# PRE-UNIVERSITY BIOLOGY STUDENTS’ AND TEACHERS’ READINESS FOR SELF-DIRECTED LEARNING

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FACULTY OF EDUCATION
UNIVERSITY OF MALAYA
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**THESIS SUBMITTED IN FULFILMENT OF THE REQUIREMENTS FOR THE DEGREE OF DOCTOR OF PHILOSOPHY**

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Field of Study: Science Education

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**ABSTRACT**

This research aimed to profile the STPM Biology students' and teachers' Self-Directed Learning (SDL) readiness. This was accomplished by developing two scales, the Self-Directed Learning Readiness Scale for Biology (SDLRSbio) and the Self-Directed Learning Lesson Readiness Scale for Biology (SDLeRSbio) for STPM Biology students and teachers respectively. Furthermore, this research proposed a notion which stated the SDL readiness as the *"specific skills and knowledge one possesses in setting and achieving the learning objective with or without the help of others, regardless of the learning styles and teaching styles"* and in relation to this three working hypotheses were put forward. The three working hypotheses were (i) a very minimum variation in the correlations between SDLR and the different learning styles is expected if at all, (ii) a very minimum variation in the correlation between SDLeR and the different teaching styles is expected if at all, and it is anticipated that (iii) if SDLR and SDLeR are independent of learning styles and teaching styles respectively, constructive interactions in the classroom contribute to SDL readiness.

The current research was conducted nationwide with schools which provide Sijil Tinggi Pelajaran Malaysia (STPM) Biology in all states in Malaysia and were agreeable to participate in the study. Written consent was also obtained from the Biology teachers' and students' from these schools who agreed to be involved in the study. The teachers and students were administered with the Self-Directed Learning Lesson Readiness Scale for Biology (SDLeRSbio) and the Self-Directed Learning Readinss Scale for Biology (SDLRSbio) respectively. The qualitative data were collected through an open-ended question, interviews and observations. A total of five hundred and eighty-six (586) students were administered with the SDLRSbio and fifty-five (55) teachers with the SDLeRSbio. Six (6) students and sixteen (16) teachers were observed. Ten (10) students and six (6) teachers were interviewed.

In order to investigate the first two working hypotheses, the correlation between Self-Directed Learning Lessons Readiness (SDLeR) of teachers and teaching styles, and the correlation of Self-Directed Learning Readiness (SDLR) of students and learning styles were determined. The results showed that no one particular teaching style or learning style was significantly related to SDLeR or SDLR, and both the hypotheses were accepted. The third working hypothesis which stated that it was constructive interactions which were responsible for contributing to SDL readiness was also accepted based upon the analysis of qualitative data of the research. Constructive interactions seemed to engage the students and teachers cognitively, emotionally and physically to the process of learning and teaching. This in turn triggered the interest in learning and teaching. Examples of constructive interactions include question and answer, eye contact, mutual trust and many more. Hence, students and teachers were progressively readied for SDL. The research also identified other factors such as an examination oriented mindset and time management which could possibly influence SDLR and SDLeR. Implications of the findings and recommendations for further research are also discussed.

**Kesediaan untuk Pembelajaran Kendiri dalam Kalangan**

**Guru and Pelajar Pra Universiti Biologi**


## ABSTRAK

Kajian ini bertujuan untuk memprofil Kesediaan untuk Pembelajaran Kendiri dalam kalangan murid dan guru Biologi STPM. Tujuan ini dicapai dengan pembinaan dua skala kesediaan, iaitu Skala Kesediaa Pembelajaran Kendiri untuk Biologi dan Skala Kesediaan Pelajaran Pembelajaran Kendiri untuk Biologi bagi para murid dan guru Biologi STPM masing-masing. Kajian ini juga mencadangkan satu tanggapan yang menyatakan Kesediaan untuk Pembelajaran Kendiri adalah *"kemahiran dan pengetahuan khusus yang diperoleh demi menentukan dan mencapaikan objektif pembelajaran dengan atau tanpa bantuan yang lain dan tidak bersandar kepada cara pembelajaran dan cara pengajaran".* Berhubungan dengan tanggapan ini, tiga (3) hipotesis kerja telah ditinjau dalam kajian ini. Tiga hipotesis kerja ini adalah; *(i) jangkaan variasi pada hubungan antara SDLR dan cara pembelajaran adalah amat minimum sekiranya ada, (ii) jangkaan variasi pada hubungan antara SDLeR dan cara pengajaran adalah amat minimum sekiranya ada, (iii) sekiranya SDLR dan SDLeR adalah tidak bersandar pada cara pembelajaran dan cara pengajaran masing-masing, maka interaksi berkonstruktif adalah dijangka menyumbang kepada Kesediaan Pembelajaran Kendiri.*

Kajian ini djalankan ke atas sekolah-sekolah yang menawar STPM Biologi di seluruh Malaysia. Semua guru dan pelajar Biologi STPM dari sekolah yang terlibat adalah sampel kajian ini. Guru dan pelajar diberikan soalselidik SDLeRSbio dan SDLRbio masing –masing. Pemerhatian kelas dan temuduga hanya dijalankan dengan guru dan pelajar selepas mendapat persetujuan mereka. Sebanyak lima ratus lapan puluh enam (586) orang pelajar telah menjawab soalselidik SDLRSbio dan lima puluh lima (55) orang guru telah menjawab soalselidik SDLeRbio. Enam (6) orang pelajar dan enam belas (16)

orang guru terlibat dalam pemerhatian kelas, dan sepuluh (10) orang pelajar dan enam (6) orang guru ditemuduga.

Kajian ini menentukan hubungan antara Kesediaan Pembelajaran Kendiri dan cara pembelajaran dalam kalangan murid, dan juga menentukan hubungan antara Kesediaan Pelajaran Pembelajaran Kendiri dan cara pengajaran dalam kalangan guru, demi meninjau hipotesis kerja pertama (i) dan hipotesis kerja kedua (ii). Keputusan kajian menunjukkan tiada salah satu cara pembelajaran atau cara pengajaran tertentu yang mempunyai hubungan yang ketara terhadap SDLR and SDLeR masing-masing, dan oleh itu nampaknya kedua-dua hipotesis kerja ini boleh diterima. Dengan merujuk kepada keputusan kajian dari data kualitatif, yang dikutip melalui soalan terbuka, temu bual dan pemerhatian kelas, hipotesis ketiga (iii) yang mencadangkan interaksi berkonstruktif menyumbang kepada Kesedian untuk Pembelajaran Kendiri juga didapati boleh diterima. Berasaskan dapatan kajian, interaksi berkonstruktif adalah penglibatan murid dan guru antara satu sama lain dari segi kognisi, emosi, dan fizikal dalam proses pembelajaran dan pengajaran. Penglibatan ini seterusnya mencetuskan minat untuk belajar dan mengajar. Contoh interaksi berkonstruktif ini termasuk interaksi secara soal dan jawab, pandangan mata, saling mempercayai dan banyak lagi. Faktor-faktor lain seperti minda berorientasi peperiksaan dan pengurusan masa yang mungkin mempengaruhi Kesedian untuk Pembelajaran Kendiri dalam kalangan murid dan guru juga telah dikenal pasti dalam kajian ini, Implikasi dan cadangan untuk kajian lanjutan juga dibincangkan.

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| | | |
|---|---|---|
| PLSbio | : | Preference of Learning Styles for Biology |
| SDL | : | Self-Directed Learning |
| SDLR | : | Self-Directed Learning Readiness |
| SDLeR | : | Self-Directed Learning Lesson Readiness |
| SDLRSbio | : | Self-Directed Learning Readiness Scale for Biology |
| SDLeRSbio | : | Self-Directed Learning Lesson Readiness Scale for Biology |
| STPM | : | Sijil Tinggi Persekolahan Malaysia (Malaysian Higher School Certificate) |
| TSS | : | Teaching Styles Survey |

## LIST OF APPENDICES

# CHAPTER 1

# INTRODUCTION

## 1.1 Introduction

Advance in science and technology in recent years has brought tremendous changes in education (Hiemstra, 2006). Over the years, new inventions, and new techniques have been developed in Biology related fields; for instance, genetics, biotechnology, and environmental science which have contributed much to the new biology curriculum content. This has pushed the biology related faculties in tertiary institutions to change their pedagogical techniques in delivering their curricula (Gregory, Ellis, & Orenstein, 2011). In addition, Biology teachers face classes where students differ vastly in emotion and readiness to learn, as well as social problems than in the past (Lohman, 2006).

As a response to the changing education field, many universities advocate that they have adopted Self-Directed Learning (SDL) in the form of student-centred learning approaches in their curriculum (Kek & Huijser, 2011). These approaches come in many forms like Problem-based Learning (PBL), Case-based Learning (CBL), group work, reflective writing, portfolio, and other student-centred learning methodologies especially in the field of medical studies (Struyven, Dochy, & Janssens, 2010). However, many new undergraduates have been found incompetent in these approaches (Kleden, 2013; Ozan, Karademir, Gursel, Taskiran, & Musal, 2005; Pepper, 2010). In order to pursue their higher level studies at the universities, students need to possess SDL skills to a certain extent. Indirectly SDL has been sort of "replaced" with student-centred approaches. However, do student-centred teaching and learning approaches equate to SDL? The present study investigates this matter.

SDL readiness seems to be a key link between pre-university education and tertiary education and even up to the level of post-graduate studies (Towle & Cottrell, 1996). In relation to this, much research about the readiness of students for SDL especially in the medical, biomedical and nursing fields have been carried out (Fisher, King, & Tague, 2001; Guglielmino, 1977; Oddi, 1986; Williamson, 2007; Ayyildiz & Tarhan, 2015)

In the Malaysia context, the question that arises here is “how well are Malaysian Biology STPM (Sijil Tinggi Persekolahan Malaysia) or known in English as the Malaysian Higher School Certificate (HSC) students readied for the SDL aspect of teaching and learning in tertiary institutions?” By addressing this question, we can better plan and design secondary education which helps to get secondary students readied for SDL prior to entering tertiary education. To be self-directed one needs to possess the skills and knowledge which are specific for a particular subject. Research suggested that the readiness of students for SDL before entering tertiary education will determine the success of the tertiary curriculum and the students’ performance (Ozan et al., 2005). Likewise, teacher SDL readiness for lessons is important (Grow, 1991). In a true SDL environment, both students and teachers must work together towards achieving the students’ learning objectives and the teachers’ teaching objectives (Du, 2012).

