AN INVESTIGATION INTO STUDENTS' ACTIVITY-BASED LEARNING IN THE SALTER’S SCIENCE COURSE

Ching-Kai Huang*, Yu-Jen Su*
*D.Phil student, Professor of Chemistry
Chemistry Department, Dept. of Science Education
York University, U.K., National Taichung Teachers College

ABSTRACT

This study focused on how teachers use an activity-based learning science course in secondary schools to teach students (Key Stage 4 in this study). The course chosen in this study was developed by the University of York Science Education Group (UYSEG) and it is called Salters’ Science course. The research questions in this study are: (i) What activities do teachers of Salters’ Science utilize in science lessons? (ii) What are the differences between activities teachers utilize in the classroom and activities suggested in the published materials? Where differences exist, what are the reasons for the differences? (iii) How do the key people involved view the effects of this course? (the teachers, the students and the course designers.)

The methods used to collect data were classroom observations, questionnaire survey, interviewing the teacher of the class in which classroom observation was conducted and the interview with a member of the staff in the UYSEG who was involved in the design of the Salters’ Science course.
The main findings in this research are: (i) The teacher mainly utilized the activities in the Salters’ Science course unit guides in his teaching. (ii) The main reasons the teachers gave for not using activities in the course were a lack of time or the teacher thought that the use of activities did not match students’ learning abilities. (iii) Overall, the teacher and the students had positive responses towards the Salters’ Science course. As there has been a trend towards activity-based learning in science education, this small scale study showed that there appears to be some benefits for teaching and learning, though further in-depth investigations are required to explore the effects in more details.

INTRODUCTION

After the Education Reform Act in 1988, the National Curriculum was established in England and Wales. It suggests a skeleton structure for the new curriculum, in which science is one of the core subjects in the National Curriculum. There are several sorts of science curriculum organised under the National Curriculum criteria. The Science Education Group in the University of York (UYSEG) developed a science curriculum named "Science - Salters' Approach" which is now being used by many schools in England. A key feature of this course is that it promotes the use of a wide range of teaching activities in science lessons.

In Taiwan, teachers transmit knowledge and information to students mainly by direct exposition. Although there are practical work for students to do, there are not many other activities for them to do in science lessons. In other words, students spend most time listening to teachers’ talk and jotting down notes written on the board. Therefore, the principal aim was to conduct a study on a science curriculum containing lots of activities which can be utilized in science lessons.
The purpose of this study was to explore the differences between the teaching activities laid out in the Salters' science course materials and what those were actually used in the classrooms.

The following specific research questions were raised:

(i) What activities do teachers of Salters' Science utilize in science lessons?

(ii) What are the differences between activities teachers utilize in the classroom and activities suggested in the published materials? Where differences exist, what are the reasons for the differences?

(iii) How do the key people involved view the effects of the course? (the teachers, the students and the course designers).

THE SALTERS' APPROACH TO SCIENCE IN KEY STAGE 4

A. The Salters' Science course

Information about the development of the course is referred to Campbell et al (1994) and some background factual details are also obtained from the interview with the member of the staff in UYSEG.

The development of the materials began in 1982. A key feature of the development process was that teachers were involved extensively in the development of materials. Teachers were invited to writing workshops where ideas were discussed and materials drafted. These were then passed onto a team of editors based at York, all of whom were former teachers. This team put together the unit guides for the course.

The process of designing the course is summarised in Figure 1. (Adapted from Campbell et al., 1994)
a. Experienced school science teachers.  
b. University-based science educators.  
c. School science advisors.  
d. Industrialists.

↓ Consist

Workshops

↓ Develop

The outline of the course

↓ Give them to

Full time editors.

Figure 1. The process of designing the Salters’ Science course

Legend:
1 Teachers who come from schools as follows: comprehensive, selective, 
maintained, independent, urban and rural.
2 Teachers who have been released from their work temporarily to be the 
full-time editors.

The first units developed originally focused on chemistry for secondary 
schools, with the Salters’ Chemistry course being introduced into schools 
in 1986. Response to the Salters’ Chemistry course was very positive and 
provided the motivation to develop physics and biology units to accompany 
the chemistry units. The Salters’ Science course was introduced in 1990.

In addition to the unit guides, which were written primarily for teach-
ers, the Salters’ Science course also has a “textbook” for students. These 
textbooks are different from traditional ones. It provides students with extra 
information and topic summaries. The main materials for teaching are actu-
ally in the unit guides. The intention was that teachers using the Salters’ Science course could draw on the materials flexibly using materials for the unit guides and textbooks to construct their own lessons.

The name “Salters” comes from the first sponsor of the course developments — the Salters’ Institute for Industrial Chemistry.

According to Campbell et al. (1994), the basic design criteria of Salters’ Science are:

(i) *Units of the course should start with aspects of the students’ lives, which they have experienced either personally or via the media, and should introduce ideas and concepts only as they are needed.*

(ii) *The course should include a wide range of activities in which students can actively engage.* (P. 419)

These provide the rough direction in the planning of the Salters’ Science course. The main aim of the course is to make science more interesting and relevant to students. It also encourages students to acknowledge that science is related to their daily life. As Campbell et al. (1994) stated

“*We wanted to make the subject interesting and accessible to all.*” (P. 420)

The member of the staff in UYSEG expressed the learning procedure in the Salters’ Science course as follows

“you start with everyday experiences, you gather that information about that, then you explain the experiences, then you are back again to look at the original context which now we can understand better.”

Another purpose of designing the course was to provide a fundamental knowledge of science for all students and inspire them to undertake science at higher levels. As the member of the staff in UYSEG stated,

“we wanted to show that the science ideas can help ordinary people to understand the things that happen round about the everyday life.”

Thus the Salters’ Science course is based on interactive teaching-learning material which would result in teachers and students engaging in a wide range of activities in the classroom.

