought to measure what it is supposed to measure (Sanders and Banda, 1997) in this case practical experience. Also, data collected may be distorted, and construct validity affected (Lubben, 2000). Cohen and Manion (1994:p.233) argue that exclusive reliance on one method "may bias or distort the researcher's picture of the particular slice of reality a researcher is investigating. Hence interview sessions were used to validate instrument 1.

An overall picture of the sample drawn by instrument 1 was that students had book familiarity. However, interview responses indicated the prevalence of teacher demonstrations where instrument 1 indicated book knowledge. It would then imply that what instrument 1 identified as book familiarity was actually teacher demonstrations. These relationship was established from both student and teacher interview responses. Although instrument 1 could not identify teacher demonstrations, on comparing data obtained from the first part of the student interview sessions (16 students) with data (same 16 students) from instrument 1 consistency was observed. Within the limits instrument 1 was found to be valid.

Instrument 2 measured students' general practical experience, and was indicated by their views about the nature of their practical experience. Respondent's views can be biased some times and this is crucial in as far as validity is concerned, as reliability of responses is a prerequisite for validity (Sanders and Banda, 1997). Students' views about their practical experiences, for some reasons, may portray a different picture of the real situation. As a result, construct validity will be affected by student responses giving a wrong impression rather than the actual situation (Lubben *et al.*, 2000).

The way instrument 2 is structured can be confusing to some respondents , hence influencing the validity of the data collected (Lubben *et al.*, 2000). For example, the use of phrases like: a few experiments, many experiments can be interpreted differently by respondents. The question is, how many experiments will be considered to be 'a few' or 'many'? Vague instructions like these ones affect criterion validity because respondents will differ very much in their responses.

Instrument 2 was therefore, found not to be a good match to instrument 1. Some discrepancies were observed when comparing data from the two instruments (instrument 1 and 2) indicating some inconsistency in students' responses to instrument 2.

Instrument 3 measured students' passive experience where they (students) had to place a tick in an appropriate space. One weakness, with this instrument, that can be pointed out is that anybody can respond to it without having practical experience. In this case validity is compromised.

Instrument 3, as well, was found not to be a good match to instrument 1. Again codes obtained from instrument 3 were higher than those in instrument 1 indicating inconsistency.

During student interviews students mentioned that most of the practical activities that were taking place at their schools were done by teachers. In other words, they were exposed to more teacher demonstrations than group or individual activities. The only exception to this was Matsieng high school where students did very few practical activities and had to rely on their text books. In an interview session S40011 from Matsieng high school said the following about practical work at this school, "We don't do it. We just talk about experiments. No practical work at all."

Teachers in their interview sessions, also mentioned that at their schools there were more teacher demonstrations than group or individual activities. According to the teachers this was because of a lack of apparatus, as TA2 (a teacher from Abdool Moosa high school) asserts, "Yes they did [practical work] but it was demonstration because we don't have enough apparatus.....".

Instrument 1, as already mentioned could not detect teacher demonstrations. As a result it could not explicitly show whether a student with code 1B was actually exposed to teacher demonstrations as this was observed in the interviews and instrument 2.

Instrument 2 could not give a true reflection of the students' actual experience because students where not consistent in their response. Another thing, it could not pick up students' everyday familiarity.

As for instrument 3 higher codes were obtained in all the cases as compared to those obtained in instrument 1, though it showed students having more of teacher demonstrations, which is exactly what was obtained from interview responses. Instrument 3 could not give a true reflection of the students' actual practical experience as inconsistencies were observed when comparing data from this instrument and instrument 1 which led to a relatively low percentage of consistent combinations as well.

An overall account on the three instruments (and the interviews) in as far as agreeing with each other is that, instrument 1 agreed very well with students' interviews but, not with instrument 2 and 3.

Question B: How do these instruments discriminate between the different practical experiences that high school chemistry students might have?

Instrument 1 shows that students at Matsieng high school had book familiarity, which was confirmed by responses from the interview sessions. So this is a true reflection of these students' practical experience. Instrument 1 also indicates that students at Abdool Moosa high school had book familiarity as well as having some laboratory familiarity. The book familiarity was actually found to be teacher demonstrations. This is also true because that is what both the students and the teachers said in the interview sessions that they (students) had the opportunity of doing group activities and watching teacher demonstrations. According to instrument 1 students at Sefika and Highlands high schools, students were exposed to teacher demonstrations. This was confirmed by student and teacher interview responses.

The other two instruments also show students' different practical experiences clearly like instrument 1. Again, from these instruments, one could see that Abdool Moosa high school students had better practical experience than the other schools.

6.3.2 Comments on the findings

From what the researcher observed during the visits to the four schools, and the data gathered from teachers and students who participated in this study, students involved in this study had different practical backgrounds. First of all, the state of the laboratories at these schools was very different, for example, at the two schools in the Black township, laboratories had almost nothing. In one of these two schools the laboratory was no longer in use because of lack of facilities and poor conditions of the laboratory. At the former Indian school, laboratories were in good condition although the teacher complained that the school did not have adequate equipment to do individual activities.

The fourth school (former "White") had good laboratories and sufficient laboratory equipment but, they also had their own problems which were mentioned in chapter five. So students there, like in the Black township had to rely mostly on teacher demonstrations. Only at the former Indian school that students had the opportunity of having group activities simply because they had to sit for a practical examination at the end of the year. The vast difference in the students' practical experience (from the four schools) could also be seen in the way they responded to the 3 instruments, as well as in the interview sessions (see table 4.2).

One of the schools (Highlands high school), had adequate laboratory apparatus, but because of problems already mentioned, students were given more teacher demonstrations (sometimes with the help of some students), little group work and no individual activities. On the other hand, Abdool Moosa high school had just enough laboratory equipment but the students performed very well in instrument 1. At this school students had occasional opportunities to do practical work in groups though most of the activities were teacher demonstrations, possibly because they had to sit for practical examinations at the end of the year.

The two Black township schools had a serious problem concerning laboratories and laboratory equipment. As mentioned earlier, in one of the former Black schools (Matsieng) the laboratory was closed because of its deteriorated conditions and lack of equipment. So students there had to rely on their text books, that is, they had more of theory than practical work. Hence that's why almost all of them had book familiarity and this is confirmed by the other instruments as well. Sefika high school (former Black school) had a laboratory but it was empty. There was basically nothing in the laboratory, also the conditions of the laboratory were not good at all. Although they had teacher demonstrations, these were rare according to the teachers and students. Teaching consisted mostly of theory with some video tapes on certain experiments.

Most students who got code 1B (book familiarity) in instrument 1 had code 2A (teacher demonstration) in instrument 2 and 3. This relationship has already been explained earlier. Instrument 1 was found to be valid despite the fact that it could not detect teacher demonstration which instrument 2 could do. It follows then that instrument 1 and 2 should be combined to construct one instrument which would be ideal for establishing chemistry practical experience of high school students.

What one can learn from this study is that,

(i) Adequate supply of laboratory equipment or facilities do not, on their own ensure laboratory familiarity.

(ii) The way practical work is implemented has an effect on students' practical experience. This means that if students passively watch teacher demonstrations then they gain little in terms of practical experience, unlike when they are given the opportunity of doing practical activities individually or in groups.

6.4 Conclusion

This study set out to validate three instruments that were used in establishing chemistry practical experience of high school students. Instrument 1 was to be validated first, and in turn it was to validate the other two instruments. A questionnaire consisting of these three instruments was given to 98 students from the four schools already mentioned.

Student interview sessions were to validate instrument 1. This means that students' responses to instrument 1 were to be matched with those from the interview sessions. Only 16 students (4 from each school) participated in the interview session, hence their data was used to validate instrument 1. Teacher interview sessions were used in a complementary way to support or negate student responses. Instrument 1, though it could not measure teacher demonstrations, was found to be valid.

There are certain factors that could have affected the validity of instrument 1. These factors include the following:

- Teacher demonstrations

Instrument 1 has limitations in that it could not measure teacher demonstrations. Since the interview responses, with a few exceptions, matched those of instrument 1, instrument 1 was considered to be valid.

- Pictures not clear

Some of the pictures in the instrument appeared not to be clear to some students. As already mentioned, some students confused a measuring cylinder for a vernier scale. One student said it was a T square used to measure small distances. These could have affected the validity of the instrument.