This study was designed to determine in particular the STPM students’ level of SDL readiness, and the STPM Biology teachers’ level of SDL readiness for lessons. In the beginning the study was designed for the specific region of Kuala Lumpur but eventually became a nationwide study.

### 1.1.1 Development of Self-Directed Learning (SDL) in Malaysian Education

SDL was introduced in adult education in the 1970s, which helped adults to learn according to their needs. SDL in the “form of student-centred learning” flourished in the field of medicine when problem-based learning was introduced by Barrows and Tamblyn, (1980). Since then many approaches of student-centred learning have been discovered and introduced in medical faculties and this has spread to other disciplines due to the effectiveness of the approaches in helping students to pursue tertiary education and stay competent in their future career (Dynan, Cate, & Rhee, 2008; Williamson, 2007).

SDL is getting more popular in tertiary biology related education as a response to the rapid development and discoveries in science and technology. Institutions find that it is getting more difficult to cover the knowledge content within the allocated time for formal lectures. In order to overcome this problem, students are encouraged to conduct research or study outside formal lecture hours to keep pace with the current discoveries of knowledge (Blair, Maharaj, & Primus, 2015) through SDL. Therefore it is not hard to see that biology education is moving towards teaching students the skills and knowledge to pursue more information by themselves (Ellinger, 2004; Shin, Haynes, & Johnston, 1993). Biology teachers are no longer playing the role as knowledge deliverers but more towards facilitating, leading, and motivating biology students to reach their own learning objectives (Halawah, 2011). It can be said that being self-directed in learning is the way to improve one's competence and to keep up-to-date (Horng, 2011).

The Malaysian medical education has also adopted the problem-based learning approach in the curriculum (Chakravarthi & Haleagajara, 2010), which has been used interchangeably with SDL (Kocaman, Dicle, & Ugur, 2009; Loyens, Magda, & Rikers, 2008). In fact, more and more Higher Education Institutions in Malaysia are adopting student-centred learning approaches in their curricula, hoping to enhance students' SDL skills and knowledge. It appears that, the most cost effective and flexible approach of learning, that incorporates technology and reduces the provision of traditional training, is to require the learner to be more self-directed (Ellinger, 2004).

However, it appears that Biology students entering tertiary education are as yet readied to be self-directed learners in their primary and secondary education (Van Den Hurk, Dolmans, Wolfhagen, & Van Der Vleuten, 2001). This problem also exists in Malaysia. Thus, a more thorough understanding of how Biology students can be readied for SDL is necessary.

## 1.2 Problem Statement

As stated earlier, education has changed rapidly due to the advancement and development in science and technology (Hiemstra, 2006). This change has caused education reforms in many countries in South East Asia including Malaysia (Hallinger, 2010). In order to ensure students' competency to learn rapidly developing knowledge, many universities especially in faculties of medicine and biological sciences have adopted and advocate SDL in the "form of student-centred learning approaches" like Problem-based Learning, Case-based Learning and group work, in their curricula (Kek & Huijser, 2011). However, the emphasis of SDL in the "form of student-centred learning approaches" may have misled students and teachers in understanding SDL. This is because, SDL should not be equated to Student-Centred Learning (SCL) in a simplistic manner as research appears to point to the fact that SDL is more about a process where one sets, plans, and evaluates the learning objectives with our without the help of others (Knowles, 1975).

Efforts have been made by the Malaysian Ministry of Education (MOE) to enhance SDL readiness of STPM Biology students through student-centred learning by increasing practical assignments and experimental reports weightage in the examination from 2012 (Majlis Peperiksaan Malaysia, 2012b). In fact, the effort of inculcating student-centred learning in the Malaysian education system can be traced way back to the 1980s while Kurikulum Bersepadu Sekolah Rendah (KBSR) or the Integrated Curriculum for Primary School and Kurikulum Bersepadu Sekolah Menengah (KBSM) or the Integrated Curriculum for Secondary School were implemented nationwide.

The educational changes in the Malaysian education system also required teachers to cover a larger amount of content with a bigger number of students per class. These changes indirectly forced teachers to be more active in the school management and operation level. Hence, teachers needed to be able to multitask (Lohman, 2006). The shift of roles has caused fear to develop among the teachers (Sargeant, Hill, & Breau, 2010). Teacher quality needs close monitoring as teachers are the crucial element in determining the success of curriculum implementation (Finucane, Shannon, & McGrath, 2009).

However, according to the findings of Hallinger (2010), results of educational reforms in Malaysia have often failed to live up to the promises. Nevertheless, are these efforts at students-centred learning actually developing SDL readiness among students and SDL lessons readiness among teachers? This can only be ensured when the teachers themselves have acquired the skills are readied for SDL in the teaching and learning process (Sail & Alavi, 2010). If the emphasis of SDL through student-centred learning approaches is misleading another question that arises here is whether teaching styles or learning styles affect SDL readiness of teachers and students? Furthermore, what are the factors which influence the SDL readiness among students and teachers? These questions will be investigated in this study.

In order to try and answer these questions, the researcher first put forward two main assumptions based upon selected literature prior to identifying the research objectives and research questions for the study. The assumptions of the study, are explained in the following section.

### 1.2.1 Assumptions of the Study

The SDL definition of Knowles (1975, p18) is taken by the present study in the identification of the assumptions made in the research process. Knowles' definition states SDL as *"a process in which an individual takes the initiative, with or without the help of others, in diagnosing their learning needs, formulating and implementing appropriate learning strategies and evaluating learning outcomes"*. In other words, being self-directed could be seen as the initiative of one to set his or her learning objectives and the abilities one has to strategize in achieving the objectives with or without the help of others. Thus, the researcher of the present study has interpreted that this could mean one may be self-directed regardless of which learning style one possessed or the teaching style that one was exposed to.

Therefore, as a starting point, a notion of SDL readiness derived from the above definition was proposed and was investigated by the researcher of this study, which was *"the specific skills and knowledge one possesses in setting and achieving the learning objectives with or without the help of others regardless of the learning styles and teaching styles"*. The others here could refer to teachers and any other knowledgeable other. The notion proposed contains two parts. First, SDL readiness is specific for learning different disciplines. Specific skills and knowledge are needed for one to be readied in a particular discipline. For example, to be readied for SDL in Biology, one needs to be equipped with Biology related skills and knowledge. This is one of the research gaps which was investigated in this research.

The notion also suggests that SDL readiness is independent of learning styles and teaching styles. In other words, one could be readied for SDL in any learning and teaching environment. Therefore the current research was planned to test out the derived notion by understanding the correlation of the readiness for SDL with the learning and teaching styles among teachers and students respectively.

Based upon the derived notion, in order to carry out the research, the first assumption made in the present research was as follows:

1. SDL readiness is independent of the teaching styles of teachers and the learning styles of the students. Thus, one will be able to be self-directed in learning regardless of exposure to either teacher-centred or student-centred learning.

Furthermore, based upon past research literature, for students to be able to acquire skills and knowledge, they need to interact with others (Verenikin, 2008). Therefore, a second assumption was made in the present research that:

2. The SDL readiness will be influenced by the constructive interactions between teacher and students and student and student during lessons in either a teacher-centred or a student-centred learning environment.

The assumptions above contradict the present understanding that implementing student-centred learning approaches is equated to SDL. The current research was designed based upon these assumptions.

### 1.2.2 Research Objectives

Based upon the above discussion the following research objectives were put forward:

1. To develop a Self-Directed Learning Readiness Scale for Biology (SDLRSbio) to measure the STPM Biology students' SDL readiness.
2. To develop a Self-Directed Learning Lesson Readiness Scale for Biology (SDLeRSbio) to measure the STPM Biology teachers' SDL readiness for lessons.
3. To profile the self-evaluated SDL readiness;

(a) Among Malaysian STPM Biology students (SDLR), and

(b) Among Malaysian STPM Biology teachers (SDLeR).

Based upon the proposed notion of SDL readiness in this research, Research Objective 4 was put forward to analyse the correlations between

4. (a) SDLR and learning styles, and
   (b) SDLeR and teaching styles.
5. (a) To describe the constructive interactions in the SDL readiness among students and teachers.
   (b) To explain the influence of the identified constructive interaction in 5(a).
6. To identify the factors influencing SDL readiness among students and teachers.

In the initial planning of the research only the Kuala Lumpur region was within the scope of this study. As the research progressed, with a research grant approved by the University of Malaya, the researcher decided to expand the research scope to a nationwide study. By expanding the scope of study this research has generated a clearer profile of the SDLR and SDLeR for Malaysian STPM Biology students and teachers respectively.

### 1.2.3 Research Questions

Based upon the research objectives above the following research questions were investigated.

1. What is the profile of self-evaluated SDL readiness
   (a) Among Malaysian STPM Biology students (SDLR), and
   (b) Among Malaysian STPM Biology teachers (SDLeR)?

2. What are the correlations between

   (a) SDLR and learning styles, and

   (b) SDLeR and teaching styles?

3. (a) What are the identified constructive interactions?

   (b) How do the identified constructive interactions influence the SDL readiness?

4. What are the factors influencing the

   (a) SDLR among the STPM Biology students, and

   (b) SDLeR among the STPM Biology teachers?

## 1.3 Working Hypotheses of the study

A hypothesis is normally used to explain facts or natural phenomenon. This can be done by scientific testing with statistical analysis which includes the testing of a null hypothesis and some alternative hypotheses. The test will then decide which hypothesis is to be accepted or to be rejected. However, the concept of a working hypothesis was proposed by Cronbach in 1975 which he called the *"relationship between description, verification, and generation of theory"* (Cronbach, 1975). In the case of insufficient data or in the process of searching for a solution to a problem (in this study was to test out the notion, p.6) a working hypothesis can be proposed. The working hypothesis is used in exploratory research which test out a newly proposed notion for further research about several possible alternatives suggested. Hence, the research can be considered as abstract, because the working hypotheses tested is novel and there is no existing related data. The purpose of any hypothesis is to direct the focus of the research and to identify the possible variables (Fanton, 2006; Marie, 1997). Therefore in this research three working hypotheses were put forward to direct the purpose of the research.

