EXPLORING THE COMMON PROBLEMS IN LEARNING SCIENCE PROCESS SKILLS AMONG FORM FOUR STUDENTS AT KOTA SAMARAHAN: A CASE STUDY

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Masters
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EXPLORING COMMON PROBLEMS IN LEARNING SCIENCE PROCESS SKILLS AMONG FORM FOUR STUDENTS IN KOTA SAMARAHAN: A CASE STUDY

BARBARA SIAN

This "KML 6066 Research Paper" is submitted in partial fulfilment of the requirement for a Master of Science (Learning Sciences)

Faculty of Cognitive Sciences and Human Development
UNIVERSITI MALAYSIA SARAWAK
(2015)
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Last but not least, I am blessed abundantly with love and endless support from my husband, Hosea Dominic and our children; Amos Keagan, Abner Owen and Azel Zidane Gawia. This success is also dedicated to my parents, in-laws and siblings who have extended their time and effort to help me with baby-sitting; and without whom I may not be where I am today. Finally, I owe my thanks to my friends, colleagues, course mates and students for their valuable input. God bless you all!
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ABSTRACT

EXPLORING THE COMMON PROBLEMS IN LEARNING SCIENCE PROCESS SKILLS AMONG FORM FOUR STUDENTS AT KOTA SAMARAHAN: A CASE STUDY

Barbara Sian

This qualitative research by case study aims to explore form four students’ common problems, the causes and solutions to the problems in learning Science Process Skills (SPS) based on their responses in an open-ended survey questionnaire. Eight students from both science and art streams were purposively selected as informants based on certain criteria. Based on the findings, the problems encountered by these students in learning Science Process Skills (SPS) were more prevalent among the students than teachers. The causes to these problems were also most prevalent among the students, in addition to teachers and school laboratory facilities. Several suggestions were proposed to improve teachers, school administration and students’ roles in making the learning of SPS easy and fun. It is hoped that feedbacks provided by the students would give some insight for the parties involved to do their part in making the learning of SPS relevant to students’ lives.
ABSTRAK

MENEROKA MASALAH YANG BIASA DALAM MEMPELAJARI KEMAHIRAN PROSES SAINS DALAM KALANGAN PELAJAR TINGKATAN EMPAT DI KOTA SAMARAHAN: SATU KAJIAN KES

Barbara Sian

Penyelidikan secara kualitatif berupa kajian kes ini bertujuan untuk meneroka masalah biasa pelajar tingkatan empat, sebab-sebab dan penyelesaian kepada masalah tersebut dalam mempelajari Kemahiran Proses Sains (KPS) berdasarkan respons mereka dalam soalan kaji selidik item terbuka. Lapan orang pelajar dari aliran sains dan aliran sastera telah dipilih sebagai informan melalui kaedah persampelan bertujuan berdasarkan kriteria-kriteria tertentu. Berdasarkan dapatan, masalah yang dihadapi oleh pelajar dalam mempelajari Kemahiran Proses Sains (KPS) lebih cenderung berlaku dalam kalangan pelajar berbanding guru. Penyebab kepada masalah-masalah ini juga paling kerap berpunca dari pelajar, selain guru dan kemudahan sekolah. Beberapa penyelesaian telah dicadangkan bagi memperbaiki peranan guru, pentadbir sekolah dan pelajar dalam menjadikan pembelajaran Kemahiran Proses Sains (KPS) mudah dan menyeronokkan. Diharap maklumbalas dari pelajar dapat memberikan ilham kepada pihak-pihak terlibat supaya memainkan peranan mereka untuk menjadikan pembelajaran Kemahiran Proses Sains (KPS) relevan kepada kehidupan pelajar.
1.0 INTRODUCTION

1.1 Introduction
This chapter discussed the background of the study, the problem statement, the research objectives, the research questions, the significance and limitations of the study and finally, the definition of terms. This chapter ends with a brief summary.

1.2 Background of the study
The aim of this study is to identify problems, its causes and solutions in learning Science Process Skills among Form Four Students. This study focuses on both Form Four Science stream and Art stream students as problems in learning Science Process Skills exist regardless of the students' stream. Since the Science Process Skills are used extensively when Science stream students further their post secondary studies in pure sciences, therefore it is crucial to find out why problems in learning them occur. Even though the Arts stream students will not necessarily use their Science Process Skills per se in their post secondary studies or training, indirectly they could unconsciously utilize these skills in their daily life. Hence, there are a few rationales to this study.