- Blanks

The instructions in instrument 1 stated that students should leave blanks if they have not used a particular piece of apparatus. The assumption is that, if students left blanks it means that they did not used that particular piece of apparatus. Now if students left blanks because they did not know the pieces of apparatus the instrument could not tell. The instructions were not explicit enough. Hence this could affect construct validity because one could not tell whether the blanks were left as per instruction or because students did not know the pieces of apparatus.

- Biology experience - laboratory experience in general

Most of the apparatus in instrument 1 could have been used in biology practicals. So a biology students with little or no chemistry practical experience could have easily handled instrument 1. The instrument may not have been able to discriminate clearly between biology practical experience and chemistry practical experience. This could influence the validity of the instrument because the focus of this study is on chemistry practical experience.

Again, responses of students with general laboratory experience could also influence negatively the validity of the instrument. The students may have used plastic bottles or cans, for instance, as beakers. Such students would have difficulties in identifying the 10 pieces of apparatus in instrument 1.

- Micro-scale equipment

Micro-scale equipment is different from standard laboratory equipment. Besides being too small the apparatus are not the same, for example, in shape. Student with the experience of micro-scale equipment may find it difficult to identify the standard pieces of apparatus in instrument 1. Instrument 1 would not have picked up this form of practical experience.

Instrument 2 was to be validated by instrument 1. Instrument 2 responses did not match with those of instrument 1. Again codes obtained from instrument 2 were higher than those of instrument 1, implying inconsistency between the two instruments. There was also some inconsistency in what some students said about they practical experience in the interview and instrument 2. Instrument 2 was found not to be a good match to instrument 1 hence was found not valid.

These findings may contradict Lubben et al.'s (2000) who compared the same aspects of instrument 1 and instrument 2. According to Lubben *et al.* (2000:p.93) the data collected in their study "show that there is no significant difference between students' perceived and remembered levels of practical experience." Their conclusion was made after some statistical calculations on the data collected.

In the current study, no statistical calculations were done. The data collected from instrument 2 were coded and compared with data from instrument 1. A simple comparison of data from the two instruments (instrument 1 and 2) showed some inconsistency in students' responses.

Lubben et al. (2000:p.93) further indicate that based on their findings on the relationship between perceived and remembered practical experience, "one could equally validly ask students' views, very generally, on how much laboratory work they have done." This is on the assumption that test for remembered practical experience as used in their (Lubben *et al.*, 2000) study is accepted to demonstrate the actual level of practical experience (Lubben *et al.*, 2000). However, in the current study there was no match between responses from instrument 1 and 2, as a result instrument 2 was considered not to be valid. To rely on one instrument which measures students perceived practical experience could be crucial for validity purposes.

As mentioned earlier, students' views may not always portray the actual situation, and the validity of their responses may be doubtful. Again, the use of only one instrument does not guarantee valid data. Another important point to mention is that the success of an instrument to produce highly valid data in one context does not necessarily guarantee the same results in another context (Sanders and Mokuku, 1994).

Lubben *et al.* (2000) when dealing with instrument 2 focused only on data from first part of the instrument where students had to tick in the appropriate space (see appendix B). They (Lubben *et al.*, 2000) did not code the part where students had stated in writing their practical experiences at their respective schools. In the current study this part was looked into and coded. Students from the same schools gave different views about their practical experiences. Most of the data collected from this instrument were not consistent with that of instrument 1.

Factors that could have affected the validity of instrument 2 include the following:

- inexplicit instructions

The instructions in part (a) of instrument 2 were may not have been clear to some students. The fact that phrases like 'a few' and 'done many' could have confused some students. One would not be sure as to how many experience are 'a few' and how many are 'many'. This has negative implications in as far as criterion validity is concerned. Hence the validity of the instrument could be questionable.

- An open-ended question (part (b) of instrument 2)

When respondents are asked to give their views on certain issues, in most cases they exaggerate for reasons know to them. They tend to portray something that does not happen in the actual situation. Biased views can be crucial in as far as validity is concerned.

Open ended questions may lead to unfocussed responses. However, sometimes open ended questions may be useful depending on what the objective is.

Instrument 3 was also not a good match to instrument 1 as seen by the relatively low percentage of consistent combinations. Codes obtained from this instrument were higher than those in instrument 1. Hence instrument 3 was found not valid.

One factors that could have affected the validity of instrument 3 is:

- the format of the instrument

Instrument 3 was testing passive knowledge as students merely had to recognise names of the apparatus rather than recall their uses. Students, like in a multiple choice test, were to tick the appropriate spaces provided. Ticking in, is a simple thing to do even a person who has no practical experience could handle instrument 3 by guess work. The validity issue can be easily distorted.

The analysis of data collected from the three instruments and interview sessions (teachers and students) reveals students' chemistry practical experience overall, as being teacher demonstrations. This means that most of the students from the four schools were exposed to more teacher demonstrations than individual or group activities. Against this background, one may conclude that these students had little practical experience. Looking at individual schools, students from Abdool Moosa high school had better practical experience compared to the other schools, while Matsieng was the lowest since students there had almost no practical activities at all.

Instrument 1 needs some minor improvements, for example, being able to measure teacher demonstrations, to establish students' practical experience. The other two instruments may not be used because they are not considered valid.

6.5 Limitations of the study

Due to the scope of this study, only four schools were selected to participate. A total of only 98 students and 8 physical science teacher from the four schools also participated in this study. Based on the sample of this magnitude one may not generalise the findings in terms of students' chemistry practical experience in South African schools. The findings of this study can only apply to those students and schools that participated in this study.

The study also did not deal with other types of practical experience. For example, there are activities that make use of representations of real objects or materials, such as computer simulations or video recordings (Meester and Maskill, 1995; and Millar *et al.*, 1999). Other examples, as Lubben et al. (2000:p.89) argue could include "visits [of students] to science exploratoria, descriptions of experiments in textbooks or films, or indeed any combination of these." The study did not cover micro-scale equipment.

Other limitations of the study include:

- The researcher could not interview all the students who participated because of the short time frame. As a result, only 16 students were interviewed.
- Again because of time only two physical science teachers from each school were interviewed.

6.6 Recommendations

The diagrammatic representation of the 10 laboratory apparatus in instrument 1 should be done in such a way that it does not confuse respondents. The pictures should be drawn to scale. In this way students would not confuse a burette with a thermometer. Because the pictures were in black and white and not in colour this might have made it difficult for some students to identify some of the apparatus. One student identified a measuring cylinder as a T square and said it was used to measure small distances. Some of the pictures can be improved by giving 3-dimensional representation of the pieces of apparatus. Alternatively, what could be done is to put the same pieces of apparatus (real) on a table, as reference, where students could see them and match them with diagrams.

Instrument 1 when used in a complementary manner with instrument 2 gives an indication of teacher demonstration, which it is unable to do when used alone. Therefore a combination of the two is recommended.

Instrument 3 should preferably be excluded as it does not require much interaction to ascertain the extent of practical experience since it involves only ticking.

Further research should be done, with a larger student and teacher sample as well as an increased number of participating schools in order to find out whether these instruments can be used any where within the country or even in other countries.

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APPENDICES

A - D

APPENDICES

APPENDIX A

Contents: A sample of a letter to the schools requesting permission to administer the questionnaire and conduct interviews.

06/09/9?

The University of the Witwatersrand
P.O. Box 257
WITS
2050

The Principal
Mr. P.K.S. Sibeko
Sefika High school

Re: Administration of a questionnaire and interviews sessions

Dear sir,

I am currently studying for the degree of Masters in Science Education in the School of Science Education at the University of Witwatersrand.

As part of my degree requirements, I am required to complete a research report with an empirical component. I wish to administer a questionnaire on Laboratory Practical Experience to Grade 12 students and, also conduct interviews with a few Grade 12 students. For the questionnaire I need about 40 minutes. With the interviews I hope that they will not interfere with the school schedule.

I hope that you will allow me to use your school for my research.