The theory of learning in Salters’ Science course is presented in the
The theory of learning in the Salters' Science Course

Learning is constructed by teachers and students. Scaife (1994) argued that "learners contribute their ideas and are involved in the teaching strategies throughout the program" (P.66).

This means that students have their experiences and views about science before they actually go to schools. Teachers have to be aware of what knowledge level the students have and then give them further information. Students could immerse themselves in science if teachers communicate and discuss what they are thinking with them. The Salters' view of the science courses can be summarised as follows:

*The most important single factor influencing learning is the active engagement of the learner with the material. Obtain this – and teach by whatever methods retain this engagement. (Campbell et al., 1994 : P.425)*.

Since there are many activities in the Salters' Science Course, the course could be termed an activity-based learning course. The term "activity-based learning" will be explored in more detail later.

The Salters' Science course contains 22 units which are a mixture of chemistry, physics and biology. There are unit guides for teachers and textbooks for students. Basically, the unit guides contain worksheets teachers could utilize and activities they could adopt in lessons. As described earlier, students' textbooks are designed to provide additional information, they are not essential for the course. Since the research project focuses on chemistry, the examples provided in the following sections focus on chemistry units.

There is an overall unit plan for each unit which summarises the content of each lesson. Part of the Food for Thought (FT) unit is shown as an example in Figure 2. (UYSEG,1990).
FT1 How are crop yields increased?

A short discussion of the world food problem is followed by an examination of the compounds in fertilizers and the setting up of an investigation into nutrients necessary for plant growth. The properties of nitrogen are examined to discover why the plentiful supply in air is not utilized by plants.

↓

FT2 What is a fertilizer?

Ammonium sulphate is heated to form an alkaline gas and an acidic residue. The properties of ammonia and its possible usage as a fertilizer are discussed.

↓

FT11 Is it possible to feed the world?

Possible ways in which the supply and availability of food can be increased and consideration of the reasons why these measures are not always implemented.

Figure 2. An example of the overall unit plan of Salters’ Science Course

C. The curriculum studied in this research

Each unit contains about ten lessons and there are several kinds of activities which teachers are able to adopt in lessons. All activities in Salters’ Science are summarised in Appendix 1. Because some activities use different titles but appeared to have the same meaning, it was decided to group such activities together under one heading.

The unit guides also suggest what teachers could do in each activity
and how to do it. The Teachers' Guides includes worksheets for students which can be photocopied and used as handout in the lesson.

Every chapter in the textbooks is divided into five parts (UYSEG, 1990 : P.15) as shown below:

(i) Introducing: A page to set the scene for the unit and raise some questions to be answered later.

(ii) Looking at: Visually attractive articles on subjects relating to the theme of the unit.

(iii) In brief: A summary of what students need to know and understand about the theme of the unit.

(iv) Thinking about: A section which explains key scientific ideas developed in the unit.

(v) Things to do: A bank of activities, including activities to try: things to find out: things to write about: points to discuss: questions to answer.

The next section contains more reasons for selection and a detailed analysis of the units used in this study, Food for Thought (FT) and Making use of Oil (MUO).

D. The choice of units

The units Food for Thought (FT) and Making Use of Oil (MUO) were chosen in this research project because the researcher's interest is in chemistry and prat of the research study involved observing the teaching of these two units.

Food for Thought

(A) Unit guide

There are eleven lessons in this unit as shown fully in Appendix 4. There are about sixteen activities that the unit guide suggests teachers can adopt in teaching and homework/suggestions. Practical work and teacher-student discussion were found to be the two most popular activities in the unit guide.
(B) Textbook

The result of the analysis of the textbook (Food for Thought unit) is given in Appendix 5.

Making Use of Oil

There are nine lessons in this unit and they are given in appendix 6. This unit provides the main research vehicle of this project therefore researcher was involved in all classes from the beginning to the end of the unit when the unit was being taught.

(A) Unit guide

Analysis of the activities included in each lesson is shown in Appendix 3. There are about ten activities suggested in the unit guide which teachers can utilize in lessons. Again, the three most popular activities in MUO were found to be homework/suggestion, practical work and teacher-student discussion.

(B) Textbook

It can be seen from the examination conducted in this study that there are more activities teachers could utilise in the FT unit than those in the MUO unit. One reason may be that the FT unit contains more lessons. However, the three most popular activities suggested by unit guides are the same in both units and "teacher-student discussion" had the highest percentage among all activities in these two units. Communication between the teacher and students may be thought to be an important issue in Salters' Science course.
ACTIVITY-BASED LEARNING IN SCIENCE

As described in previous section, the Salters' Science is an activity-based learning course.

Dewey (1968) asserted that the word "learning" has two meanings:

(i) learning is the sum total of what is known, as that is handed down by books and learned by men.

(ii) learning means something which the individual does when he studies. It is an active, personally conducted affair. (pp.334 - 335)

The first point is well known by teachers in that they transmit knowledge to students as experts in their specific academic areas. This method could be classified as a traditional form of learning. It cannot be neglected because people need some basic knowledge to explore the higher levels of knowledge. As Capel et al. (1995 : P.232) argued,

"many of these facts may need to be learned by heart, by rote methods...
they are the subroutines which allow us to function at a higher level."

It should be stressed that it is a "sub-routine", and not the main mechanism. Learners do not only receive information from teachers but they also have thoughts of their own. As Einstein (1921) said:

"The value of an education ...... is not the learning of many facts but the training of the mind to think something that cannot be learned from text-books." (Dyson 1997 : P.37).

Moreover, a school is not the only source of knowledge. Students have many experiences from daily life. Novak and Gowin (1994) pointed out that:

"students always bring something of their own to the negotiation; they are not a blank tablet to be written or an empty container to be filled."
(P.21).