The three working hypotheses were in relation to the correlations investigated in Research Question 2. This study was looking as to whether there could be significant differences in the degree of the correlations between SDLR and learning styles and

SDLeR and teaching styles. Therefore, for Research Question 2, which is subjected to statistical testing, the following working hypotheses were generated:

Based upon the notion put forward in this research,

1. It is anticipated that SDLR is independent of learning styles, hence, a very minimum variation in the correlations between SDLR and the different learning styles is expected if at all. In other words, there shall be no particular learning styles which will be related more significantly with the students' SDLR.
2. It is anticipated that SDLeR is independent of teaching styles, hence, a very minimum variation in the correlations between SDLeR and teaching styles is expected if at all. In other words, there shall be no particular teaching styles which will be related more significantly with the teachers' SDLeR .
3. It is anticipated that if SDLR and SDLeR are independent of learning styles and teaching styles respectively, constructive interactions in the classroom contribute to SDL readiness.

## 1.4 Rationale of the Study

There are comments about Malaysian graduates being not able to meet up to the job market expectations. These graduates are found incompetent in their jobs (Giles & Ski, 2009; Lim, 2011; Noor Azina, 2011). The competency ranged from professional knowledge and skills, language proficiency, to emotional and personal characteristics. These seemed to reflect that the Malaysian Education System has failed in producing a younger generation that can contribute to the overall development of the country.

As discussed earlier, the advancement in biology education due to new discoveries in science and technology has brought about changes in the biological fields of study. These changes lean towards an alteration in the curricula of biology education towards SDL in the form of student-centred learning approaches. Students leaving secondary school education are expected to be SDL readied prior to entering tertiary education. As most of the tertiary institutions have infused student-centred approaches in their curricula (including biology), they expect the undergraduates to be Self-Directed learners to a certain extent. However, students leaving our secondary education may not as yet be readied to be Self-Directed learners. This triggered the concern of many researchers about the overall SDL readiness of undergraduates. Therefore many attempts have been made to understand the readiness of undergraduates in SDL. For instance, Stockdale and Brockett, (2010) developed the Personal Responsibility Orientation to study the readiness among college students; Williamson, (2007), and Fisher, King, and Tague, (2001) developed the Self-rating scale of SDLR to study the readiness among undergraduate nursing students; Oddi, (1986) developed the Oddi Continuing Learning Inventory for graduate students in Law, Nursing and Education; and Guglielmino's Self-Directed Learning Readiness Scale was developed in 1977 (details of the scales are recorded in Table 3.2). Nevertheless, these scales are general scales and not subject specific.

Additionally, teachers have been viewed as the most crucial element in the delivery of any curriculum (Finucane et al., 2009). Hence, it is very important to understand if teachers are also SDL readied for conducting lessons. In fact, the role of teachers as facilitators becomes more important. Thus, teachers play an important role in helping students to become SD learners (Neville, 1999), or to help to increase the SDLR of the students. However, there is a lack of studies in relation to teachers' readiness in SDL lessons.

Being a pre-university Biology (STPM) educator, the researcher had also noticed that students are not SDL readied and the use of student-centred teaching strategies does not necessarily bring about students demonstrating SDL. Based upon the gap in past research of SDLR among students and the lack of research on the teachers' SDL readiness for lessons, the present study aimed to understand the readiness of Malaysian pre-university (STPM) students and teachers for SDL respectively in particular for Biology. The study of pre-university's students' readiness for Biology learning has as yet to be investigated. Being one of the government funded pre-university programmes, STPM Biology students and teachers were thus selected as the research target groups in this study.

Referring to the definition of SDL put forward by Knowles (p.6), self-directed learners were referred to as learners who can achieve their learning goals with or without the help of others. Therefore, it could be that being self-directed may not be confined or related to any particular teaching style or learning style that one prefers. Being a self-directed learner, one should be able to achieve one's learning objective by the way one thinks it should work. Therefore, the current research was carried out to investigate in depth about SDLR and SDLeR in particular for STPM Biology.

## 1.5 Definition of Terminologies

### 1.5.1 Pre University

Pre University refers to the transition level of education between secondary and tertiary education. At this level, students are in the age range of 17 – 20 years old in general. Two (2) years or 18 months durations are allocated for the preparation of the students for tertiary education. There are several pre-university programmes offered by the Malaysian Government and also the private institutions in Malaysia. In this research, only the Sijil Tinggi Persekolahan Malaysia (STPM or the Malaysian Higher School Certificate) Biology students were studied.

In general, STPM is also known as Form 6 education in Malaysia as the extension of the secondary education. STPM is one of the programmes which the Malaysian Government offered in public secondary schools to prepare pre-university students for tertiary education. STPM is one of the major channels which Malaysian students will choose after their five years of secondary education.

### 1.5.2 Self-Directed Learning (SDL)

In the context of the present study, based upon the notion put forward, SDL means students take the initiative in setting their own learning goals and achieve the goals with or without the help of others. In other words, being self-directed in learning is independent from the learning styles the student prefers. In the context of this study, the subject matter is Biology. Thus, being self-directed in Biology means students must possess the necessary biology skills and knowledge to pursue biological study and achieve the goals by themselves or by interacting with others.

### 1.5.3 SDL readiness

This study investigated the STPM Biology students' Self-Directed Learning Readiness (SDLR) and the STPM Biology teachers' Self-Directed Learning Lesson Readiness (SDLeR). These two readinesses were measured with two self-evaluation readiness scales developed in the current study. These scales are the Self-Directed Learning Readiness Scale for Biology (SDLRSbio) and the Self-Directed Learning Lessons Readiness for Biology (SDLeRSbio).

#### 1.5.3.1 (i) STPM Biology students' SDL readiness (SDLR)

In this study, students' self-evaluated readiness was measured in terms of two (2) aspects. The first aspect, the "General skills readiness", consists of the "Biology Cognitive Readiness", "Biology Learning Skills Readiness" and "Emotional Readiness". The second aspect, consists of the "Specific Biology Skills Readiness", consists of the "Laboratory Skills", "Experimental Design Skills" and "Data Analysis and Interpretation

Skills”. In order to measure the students’ SDL readiness, the Self-Directed Learning Readiness Scale for Biology (SDLRSbio) based upon the two (2) aspects was developed. A total of forty-six (46) items were developed for the two aspects. This developed scale was used to profile the SDL readiness of STPM Biology students before they pursue their tertiary education in any field of biology.

#### 1.5.3.2 (ii) STPM Biology teachers’ SDL lessons readiness (SDLeR)

In this study, teachers’ self-evaluated readiness in SDL lessons was measured in terms of three (3) aspects. The first aspect, the “General skills readiness”, consists of the “Biology Cognitive Readiness”, “Biology Learning Skills Readiness” and “Emotional Readiness”. The second aspect, the “Specific Biology Skills Readiness”, consists of the “Laboratory Skills”, “Experimental Design Skills” and “Data Analysis and Interpretation Skills”. The third aspect is the “Interacting Skills Readiness”. In order to measure the SDL lesson readiness of teachers, the Self-Directed Learning Lesson Readiness Scale for Biology (SDLeRSbio) based upon the 3 aspects was developed. A total of 53 items were developed for the three aspects. This developed scale was used to profile the SDLeR of STPM Biology teachers.

### 1.5.4 Teaching Styles

In the present research, teachers’ teaching styles were identified by using the Grasha-Riechmann Teaching Styles Survey (TSS) which is available online. This survey was adopted in this research. There were five (5) categories of teachings styles which included “Expert”, “Formal authority”, “Personal model”, “Facilitator”, and “Delegator”.

The TSS is a measurement of teachers’ preference of teaching styles. Hence, teachers may prefer more than one teaching style where they may have one dominant teaching style frequently applied in conducting Biology lessons. However, this does not indicate the absence of other teaching styles.

### 1.5.5 Learning Styles

In the present research, students' learning styles were identified by using the adapted questionnaire of Preference of Learning Styles for Biology (PLSbio). This questionnaire was adapted from Honey and Mumford's Learning Styles Questionnaire. The learning style has four (4) categories, The Activist, The Reflector, The Theorist, and The Pragmatic.

The PLSbio measured the preference of learning styles. Similar to the teaching styles, students may possess more than one learning styles but one may be dominant. However, this does not indicate the absence of other learning styles.

### 1.5.6 Constructive Interaction

Constructive interactions are interactions between the teachers and students, and students and students during lessons which contribute to the SDLR and SDLeR. Based upon the notion put forward in this research, constructive interactions are believed to influence SDL readiness.

In the context of the current study, these interactions were observed and recorded in observation field notes during classroom observations. The interactions were considered constructive when these interactions were able to engage the teachers and students to the lessons. These engagements includes emotional engagement (such as attentiveness, happiness, and laughter), cognitive engagement (such as answering of questions, contribution of ideas), and physical engagement (such as involvement in class activities, searching of answers in books). These types of engagement can trigger the interest towards learning and teaching processes while developing SDL readiness among students and teachers. However, this research recorded only the interactions observed in the classroom. Hence, the interactions which may have happened outside the classroom were not captured in this study.

### 1.5.7 Nationwide study

A nationwide study may provide a comprehensive outlook which may not fully cover the whole country, but will provide detailed information in relation to most of the relevant areas within the country (Boff & Johnson, 2002). A nationwide study can also apply a purposive sampling methodology as in Patton's (2002) research. Through purposive sampling in a nationwide study, the data could be used for profiling the related information of the nation (Co & Mitchell, 2006).

This present research was a nationwide study as it collected data from all the thirteen (13) states and the Federal Territory. The quantitative data collected from all the Malaysian states was used in profiling the SDLR and SDLeR among the STPM Biology students and teachers respectively. However, the qualitative interviews and observations did not cover all the states due to unavoidable challenges which is explained in the methodology chapter. Nevertheless, the qualitative data was gathered from as many states as possible.

In order to conduct the nationwide study, this research had obtained a list of schools offering STPM Biology curriculum in Malaysia from the Education Planning and Research Department (EPRD), Ministry of Education (MOE). The researcher then contacted every school to conduct the research. Research was conducted with the schools which agreed to the research request. Teachers and students involved in STPM Biology of the schools were the respondents and participants of the current research. Nevertheless, consent was obtained from them prior to commencement of the research.