Yours sincerely

Thabo Johannes Khoali
Student number: 9602643K

APPENDIX B

Contents:

(1) A sample of the questionnaire administered to the students

(2) A sample of filled-in questionnaire

(3) Table A: A comparison of codes from instruments 1 and 2

(4) Table B: A comparison of codes from instruments 1 and 3

SURNAME:		FIRST NAME:	
Male/Female		Home language	

NAME OF SCHOOL: ______________________________

The University of the Witwatersrand

Department of Chemistry

Practical Experience Questionnaire

Instructions:

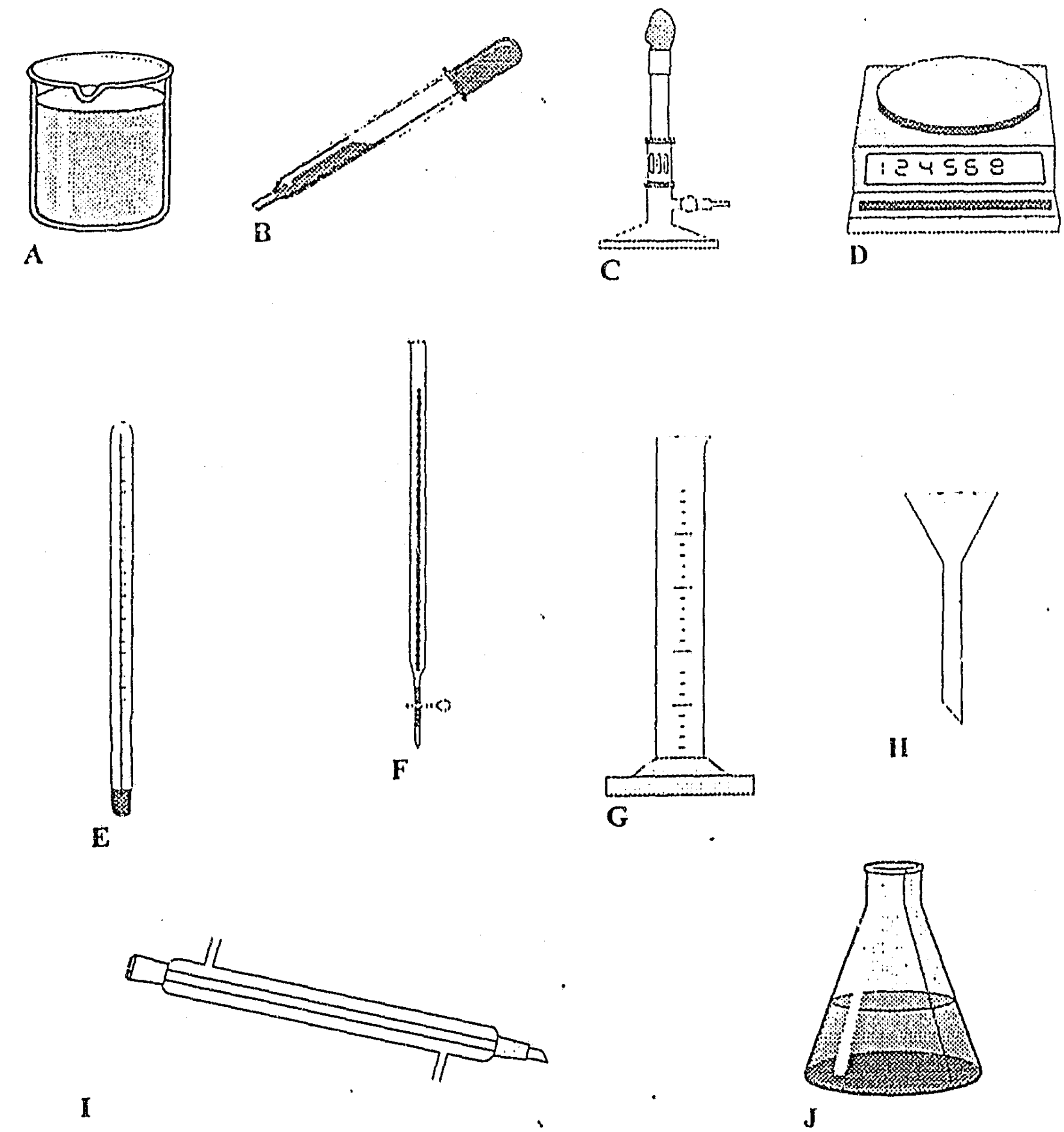
Inside this envelope there are papers numbered up to 5
There are THREE tasks to be done in this questionnaire
Read the questions carefully before you answer them.
When you have completed a question, put the sheet inside the envelope and do not take it out again, even if you want to change your answer.

Please answer all the questions in order and do not skip any sheet. Please write your answers in the spaces provided.

NOTE: Please remember that this is not a test it is meant just to help the University of Witwatersrand Chemistry Research Group gather information about High School Chemistry students' background on practical experience. Thank you for agreeing to participate in this project.

TASK 1. (Primary instrument - Instrument 1)

In the pictures below are 10 pieces of laboratory apparatus, labelled A-J. They are not drawn to scale. For example, F is really much longer than G.



In the table on the next page, write down below the names of any of these which you know. Then say if you have used it before and what you used it for.

Label	Name of Apparatus	**We used this apparatus to ....** (Leave blank if you have not used it)
A		
B		
C		
D		
E		
F		
G		
H		
I		
J		

TASK 2. (Instrument 2)

(a) How much do you know about practical work?
(Tick those choices that apply for each science subject)

	Physics	Chemistry	Biology
I have never done an experiment in.....			
I have done a few experiments in....			
I have done many experiments in			
My teacher demonstrates experiments to the class in			
I have read about experiments in			

(b) Please describe your experience of practical work.

____

____

____

____

____

____

(c) Do you think that laboratory work is an important part of ...
(Circle yes or no for each subject.)

Physical science	Yes	No
Biology	Yes	No

Explain your answers.

____

____

____

____

____

____

____

____

TASK 3. (Instrument 3)

Tick the practical scientific activities you have done at school.

Activity	Done it myself	Seen the teacher do it	Never seen it only seen a picture	Do not know what it is
Using a Bunsen burner or spirit burner				
Doing chemical reactions in test tubes				
Using a burette				
Using a balance				
Using a measuring cylinder				
Using a calorimeter				
Using a stopwatch				
Using a magnifying class				
Recording and collecting data				
Using a pipette				

3006

SURNAME:		FIRST NAME:	
Male/Female	MALE	Home language	ENGLISH

NAME OF SCHOOL: ______ ____________________

The University of the Witwatersrand

Department of Chemistry

Practical Experience Questionnaire

Instructions:

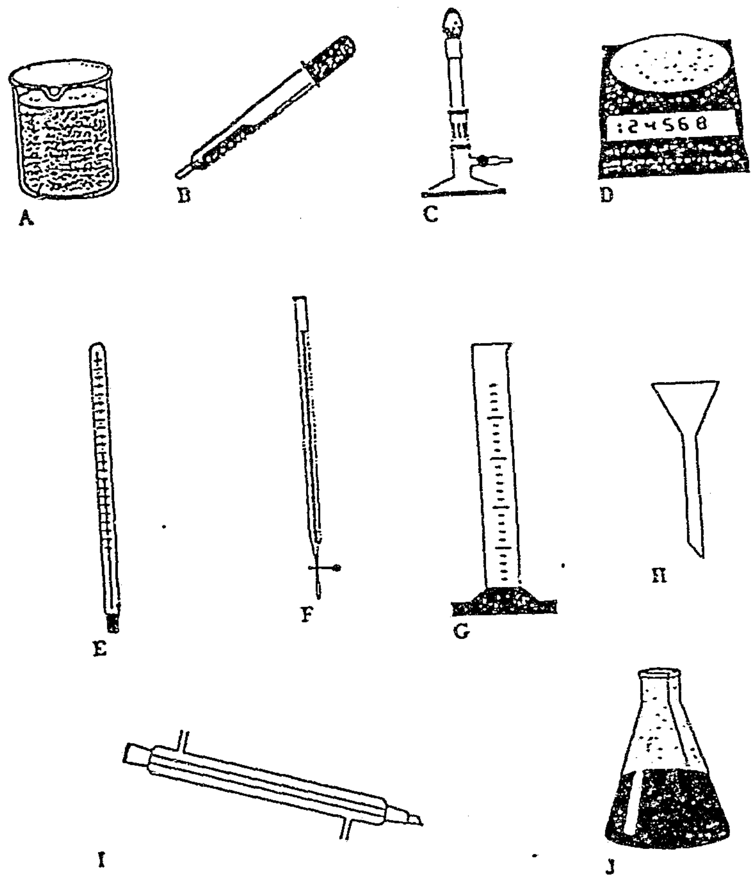
Inside this envelope there are papers numbered up to 5
There are **THREE** tasks to be done in this questionnaire
Read the questions carefully before you answer them.
When you have completed a question, put the sheet inside the envelope and do not take it out again, even if you want to change your answer.