Therefore, learning should include teacher-student interaction. Dewey (1933) used a metaphor that our mind is like a verb, we need to think then
do things rather than to be filled like a sponge. Adolescents have a fundamental knowledge and creative power. They often seek to investigate something new by themselves. In this sense, teachers have to know what level of knowledge students have before they start teaching them to induce students to explore the world. Teachers should "open the cage door and release this creative power." (Brandes and Ginnis, 1994). Teachers could reach this goal by adopting activity-based learning methods. The second point above could express the idea of activity-based learning. As Capel et al. (1995 : P.229) identified, activity-based learning implies "something of interest and value to the learner has been accomplished and understood."

Activity-based learning lets students learn by doing, not just by listening to their teachers. For instance, students can learn through engaging in group discussion, experiments, models making, oral presentation or role play. In activity-based learning, students play a part in the learning process and they enjoy learning by doing activities in lessons. As Ramsden and Harrison (1993) stated, doing activities " ...... give learners opportunities to develop their understanding by actively engaging with some form of relevant challenging situation." (P.66)

The characteristics of activity-based learning are listed as follows and the ideas are based on those described by Brandes and Ginnis(1996) and Capel et al. (1995) :

(i)Teachers' role as helpers: The teacher is not the person who transmits information but he/she knows what students need, answers their questions and gives them guidance.

(ii)The teacher should choose suitable activities for different topics and have plans of lessons. This means the teacher does not give up his/her power totally but lets students have opportunities to take the responsibility for their learning via the doing of activities.

(iii)The teacher needs to communicate with students and listen to their ideas.

(iv)The students know the reason they learn each topic because they
can see the relationship between lessons and their daily lives.

(v) Students have more confidence in themselves because they are able to explore the nature of the phenomena of interest by doing activities. They do not simply sit there and listen to the teacher only.

(vi) Students have more interests in learning science because they can learn by doing.

(vii) Students can develop their skills of communication with peers or the teacher.

There have been a number of research studies related to activity-based learning. Firstly, there are several projects about how teachers taught and what the students' responses were to activities in lessons. Examples are as follows: Trowbridge and Bybee's (1986) research was about how students learned through science activities. Cavallo and Schater (1994) conducted a project about students' learning and understanding of biological topics. Simpson (1995), Stewart and Dale (1989) and Allison and Shrigley (1986) discussed how students did activities in science lessons and what their feelings were about the science. Tobin and Fraser (1989) investigated the use of a curriculum in which students were required to do activities in the classroom.

Secondly, there were some comparative research studies about activity-based learning: Ames and Archer (1988), Boujaoude (1992) and Rubin and Norman (1982), for example, compared the different performance and attitude of students who were taught in more activity-oriented and less activity-oriented ways, i.e. students doing activities in lessons vs students mostly receiving information from teachers. Thirdly, Gilbert and Watts (1983), Solomon (1988) and Osborne and Wittrock (1983) looked at the implications of a wide range of activities used in teaching. They suggested that teachers could motivate students and make conceptual change via broadening the range of teaching activities. Finally, Harmin (1995) gave a range of advice to teachers about what activities they could adopt in the classroom, for example, asking questions, discussions with students, allow
students to practice new ideas as much as they can and reviewing lessons.

From an overall perspective, activity-based learning is an interactive teaching and learning method. Teachers are able to understand students' previous experiences before they go to schools and try to correct some improper concepts. Students can express their ideas to teachers and other students. They do not have to put their original thoughts away without discussion. Activity-based learning thus provides a chance for students to develop the habit of learning and apply it to their daily lives. As Capel et al. (1995 : P.230) state:

"Teachers expect that what is learned in schools will be of use in the work place, the home and generally enhance pupils' capacity to cope with everyday life."

RESEARCH METHODOLOGY
AND PROCEDURE

A. Sample

As identified earlier in this paper, a number of schools in the Yorkshire area use the Salters' Science course. The study was undertaken at a "typical" school where the course is used, an 11-16 mixed ability comprehensive school. The recent inspection report (DFE 1996) gives the following details of the teaching in the school. The performance is above the national average and students' behaviour is generally good and they have positive attitudes to work. The teaching standard is high (only 5% less than satisfactory) and teachers have plans for their lessons. In general, this school was judged to be a good school which created a suitable atmosphere conductive for learning.

Compared with the national picture, the science attainment is at or slightly above average. The plan of teaching is well designed. Students are divided into groups by different learning abilities in science. The average
group size is 20 at Key Stage 4. Teachers use many practical activities to support teaching and students usually have homework to do after lessons. The HMI report indicates that the quality of science teaching at Key Stage 4 has been judged to be good in this school.

The school had the additional advantage of the Head of Science having recently completed a part-time master's degree and, as such, he was sympathetic to both the aims of the study and to some of the potential difficulties associated with data collection.

**B. Data collection**

Classroom observation is a way to acquire data directly. As Bell (1996) stated, "Direct observation may be more reliable than what people say in many instances." (P.109)

Burgess (1984) also mentioned that observations give the researcher a chance to "collect rich detailed data based on observations in natural settings." (P.79)

The main purpose of this study was to know what activities teachers utilize in lessons and what the differences are between the material in the publications and what is actually used in the classroom. Observation can record what actually happened in science lessons and how teachers utilized activities to support teaching. Therefore, it was chosen to be one method for collection of data.