## 1.6 Significance of the Study

Being SDL readied is understood to be the mastery of some skills and knowledge which enable the students to pursue learning by themselves. However, no congruent understanding of SDL readiness is available. Therefore, in this research, a notion was suggested to SDL readiness which is *"the specific skills and knowledge one possesses in setting and achieving the learning objectives with or without the help of others regardless of the learning styles and teaching styles"*.

By understanding that SDL readiness is independent of learning styles and teaching styles, and constructive interactions influence the readiness for students' and teachers' for SDL, many parties would be benefit. For example;

a) Teachers and students;

Teachers and students could put more focus in ensuring constructive interactions during lessons. Both of the teachers and students also could work together in order to minimise the non-constructive interactions during the lessons. Hence, they could be more engaged with the lessons and in turn improve their interest and sharpen their skills and knowledge needed.

b) Curriculum developers

Curriculum can be designed in a way which encourages constructive interactions. Different approaches in teaching and learning could be introduced, to ensure more chances for constructive interactions during the lessons.

c) Teacher trainers

It is also for the teacher training coaches to know that constructive interactions influence the SDL readiness. Hence, constructive interaction could be infused into the training process. By doing this, teachers would be equipped with the interactions, skills and knowledge to ensure constructive interactions take place during lessons.

d) Future researchers

This research is novel in introducing constructive interactions into SDL. However, it is as yet a starting point of the research. Hence, this research could be a foundation for future researchers to work upon. Two scales were developed for measuring Biology students' and teachers' SDLR and SDLeR respectively in the current research. These two scales can be the reference point for further understanding of readiness for different disciplines or for different pre-university programmes.

Besides, the above importance, the study is also significant for the development of theory related to SDL. It is the hope of the researcher of the present study that the current research would bring benefit to the Malaysian education system in generating more self-directed learners among the younger generation.

## 1.7 Scope of Study

This research was carried out only with the students and teachers of STPM Biology. This programme is one of the pre-university programmes offered by the Malaysian government schools with the aim to prepare students for Biology related tertiary education. The present study moved from a smaller selected sample to a nationwide study among STPM Biology students and teachers, in order to determine the STPM students' SDL readiness (SDLR) and STPM teachers' SDL lesson readiness (SDLeR) profile. The self-evaluated readiness scales were used to determine students' and teachers' SDL readiness. The study also attempted to identify the factors influencing the SDLR and SDLeR among students and teachers respectively.

In order to keep pace with the advancing knowledge and technology, it is important for students to obtain skills and knowledge to pursue their own learning. In this case, the SDL skills and knowledge are vital as these are always related to the continuous development of one's competency in one's career and life. These results were used to profile readiness for SDLR and SDLeR among students and teachers respectively. The profile was to only understand the level of readiness and the distribution of the readiness of domains according to the self-evaluation of the students and teachers. However, the current research did not intend to look into the comparison of the self-evaluated readiness with the actual practise of the teaching-learning process among teachers and students.

Overall, a notion of SDL readiness and three (3) working hypotheses were tested in the current research. No intervention was applied in this research. This research did not cover any other disciplines of study offered in the STPM curriculum except for Biology.

## 1.8 Limitation of the Study

This study focused only on STPM Biology curriculum, which does not represent the entire pre-university education in Malaysia. The development of scales are valid and reliable only in the context of perusal of biology related subjects offered at the pre-university level education in Malaysia. The scales were used only to profile the SDLR of STPM Biology students in pursuing biology related fields in the tertiary education and the SDLeR of STPM Biology teachers in conducting biology lessons. In view of the sample of the research, the results must be confined to Malaysian STPM Biology students and teachers only.

In addition, although all the states in Malaysia were covered in this research, a bigger number of observations and interviews were conducted in the Federal Territory (Wilayah Persekutuan) and Selangor. This was due to the fact that many teachers from the other states were not willing to allow more than one observation and a single interview. Indeed the teachers were reluctant to be interviewed or to be observed. Nevertheless, the researcher managed to collect data from all states for the quantitative analysis as discussed in Chapter 4.

## 1.9 Chapter Summary

As a response to a changing world, biology courses taught in tertiary education have altered the implementation of their curricula towards student-centred approaches which is generally mistakenly equated with the SDL approach. Hence, the urgency to study the SDL readiness of biology students and the SDL readiness of biology teachers in conducting lessons is essential.

A notion was suggested for SDLR in this research. SDLR is anticipated to be the specific skills and knowledge needed for the particular subject of Biology. This readiness was speculated as independent of one's learning styles or the teaching styles that they are exposed to.

The study planned to develop scales to study the readiness which would help the Malaysian MOE to profile the level of readiness of teachers and students prior to entering tertiary education. This can also assist in refining the Malaysian teacher training in relation to SDL. Finally, this research also described the constructive interactions which are believed to contribute to the SDLR and SDLeR.

For better presentation of the research, this thesis is presented in the eight (8) following chapters:

Chapter 1: Introduction

Chapter 2: Literature review

Chapter 3: Conceptualisation of the study

Chapter 4: Methodology

Chapter 5: SDL readiness profile among STPM Biology students and teachers

Chapter 6: Notion of SDL readiness and constructive interactions.

Chapter 7: Factors influencing the Readiness for Self-Directed Learning

Chapter 8: Summary, implications and conclusion

# CHAPTER 2

# LITERATURE REVIEW

## 2.1 Introduction

New discoveries and developments in the field of biology had brought changes in the content and delivery methods of the subject. In Malaysia, for STPM Biology, changes have been made to cater for the needs of cultivating students' interest and capabilities to pursue biology related education.

In tertiary education, biology related fields have reformed their curricula to embrace SDL. Hence students entering tertiary education are ex pected to be self-directed to certain extent. This raised the urge to identify the level of SDL readiness among students prior to entering tertiary education. Similarly teachers' SDL readiness to conduct lessons also needed to be studied for better planning and design of the curriculum.

In this chapter, an extensive literature review conducted is recorded to direct readers in understanding the related topics thoroughly. This chapter covers the topics related to the point of the date of this research being conducted.

## 2.2 STPM Biology Education in Malaysia

Sijil Tinggi Persekolahan Malaysia (STPM) or the Malaysia Higher School Certificate was founded in 1980 to replace the former High School Certificate (HSC, Sijil Tinggi Persekolahan) which was organised and conducted by University of Cambridge Local Examination Syndicate (Malaysia Examinations Council, 2012). STPM was begun with the aim of training secondary school leavers for local and foreign tertiary education. However, many STPM Biology students were found not prepared for biology related tertiary education (Chakravarthi & Haleagajara, 2010). This was reflected by the critics who pointed out that there was insufficient SDL skills among the graduates (Giles & Ski, 2009). Study of the SDL readiness of STPM Biology students entering tertiary education institutions which were converting to SDL delivery is hence essential. This research helped to understand how well the STPM Biology students were readied for SDL at the tertiary level.

Initially STPM students were given 18 months to complete the curriculum, and sit for a terminal examination. Students were required to take 4 to 5 courses according to their interest, with General Study (Pengajian Am) as the core course. Basically students will choose to major in science subjects like Physic, Chemistry, Biology and Mathematics or major in art and commerce subjects like Accounting, History, Literature, and other social science courses (Majlis Peperiksaan Malaysia, 2012a, 2012b).

Over the years of implementation, STPM faced tremendous challenges from other pre-university programmes provided by private institutions as well as other government founded institutions. According to MOE, out of 506, 620 candidates of Sijil Peperiksaan Malaysia (SPM), only 55, 663 enrolled in STPM in 2009. While in 2010, among 482, 334 SPM candidates only 53, 674 enrolled in STPM (Malaysia, 2011). As a response to the challenges and decline in the number of enrolment, starting from 2012, MOE has reformed the STPM curriculum following a semester system. Starting from 2012 STPM was conducted within the duration of 18 months which were separated into three (3) semesters. The STPM Biology content was redesigned in the way to be covered within the three (3) semesters. A public examination will be commenced at the end of each semester. The accumulative grades of the three (3) semesters will be the final assessment result of the student.

The public examination at the end of each semester consists of a written examination covering 80% of the STPM result. The examination also consists of a practical assessment with a weightage of 20%. The practical assessment is 10% more compared to the previous system. With the increment of 10% in the practical assessment, MOE hopes that students will pay more attention to the laboratory skills and other soft skills needed. In view of the move towards SDL in the tertiary Biology related education, it is important to ensure STPM Biology students be SDL readied. Meanwhile teachers' SDL readiness to conduct lessons needed to be enhanced in order to ensure the success of the change in the tertiary curriculum.

**2.3 Self-Directed Learning (SDL)**

Self-Directed Learning (SDL) is believed to be a process of learning conducted beyond the boundaries of school (Guglielmino, 1977). SDL is also seen as a natural acquired ability in learning (Brookfield, 1985). SDL has been seen as a method of instruction increasingly in biology related tertiary educations like medical, nursing, biomedical and biosciences since the implementation of Problem Based Learning (PBL) in medical faculties. The concept of SDL covers not only formal education but also informal education (Guglielmino, 1977). This means that SDL is not confined to the teaching and learning environment as proposed in this research. Garrison (1992) in his study put self-direction as a matter of "degree". Hence, it is a fallacy to assume the ultimate goal of SDL is fully student-centred learning. Garrison further argued that self-direction depends upon both the opportunity and ability to make learning decisions. Therefore, SDL involves the collaboration between teachers and students in seeking for ways to achieve the learning goals. In this research constructive interaction is assumed to contribute to SDL readiness in providing the opportunities for obtaining the competency (skills and knowledge) in being readied for SDL.

Currently, the term "self-directed learning" has been used widely in the literature to describe various concepts in learning such as self-planning learning, learning projects, self education, self- teaching, autonomous learning, independent study, and open learning (Aminuddin Hassan et al., 2011). In addition, SDL has been frequently used interchangeably with PBL (Hassan Murad & Parthibha Varkey, 2008). This is due to the similarity of PBL and SDL in nature; learners involved in selecting learning resources and strategies, teachers as facilitators rather than as sources of content (Mazmanian & Feldman, 2011), and learners determined the learning objectives by themselves.