Please answer all the questions in order and do not skip any sheet.
Please write your answers in the spaces provided.

NOTE: Please remember that this is not a test it is meant just to help the University of Witwatersrand Chemistry Research Group gather information about High School Chemistry students' background on practical experience. Thank you for agreeing to participate in this project.

STUDENT NAME: _ ____________

TASK 1.
In the pictures below are 10 pieces of laboratory apparatus, labelled A-J. They are not drawn to scale. For example, F is really much longer than G.



In the table on the next page, write down below the names of any of these which you know. Then say if you have used it before and what you used it for.

STUDENT NAME: ___ ____________

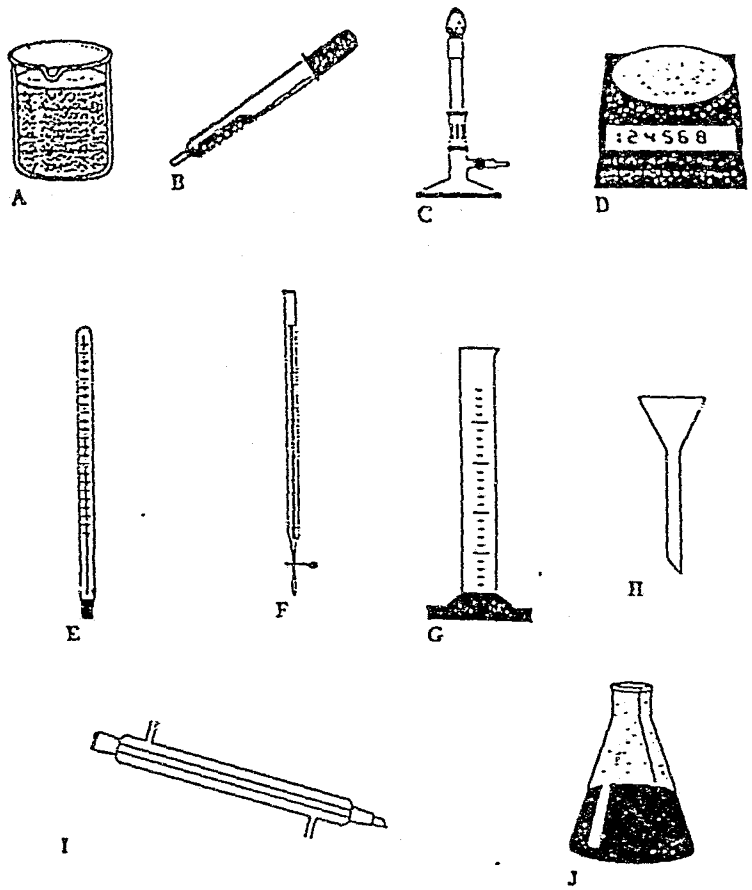
Label	Name of Apparatus	We used this apparatus to .... (Leave blank if you have not used it)
A	BEAKER ✓	TO DISPENSE ACID/WATER IN EXPERI.
B	DROPPER ✓	TO ADD DROPS OFF A SUBSTENCE.
C	BUNSEN BURNER	TO HEAT MATERIALS DURING AN EXPERI.
D	ELEC. SCALE	TO MEASURE THE WEIGHT/mass OF SUBSTANCES.
E	THERMOMETER	TO MEASURE THE TEMPRETURE OF SOMETHING.
F	Burette ✓	TO TITRATE i.e. to allow ACID TO PASS DOWN
G	VOLUMETRIC FLASK	TO MEASURE IN dm^3
H	FUNNEL. ✓	TO ADD ACID INTO PIPE WITHOUT SPILLING.
I		
J	VOLUMETRIC FLASK	MIX LIQUIDS TO A CERTAIN CONC.

3006

STUDENT NAME: _

TASK 1.

In the pictures below are 10 pieces of laboratory apparatus, labelled A-J. They are not drawn to scale. For example, F is really much longer than G.



In the table on the next page, write down below the names of any of these which you know. Then say if you have used it before and what you used it for.

125

Code 2 ✓

STUDENT NAME: __

Label	Name of Apparatus	We used this apparatus to .... (Leave blank if you have not used it)
A	BEAKER ✓	TO DISPENSE ACID/WATER IN EXPERI.
B	DROPPER ✓	TO ADD DROPS OFF A SUBTENCE.
C	BUNSEN BURNER ✓	TO HEAT MATERIALS DURING AN EXPERI.
D	ELEL. SCALE. ✓	TO MEASURE THE WEIGHT/mass OF SUBSTANCES.
E	THERMOMETER ✓	TO MEASURE THE TEMPRETURE OF SOMETHING.
F	Burette ✓	TO TITRATE i.e. to allow ACID TO PASS DOWN
G	VOLUMETRIC BEAKER	TO MEASURE IN dm^3
H	FUNNEL. ✓	TO ADD ACID INTO PIPE WITHOUT SPILLING.
I		
J	VOLUMETRIC FLASK ✓	MIX LIQUIDS TO A CERTAIN CONC.

906

3006

Practical Experience Questionnaire

STUDENT NAME: ______________________

TASK 2.

(a) How much do you know about practical work?
(Tick those choices that apply for each science subject)

	Physics	Chemistry	Biology
I have never done an experiment in.....			✓
I have done a few experiments in.....	✓	✓	
I have done many experiments in			
My teacher demonstrates experiments to the class in	✓	✓	
I have read about experiments in	✓	✓	

2A

(b) Please describe your school experience of practical work.

In std. 9 no experiments were done in the previous school. This was possibly because of no equipment or laziness of the teacher. However, this year we did hands on experiments for the first time. For exam purposes, I had to read about the experiments needed. This was not at all helpful and till now as I am still confused. But this year was more fruitful and all practical work was done.

3006

Practical Experience Questionnaire

STUDENT NAME: ______________

(c) Do you think that laboratory work is an important part of ...
(Circle yes or no for each subject.)

1A

Physical science	(Yes)	No
Biology	Yes	No

NOT STUDIED

Explain your answers.

Physics in a subject that involves things undertaken in every day life. In order for students to really understand what is being thought, they should see it.

ok

(I do not do Biology)

3006

Code 3

Practical Experience Questionnaire

STUDENT NAME: ______________________

TASK 3.

Tick the practical scientific activities you have done at school.

Activity	Done it myself	Seen the teacher do it	Never seen it only seen a picture	Do not know what it is
Using a Bunsen burner or spirit burner		✓2		
Doing chemical reactions in test tubes		✓2		
Using a burette	✓3			
Using a balance				✓0
Using a measuring cylinder	✓3			
Using a calorimeter				✓0
Using a stopwatch	✓3			
Using a magnifying class	✓3			
Recording and collecting data	✓3			
Using a pipette	✓3			

1

1

0 – Task 1 Correct name & use
– Task 3 Don't know what it is (Balance vs scale ??)