According to the latest Sijil Pelajaran Malaysia or SPM examination format (LPM, 2012), Science Paper 2 has two parts namely the structure and essay. The structure part is divided into two more sections; Section A and Section B. Section A contains four questions that assess students' scientific skills in experimenting which altogether carry 20 marks. Section B contains five questions that assess students' scientific concepts, contributing 30 marks. The essay part is Section C; containing three questions whereby Question number 10 which assess students' ability in planning an experiment is compulsory and the other two which focus on students' ability to solve problems are optional. This study is going to focus on Section A and Question no. 10 which assess students' science process skills. This might seem small but due to the hands-on nature of activities involving science skills that can be improved through
frequent practice compared to the fact-based lessons which demands more cognitive abilities, students would fare better in answering questions related to scientific skills than scientific facts.

In the essay section, students are required to answer two of three questions whereby one of the two is compulsory and assesses students' scientific skills in planning an experiment and contribute 10 marks to the whole paper 2. Hence, the ratio of science process skill-based questions to fact-based questions is 30:70 or approximately 43%. Not only that, Science Paper 3 which is an additional school-based assessment (PeKA) focused on students' Science Process Skills, scientific attitude and noble values. According to Kupasan Jawapan Sains SPM (2010), in Science Paper 2, many students cannot answer questions which assess scientific skills such as hypothesizing, identifying variables, relating, making inference and stating conclusion. Based on experience in marking laboratory reports of these students, making inference is the most difficult skill to be acquired. This is followed by identifying variables and hypothesizing. So there is a need to identify the problems that might hinder students' effort in acquiring the Science Process Skills to enable solutions to the problems.

Starting the year 2016, other than sitting for Paper 2 like the Art stream students, Science stream students will have to sit for a centralized Paper 3 for Chemistry, Biology and Physics which means the marks will not only come from the school-based assessment (PeKA) but also from a centralized practical exam as was the norm prior to year 1999. A failure in the centralized practical exam will result in a failure in the overall SPM Pure Science papers. This extra requirement demands more emphasis on the teachers' side to find better ways to counter possible problems in students' learning of the Science Process Skills.

Although the Art stream students are not required to pursue careers that are purely Science-related but a credit in Science is a must-have additional requirement in most post secondary courses in colleges and universities, be it non-technical or technical in
nature (MOE, 2012). A credit in SPM Pure Science and Core Science papers can only be possible if students can answer most of the Science Process Skills-related questions.

1.3 Problem statement

Gaps in terms of lacking qualitative studies

There is already a vast collection of research using quantitative approach in investigating relationship between science process skills and students' achievements in science (Oloyee, 2012; Ö zgelen, 2012; SA Rahman & Mat Saat, 2005) using various modified instruments (Monica, 2005; Okey et al., 1982; Ong et al., 2011). Not only that, the relationship between the implementation of science process skills and prospective teachers' achievement in science process skills test has also been studied (Munip & Chin, 2010). The level of students' mastery (Ngah, 2005; Sahar & Abdullah, 2011) and in-service teachers' mastery (Sharif, 2006; Yeam, 2007) of science process skills have also been documented.

But only a handful of researchers are interested in using qualitative approach in investigating the implementation of science process skills (Ambross, 2011), the inculcation of science process skills among students (Abdul Rauf et al., 2013) and in revealing problems and the solutions in acquiring science process skills (Ali, 2009). Abdul Rauf and his colleagues (2013) opined that a qualitative approach was preferred to provide insights and describe when and how the science process skills were inculcated.

Science process skills should be taught to students in the middle or lower secondary schools to prepare those who will advance to the pure science stream and to inculcate scientific literacy in those who will go to the Art stream (Webb & Glover, 2004 as cited in Ambross, 2011). Generally, students enjoy practical work which demands science process skills but the enjoyment diminishes as they progress to higher secondary level (Sharpe, 2012). Hence, there is a need to address this problem as
students' attitude toward science will affect their post secondary course selection and career choice (Nieswandt, 2005 as cited in Sharpe, 2012). As mentioned by Krajcik and his colleagues (2003); The Third International Mathematics and Science Study (TIMSS, 1997, 1998; Schmidt et al., 2001) found that the reasons why students gradually dislike science are because the way science is taught (passively) and the type of curriculum used (irrelevant to students' lives). Roth (2007) believed that the learning and acquisition of science concepts and skills should be studied in its real time dynamic state such as recording student-teacher interaction in classroom instead of focusing on evaluation of learning products only.

1.4 Research Objectives

1.4.1 The main objective of this study is to identify the problems, causes and solutions in learning Science Process Skills among Form Four Students.

1.4.2 The specific objectives are:

- To identify problems in learning Science Process Skills among Form Four Students.
- To identify causes to the problems in learning Science Process Skills among Form Four Students.
- To identify solutions to the problems in learning Science Process Skills among Form Four Students.

1.5 Research questions

- What are the problems in learning Science Process Skills among Form Four Students?
- What are the causes to the problems in learning Science Process Skills among Form Four Students?
- What are the solutions to the problems in learning Science Process Skills among Form Four Students?
1.6 Significance of the study

Knowledge
This study may not be able to be generalized to the entire population but would contribute to the richness of contexts in which Science Process Skills are taught.