As self-directed learners, students can create their own interest on a topic when they are aware of the importance of the application of the knowledge (Brookfield, 1984; Guglielmino & Guglielmino, 2006). Self-directedness is involved when learners can make sense or meaning to their acquired knowledge within their existing values, beliefs, and social forms to recreate aspects of their working life, personal relationships and socio structures (Brockett, 1985a). This school of thought was explained by Brookfield (1984), when SDL is referred to the activities involved in the acquisition of skills and knowledge of a particular field.

According to a study by Garrison (1997), SDL involves self-management, self-monitoring and self-motivating. These three elements of SDL will determine learners' learning outcomes and interest to persist in their learning. They are also the elements which can be measured with scales developed by past researchers like Guglielmino (1978), Murray Fishers (2010), and Oddi. Hoban and Hoban (2004) further explained that SDL includes two (2) dimensions. The first dimension includes motivation, metacognition and self-regulation. The second dimension includes self-confidence, competency, selection and control. Undeniably, these elements are needed by self-directed learners to continue their learning according to their own learning styles. However, for one to be self-directed in a certain field of study, one must possess the required skills and knowledge to engage with the learning process. In this study Biology is the subject matter. Hence, to be self-directed in learning Biology one should also possess the skills and knowledge of Biology.

SDL can occur in a wide variety of situations regardless of a formal learning setting, or in the workplace, or in one's personal life, or in an informal learning setting (Gyawaii, Jauhari, Shankar, Saha, & Meraj, 2011). With the SDL skills learned and practiced, one will develop a lifelong learning ability to pursue related knowledge when formal education ends. This is very important for careers like being a doctor, nurse, scientist, biologist and other biological related careers where knowledge and new discoveries are rapid (Towle & Cottrell, 1996). The cultivated self-directedness behaviours will ensure the competency of an individual over his span of career (Noor Azina, 2011).

Knowles in 1975 defined SDL as *"a process in which an individual takes the initiative, with or without the help of others, in diagnosing their learning needs, formulating and implementing appropriate learning strategies and evaluating learning outcomes".* This definition of SDL was applied throughout the present study of SDL. Despite many researchers having endeavoured in defining SDL in their own way, there appears to be some common criteria in definition of SDL. Most researchers agree that in SDL an individual could set their own goals, strategies and evaluation methods in pursuing their learning. Initially SDL was advocated in adult education. However, recently SDL has been advocated for all levels of education. Regardless of which level SDL is advocated, much responsibility is placed on the students in the process of learning (Williams, 2001). SDL has also been referred to as an essential skill in keeping one competent in a changing world (Hmelo & Lin, 2000).

## 2.4 Self-directed Learning in Malaysia

Education development in Malaysia has always been responsive to the needs of the nation as a whole (Rahimah Haji Ahmad, 1998). In the 1980s, Malaysia education reformed to inculcate student-centred learning in the system (Lee, 1999). However, the implementation of these reforms have not been completely successful (Hallinger, 2010; Lee, 1999). Recently education development in Malaysia is moving in the direction to ensure an education that is relevant and functional with an efficient delivery system (Hussein Ahmad, 2012). Consequently, many higher education institutions have adjusted their curricula to embrace SDL, especially in biology related faculties like medicine, nursing and biosciences.

Recently a new National Educational Blueprint (NEB) was launched in December 2012. According to the NEB, the Malaysian Government has instilled various new policies and implementation to the Malaysian education system in order to achieve the objective of being a world-class education hub in the Southeast Asia region (Ministry of Education, 2013). Addition to this, the Higher Education Institutions in Malaysia are striving towards instilling life-long learning (Grapagasem, Krishnan, & Mansor, 2014), which is much inclined towards SDL. This involved the designing of curricula which instils skills and knowledge needed in specific careers (Jayakumar & Terence, 2013) Hence, SDL is needed in helping students to keep competent in their studies and their future career.

In Malaysia, SDL has mostly been focused upon at the university level especially in medical faculties (Chakravarthi & Haleagajara, 2010; Kek, Darmawan, & Chen, 2007). However, not many lecturers or teachers are knowledgeable about SDL (Chakravarthi, Haleagajara, & Judson, 2010) As a result of this, Malaysian fresh medical graduates of were recently being commented upon as unprepared and incompetent in their jobs with low level of soft skills (Chakravarthi & Haleagajara, 2010). A similar result was reported by Giles and Ski (2009); Jusoh, Simun and Chong (2011); Quek (2005); and Wickramasinghe and Perera (2010) in their research. This phenomenon has raised the concern of researchers and educators about the quality of our Malaysian future human resource.

Despite much efforts being put into instilling the skills and knowledge among the graduates they are as yet lacking in employability potential (Grapagasem et al., 2014). Grapagasem et.al.(2014) in their report claimed that the inefficiency of delivery system in higher education could be the reason. Obviously the attempt to inculcate SDL skills among Malaysian student needs more attention. Therefore the present study of SDL in Malaysia is important in order to understand its' implementation and to get the students SDL readied as they pursue tertiary education.

**2.5 Self-directed Learning Readiness**

Readiness can be defined as the capabilities of an individual in achieving one's learning objectives. Grow (1991) refers to readiness as the "ability" and "willingness" to carry out a task or engage in a particular learning stage. The degree of control that learners are willing to take for their own learning will depend on their attitude, abilities and personality characteristics (Fisher et al., 2001). Thus, each and every learner will have their own level of SDL readiness (Hendry & Ginns, 2009). The readiness is not a particular kind of change in consciousness, but refers to the activity involved in acquiring particular skills or knowledge in related fields of study (Brookfield, 1984). Since it is the acquisition of skills and knowledge, therefore, it could be acquired through any activities of any learning and teaching environments. Readiness in learning depends on the accumulated skills, maturity and metacognition in interpreting these to the desired specific skills (Jensen, 1969). Hence, for students to be self-directed, we need to understand their level of SDL readiness. Therefore, being SDL readied is when an individual possesses the needed skills and knowledge to set the learning goals within ther own initiative (Geertshuis, Jung, & Cooper-Thomas, 2014) and to strategise in achieving the goals.

Being SDL readied is not merely being able to set goals, strategise to achive the goals or to acquire the skills and knowledge for the field. The thoughts of Tough (1979) that being SDL readied is the ability to read and to engaged in learning without concerning the moral aspect of the learning was condemned by many researchers. This is because learning in that way could have neglected the moral or ethical foundation of learning (Roberson, 2005). As one could be very self-directed in learning the skills and knowledge of bringing harm to others. Therefore, a study of SDL readiness is needed to ensure that one is a self-direct learner in learning things which benefit others.

Some general skills of readiness to pursue SDL had been studied by many researchers like Guglielmino (1977), Murray Fisher (2001), Oddi (1986) and Brockett (1985). These skills basically suited for students in any disciplines of study (Hoban, Lawson, Mazmanian, Best, & Seibel, 2005), as it reflects the readiness of students in terms of cognitive, emotion and learning skills towards any form of learning. In order to engage in SDL, students should possess requisite skills, competences and emotional maturity (Du, 2012), and these skills should be specific towards the subject matter.

Oddi (1986) suggested that the ability to be a self-directed learner relates neither to the intelligence nor to intellectual achievement. Readiness refers to the capabilities of one towards completion of a task. This readiness needs to be measured based on the specific skills and knowledge one possesses to perform the task given. There are two types of skills according to the degree of specificity; general skills and specific skills (Schunk, 2012). The general skills are skills which are generally needed to pursue desired knowledge regardless of discipline, for example the skills of writing, reading and calculating. However, the specific skills are skills which are needed specifically to pursue knowledge of an identified discipline. For instance, if one is interested in biology, he or she should possess the biology skills and knowledge needed to pursue biology lessons. Therefore, readiness is specific and varies according to the discipline of study. It cannot be made general and be applied to a cross disciplinary context. This is especially clear in science related subjects like Biology which requires specific skills and knowledge in conducting laboratory experiments and assignments. Similarly, SDL readiness should also be measured specifically for a particular discipline. As in the findings of Khiat (2015), students need to identify the related skills which they are lacking in order to effectively improve their SDL readiness. Therefore, in order for students to be self-directed in biology related studies, they need to be readied in Biology related skills and knowledge. These skills and knowledge include the biology experimentation skills, and experimental reporting skills (Gregory et al., 2011). Additionally, being readied for SDL includes the development of metacognitive knowledge in specific skills and knowledge (Hagstrom, 2006). This includes the ability to utilise the learned skills and knowledge in pursuing one's learning objectives. In past research, students were found to be unable to use the learned skills and knowledge in pursuit of further knowledge (Gallagher, Coon, Donley, Scott, & Goldberg, 2011; Kleden, 2013). This phenomenon may have contributed to the rejection of learning among the students (Pepper, 2010).

Advancements in Biology sciences has increased the content of Biological studies. This phenomenon has brought difficulties for teachers to cover the syllabus of growing content in Biology (Gregory et al., 2011) especially in areas such as biomedical research (Kuper & D'Eon, 2011). Consequently, students finish high school with weak background knowledge and skills necessary for advanced coursework in Biology (Gregory et al., 2011). Additionally, most biology teachers tend to focus on traditional day-to-day activities (lectures and discussions) more than on long-term planning (course objectives, and syllabus) or more innovative non-traditional teaching styles (Fleet et al., 2006). Fleet (2006) also reported that most of the teaching force in Biology related fields were lacking teaching experience. This was mainly because they were scientists who emphasised in laboratory work and scientific facts without pedagogical training.

The advances in Biology has urged biologists to possess interdisciplinary skills and knowledge. However, Usman and Singh (2011) found that some biologists lack the skills and knowledge to analyse and interpret the data collected. In addition, some of the lecturers lack teaching experience (Fleet et al., 2006). Thus, many institutions embrace SDL with a teaching force which lacks understanding of SDL especially in the study of Biology (Larisey, 1994). This raises the concern of effective learning will be. The success of SDL lessons is highly dependent on the lecturers' facilitating skills (Finucane et al., 2009). In short, Fleet et. al. (2006) suggested that the prospective teaching force should be exposed to the real teaching situation in order to be able to accumulate experience prior to entering the teaching arena. With the experience in teaching, lecturers will acquire the skills and knowledge for teaching and be more SDL readied. This was supported by the findings of Cummings (2011) that teachers who embraced the process of teaching (setting the climate, designing and engaging in the teaching activities, and evaluating his own teaching outcomes) would have embraced the "spirit" of SDL.