0 – Wrong name + use (Task 1)
– Done it myself (Task 3)

14/3 Code 2

22/30

Code 3

Table A: A comparison of codes from instruments 1 and 3 for 98 students

THE FOUR SCHOOLS OVERALL PERFORMANCE ON TASKS 1 AND 2		
Student Number	TASK 1	TASK 2
1001	1B	2A
1002	1A	2A
1003	1A	2A
1004	1B	2A
1005	1B	2A
1006	1A	2A
1007	1A	2
1008	1B	3
1009	1B	2A
10010	1B	2A
10011	2	2A
10012	2	2A
10013	1B	3
10014	1A	3
10015	2	2A
10016	1B	2A
10017	2	2A
10018	1B	3
10019	1B	3
10020	1B	2
10021	1A	3
10022	1B	2A
2001	1B	2
2002	1A	2
2003	1A	1B
2004	1B	2A
2005	1B	2
2006	1B	2A
2007	1B	1B
2008	1B	2A
2009	1B	2A
20010	1B	2A
20011	1A	2A
20012	1A	2A
20013	2	2
20014	2	2A
20015	1A	1B
20016	1A	1B
20017	1B	2A
20018	1B	1B
20019	1B	2
20020	1A	2A

THE FOUR SCHOOLS OVERALL PERFORMANCE ON TASKS 1 AND 2		
Student Number	TASK 1	TASK 2
20021	1B	2
20022	1B	2A
20023	1B	1B
20024	1A	2
20025	1B	2A
20026	1B	2A
20027	1B	2A
3001	2	2A
3002	2	2A
3003	2	3
3004	1B	3
3005	1B	2A
3006	2	2A
3007	1B	2A
3008	1B	2A
3009	3	3
30010	1B	2A
30011	1B	3
30012	2	3
30013	1B	3
30014	1B	1B
30015	1B	2
30016	1B	3
30017	3	2A
30018	2	2
30019	1B	3
30020	3	2A
30021	1B	2
30022	3	2A
30023	1A	2
30024	1B	2
30025	1B	3
30026	1A	2
30027	1B	3
30028	1B	3
30029	2	3
30030	1A	2
30031	2	3
30032	3	3
4001	1B	1B
4002	1B	1B
4003	1B	1B
4004	1B	1B
4005	1B	2A
4006	1B	1B

THE FOUR SCHOOLS OVERALL PERFORMANCE ON TASKS 1 AND 2		
Student Number	**TASK 1**	**TASK 2**
4007	1B	1B
4008	1B	1B
4009	2	2A
40010	1B	1B
40011	1B	1B
40012	1B	1B
40013	1A	1B
40014	1B	1B
40015	1A	1B

Table B: A comparison of codes from instruments 1 and 3 for 98 students

THE FOUR SCHOOLS OVERALL PERFORMANCE		
ON TASKS 1 AND 3		
Student Number	TASK 1	TASK 3
1001	1B	2A
1002	1A	3
1003	1A	2
1004	1B	2A
1005	1B	2A
1006	1A	2A
1007	1A	2
1008	1B	2A
1009	1B	2A
10010	1B	2A
10011	2	2A
10012	2	3
10013	1B	2A
10014	1A	2A
10015	2	3
10016	1B	2A
10017	2	2A
10018	1B	2A
10019	1B	2A
10020	1B	2A
10021	1A	2A
10022	1B	2A
2001	1B	2A
2002	1A	2
2003	1A	2A
2004	1B	2
2005	1B	2A
2006	1B	2A
2007	1B	2A
2008	1B	2A
2009	1B	2A
20010	1B	2
20011	1A	2A
20012	1A	2A
20013	2	2
20014	2	3
20015	1A	2A
20016	1A	2A
20017	1B	2A
20018	1B	2
20019	1B	3
20020	1A	2A

Table B: A comparison of codes from instruments 1 and 3 for 98 students

THE FOUR SCHOOLS OVERALL PERFORMANCE ON TASKS 1 AND 3		
Student Number	TASK 1	TASK 3
1001	1B	2A
1002	1A	3
1003	1A	2
1004	1B	2A
1005	1B	2A
1006	1A	2A
1007	1A	2
1008	1B	2A
1009	1B	2A
10010	1B	2A
10011	2	2A
10012	2	3
10013	1B	2A
10014	1A	2A
10015	2	3
10016	1B	2A
10017	2	2A
10018	1B	2A
10019	1B	2A
10020	1B	2A
10021	1A	2A
10022	1B	2A
2001	1B	2A
2002	1A	2
2003	1A	2A
2004	1B	2
2005	1B	2A
2006	1B	2A
2007	1B	2A
2008	1B	2A
2009	1B	2A
20010	1B	2
20011	1A	2A
20012	1A	2A
20013	2	2
20014	2	3
20015	1A	2A
20016	1A	2A
20017	1B	2A
20018	1B	2
20019	1B	3
20020	1A	2A

THE FOUR SCHOOLS OVERALL PERFORMANCE ON TASKS 1 AND 3		
Student Number	TASK 1	TASK 3
20021	1B	2
20022	1B	2A
20023	1B	2
20024	1A	2A
20025	1B	3
20026	1B	2
20027	1B	2A
3001	2	2A
3002	2	3
3003	2	3
3004	1B	3
3005	1B	3
3006	2	3
3007	1B	2A
3008	1B	2A
3009	3	2A
30010	1B	2A
30011	1B	2A
30012	2	3
30013	1B	2A
30014	1B	2A
30015	1B	2A
30016	1B	3
30017	3	3
30018	2	3
30019	1B	2A
30020	3	3
30021	1B	3
30022	3	3
30023	1A	3
30024	1B	3
30025	1B	2A
30026	1A	2A
30027	1B	3
30028	1B	3
30029	2	3
30030	1A	3
30031	2	3
30032	3	3
4001	1B	2A
4002	1B	2A
4003	1B	1B
4004	1B	2A
4005	1B	1B
4006	1B	1B

THE FOUR SCHOOLS OVERALL PERFORMANCE ON TASKS 1 AND 3		
Student Number	TASK 1	TASK 3
4007	1B	1B
4008	1B	1B
4009	2	2A
40010	1B	2A
40011	1B	1B
40012	1B	1B
40013	1A	1B
40014	1B	2A
40015	1A	1B

APPENDIX C

Contents:

(1) Student interview schedule

(2) Teacher interview schedule

STUDENT INTERVIEW SCHEDULE

QUESTION 1.

Ten pieces of pieces of laboratory apparatus (real equipment) numbered from 14 to 23 are randomly arranged on a table. Students have to pick any piece(s) of apparatus s/he recognises, name it and say whether they have used it, and give its function.

QUESTION 2.

A. (I) How often do you do practical work?

(ii) Can you give some examples of the practical activities/experiments you have done?

(iii) How were they organised?

(Teacher demonstration? Then..) Give an example and equipment used.
(Group work ? Then ..) Give examples and equipment used.
(Individual activities? Then ..) Give examples and equipment used.

B. Were there any experiments which involved measurements? How often? Give some examples

QUESTION 3.

(i) Do you like practical work?

(ii) How do you like it organised? Why?

(ii) Is practical work important in science?

TEACHER INTERVIEW SCHEDULE

QUESTION 1.

(I) How long have you been teaching physical science in this school?

(ii) How many students take physical science in this school?

(iii) How many students are there in the class?

(iv) Do the students do any practical work in chemistry?
(If no - why?)
(If yes - then question (v))

(v) How often do students do practical activities?

(vi) How do you organise the experiments?
- If teacher demonstration - how often? - what equipment do you use?
- If group work - how often - what equipment do you use?
- If individual work - how often? - what equipment do you use?

(vii) Were there any experiments which involved measurements? Give examples. What were they supposed to measure?

(viii) How is the equipment (apparatus) in the laboratory?

QUESTION 2.

(I) Do you think the students have gathered enough experience in practical activities at high school to handle practical work at university level?

(IF YES) What makes you think so?

(IF NO) What could be the problem (s)? How can that be solved?

(ii) How many students in your class do you think will pursue science-based subjects at tertiary level, for example, engineering, in the field of medicine, dentistry etc. ?

APPENDIX D

Contents:

(1) A sample of student reponses to interview schedule

(2) A sample of teachers' reponses to interview schedule

(3) Table A: Student and teacher's views about practical work

(4) Table B: Students' perceived practical experience.

Please note:

Number	Name
14	Burette
15	Liebig condenser
16	Measuring cylinder
17	Thermometer
18	Conical flask
19	Electronic balance / scale
20	Medicine dropper / dropper
21	Funnel
22	Bunsen burner
23	Beaker

Interview sessions with physical science students at school 100
II: Student number 2 (S1001) (female)

I: Afternoon!
S2: Afternoon.
I: You're a Grade 11 student at this school, isn't it?
S2: Yah.
I: OK. Now, I just want to find out about your practical experience in physical science more especially in chemistry. So on the table here, like you see, I have a few pieces of apparatus and are numbered. OK? Now what I am asking you to do is to just pick one at random, tell me its number and name. Whether you have used it before and tell its use. OK? That's the task I want you to do for me. Once you finish with one just put it aside so that you don't confuse them. If you don't know the apparatus don't be shy to say I don't know but, please try. OK?
S2: Yes.
I: You may start.
S2: Number 21.
I: Number 21.
S2: Its a funnel.
I: OK.
S2: We use it to ....like.....if you want to pour something into a smaller container.
I: OK.
S2: Number 23 is a beaker. We use the beaker to measure or to mix substances.
I: OK.
S2: Number 17.
I: Number 17.
S2: Its like a thermostat.
I: Thermostat? OK.
S2: We used it to measures temperature.
I: OK.
S2: Number 18 I don't know.
I: Number 18 you don't know. What do you think is used for?
S2: I think it is the same like a beaker
I: OK.
S2: Number 16. I don't know what number 16 is.
I: What do you think it is used for.
S2: I suppose it is also used to measure.
I: Measure what?
S2: Measure stuff that you are mixing.
I: The stuff you are measuring is in what form?
S2: Powder or liquid
I: Powder or liquid?
S2: Yes.