At the start of the study, we did not know which unit we would be able to observe in the school, so planning of the observation schedule was based on a review of activities in all the units about chemistry in Salters' Science course. As described earlier, a range of activities is employed in the course, and we produced a list of about 30 activities based on an analysis of those used in the chemistry units in Salters' Science course. Once the decision was made about which unit was available for observation, those activities used in that unit were selected and the observation schedule was tailored to the activities actually used in the units being observed. Thus the
number of activities in the schedule is less than 30. The observation schedule finally used is shown in Table 1:

**Table 1. The observation schedule used in this study**

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<th>SHool :</th>
<th>CLASS :</th>
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<tbody>
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<td>TOPIC :</td>
<td>TEACHER :</td>
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<td>DATE :</td>
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<th>4. Data interpretation</th>
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<td>12. Group work</td>
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<td>13. Homework/Suggestions</td>
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<td>18. Planning an investigation</td>
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<td>25. Teacher Demonstrations</td>
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<td>26. Teacher explanations</td>
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<td>27. Teacher introductions</td>
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<td>28. Teacher-student discussions</td>
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<td>29. Text-related activity</td>
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<td>30. Viewing a video/slide set</td>
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Because there may be some activities the teacher utilized in lessons which did not appear in the observation schedule, there was some space left for note taking in each observation sheet. Every lesson lasted 60 minutes so three sheets were required for each lesson. The time interval for observation in this study was three minutes because, based on the experience of the pilot study, it was found that three minutes was an appropriate
interval in which to record what the teacher did and using tick boxes and note taking could also be done at the same time. The observation schedule was derived from the Association for Science Education (1989) and Eggleston, Galton and Jones (1975).