Practice
Being a teacher herself, it is the author's fervent hope that this study would help fellow educators to reflect on their own practice in the teaching and learning of science and find ways in improving it.

Policy
This study may not affect policy making in big waves but emergent issues in learning look upon qualitative studies for specific treatments.

Theory
The open-ended nature of this study may contribute to the many theories of learning and instructions in terms of motivation, collaboration, self-efficacy and metacognition theories; to name a few.

1.7 Limitation of the study
This study is limited to identifying only the problems, causes and solutions in learning Science Process Skills among eight Form Four secondary school students from SMK Kota Samarahan. Therefore, its outcome cannot be used to generalize over a bigger population of Form Four students.

1.8 Definition of terms

1.8.1 Problems
Problem is defined as something difficult to deal with or understand (Oxford School Dictionary & Thesaurus, 2005). The Longman Dictionary of Contemporary English (2003) defines problem as difficulty or something that causes difficulty.
In this study, problems are defined as difficulties that hinder the learning of Science Process Skills.
1.8.2 Causes
A cause is defined as a source, origin, root, basis, reason, person or thing (Oxford School Dictionary & Thesaurus, 2005) or event (Longman Dictionary of Contemporary English, 2003) that makes something happen or produces an effect.
In this study, causes are the reasons for the difficulties that hinder the learning of Science Process Skills.

1.8.3 Solutions
Solution is defined as the answer to a problem or puzzle (Oxford School Dictionary & Thesaurus, 2005). The Longman Dictionary of Contemporary English (2003) defines solution as a way of solving a problem or dealing with a difficult situation.
In this study, solutions are prescribed actions carried out by the teacher or suggestions given by students to deal with the difficulties that hinder the learning of Science Process Skills.

1.8.4 Learning
Learning is defined as gaining knowledge of a subject or skill, by experience, by studying it, or by being taught (Longman Dictionary of Contemporary English, 2003). Learning also can be defined as mastering, acquiring, understanding, assimilating, picking up, knowing and memorizing a knowledge of something (Oxford School Dictionary & Thesaurus, 2005).
In this study, learning is all activities related to acquiring knowledge and skills in Science Process.

1.8.6 Scientific skills or Science Process Skills (SPS)
Science process skills (SPS) are seen as a problem solving skill in which a problem is represented, a systematic process is carried out in order to arrive to solve the problem (Gagne et al., 1993 as cited in Abd Rauf, 2013).
The science process skills are subdivided into two; the basic science process skills and the integrated science process skills. As cited in Abd Rauf (2013), Germann and Aram
(1996) opined that the basic science process skills provide the intellectual groundwork in scientific inquiry. The basic process skills are the prerequisites to the integrated process skills. The integrated process skills are the terminal skills for solving problems or doing science experiments.

1.8.6 *Form Four students*

Longman Dictionary of Contemporary English (2003) defines form as a class in school. Therefore, a Form Four student is a student who attends the fourth year class in a secondary school.

The Form Four students in this study are individuals aged 15 to 17 in Arts stream taking Science as the core subject or in Science stream taking Biology, Chemistry and Physics as elective subjects in Malaysian secondary schools.

1.8.7 *Secondary school*

According to the Longman Dictionary of Contemporary English (2003), secondary school is a school for children between ages of 11 and 16 or 18.

In this study, a secondary school is a learning institution where individuals aged of 13 to 17 are taught.

1.9 *Summary*

In this chapter, the background of the study, the problem statement, the research objectives, the research questions, the significance and limitations of the study and finally, the definition of terms have been extensively discussed. The next chapter review the relevant literature on this study.
2.0 LITERATURE REVIEW

2.1 Introduction

In this chapter, the issues pertaining to science process skills are discussed. The theories and models related to the study and the findings on past studies on similar topic are given coverage. The chapter closed with a summary.

2.2 What are Science Process Skills?

Martin, Sexton, Franklin and Gerlovich (2005) in their book "Teaching Science for All Children: An Inquiry Approach" opined that there are three essential features of science namely; science attitude, science process skills and science knowledge. In learning science process skills, children learn how to learn. By learning how to learn, children make discriminating observations, organize and analyze facts and concepts, give reasons for expecting particular results, evaluate and interpret results of experiments, draw justifiable conclusions and predict what will happen if the conditions of a phenomena in nature are changed (Victor, 1985, p. 47) as cited by Martin, Sexton, Franklin and Gerlovich (2005). In fact, these activities are carried out unconsciously in our daily lives. Hence, teachers should find the opportunities to relate science process skills to actions in daily lives.

There are two types of science process skills: basic skills and integrated skills (Arena, 1996) as mentioned by Martin et al. (2005). Basic skills are covered in the lower
elementary science which will act as the foundation for using integrated skills in the later grades. The basic skills are observing, classifying, communicating, measuring, estimating, predicting and making inferences. Table 2.0 below illustrates the description and example of basic skills.