I: OK.
S2: I don't know this one.
I: Just give me its number.
S2: Number 15.
I: You don't know what it is?
S2: Yes.
I: Have you used it before?
S2: No.
I: OK.
S2: I don't remember what this is. We use to open it at the bottom. Number 14 to drop slowly.
I: What is dropping slowly?
S2: Liquid inside.
I: So what can you say is its use?
S2: I don't remember.
I: You have seen some liquid dropping from it?
S2: No. I can't remember.
I: You can't remember. OK.
S2: I don't know this one.
I: What number is that?
S2: 22.
I: 22. What is its name?
S2: I don't know its name.
I: Do you perhaps know what it is used for?
S2: No.
I: OK.
S2: Number 19. Its a scale.
I: Number 19, a scale.
S2: Yah. We used it for weighing.
I: What were you weighing?
S2: When weighing a mixture or a solid.
I: Only solids?
S2: Yes.
I: OK. Now the last one.
S2: I don't know.
I: You don't know what it is?
S2: I don't know.
I: Have you seen it before?
S2: Yes.
I: What number is that?
S2: Number 20.
I: What do you think it is used for?
S2: It is used to suck a mixture in and let it out as drops.
I: Alright. OK. We have finished with the apparatus. Suzan do you do practical work at this school?

S2: We don't do it ourselves. Some students do but, mostly the teacher does it.
I: What do you mean some students do it? What kind of students do that.
S2: The teacher asks someone else to help her.
I: OK. Just for helping the teacher?
S2: Yah.
I: Now, how often does the teacher do practical work?
S2: Like if we do work in the book and there is an experiment to be done, she does it.
I: How many times would you say in a week?
S2: About three times.
I: About three times?
S2: Yah.
I: OK. Now can you give me just one example of a practical activity that the teacher did?
S2: That one of sugar.
I: What was happening to the sugar?
S2: She put sugar in the beaker. The experiment was to show us how it changes colour. She put lead acetate in and it absorbed all the sugar and it turned black.
I: OK. Alright. You said lead acetate and sugar? OK. What apparatus did she use?
S2: She used a beaker.
I: A beaker?
S2: Yes.
I: And what else?
S2: Nothing.
I: In other words you are telling me that she used only a beaker, not other pieces of apparatus?
S2: No. She only used a beaker.
I: OK. Can you remember another experiment she did?
S2: I can't remember.
I: How many experiments have you done so far?
S2: Many experiments.
I: Many? Can you give a rough estimation of the number of experiments you have done so far?
S2: (silence)......
I: Would you say 10? 15?or 20?
S2: More than 20.
I: More than 20. Now can you remember another one?
S2: I can't.
I: Alright. In this experiment or any other experiments that you have done so far, did the teacher have to measure?
S2: We don't know what is measured. We can't measure because there isn't enough time.
I: You don't measure?
S2: No.
I: Is it because there is no time or what?
S2: Sometimes there is no time. Sometimes she does measure.
I: How does she measure?
S2: She just use a beaker to measure.

I: She never used a scale, for instance?
S2: No.
I: Alright. Suzan, do you like practical work?
S2: Yah.
I: Why?
S2: I think you understand something better if you see what you are doing.
I: In other words you want to see?
S2: Yes I do.
I: Now if I showed you some pictures would you be OK?
S2: No. I mean like in science you can always understand what you read. So if you do experiments you understand better.
I: OK. Now you say you like practical work. How do you like it organised or done?
S2: (pause)..........
I: What I mean is would you like the teacher demonstrating the experiment to you? Or do you want to do it yourself or in a group?
S2: I think I like doing it myself.
I: You don't want a group? You want to do it yourself.
S2: I want to do it myself.
I: Why do you like to do it yourself?
S2: So that I can know what's going on.
I: But still in a group you can know what's going on because you will be watching or doing.
S2: People will laugh at me.
I: Laugh at what?
S2: At me fumbling.
I: Alright. Now one last question. Do you think practical work is important in science?
S2: Yes especially in science.
I: How so?
S2: It actually helps us to understand better.
I: So what you are saying is that practical work helps you understand better?
S2: Yah.
I: In other words if you are just reading from a book.....(S2: interrupts)...
S2: You won't understand better.
I: OK. On that note, thank you Suzan.
S2: Thank you.

End of interview.......

Interview session with two physical science teachers at school 100
Teacher number 2 (TH2) (female)

I: I think we should start. First of all let me introduce myself. I'm from Wits University. At the present moment I'm doing a research on practical experience of high school students in physical science more-especially in chemistry.

T2: In chemistry?

I: Yah. So What I'm asking from you or from the school is practical experience of the school that is what students do in terms of practical work and what kind of laboratory apparatus you have in the laboratories and so on and so forth.

T2: OK. The biggest problem that we have got at this stage is that we have got the apparatus but there is not enough space for the kids to do their own experiments. So what's happening is that I'm doing demonstrations for them, and then the result I have to pass around the class because I sit with 52 matrics in one class. There is not even enough space for them to sit. So that's my biggest problem but, actually I think it's working well because the moment I do experiments they are really interested to see the results. A lot of questions that come out in the final exam are based on the experiments that they doing in class, and that I have to see to it what's happening and all that. The only problem is that they cannot do that themselves because, first of all we don't have a laboratory assistant. You know, if you have a laboratory assistant you can put up your papers and stuff like that and ask her/him to put up what you need for your experiments. I can't do that anymore, and I don't have free periods. So that's my biggest problem. And the class is big and there is no working space. The kids will not fit into it. So we do the best that we can, and that is, do the experiments ourselves, demonstrate to them, let them smell it, let them see it, things like that. And I think its working rather well because my matrics did very well last year. Not one single failure.

I: OK. Now how long have you been teaching in this school?

T2: I'm her since 199.). I was at Africa Boys schools - Afrikaans schools before that for 14 years.

I: OK. So what Grades have you been teaching since 1993?

T2: It's Grades 10, 11 and 12.

I: Roughly how many students take physical science in this school?

T2: You must remember that this school is a technical school, its compulsory.

I: OK.

T2: So there is no choice, and that is a big problem. You know its not like in other schools where the clever students choose to take science, not here. Everybody has to take science. So all the technical pupils.

I: That makes its how many students?

T2: In Grade 12 they are 52, in Grade 11 I have got 102 and Grade 10 we got 200.

I: Hmmm. OK. You said you do the experiments yourself as demonstrations?

T2: Yah.

I: Is there anytime whereby you find that you put students in groups and give them an activity to do or is it basically demonstrations?

T2: It's basically demonstrations. I will tell you why. It will take a lot of time to prepare them in groups and let them work like that. Like I said before, I don't have the help of a laboratory assistant. So what I have to do in the class I have to put up myself. So if you have to prepare for groups you must be able to do that after school and all that, and that is our biggest problem. So I do the experiments but I let them handle it as well. I don't just stand and do the experiments. I just walk through them and let them taste and let them see, and all that.

I: Does it mean every student get the chance to touch whatever you are doing?

T2: Yah, yah. Not always because the time doesn't allow. And the problem with our periods now is ..eh..... the spacing of it, you know, because we are so loaded with periods.

I: OK. Is there any other way of checking whether the students have actually been observing or listening?

T2: Oh! Yes. The whole concept in which I'm working is questions.

I: OK.

T2: You see we do all the work. I explain and there are some questions and they must answer. In other words they have to work on worksheets.

I: OK.

T2: The use of worksheets is very important. Once we have done the experiment I send them home, "here is your worksheet, you go and do it and tomorrow when you come back we mark."

I: OK. Now, how often do you do these demonstrations?