C. The procedure of classroom observations

The classroom observation was based on using the observation schedule and supported by note taking. The activities were observed as the teacher conducted them in lessons and a mark was made on the schedule every three minutes. The box was ticked if an activity happened in the time interval. After recording the events that happened in the lesson, all data were transferred to a word processor. The procedure of classroom observation is shown in Figure 3.

```
To analyse units in the unit guides
  ↓
To design the classroom observation schedule
  ↓
To write letters to schools
  ↓
To obtain the permission to enter schools
  ↓
To conduct observations
  ↓
To analyse data
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Figure 3. The procedure of classroom observation

Initially, three schools which use Salters’ Science course were identified as possible for undertaking the observation. Those schools were in
reasonable travelling distance from the university. Three schools were identified in the first instance because it was anticipated that some schools would be too busy to allow the researcher to observe their lessons. It was hoped that, by contacting three schools, at least one would agree to help with this study.

Before the classroom observation started, we went to the school and discussed our plans with the Head of Science. His teaching schedule indicated only Making Use of Oil (MUO) would be available for us to observe the whole unit throughout that the term. It was therefore decided to make this unit the main target of classroom observation. There was more than one teacher teaching MUO but all teachers who taught MUO had lessons at the same time. Hence there was only one class available.

In order to become familiar with the style of science lessons in England and at the school in particular, we did some classroom observations of the unit Food for Thought (FT) unit. This also served the additional useful purpose of assisting in the finalisation of our observation schedule.

The school divided students into different groups by learning abilities and the group observed in FT was a lower ability group. When this observation was in progress, we had not decided which ability group would be observed when the MUO unit started. There were three teachers doing MUO in the term. After conducting four lesson observations, we found that it was not easy for the teacher to do activities in lessons because the teacher needed to spend a good deal of time on repeating instructions to students. For this reason we decided to select the top group for observation when Muo was taught.

There were two science lessons for the top group every week and the teacher spent about six weeks in total teaching this unit. I observed every lesson in this unit. Every time I sat at the back in the classroom and watched what the teacher and students did and then made a record. The writing of the teacher was also copied by me. The teacher usually told me
what would be included in the lesson before the students entered the classroom and that was very helpful as it gave me a brief idea of what he had planned for the lesson.

There were eleven lessons observed in MUO unit and the timetable of visiting schools is shown in Table 2. The observation of MUO unit was from May 15th to July 1st, 1997.

Table 2. The timetable of the classroom observation

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<tr>
<th>Date</th>
<th>15/5</th>
<th>20/5</th>
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<th>10/6</th>
<th>12/6</th>
<th>17/6</th>
<th>19/6</th>
<th>24/6</th>
<th>26/6</th>
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<tbody>
<tr>
<td>Lesson</td>
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</table>

Two problems were encountered during classroom observations. Firstly, there were some activities which were not set in the observation schedule. Sometimes I needed to make notes and tick activities happening in the observation schedule at the same time. For example, there were occasions when I needed to copy the words the teacher wrote on the board but also had to pay attention to what the teacher was doing. When this happened, I focused on observing the teacher. Another problem arose when the teacher walked around the classroom while students were doing experiments, and I could not really be sure if the teacher was giving instructions or discussing ideas with students. The words could be heard sometimes but not always, and so it was occasionally unable to make entries in the observation schedule.

D. Questionnaire surveys

The questionnaires were administered to the students in the group being observed. The reason for using questionnaires in this study was to gather students' ideas about activities they did in the MUO unit. By using questionnaires, the ideas of students in the whole class could be collected in a short time and some qualitative data could be obtained. As Bell (1996)
stated, "Questionnaires are a good way of collecting certain types of information quickly." (P.76).

Some questions in the questionnaires were used in interviews with the teacher and the member of staff in UYSEG as well in order to compare the different thoughts among students, the teacher, and the member of staff in the UYSEG.

(A) The design of the questionnaire

The questionnaire was composed of two parts: one part asked how much students liked the activities in each lesson, and this information was obtained through the use of tick boxes. The activities which appear in the unit guide, but the teacher did not do, were not included in the questionnaire. The other part had four open-ended questions for students to complete, enquiring about their views as to which activities they had enjoyed most or least (and why) and which they had found was the most or least interesting activity (and why).

(B) The procedure of using the questionnaire

The questionnaires were given to students when the teacher finished the unit, and then all questionnaires were returned to the researcher. The procedure of using the questionnaire is shown in Figure 4.
Figure 4. The procedure of using questionnaire

(C) Using the questionnaire with students

The teacher gave questionnaires to students when the MUO unit was completed and the teacher asked students to return them to the researcher after they had answered all questions. It took about fifteen minutes to finish the questionnaires. Questionnaires from 25 students were returned to the researcher. In fact there were 28 students in the top group but three of them were absent on the day the questionnaire survey was administered.

Two problems were encountered when using the questionnaires. The questionnaires were given to the students in the last lesson and they were asked to complete it right away. Some students discussed their answers with each other while answering the questionnaires. This may indicate that
the answers were not representative of individuals in the group. Also because the time available was quite short, the students may not have had enough time to answer questions in the second part. However, it was not possible to do anything about these aspects.

E. The interviews

Two people were interviewed in this study. As mentioned in previous section, they were the teacher whose lessons were observed and a key member of staff in the University of York Science Education Group (UYSEG) who had been significantly involved in planning and writing up the Salters' Science course materials.

(A) The design of interview questions

The teacher interview schedule consisted of two parts:

(i) General questions: They were about the teacher's opinions of Salters' Science course, how the teacher planned his teaching and how he used the unit guides.

(ii) Questions about teaching activities:

This part was aimed at trying to find out the differences between the activities in unit guides and those the teacher actually utilized in lessons. The questions were split into two groups: one on the activities the teacher did but not in unit guides and the other on the activities in unit guides but the teacher did not utilize. The questions were designed lesson by lesson and asked the teacher why s(he) did such activities when s(he) taught. The interview schedule was drawn up after the observation of the lessons had taken place.

The interview schedule used with the member of staff in UYSEG had three parts: (a) the development of the Salters' Science, (b) the design of unit guides in the textbooks, (3) the use of Salters' Science course. Some of the questions were also asked of the teacher and the students in order to make comparisons in responses.
(B) Interview procedure

For the teacher interviews, after the teacher had completed the MUO unit, the interview was conducted in the classroom. The teacher was given a copy of the questions one week before the interview to allow more time to think about the questions in advance such that more reliable data could be gathered. The teacher referred to unit guides and the notes in his folder when the interview was being in progress to support verbal responses. A tape recorder was used and transcriptions were made afterwards. The procedure of interviews is shown in Figure 5.

A. The interview with the teacher

<table>
<thead>
<tr>
<th>Complete the classroom observation</th>
</tr>
</thead>
<tbody>
<tr>
<td>↓</td>