However, much of the research about SDL readiness has focused on the students. Less interest is paid to the understanding of teachers' SDL readiness. Therefore the current research attempted to profile the SDL readiness not only for the students, but also for the teachers of STPM Biology. The SDL readiness is believed to be varied among individual (Hendry & Ginns, 2009) and falls in a continuum (Fisher et al., 2001). Hence, the current research profiled the SDL readiness on a continuum with the readiness of domains in order to provide a better understanding of the level of readiness of Malaysian STPM Biology students and teachers.

## 2.6 Self-Directed Learning Readiness Scales

Since the implementation of SDL in adult education, many attempts were made to identify the SDL readiness of learners. Over the last few decades there have been researchers who have endeavoured in the study of SDLR. These attempts had urged researchers of SDL to come out with scales for measuring the readiness. Among the scales developed, the pioneer scale to measure the SDLR was developed by Guglielmino in 1977, the Self-Directed Learning Readiness Scale (SDLRS). This SDLRS is one of the most famous and widely used scales in the study of SDLR.

With the help of the SDLRS to conceptualise SDLR, Guglielmino defined self-directed learner as *"one who exhibits initiative, independence, and persistence in learning; one who accepts responsibility for his or her own learning and views problems as challenges; one who is capable of self-discipline and has a high degree of curiosity; one who has a strong desire to learn or change and is self-confident; one who is able to use basic study skills, organize his or her time and set an appropriate pace for learning, and to develop a plan for completing work; one who enjoys learning and has a tendency to be goal-oriented".*(Guglielmino, 1977, p 73)

However, there were critics and doubts about the scale's validity and reliability in measuring SDLR (Bonham, 1991). Some has raised the issues of its flaws in the items development, and suggested to discontinue the use of the SDLRS in the study of readiness (Field, 1991). Consequently many have endeavoured in developing current valid and reliable scales in measuring SDL readiness.

In 1986 Oddi developed the Oddi's Continuous Learning Inventory (OCLI). This scale was used to describe the personality characteristics of self-directed continuing learners (Oddi, 1986). In measuring SDL readiness among undergraduates of nursing education, Murray Fisher developed the Self-Directed Learning Readiness Scale for nursing education in 2001. This scale has been adopted by many nursing education researchers in identifying the readiness of undergraduates in nursing education throughout the world (Hassan Murad & Parthibha Varkey, 2008; Kocaman et al., 2009). While in 2003, Stockdale developed the Personal Responsibility Orientation of Self-

Directed Learning Scale (PRO-SDLS) to measure the self-directedness among college students (Stockdale & Brockett, 2010). Recently a scale was developed by Ayyildiz and Tarhan (2015) which yet again focused on measuring the general skills of SDL. Table 2.1 shows the scales developed in measuring the students' Self-Directed Learning Readiness.

Table 2.1 *Self-Directed Learning Readiness Scales*

| Researcher | Year | Scale |
|---|---|---|
| **YilDizay Ayyildiz Leman Tarhan** | 2015 | Self-Directed Learning Skills Scale |
| **Stockdale, Susan L. Brockett, R. G.** | 2011 | Personal Responsibility Orientation Model of Self-Directedness in Learning (PRO-SDLS) |
| **Swapna Naskar Williamson** | 2007 | Self-rating scale of Self-directed learning (SRSSDL) |
| **Murray Fisher** | 2001 | Self-directed learning readiness scale for nursing education |
| **Oddi** | 1986 Revised in 2006 | Oddi Continuing Learning Inventory (OCLI) |
| **Guglielmino** | 1977 | Self-directed learning readiness scale (SDLRS) |

The critique about these developed scales for SDL readiness is that, these scales have mainly focused on basic skills which are too general or common and can be applied for different disciplines and thus raised the concern of non-specificity in SDL measurement (Brockett, 1985b; Brookfield, 1985; Hoban et al., 2005) and should be more accurately called self-learning characteristics of an individual instead. Besides, it is too common and general to make conclusions based on students' emotional readiness, knowledge readiness to justify their readiness in SDL towards a particular subject matter (Brookfield, 1985; Hoban et al., 2005). As mentioned by Bloom, readiness in pursuing certain subjects needs to include the skills, knowledge and techniques used specifically for the subject (Anderson et al., 2001).

In the Self-rating Scale of Self-Directed Learning (SRSSDL) developed by Swapna Naskar Williamson (2007), "Interpersonal Skills" was one of the construct measured as readiness for SDL. However, this interpersonal skills focused on how one interacts with others, and did not mention on how constructive the interactions are in aiding learning. Therefore in the current research, classroom observations were conducted to understand the interactions that occur during lessons and to identify the constructive interactions.

Thus, in this study, in order to understand the readiness of STPM Biology students' SDL readiness, the scales for measuring SDL in biology included the technical skills and laboratory skills which are specific to biology.

According to the literature review, the developed scales discussed above focused at the SDL readiness of students. Many researchers have mentioned that the success of SDL mainly depends on the teachers (Finucane et al., 2009; Pepper, 2010). Past research has focused on relating teachers' facilitating skills in motivating students for SDL readiness (Sargeant et al., 2010), and matching teachers' teaching styles with students' learning styles to provide the best learning outcome (Dynan et al., 2008; Lau, 2010). However, there were no attempts in identifying the SDL lesson readiness among teachers. Hence, it is one of the objectives of this research to endeavour in developing a scale in measuring teachers' SDL lesson readiness.

## 2.7 Factors influencing SDLR and SDLeR

The factors that influence SDL readiness has also been the focus of past research. Based upon the literature review about factors influencing SDL, the factors basicallycan be separated into two categories; the human factors and the non-human factors.

In terms of the human factors, according to Pepper (2010) and Finucane et al. (2009) the teacher seemed to be the crucial element in determining the success of lessons which are highly related to SDL. Teacher quality which includes the ability to facilitate, classroom management skills and pedagogical skills (Halawah, 2011) have been found to be important. These qualities of teachers will influence the teaching process. This is further supported by Cummings' (2011) research that teachers are the examples for SD learners, and can influences the students' interest in learning. Teachers should maintain positive attitudes toward students, be open-minded, friendly, enthusiastic, knowledgeable and possess good personal qualities that motivate students (Mohamad et al., 2009). In addition, the character of a teacher also plays a significant role in determining the limits of his or her teaching (Halawah, 2011). The way a teacher teaches reflects the values and beliefs of the teacher (Maggioni & Parkinson, 2008). Teachers' understanding of principles in providing quality education is important in enhancing students' independent leaning skills (Halawah, 2011).

Another human factor is the interaction between teacher and student. Rapport between teacher and student was found vital in maintaining students' interests in the subject taught (Kek & Huijser, 2011; Neville, 1999). Based on Nijman, Nijhof, Wognum, and Veldkamp's (2006) research, it is assumed that better interaction between teachers and students will induce acquisition of SDL skills and vice versa. In Forrest's (2008) study, teacher-student interaction provides space for students to interact among themselves and with the teacher through discussion. These interactions helped move students closer to the teaching and learning objectives. In the current research, meaningful interactions with the students, is believed to help in triggering students' interest to further their learning. This in turn will influence the SDL readiness.

Students need to be motivated in order to be focused and interested in the learning process (Ayelet Baram-Tsabari & Yarden, 2007). This motivation is enhanced when students collaborate and are empowered to conduct their own learning. Thus, to ensure the interest in Biology related subjects, students' involvement in conducting biological research and fieldwork would motivate them to indulge in the subject (Ayelet Baram-Tsabari & Yarden, 2007). By motivating the students to partake in the learning activities, it is believed that these will help them in acquiring the skills and knowledge needed in learning the related subject. Hence, in turn preparing them to be SDL readied.

In terms of the non-human factors, teachers need the support of the school management in creating an environment to encourage students' participation in questioning, explaining, justifying and evaluating ideas in the classroom by creating a student-centred teaching approach (Kek & Huijser, 2011). An environment in which students feel comfortable and safe to elaborate their thoughts will encourage the development of students' confidence and self-esteem in providing their own learning outcomes. This is very important in trying to get students SDL readied. A conducive environment which encourages students' interaction with each other, with teachers and with other individuals is especially essential in Malaysia as a multi-racial country. The Malaysian education system has been identified as examination-oriented, which focuses on rote-learning, spoon-feeding and hinders students from possessing generic skills (Jusoh et al., 2011; Lee, 1999; Sail & Alavi, 2010). Hence, there is a need to understand how Malaysian learning environments influence SDL readiness among Malaysian students and teachers, and in this study the subject matter selected is STPM Biology.

Besides the support from school management in creating a conducive environment for SDL, Weaver, Rosen, Salas, Baum, and King (2010) suggested that the support of schools' board of managements for this will influence teachers' readiness for teaching. This support includes facilities, monetary, and moral support from the institution, colleagues, staff and the management board. The most well planned programmes will fail unless they are supported by an organized and professional culture, which enhance collaborative work (Weaver et al., 2010). The school management should give support to the teachers to ensure their quality in teaching. This support is crucial and will influence the interest of teachers in teaching and the interest of students in learning.

Another non-human related factor is the accessibility to facilities like computers and internet connection. The accessibility to these facilities influence SDL readiness among students and teachers. Students being more accessible to computers have better mastery of their learning (Horng, 2011). In addition, the accessibility to other external facilities like zoos, botanical gardens, libraries, museums, experts, or other related professionals will help students in developing better understanding of the subjects, especially when they are conducting biology related field work (Thair & Treagust, 1997). By mastering ICT skills, students and teachers will be able to access to reading materials more easily and enhance their reading. By doing independent reading student would be able to enhance their self-directedness in learning (Halawah, 2011).