T2: As the syllabus asks for it. I mean if I do inorganic chemistry and I'm working on hydrogen sulphide then I do all the experiments. We don't miss one.

I: Roughly how many experiments do you ....(T2 interrupts)..

T2: Oh..that's difficult to ask...that I can't tell you.

I: OK. Let's say in a month. How many do you think you do?

T2: Hmmmm.....(T2 tries to think). You see its something you can't say. You tackle a topic and then you do the experiments on that. This topic has got 10 experiments and that one has 2 and this one has got 5. So it depends on your topic.

I: OK.

T2: So I can't say every week I'm doing so many experiments.

I: OK.

T2: That's the problem.

I: But you said you don't miss any experiments?

T2: I don't miss any experiments because I know it is very important for the final exams.

I: OK. Now can you just give an example of one experiment or activity that you did for the students, that is as a demonstration?

T2: OK. Say for instance, hydrogen sulphide where I have to prove that it is a reducing agent. Then we make solutions of copper sulphate, iron chloride, and ..eh.....potassium permanganate which has got colours. And then before it I will explain a theory to them. OK? And then I make the H_2S and then we bubble that through the solutions, so that they can see what the colour changes is, because the colour changes is very important. It shows the change in oxidation numbers. And they must understand that and then from that they must do redox reactions. So they will see how the colours change and then they must explain why the colours change like that.

I: OK.

T2: And this is the type of experiments that we do. So whether they do it themselves or I do it, the main thing is to see how the colours change and what's happening there.

I: Yah. Now what equipment did you use........(T2 interrupts)

T2: The equipment that we got its not so bad. I got all the chemicals that I need and I make sure that if there is a shortage I order it again. Basically we have got the glass apparatus that we use.

I: So for that experiment you used which glass apparatus did you use?

T2: Ahh... test tubes, flasks, and things like that.

I: OK. So you said the students never do experiments on their own because of the large number?

T2: The large number and I, actually I mean if you want to do experiments like for instance, titration for acids and bases we don't even have enough apparatus for them to work on. There are about 4 burettes that we can use.

I: OK.

T2: So it means if you divided them its like 15 pupils on one. So its better for them to see it right way. I think its working well.

I: Now in these experiments that you did, did you have to measure?

T2: Oh yes! Oh yes! Like if for instance you were to do titration you have to measure exactly Because they must be able to calculate the mole concentration.

I: Hmmm....Now what apparatus do you use to measure?

T2: I have got a chemical scale, but there is only one.

I: So it has to be you who uses it?

T2: Yah! Yah!

I: OK. Alright. So you did the measurements using the scale and burettes and the likes.

T2: Yah! Yah! Like even for the junior classes, what I do there is, like for instance, the optical experiments with the light, I put up the experiment and call them in groups while the others are busy with the worksheet. And then they can come and look at it and arrange the things and see how the light rays are bending and all that. Then they can actually do it themselves. But that's the only experiments that is put up and I let them come by rows.

I: OK. Now with this kind of experience do you think the students are ready to handle university level......(T2..interrupts..)

T2: Oh! Lots of our kids go to university. A lot of them go there, and they are quite good.

I: In other words they have gathered enough experience.

T2: Oh yes! They often come back to me and say to me those things you have given us we are doing the same thing now, and all that.

I: OK.

T2: Now we don't really have a problem.

I: How many students do you think will pursue science based subjects at tertiary level from this group?

T2: OK. The problem is....I don't know what you mean. Whether they want to go to university or technikon?

I: Not necessarily university. What I mean is how many do you think will follow science?

T2: A lot of them go into engineering because of their technical background like electronics and electrician works and all that. They go into engineering.

I: Actually, the essence of this question is to find out whether they are really interested in science.

T2: Oh. You mean like a BSC just plain.

I: Yah or going into medicine, stuff like that.

T2: Oh no! They can't do medicine from this schools because we don't have biology. Its a technical school.

I: OK.

T2: Its either they go into engineering or other practical areas. You must remember its a technical school.

I: OK. Does the background they have allow them to go to university?

T2: Yah. They are writing the same exams as the other schools. But we don't have biology. It is only up to Grade 9.

I: OK.

T2: I don't think the students would go into a plain BSc, not very easily.

I: Yah.

T2: Yah.

I: Well on that note I would like to thank you. I think I have exhausted my questions. Thank you very much.

T2: My pleasure. It was a pleasure!

End of interview........

Table A: Students' perceived practical experiences

SCHOOL	RESPONSES TO INTERVIEWS	RESPONSES TO INSTRUMENT 2	REMARKS
Highlands	S1002: "The teacher does all the work every time we start a new section. She just showed us what happens. What colour changes, bad smell. Stuff like that."	S1002: "You learn by doing."	No group or individual activities. Only teacher demonstrations.
	S1001: "We don't do it ourselves. Some students do but, mostly the teacher does it. The teacher asks someone else to help her." (App.D. S1001).	S1001: "At school our teachers do many experiments with us. We particularly do many experiments in chemistry to help us understand our work better and to see what happens, not only to read about it."	No group or individual activities. Only teacher demonstrations.
	S1003: "About four times a week. The teacher did the activities. We were like, listening and observing what the teacher was doing."	S1003: "It is logic. You can understand what you are doing. You gain more experience."	Practical activities were done as teacher demonstrations only.
	S1004: "Most of the periods when we go to science we do practicals. Approximately four times a week. The teacher did the experiments. We watched and also writing observations down. I have never done an experiment on my own." As a group. "It was last year, but it was not in chemistry."	S1004: "...teachers are well experienced in practical work. They know how to make pupils understand the work. They explain repeatedly so that one can gain full knowledge and do what is required of him/her."	Most practical activities were teacher demonstrations. A few group activities, though not in chemistry. No individual activities at all.
Abdoo Moosa	S3007: "When we start a new subject we first do the theory and then practicals after that, once a week. We have done one or two experiments for practical work on our own where the teacher has just watched us. Just guided us and watched us. And some other experiments he did it in front of the class where we watched. No individual activities"	S3007: "It is exciting and fun and at the same time you learning and gaining knowledge. We are also very enthusiastic towards our practical work."	Some practical work but, more of teacher demonstrations than group work. No individual activities
	S30030: "We wouldn't say how many times in a week, of course according to the syllabus, mostly we have done the experiments for chemistry for one term. Like we did about mostly 5 experiments that's all in a term......[The teacher] shows to us, after that he helps us and we do it ourselves. We do it in groups."	S30030: "It is very exciting to learn about practical work because when we read about it, it makes no sense to one's brains, but once you have done the practicals, you have an understanding about the experiment."	Some practical work but more of teacher demonstrations and group work.
	S3008: "We do practicals but, not all of the practicals. More of theory than practicals. Once in three weeks. The teacher had everything set up on his desk and he showed it to us. The teacher was demonstrating. In science the teacher demonstrated everything to us."	S3008: "It has been fun and interesting but teachers should concentrate on doing more practicals as it enhances our knowledge and it makes it easier to understand and see things more clearly."	More theory than practical work. Mostly teacher demonstrations.
	S30031: "Practical work, quite honestly, we have only done practical work this year. We have done practicals but not us as pupils, our teachers have done practicals....the experiments for us. And this year we did a few experiments ourselves for our practical marks. The teacher does the experiment in front of the class and we all are observers."	S30031: "Up to matric level all experiments were carried out by teachers. Due to the need for practical marks, students are allowed to do experiments by themselves only in STD 10. The unavailability of chemicals and equipment also play an important role in the fact that teachers do experiments."	More teacher demonstrations because of a lack of apparatus. Students do practicals on their own for practical examination marks.
Matsieng	S4007: "We haven't done that. The teacher says we don't have the apparatus. No teacher demonstrations, no group or individual activities."	S4007: "We have done some experiments, but not practically, on some air freshener, also [teacher] tried to show us how force of gravity can affect some substances."	No practical work due to a lack of apparatus. Practical activities are done theoretically.
	S40011: "We don't do it. We just talk about experiments. No practical work at all."	S40011: "There's a practical work but never been done, not that I know of."	No practical work at all. It is done theoretically.
	S4001: "No experiments in chemistry. Mostly in biology. Teacher demonstration in biology."	S4001: "It is not very good because of less apparatus. But we are trying to have ideas when we came upon an experiment in the book."	Due to a lack of apparatus, students read about practical activities from books. Biology practicals are teacher demonstrated.
	S4005: "Ah..we don't usually do practical work, we don't have equipment. We did 3 or 4 experiments last year. The teacher was showing us."	S4005: "Mostly it depends on the teacher who is teaching that subject. We didn't do much in chemistry. Our problem was that we didn't have much apparatus so far."	Because of a lack of apparatus, little practical work was done and was teacher demonstrated.