</tr>
<tr>
<td>Design interview questions (There were two parts in interview questions and one of them was based on the classroom observation result.)</td>
</tr>
<tr>
<td>↓</td>
</tr>
<tr>
<td>Give the interviewee interview questions in advance (1 week earlier)</td>
</tr>
<tr>
<td>↓</td>
</tr>
<tr>
<td>Conduct the interview</td>
</tr>
<tr>
<td>↓</td>
</tr>
<tr>
<td>Arrange the time for interview</td>
</tr>
</tbody>
</table>

B. The interview with the staff in UYSEG

<table>
<thead>
<tr>
<th>Design interview questions</th>
</tr>
</thead>
<tbody>
<tr>
<td>↓</td>
</tr>
<tr>
<td>Contact the staff responsible for the development of the Salters' Science</td>
</tr>
<tr>
<td>↓</td>
</tr>
<tr>
<td>Give the interviewee interview questions in advance (1 week earlier)</td>
</tr>
<tr>
<td>↓</td>
</tr>
<tr>
<td>Arrange the time for interview</td>
</tr>
<tr>
<td>↓</td>
</tr>
<tr>
<td>Conduct the interview</td>
</tr>
</tbody>
</table>
Figure 5. The procedure of interviews

The member of staff in the UYSEG, as with interviewing the teacher, was given a copy of interview questions one week in advance. Unlike the teacher, the member of staff did not repeat each question before answering but gave a talk covering the questions in sequence. A tape recorder was used and the transcription was completed afterwards.

There were no serious problems during both interviews and the data was gathered using a reliable process in the light of the pilot study findings.

RESULTS AND FINDINGS

A. Data analysis and results of classroom observations

(A) Results

The activities which the teacher actually did in lessons are ticked in boxes. They are shown firstly in Table 3 and Table 4.
Table 3. The results of classroom observations

<table>
<thead>
<tr>
<th>If the activity occurred in the lesson</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
</tr>
</thead>
<tbody>
<tr>
<td>Types of activity</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>4. Data interpretation</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>9. Display/Transparency</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td></td>
<td></td>
</tr>
<tr>
<td>11. Group discussion</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>12. Group work</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td></td>
<td>✓</td>
</tr>
<tr>
<td>13. Homework/Suggestion</td>
<td>✓</td>
<td>✓</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>14. Individual work</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>✓</td>
</tr>
<tr>
<td>15. Model making</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>✓</td>
</tr>
<tr>
<td>16. Multi-media display</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>18. Planning an investigation</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>19. Practical work</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td></td>
<td>✓</td>
</tr>
<tr>
<td>20. Presenting a poster</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>25. Teacher Demonstrations</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td></td>
<td>✓</td>
</tr>
<tr>
<td>26. Teacher explanation</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td></td>
<td>✓</td>
</tr>
<tr>
<td>27. Teacher introduction</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td></td>
<td>✓</td>
</tr>
<tr>
<td>28. Teacher-student discussion</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td></td>
<td>✓</td>
</tr>
<tr>
<td>29. Text-related activity</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>30. Viewing a video/slide set</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

The shaded blocks are activities in the unit guide.
Table 4. The results of classroom observations

<table>
<thead>
<tr>
<th>If the activity occurred in the lesson</th>
<th>6</th>
<th>*7</th>
<th>N</th>
<th>8</th>
<th>9</th>
</tr>
</thead>
<tbody>
<tr>
<td>Types of activity</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>4. Data interpretation</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>9. Display/Transparency</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td>11. Group discussion</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>12. Group work</td>
<td></td>
<td>✓</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>13. Homework/Suggestion</td>
<td>✓</td>
<td></td>
<td></td>
<td>✓</td>
<td></td>
</tr>
<tr>
<td>14. Individual work</td>
<td></td>
<td>✓</td>
<td>✓</td>
<td></td>
<td></td>
</tr>
<tr>
<td>15. Model making</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>16. Multi-media display</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>18. Planning an investigation</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>19. Practical work</td>
<td></td>
<td>✓</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>20. Presenting a poster</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>25. Teacher Demonstrations</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>26. Teacher explanation</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td>27. Teacher introduction</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td>28. Teacher-student discussion</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td>29. Text-related activity</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>30. Viewing a video/slide set</td>
<td>✓</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Legend: *7: The teacher did not teach lesson 7.
N: The teacher added non-Salters' material for teaching.
The shaded blocks are activities in the unit guide.
Secondly, activities the teacher did but were not in the unit guide:

(Table 5)

**Table 5. Activities the teacher did but were not in the unit guide**

<table>
<thead>
<tr>
<th>Unit</th>
<th>Number of all activities</th>
<th>The activities done by the teacher but not in the unit guide</th>
<th>%</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>6</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>2</td>
<td>5</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>3</td>
<td>4</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>4</td>
<td>4</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>5</td>
<td>4</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>6</td>
<td>4</td>
<td>1</td>
<td>25</td>
</tr>
<tr>
<td>*7</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>8</td>
<td>5</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>9</td>
<td>5</td>
<td>0</td>
<td>0</td>
</tr>
</tbody>
</table>

*7: The teacher did not teach this lesson.

Thirdly, activities in the unit guide but the teacher did not utilize:

(Table 6)

**Table 6. Activities in the unit guide but the teacher did not utilize**

<table>
<thead>
<tr>
<th>Unit</th>
<th>Number of all activities</th>
<th>The activities done by the teacher but not in the unit guide</th>
<th>%</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>6</td>
<td>2</td>
<td>33</td>
</tr>
<tr>
<td>2</td>
<td>5</td>
<td>2</td>
<td>40</td>
</tr>
<tr>
<td>3</td>
<td>4</td>
<td>1</td>
<td>25</td>
</tr>
<tr>
<td>4</td>
<td>4</td>
<td>2</td>
<td>50</td>
</tr>
<tr>
<td>5</td>
<td>4</td>
<td>2</td>
<td>50</td>
</tr>
<tr>
<td>6</td>
<td>4</td>
<td>2</td>
<td>50</td>
</tr>
<tr>
<td>*7</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>8</td>
<td>5</td>
<td>3</td>
<td>60</td>
</tr>
<tr>
<td>9</td>
<td>5</td>
<td>1</td>
<td>20</td>
</tr>
</tbody>
</table>

*7: The teacher did not teach this lesson.

The number of "units" for each activity in lessons is displayed in Table 7.
Table 7. The number of “units” of each activity in lessons

<table>
<thead>
<tr>
<th>Lesson</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
<th>6</th>
<th>N*</th>
<th>8*</th>
<th>9*</th>
</tr>
</thead>
<tbody>
<tr>
<td>4. Data interpretation</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>9. Display/Transparency (blackboard)</td>
<td>6</td>
<td>7</td>
<td>4</td>
<td>17</td>
<td>5</td>
<td>8</td>
<td>4</td>
<td>6</td>
<td>16</td>
</tr>
<tr>
<td>11. Group discussion</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>12. Group work</td>
<td>8</td>
<td>5</td>
<td>8</td>
<td>0</td>
<td>20</td>
<td>0</td>
<td>9</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>13. Homework/Suggestion</td>
<td>0</td>
<td>3</td>
<td>2</td>
<td>0</td>
<td>0</td>
<td>3</td>
<td>0</td>
<td>1</td>
<td>0</td>
</tr>
<tr>
<td>14. Individual work</td>
<td>0</td>
<td>6</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>10</td>
<td>11</td>
</tr>
<tr>
<td>15. Models making</td>
<td>0</td>
<td>8</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>16. Multi-media display</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>18. Planning an investigation</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>19. Practical work</td>
<td>6</td>
<td>5</td>
<td>8</td>
<td>0</td>
<td>14</td>
<td>0</td>
<td>9</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>20. Presenting a poster</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>25. Teacher Demonstrations</td>
<td>6</td>
<td>6</td>
<td>0</td>
<td>4</td>
<td>5</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>26. Teacher explanation</td>
<td>14</td>
<td>8</td>
<td>5</td>
<td>15</td>
<td>19</td>
<td>12</td>
<td>8</td>
<td>5</td>
<td>5</td>
</tr>
<tr>
<td>27. Teacher introduction</td>
<td>0</td>
<td>4</td>
<td>3</td>
<td>1</td>
<td>5</td>
<td>2</td>
<td>1</td>
<td>2</td>
<td>1</td>
</tr>
<tr>
<td>28. Teacher-student discussion</td>
<td>5</td>
<td>12</td>
<td>11</td>
<td>8</td>
<td>13</td>