Table 2.0: Description and example of Basic Skills

<table>
<thead>
<tr>
<th>Basic skills</th>
<th>Description and example</th>
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<tr>
<td>Observing</td>
<td>• Using all senses.</td>
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<td>• Eg: See change of colour as two different colours of light are added.</td>
</tr>
<tr>
<td>Classifying</td>
<td>• Organizing observations in ways that carry special meanings.</td>
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<td></td>
<td>• Eg: Group objects based on differences or similarities.</td>
</tr>
<tr>
<td>Communicating</td>
<td>• Using language (written, spoken, symbols) to express thoughts in ways that others can understand.</td>
</tr>
<tr>
<td></td>
<td>• Eg: Describe the movement of a car as it is moving.</td>
</tr>
<tr>
<td>Measuring</td>
<td>• Using standard tools like ruler or arbitrary units Like stones to quantify.</td>
</tr>
<tr>
<td></td>
<td>• Eg: Use a metre stick to describe the height of a plant.</td>
</tr>
<tr>
<td>Estimating</td>
<td>• Judging an approximate amount or value, based on knowledge of a measurement but not a direct measure.</td>
</tr>
<tr>
<td></td>
<td>• Eg: Pour water about half the volume of the glass.</td>
</tr>
<tr>
<td>Predicting</td>
<td>• Guessing the best bet based on available information.</td>
</tr>
<tr>
<td></td>
<td>• Eg: Predict what happens to the balloon when it is heated.</td>
</tr>
<tr>
<td>Making inferences</td>
<td>• Concluding about the cause of an observation.</td>
</tr>
<tr>
<td></td>
<td>• Eg: The pond weed releases gas bubbles in water when exposed to light because it is photosynthesizing.</td>
</tr>
</tbody>
</table>

Source: Martin et al. (2005)
The integrated skills are a combination of several basic skills to form more powerful tools to solve problems. The integrated skills are identifying variables, controlling variables, defining operationally, forming hypotheses, experimenting, plotting graph, interpreting data, modelling and investigating. Table 2.1 below illustrates the description and example of integrated skills.

**Table 2.1: Description and example of Integrated Skills**

<table>
<thead>
<tr>
<th>Integrated skills</th>
<th>Description and example</th>
</tr>
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</table>
| Identifying and controlling variables | • Identifying aspects of an experiment that can affect the outcome and to keep as many aspects constant as possible while manipulating the only aspect that is independent.  
• Eg: Change the amount of light given to similar plants while keeping the amount of water, fertilizer, soil type and temperature the same. |
| Defining operationally             | • Using observations and other information gained through experience to describe and label an object or event.  
• Eg: Acceleration is when a car speeds up. |
| Forming hypotheses                 | • Using information to make the best educated guess about the expected outcome of an experiment.  
• Eg: The more salt is added to water, the better the apple floats. |
| Experimenting                       | • Using many thinking skills to design and conduct a controlled scientific test.  
• Eg: The entire operational process of asking a research question, forming hypothesis, identifying and controlling variables, using operational definitions, conducting experiments and interpreting data. |
| Graphing                           | • Converting measurements into a diagram to show the relationships among and between the measures.  
• Eg: Construct a graph to show the amount of current passing through both types of metal wires; copper and nichrome of the same length for every minute. |
### Table 2.1: Description and example of Integrated Skills (cont.)

<table>
<thead>
<tr>
<th>Integrated skills</th>
<th>Description and example</th>
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</table>
| **Interpreting data** | • Collecting observations and measurements (data) in an organized way and drawing conclusions from the information obtained by reading tables, graphs and diagrams.  
• Eig: Read information in a table or graph about the growth of bacterial colonies in the experiment above and form conclusions based on the interpretation of data. |
| **Modeling** | • Creating an abstract (mental) or (concrete) physical illustration of an object or event.  
• Eig: A model shows the best number of blades on a fan and the consequences of using too little or too much. |
| **Investigating** | • Using observations, collecting and analyzing data and drawing conclusions to solve problems.  
• Eig: Carry out an investigation to evaluate the drip irrigation model as a way of deciding on a plant watering routine at home. |

Source: Martin et al. (2005)

In their book “Teaching Science in Elementary School and Middle School Classrooms: A Project-Based Approach”, Krajcik, Czerniak and Berger (2003) iterated that the process of science involves asking questions, finding information, planning and designing investigations, building and setting up the apparatus, collecting data, analyzing data, making conclusions, finding solutions and communicating the findings.

### 2.3 Why are Science Process Skills important?

Children evolve as a learner through the experience of using basic skills to become critical thinkers (Krajcik, Czerniak & Berger, 2003), complex problem solvers and