Table 2.2*Predetermined Factors Influencing Self-Direceted Learning Readiness*

| **Factors** | | **Research involved** | **Explanations** |
|---|---|---|---|
| **Categories** | **Predetermined Themes** | | |
| **Human** | **Tutors / facilitators** | Pepper (2010)<br>Finucane et al., (2009)<br>Mohamad et al., (2009)<br>Halawah (2011) | Quality of knowledge<br>Ability to facilitate<br>Personal characteristics<br>Pedagogical and classroom management skills |
| | **Teacher-student interaction** | Kek and Huijser (2011)<br>Neville (1999) | Teacher-student rapport<br>Creating conducive environment for SDL skills cultivation. |
| | **Students' motivation** | Ayelet Baram-Tsabari and Yarden (2007) | Empowering students to take control of their learning.<br>Engaging students in the learning processes. |
| **Non-Human** | **Accessibility to facilities** | Horng (2011)<br>Thair and Treagust (1997) | Access to ICT.<br>Access to educative facilities and professional personnel. |
| | **Support** | Weaver et al., (2010) | Management support<br>Monetary support<br>Morale support<br>Team support |

These identified factors, as summarised in Table 2.2, were used as the predetermined themes in identifying the factors influencing the SDL readiness through interviews and classroom observations in this research. However, the present research was open to new emerging themes for the hindering factors which emerged during the interviews and classroom observations.

## 2.8 Teaching Styles

Teaching styles reflects the beliefs and philosophy of a teacher (Khandaghi & Farasat, 2011, cited in Suntonrapot, 2014). Hence, teachers may practice different teaching styles. However, not all teachers can apply all teaching styles in conducting their lessons. To maximize learning, teachers can adopt different styles which they think is suitable (Suntonrapot, 2014).

Additionally, research has shown that students preferred a combination of teaching styles to maximize their learning (Arunodaya, Rogayah, & Ahmad Fuad, 2009). Therefore, it is believed that teachers should alter their teaching styles according to the students learning styles (Neville, 1999). Practically teachers practise not only one type of teaching style in delivering their lessons. Normally, a few teaching styles would be applied with one dominant style which the teacher prefers when conducting lessons.

Some past researchers measured teaching styles as a correspondent to the learning styles (Felder & Silverman, 1988). The tool used in measuring the teaching styles was a model with qualitative questions. To overcome the problem of qualitative measurements of teaching styles, some used the Spectrum of Teaching Styles (Morgan, Kingston, & Sproule, 2005). This Spectrum of Teaching Styles is a continuum that categorise teaching styles based on planning, teaching and evaluation. However, the tools were too expensive to be used in this research due to financial constraint.

In view of the financial status, and also the measurement dimensions, Grasha-Riechmann Teaching Style Survey (TSS) is used in this current research. The TSS is available online at *longleaf.net/teachingstyle.html* which teachers can access the tool online freely. Teachers can access to the internet and fill up the survey at any time. The TSS is chosen for this research is because it covered both the teacher-centred and student-centred teaching styles quantitatively. With the quantitative data collected for the teaching styles it makes the correlation of the SDLeR and the teaching styles possible.

Table 2.3 *Five Teaching Styles*

| Teaching Styles | Descriptions |
|---|---|
| **Expert** | Possesses knowledge and expertise that students need. Strives to maintain status as an expert among students by displaying detailed knowledge and by challenging students to enhance their competence. Concerned with transmitting information and insuring that students are well prepared. |
| **Formal Authority** | Possesses status among students because of knowledge and role as a faculty member. Concerned with providing positive and negative feedback, establishing learning goals, expectations, and rules of conduct for students. Concerned with the correct, acceptable, and standard ways to do things and with providing students with the structure they need to learn. |
| **Personal Model** | Believes in "teaching by personal example" and establishes a prototype for how to think and behave. Oversees, guides, and directs by showing how to do things and encouraging students to observe and then to emulate the instructor's approach. |
| **Facilitator** | Emphasizes the personal nature of teacher-student interactions. Guides and directs students by encouraging cooperative as well as independent learning activities. Good at questions, exploring options, suggesting alternatives, and encouraging students to make informed choices. Overall goal is to develop in students the capacity for independent action, initiative, and responsibility. Works with students on projects in a consultative fashion and tries to provide as much direction, support, and encouragement as possible. |
| **Delegator** | Concerned with developing students' capacity to function in an autonomous fashion. Interested in having people become self-directed, self-initiating learners. Students work independently on projects or as part of autonomous teams. The teacher is available at the request of students as a consultant and resource person. |

Source: Grasha and Yangarber-Hicks (2000)

According to the Grasha-Riechmann Teaching Style survey, five teaching styles can be identified. Table 2.3 below shows the types and descriptions of the teaching styles. SDL seems to fit into the teaching styles of "Facilitator" and "Delegator" as mentioned by Grasha-Riechmann. However, correlation of the teaching styles to the teacher's SDL readiness has not been investigated. Hence, in this research, the researcher intends to determine the correlation between SDL readiness and teaching styles.

According to Hendry and Ginns (2009), some learners may prefer or learn better with the teaching styles of "Expert", "Formal Authority" and "Personal Model" which carry more of a teacher-centred learning characteristic. Hence it is the aim of the current research in finding the correlation of SDLeR and teaching styles. By looking into the correlation of SDLeR and teaching styles, the current research can provide a better understanding of SDL readiness in different teaching approaches.

### 2.9 Learning Styles

Learning styles are described as "the ways in which an individual characteristically approach different learning tasks" and as "a particular set of behaviours and attitudes related to learning context" (Williams, Brown, & Etherington, 2012). Kolb (1984) believed that learning is a process of acquiring and transforming of skills and knowledge. Thus, learning styles are referred as particular sets of behaviours through which students acquire skills and knowledge and which optimizes learning.

Curry (1983) reorganized learning style constructs encompassed the psychometric standards. She introduced the Curry's Onion Model to illustrate the learning style constructs which include the Instructional Preference, Information Processing Styles and Cognitive Personality. This notion of learning styles seemed fit into the current research's notion of learning which is not confined to the psychometric standard but at a higher level of metacognitive learning process.

Many learning styles measuring tools were developed in the past. These include the Honey and Mumford's Learning Styles Questionnaire (LSQ) which has 80 items specifically developed or the use in industry and management. Bigg's Study Processes

Questionnaire (SPQ) was developed in 1985 which incorporate the motivational dimension. In 42 items originally, it was revised to be a 20 items instrument which measure the scores in relation to strategy and motive (Cassidy, 2004). In view of the dimensions measured by LSQ are more suitable for the present research, LSQ was chosen as the tool to measure the learning styles. However, the amount of the items seemed to be unfit for students. Therefore, Preference of Learning Styles for Biology (PLSbio) which is adapted from the Learning Styles Questionnaire (LSQ) (Mumford & Honey, 1992) is used in this research in measuring the students' learning styles. This is because LSQ measured not only the major sensory modes of learning (visual, aural, and kinaesthetic) but learning in the dimensions of processing information and their past experiences.

The Kolb Learning Cycle suggests a notion of learning which evolves as the students progress through their academic learning and practical skills training (Chan, 2012; Murphy, 2007). There are four different kinds of abilities being recognized in the process of learning: learning from concrete experiences, learning from reflective observations, learning from abstract conceptualization and learning from active experimentation (Swailes & Senior, 1999). Diverse characteristics were identified in high performing students who applied more than one learning style (Swailes & Senior, 1999). This indicated that learning styles did not determine the process of learning, but the engagement of learning which involved the experiences that made learning meaningful (Maggi Savin-Baden, 2000). Experience needed one to engage in the learning process. This seemed fitting into the notion of readiness proposed in this research where being readied for SDL is the engagement of one in the learning process regardless of which learning style one prefer.

The LSQ was developed based on Kolb's learning styles inventory (LSI). Due to low validity for Kolb's LSI, in 2000 Honey and Mumford decided to develop the LSQ to identify students' learning styles (Honey & Mumford, 2000). This questionnaire was developed based on Kolb's learning theory. Four types of learners were identified as shown in Figure 2.1. The learning styles are "Reflectors", "Theorists", "Pragmatists" and "Activists".

"Reflectors" learners focus on predicting outcomes, reflecting and trying to understand meaning through observation and description of processes. "Activists" learners are those who enjoy new experiences, love challenges and collaborating with others. They are active in role playing and assimilation, and tend to make decisions intuitively, but dislike structured procedures. "Theorists" learners, unlike the "Activists", prefer to think problems through in a step-by-step manner. They focus on ideas, logic and systematic planning. These learners do not prefer intuition and emotional involvement. Lastly, the "Pragmatists" learners are those prefer to apply new learning to actual practice to see if they work. They like practicality, down-to-earth approaches, group work, debate and risk taking, but tend to avoid reflection and deep levels of understanding.

Students have different preference in learning which depends on their past experiences. There are many ways of measuring students' learning styles. The researcher of the present study assumed that being readied for SDL is not confined to the learning styles one prefers. As for the teaching styles, one will be self-directed when one possesses the skills needed for specific subjects. Thus, learning styles would be irrelevant.

In past research, the SDLRS which was developed by Guglielmino in 1977 has been used widely in identifying students' SDL readiness. However, this scale has highly focused on books and schooling which has limited the impact of skills and attitudes (Brockett, 1985b). Students will be self-directed when they are aware of what they want to learn and know how to go about learning it (Brockett, 1985b). Thus, regardless of which learning style the students preferred they can become SDL readied.

Some researchers may find the LSQ was not reliable as it had low Cronbach alpha value from past research. However, Swailes & Senior, (1999), argued that the instruments have been used in many educational and psychological research as a valid measure of learning styles. Hence this instrument was adapted in this research to measure the learning styles preference of the STPM Biology students. This adapted Preference Learning Styles for Biology (PLSbio) yielded high reliability during the pilot test and the actual study.