<td>3</td>
<td>9</td>
<td>7</td>
<td>3</td>
</tr>
<tr>
<td>29. Text-related activity</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>30. Viewing a video/slide set</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>8</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
</tbody>
</table>

Note:

a) N* - Non-Salters’ lesson.
b) The number of occasions each activity occurred.
c) Because the teacher taught lesson 8 and lesson 9 together in one lesson, the “unit” of activities are added together in 8*. In 9*, the number comes from the last classroom observation plus the number obtained from 8*. 

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(B) Findings

From Tables 5 and 6, it can be seen that the teacher basically adopted activities in the unit guide in teaching. However, there were fairly high percentage of activities which the teacher did not utilize in the unit guide. This is due to the flexibility of the Salters' Science course in that teachers could select different teaching activities to match students' needs in different learning ability groups.

From Table 7, a brief sketch of the teacher's instruction can be uncovered. The teacher used display /transparency, teacher explanations, teacher introductions and teacher-student discussions quite often during teaching. They are all traditional ways to transmit information to students. However, these activities are not suggested for use in the unit guide to a great extent. The teacher may think they are good ways to give students some background or fundamental knowledge before continuing to let students do some other activities to enhance the effectiveness of learning and teaching.

(C) Summary

Such classroom observation provides my personal view from "standing out there and looking in". Although data shown in the tables and diagrams has revealed some sort of insight, there still needs other supporting evidences. In the following, the views from students will be presented via analyzing questionnaires which can provide a crucial mechanism through combining both quantitative and qualitative data to gain deeper information.

B. The findings from interviews

The learning activities could be divided into three groups: the first one relates to which activities students like more than they dislike, and this includes burning crude oil (91.7 %), burning liquid paraffin (87.5 %) and making soap (86.9 %). Clearly these are all forms of practical work. Students like to do something and observe what really happens when they learn science. The second group has activities which students do not like to
do very much. They are copying down writings of the teacher (66.6 %), answering questions on the sheet (50 %) and doing homework (95.8 %). These activities may take time in terms of writing when compared with the practical work, and students need to be more quiet and could not do anything else. That may make them feel bored if it takes a long time to complete them. The last group consists of activities which half or nearly half the students chose as “middle” but there was still a slight difference in these activities. They are discussed as follows (The percentage given after each comment is for the “middle” category):

(i) Answering the teacher’s questions (54.2 %): the percentage of students who did not like this activity was more than that of the students who liked it. Many students may not like answering questions. According to the situation in the classroom observation, it was found that less than ten students gave responses when the teacher asked questions.

(ii) Making a model of the structure of rocks (50.0 %): there were more students who liked this activity than those who disliked it. This may be because it enabled students to do something in the lesson but not to just sit over there and listen to the teacher or copy writing from the teacher.

(iii) Observing the teacher’s demonstration of burning crude oil (41.7 %): such finding is similar to that in (ii). Though students did not do the experiment by themselves, it might be still interesting to see something happening in front of them.

(iv) Watching the video about polyethylene (54.2 %): Opinion was evenly-divided among students. There were 20.8 % students who liked it and there were 25.0 % students who disliked it. Over 50 % students did not have strong feeling about it.

To sum up, it has been demonstrated from the above analyses:

(i) Salters’ Science course has effect on the style of exams: because Salters’ Science course contains lots of activities related to students’ daily life, it can motivate the questions in exams towards this emphasis. This can be witnessed from one of the excerpts from the interviewee, “Examina-
tions now have tended to move more towards providing some sort of contexts to schools and asking students to use science knowledge to answer questions about them.

(ii) Salters' Science course has influenced other syllabi to change to be more close to students' daily life and not only to concentrate on the acquisition of theoretical knowledge. (iii) Salters' Science course has allowed more people to think about what is a better way to teach science and this has influenced their approach to teaching and preparation.

C. The findings from interviewing the teacher

In general, the teacher had good lesson plans and was concerned about what may be the most suitable material for students to learn and what students may like, and tried to inspire students' interests on learning. He considered the utilization of different activities for different groups of students. This is thought to be a positive approach because different groups of students have different levels of receiving information and their focus may be varied. As described in previous sections, the teacher also performed the role of a helper for students. This has matched very well with some characteristics of activity-based learning. Although not very experienced, the teacher was strongly enthusiastic about teaching and expressed a desire to learn more from his practice in teaching.

D. The interview with the member of staff in UYSEG

In relation to the views of the member of staff from UYSEG, the following points were found: besides providing a good deal of background information, the interview data shows that the design team of Salters' Science considered the teachers' and students' actual needs then organised teaching materials for teachers. This has made Salters' Science more practical and relevant to teachers and students.

Another important point is that Salters' Science has caused some impact on science teaching. It has encouraged people to seek a better way
of teaching and learning. When people start to debate on this issue, then innovation happens. This is a positive impact because teaching quality has to be improved continuously so that students can learn more effectively.

E. Triangulation of the data

In this section, the answers to the questions applied to the teacher, the students and the member of the staff in UYSEG were compared one another. The data from classroom observations are also included in discussions. All data are divided into four main categories and then considered separately.

a. The activities teachers liked or disliked

The teacher did not say what he liked about the Salters’ Science course but he thought that it is a good source of teaching materials. According to the member of the staff in UYSEG, the design of the Salters’ Science course was based on considering the teachers’ needs in the real teaching situation. Therefore the teacher, it was anticipated, may like the teaching materials in unit guides. This matches the teacher’s opinions. It can be concluded from the data that, in the school during the study was carried out, the Salters’ Science course reaches its goal in meeting teachers’ needs in this aspect. From the classroom observation data and the second part of the interview with the teacher, it can be seen that the teacher basically adopted the sequence of lessons and activities in the unit guide when he taught MUO. This provides further evidence that the teacher valued the content of the Salters’ Science course.

Secondly, the teacher stated that he did not like the “role play” activity because it was not effective in terms of leaning and teaching when he used it. The member of the staff in UYSEG had aired his different views. He did not in fact mention anything about “role play” when he talked about the activities teachers may not like. In his opinion, the teacher may not like that the Salters’ Science course has not offered a significant theoretical idea in each unit and this may confuse teachers when
they are teaching. For example, a teacher may not be sure of the levels of knowledge of students when he/she starts a new unit, because the previous unit which relates to the same topic may not be taught by him/her. This concern is sensible and it may occur in practice. It would have been better to ask the teacher if he was encountered the sort of problem when he was teaching then to compare his answer with the member of the staff in UYSEG.

b. The activities students may like or dislike