Table B: Students' perceived practical experiences

SCHOOL	RESPONSES TO INTERVIEWS	RESPONSES TO INSTRUMENT 2	REMARKS
Highlands	S1002: "The teacher does all the work every time we start a new section. She just showed us what happens. What colour changes, bad smell. Stuff like that."	S1002: "You learn by doing."	No group or individual activities. Only teacher demonstrations.
	S1001: "We don't do it ourselves. Some students do but, mostly the teacher does it. The teacher asks someone else to help her." (App.D, S1001).	S1001: "At school our teachers do many experiments with us. We particularly do many experiments in chemistry to help us understand our work better and to see what happens, not only to read about it."	No group or individual activities. Only teacher demonstrations.
	S1003: "About four times a week. The teacher did the activities. We were like, listening and observing what the teacher was doing."	S1003: "It is logic. You can understand what you are doing. You gain more experience."	Practical activities were done as teacher demonstrations only.
	S1004: "Most of the periods when we go to science we do practicals. Approximately four times a week. The teacher did the experiments. We watched and also writing observations down. I have never done an experiment on my own." As a group. "It was last year, but it was not in chemistry."	S1004: "...teachers are well experienced.in practical work. They know how to make pupils understand the work. They explain repeatedly so that one can gain full knowledge and do what is required of him/her."	Most practical activities were teacher demonstrations. A few group activities, though not in chemistry. No individual activities at all.

Sefika	S2001: "Not very often, to be honest. So far we have done very few experiments in chemistry. In physics we haven't done any experiments. But at least in biology we have done plenty. We did them as a class and then someone, like, a student would come forward and conduct the whole thing and then if we can't find something, then the teacher would come and help us where may be we can't may be do well." S2003: "In a month I think about.....some of them they are many but, I actually see them in biology because in biology we do them a	S2001: "My school is not that experienced when it comes to experiments because some of the experiments we do them without all the apparatus needed. We need to have more of the materials in order to do more experiments." S2003· "My school experience of practical work was when we do experiments in biology and physics and when we experiment doing	Lack of apparatus. Teacher demonstrations and some group work. Little of practical work in chemistry, and are teacher demonstrations.
Matsieng	S4007: "We haven't done that. The teacher says we don't have the apparatus. No teacher demonstrations, no group or individual activities." S40011: "We don't do it. We just talk about experiments. No practical work at all." S4001: "No experiments in chemistry. Mostly in biology. Teacher demonstration in biology." S4005: "Ah..we don't usually do practical work, we don't have equipment. We did 3 or 4 experiments last year. The teacher was showing us."	S4007: "We have done some experiments, but not practically, on some air freshener, also [teacher] tried to show us how force of gravity can affect some substances." S40011: "There's a practical work but never been done, not that I know of." S4001: "It is not very good because of less apparatus. But we are trying to have ideas when we came upon an experiment in the book." S4005: "Mostly it depends on the teacher who is teaching that subject. We didn't do much in chemistry. Our problem was that we didn't have much apparatus so far."	No practical work due to a lack of apparatus. Practical activities are done theoretically. No practical work at all. It is done theoretically. Due to a lack of apparatus, students read about practical activities from books. Biology practicals are teacher demonstrated. Because of a lack of apparatus, little practical work was done and was teacher demonstrated.

Sefika	S2001: "Not very often, to be honest. So far we have done very few experiments in chemistry. In physics we haven't done any experiments. But at least in biology we have done plenty. We did them as a class and then someone, like, a student would come forward and conduct the whole thing and then if we can't find something, then the teacher would come and help us where may be we can't may be do well."	S2001: "My school is not that experienced when it comes to experiments because some of the experiments we do them without all the apparatus needed. We need to have more of the materials in order to do more experiments."	Lack of apparatus. Teacher demonstrations and some group work.
	S2003: "In a month I think about.....some of them they are many but, I actually see them in biology because in biology we do them a lot. But in physical science we don't. We do them once in that time, that's all or twice. Practical work here at school we do it when we want to do experiments and we do them most of the time in class with our teacher."	S2003: "My school experience of practical work was when we do experiments in biology and physics and when we experiment doing electricity and testing whether a substance is a liquid or a solid also indicators. We did all those experiments in class."	Little of practical work in chemistry, and are teacher demonstrations.
	S2005: "We are not familiar with practical work because of lack of apparatus. The chemicals that we have, have just arrived, its too late now.... and they are like micro. So we cannot use like to satisfaction. The teacher did it for us. He then gave us a chance to do it, some of us. Usually we watch the teacher doing it, like in biology the teacher do it for us."	S2005: "At my school we are not very familiar with practical work because of lack of apparatus but with the few apparatus we have we can do certain practical work."	Little practical work, and are teacher demonstrations because of a lack of apparatus.
	S20018: "This year we did practical work two times. Last year we never did any. The teacher chose two people to assist her, and told them to mix something and showed to the whole class. We have done one practical as a group. It was on titration. Mostly they are done by the teacher. She would, may be, choose two students to help her."	S20018: "I have been in my school about six years and I have done about 2 experiments. Our teacher supplies us with theoretical part of subjects. Most of the time they ask the questions on experiments on the final paper which is difficult to answer because I have never done that practical work."	More theory than practicals. Little practical work and is teacher demonstration. Almost no group or individual activities.
Abdoo Moosa	S3007: "When we start a new subject we first do the theory and then practicals after that, once a week. We have done one or two experiments for practical work on our own where the teacher has just watched us. Just guided us and watched us. And some other experiments he did it in front of the class where we watched. No individual activities"	S3007: "It is exciting and fun and at the same time you learning and gaining knowledge. We are also very enthusiastic towards our practical work."	Some practical work but, more of teacher demonstrations than group work. No individual activities
	S30030: "We wouldn't say how many times in a week, of course according to the syllabus, mostly we have done the experiments for chemistry for one term. Like we did about mostly 5 experiments that's all in a term......[The teacher] shows to us, after that he helps us and we do it ourselves. We do it in groups."	S30030: "It is very exciting to learn about practical work because when we read about it, it makes no sense to one's brains, but once you have done the practicals, you have an understanding about the experiment."	Some practical work but more of teacher demonstrations and group work.
	S3008: "We do practicals but, not all of the practicals. More of theory than practicals. Once in three weeks. The teacher had everything set up on his desk and he showed it to us. The teacher was demonstrating. In science the teacher demonstrated everything to us."	S3008: "It has been fun and interesting but teachers should concentrate on doing more practicals as it enhances our knowledge and it makes it easier to understand and see things more clearly."	More theory than practical work. Mostly teacher demonstrations.
	S30031: "Practical work, quite honestly, we have only done practical work this year. We have done practicals but not us as pupils, our teachers have done practicals....the experiments for us. And this year we did a few experiments ourselves for our practical marks. The teacher does the experiment in front of the class and we all are observers."	S30031: "Up to matric level all experiments were carried out by teachers. Due to the need for practical marks, students are allowed to do experiments by themselves only in STD 10. The unavailability of chemicals and equipment also play an important role in the fact that teachers do experiments."	More teacher demonstrations because of a lack of apparatus. Students do practicals on their own for practical examination marks.
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	S40011: "We don't do it. We just talk about experiments. No practical work at all."	S40011: "There's a practical work but never been done, not that I know of."	No practical work at all. It is done theoretically.
	S4001: "No experiments in chemistry. Mostly in biology. Teacher demonstration in biology."	S4001: "It is not very good because of less apparatus. But we are trying to have ideas when we came upon an experiment in the book."	Due to a lack of apparatus, students read about practical activities from books. Biology practicals are teacher demonstrated.
	S4005: "Ah..we don't usually do practical work, we don't have equipment. We did 3 or 4 experiments last year. The teacher was showing us."	S4005: "Mostly it depends on the teacher who is teaching that subject. We didn't do much in chemistry. Our problem was that we didn't have much apparatus so far."	Because of a lack of apparatus, little practical work was done and was teacher demonstrated.

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