The teacher thought that students may like lots practical work in science lessons because doing experiments can inspire students' interest in science. The member of the staff in UYSEG thought that students liked to experience lots of things by themselves and they like activities which are relevant to everyday life. The opinions from these two resources reveal that from the point of view of both the developers of the materials and of this teacher, practical work may be the activity students like the most. From the classroom observation, it can found that the teacher encouraged students to do experiments in several lessons. Thus the teacher did try to make science lessons more attractive to students.

Considering the activities students may dislike, the member of the staff in UYSEG and the teacher had different opinions. The member of the staff in UYSEG thought that students may be confused about what they should learn, and they may lack some information because they had worksheets and they did not have to take so many notes. From the teacher's point of view, he thought that students do not like worksheets because they need to write something. However, the teacher needed to use worksheets because there were not textbooks for students in this school. He tended not to use too many worksheets in lessons.

The main point here is: the students may not like worksheets but it is necessary for teaching and learning. Worksheets provided background information students need and told them essential knowledge they have to learn. The question of how to use worksheets properly is a challenge for teachers.
Teacher need to find the suitable point at which knowledge is transmitted and students do not get bored from written work. The other task for teachers is that they may need to tell students what they need to know in lessons to reduce the possibility of confusion. Here teachers become advisers to the students. They prepare background information for students but let students explore more knowledge for themselves, for example, in letting them do practical work then observe phenomena and make records.

F. The activities most/least useful to students

The teacher and the students all thought that practical work was the most useful activity for learning because students remembered and understood better when they did experiments by themselves. As Woolnough (1991) stated,

"First, it is fundamental to learning for students to be personally and actively linking the concepts, experiences and broader contexts which they possess and which are involved in the practical work ···· Second, it is crucial for students to understand and control the how, when, what and why of such linking." (p. 76)

There was a minority of students who considered that copying words from the OHP and homework were useful activities for learning. This may be partly due to the fact that they did not like writing. Most students thought copying from the board was the least useful activity because, in their opinions, copying did not make them think and they sometimes did not understand what they were writing. Some writing was based on the worksheets. The teacher thought worksheets could offer basic information for students but he thought worksheets were less useful for learning. He did not like to use too many worksheets and he selected different worksheets for different groups.

Another less useful activity students selected was watching the video on polyethylene. They thought that was boring and the information was outdated. This is quite different from the teacher's point of view. From the
interview, the teacher mentioned that students may like videos. This conflict may be because the content of the video was not attractive enough to students but it cannot be concluded that students do not like videos. Students’ ideas about the video may depend on the content of the videos.

G. The activities most/least interesting to students

Here the result is consistent with that found in the previous section. Both the teacher and students thought practical work was the most interesting activity and writing was the least interesting activity. Practical work is popular with students because they like to learn by doing activities. As Hodson (1996) stated:

“Not only do students need to know certain chunks of scientific knowledge, they also need to know why and how scientists have come to know ...to engage in these problems for themselves.” (P.757)

Gonzalez and Gilbert (1980) also asserted that students thought practical work is helpful for learning. There have been many research studies related to practical work and it seems to suggest that practical work is popular in school science and some of the articles revealed that students like to do practical work in science lessons. (Hodson, 1990; Garrett & Roberts, 1982; Millar, 1987; Clackson & Wright, 1992; Woolnought & Toh, 1990)

H. Others

The teacher expressed the view that because the group was an upper set, the did not teach some lessons and gave them as homework. the teacher also said that students “would believe in formation we talk about or I explain it and they all get information.” (The teacher’s writing could be a way to transmit the information.) He believed that students could understand well by themselves. from the student’s responses to the questionnaires, not all of them agree on this point. Two students did not know if they did things correctly, three students said copying from the OHP was “doing but not understanding” and two students stated that they learnt
nothing from copying words from the board or answering questions. Another two students expressed the view that copying off the board was not helpful to learning and one students said he did not understand when he answered questions.

This reveals the gap between the teacher and the students. Students may do the work the teacher requires well but they do not really obtain and understand the information the teacher wants them to acquire. In order to narrow down the gap, more communication between the teacher and the students is needed. In other words, teacher-students interaction is an important factor to influence the effectiveness of learning. As Kyriacou (1995) asserted:

"the teacher’s skill in relaxing control over the direction of contributions, while at the same time retaining appropriate control over the mature and procedure of the discussion, is important." (P.18)

Students and the teacher can therefore know each other’s ideas in more detail via discussions but the outcome may be superficial in nature. The teacher adopted teacher-student discussion activity in teaching MUO, but the situation was that usually the teacher asked questions then the students answered, or the teacher introduced new concept then explained it to the students. The students did not have many opportunities to "discuss" with the teacher or with other students. This may be the main reason to cause such different views of the same thing between the teacher and the students here.

CONCLUSION

As the teacher reflected at the end of interviewing: "I am still learning, still learning teaching" and he regarded teachers as "adult learners". They do not stop learning when they become teachers but they learn from students when they are teaching. Bell and Gilbert (1996) provided several
examples of teachers' expressions about how they felt that they were also learners when they taught. Salters' Science course is an activity-based learning course. Teachers could have lots of communications and interactions with students via activities they conducted in the classroom, which means teachers have an opportunity to learn something from students. For example, students may have new ideas or suggestions which teachers have never thought of before. When these thoughts come out, they may inspire teachers to improve their teaching in subsequent lessons. Then the next group of students could learn better and more thoughts appear.

The Salters' Science contains a great deal of activities in which students have many opportunities to experience scientific phenomena by themselves. The teacher's role is as an advisor who gives instructions to students. The instructions therefore become an important factor to affect teaching and learning in Salters' Science course. As Linn and Songer (1993) stated:

"Effective instruction can help students organize their intuitive conceptions into "principle" consistent with those help by experts." (P.141)

This was the method that the teacher adopted in his teaching in this case study as he utilized different activities for different learning ability groups. Teachers should therefore know the ability level of their students and adjust their teaching accordingly. Furthermore, teachers need to appreciate what students really need. "Learners are not forced to run before they can walk ...... encouraging learners to develop their won intuition about what new challenges will be suitable and productive." (Claxton, 1991: P.101) Again, teacher-student interaction affects the effectiveness of teaching and learning.

From the teacher's and the students' responses in this study, the teacher had a positive attitude towards the Salters' Science course and the students liked activities contained within it, though not every activity was used in lessons. Activity-based learning may be a good way for teaching and learning and it may become a trend for science education in the future.
The full benefits of this method of teaching and learning can, however, only be revealed by further and more in-depth research.

REFERENCES


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Education.