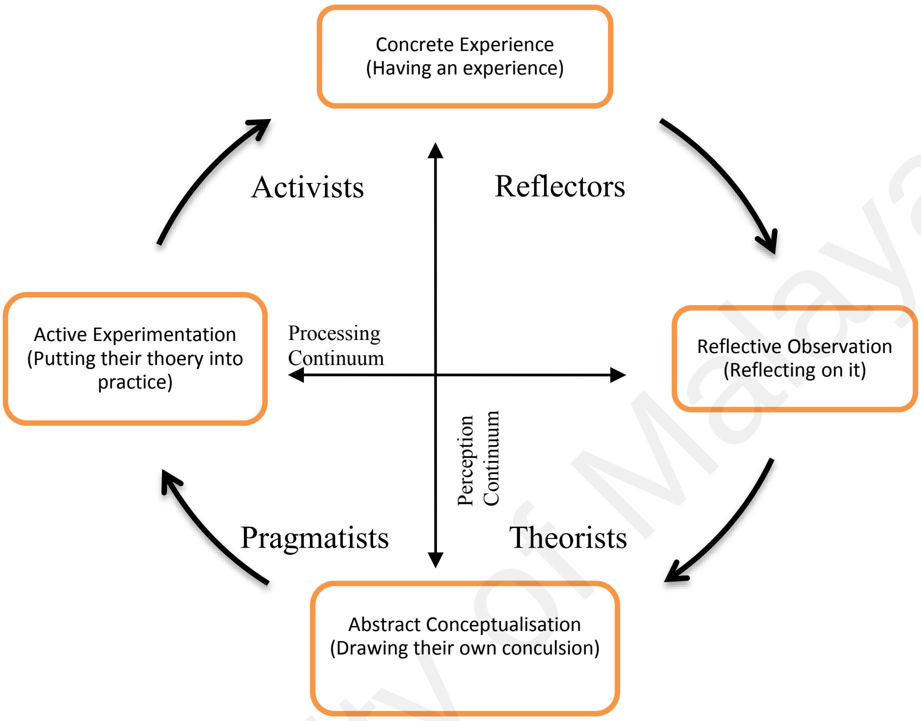



*Figure 2.1* Learning Styles in Kolb's Learning Cycle
Source: Honey & Mumford (2000)

## 2.10 Bloom's Taxonomy

Bloom's Taxonomy is one of the Educational Theories underpinning this research. The taxonomy is used in understanding the levels and categories of skills and knowledge for SDL. The taxonomy was also involved in the development of the SDLRSbio and SDLeRSbio in measuring the SDL readiness among students and teachers of STPM Biology in this research.

In Dynan's (2008) study, Bloom's taxonomy was used to explain the SDL readiness level. For one to be ready for SDL one should possess a higher level in knowledge domains and cognitive domains of Bloom's taxonomy (Dynan et al., 2008).

In Bloom's Taxonomy, learning domains were divided into three (3): the psychomotor (skills), the affective (attitude) and the cognitive (knowledge) (Seaman, 2011). It is believed that, as a person's knowledge increases, the SDL readiness for learning will be enhanced. The complex cognitive processes are also assumed to increase as a person becomes more SDL readied towards biology study. Thus, according to Bloom's understanding, the SDL readiness of one towards learning needs the combination of the three learning domains in developing their capabilities of searching for the knowledge and skills needed in pursuing a study. This was then refined in the revised version of Bloom's Taxonomy as "Metacognitive knowledge".

According to the revised Bloom's taxonomy, knowledge is divided into four (4) categories; "Factual knowledge", "Conceptual knowledge", "Procedural knowledge", and "Metacognitive knowledge". These categories of knowledge lie in a continuum from concrete to abstract (Anderson et al., 2001). Each subject matter has its own specific knowledge dimensions, thus, for one to study biology one should possess the knowledge dimensions needed for biology. Therefore, one needs to be readied in terms of skills and knowledge in biology in order to be self-directed in the subject.

In view of Bloom's Taxonomy which can be used to identify the level of understanding and readiness of students and teachers in SDL skills and knowledge, the taxonomy was used in developing the SDLRSbio, and the SDLeRSbio in this research.

Table 2.4*Categories of Constructs in Bloom's Taxonomy for SDLRSbio and SDLeRSbio*

| Knowledge domains | Constructs |
|---|---|
| **Factual knowledge** | - |
| **Conceptual knowledge** | Biology cognitive readiness |
| **Procedural knowledge** | Biology learning skills readiness |
| | Use of instrument |
| | Laboratory techniques |
| | Data collection / reading instrument |
| **Metacongitive knowledge** | Emotional readiness in Biology |
| | Experimental design skills |
| | Data analysis and interpretation skills |
| | Interacting skills readiness |

Since higher level of knowledge domains are needed to be SDL readied, therefore, the constructs of the scales developed in this research focused at measuring the constructs with higher level of knowledge domains. Table 2.4 shows the categories of constructs for SDLRSbio and SDLeRSbio in relation to Bloom's Taxonomy of knowledge domains. The process of categorizing the domains of readiness in Bloom's Taxonomy is discussed in detail in Chapter 4.

## 2.11 Constructivist Theories of Education

This research is underpinned by a few constructivist theories. These theories help in explaining the current research and its findings. The theoretical framework of this research was built according to the following theories.

### 2.11.1 Jerome Brunner's Constructivist Theory

Constructivism deals with the cognitive processes in which the learners develop their knowledge. Brunner's constructivist theory said students learned by developing the prior knowledge (Schunk, 2012). Brunner supports the construct of new ideas and concepts based upon existing knowledge. It is important to know that students interpret and approach learning tasks based on the frame of pre-existing knowledge (Loyens, Rikers, & Schmidt, 2006). The process of learning is active and involves transformation of information, deriving meaning from experience, forming hypothesis, and decision making. The process of knowledge development spiral up and develop as learners are exposed to more complex knowledge.

According to Brunner, students learn through active problem solving and are capable of exploring more difficult subjects of instruction. Students will construct new knowledge and new meaning from authentic experiences. Thus, students must find the lesson useful and relevant in order to be interested in the subject (Langen & Welsh, 2006).

Students need the opportunity to acquire scientific research skills and to experience joy of discovery in order to maintain their interest in pursuing science related studies (Lamanauskas & Augiene, 2011).

Thus, in readiness of SDL, students need the opportunity to be exposed to the SDL environment (Gurjeet, Navkiran, Cecilia, & Bulik, 2002). A proper planned curriculum, supported by a force of SDL readied implementers, STPM Biology students should be readied for SDL prior to entering tertiary education.

### 2.11.2 Ausubel's Meaningful Learning

David Paul Ausubel was an American psychologist who contributed to the fields of educational psychology, cognitive science, and science education learning since the 1960s. He introduced the concept of meaningful learning, that is one would learn well when they can relate the new skills and knowledge to their existing cognitive structure (Schunk, 2012). Ausubel also further explained his theory that learner could learn much better when they have existing related skills and knowledge about the related concepts. This indeed is very similar to the proposed notion in the current study which suggested that being readied for SDL one needed specific skills and knowledge of the particular discipline.

Similar to Piaget's ideas of conceptual schemes, Ausubel related his explanation of how people acquire knowledge. Ausubel proposed that students acquired knowledge by directly being exposed to it. In other words, Ausubel believed that understanding concepts, principles, and ideas are achieved through deductive reasoning. Students must make meaning to the new knowledge in order to master the knowledge. Thus, meaningful learning is much more important compared to rote memorization. Therefore, teachers should ascertain the readiness of students so that they can strategize their teaching to help the students become better in making sense of their learning (Gyawaii et al., 2011).

By making their learning meaningful personally and socially worthwhile (Garrison, 1997) students will be more engaged to their learning. This could then, enhance their SDL readiness in the subject. By this way, students are likely to maintain their motivation, interest and participation whether in further study, future careers, or involvement in science projects (Ainley & Ainley, 2011). Therefore, meaningful learning is needed for students to engage themselves in the learning process. This engagement is needed in the SDL readiness as well.

### 2.11.3 Vygotsky's Social-Cultural Constructivism

Lev Semyonovich Vygotsky was a Russian psychologist. According to Vygotsky's social-cultural constructivist theories, he proposed that students will learn from the interactions with others (Schunk, 2012). SDL does not mean learning in isolation, but rather advocates the use of experts as facilitators and resources (Kocaman et al., 2009) to help one in achieving the learning goals. From the experience of interacting with others, students will develop their knowledge and skills. This is how it fits into the notion of SDL where students will determine the way and style of learning by themselves.

In his Zone of Proximal Development (ZPD), Vygotsky also mentioned the potential development of students with the guidance of a more capable person. In other words, through the assistance of a more capable person, a student is able to learn skills or aspects of a skill that go beyond the student's actual developmental or maturational level. Therefore, development of teaching always follows the student's potential to learn. However, there is also the possibility where students will develop negative learning from others (Murphy, Mufti, & Kassem, 2009). Thus, constructive interaction between students and teachers is speculated to be influencing SDL readiness in this research.

On the other hand, it is the school's management board and teachers' responsibility to create the learning culture and environment for students to be SDL readied (Basl, 2011). In this sense, teachers should assess the self-directedness of students in order to help themselves in being SDL lesson readied (Kek & Huijser, 2011). This has been put forward that matching teaching style to the learning style is an important effort of teachers in SDL lessons (Aminuddin Hassan, Tajularipin Sulaiman, & Roselan Baki, 2011; Arunodaya et al., 2009; Dynan et al., 2008; Finucane et al., 2009; Neville, 1999). Nevertheless, teaching styles should be governed not only by the subject matter, but the balance between teacher 'directiveness' and student control (Grow, 1991) according to the students' SDL readiness level. This study put forward that through constructive interactions both students and teachers should be readied for SDL.

## 2.12 Constructive Interactions

Interactions take place at every moment during a lesson. However, not all interactions that happen during lessons help in leading teachers and students in skills and knowledge development. Most of the time, we believe that students receive passively whatever the teachers teach. However, in the concept of ZPD, for knowledge transfer to take place, both students and teachers should benefit from the interactions for themselves. An individual learns through interacting with others (Doolittle, 2014; Ribeiro, 2011). The interaction should satisfy some emotional need as well as support cognitive processes, which makes the learning both rewarding and meaningful with a positive impact on both teachers and students (Murphy et al., 2009). Hence, in this research the interactions were estimated to be constructive in contributing to the acquisition of skills and knowledge needed in order to be considered contributing to readiness of SDL.

In this research, constructive interaction was defined as the interactions which enhance the process of teaching and learning during lesson. This communication included the social interaction with the environment, which includes human beings and other entities (Alvarez & Cuesta, 2011; Vygotsky, 1978) during the lesson. Interactions which can enhance the engagement of students and teachers to the teaching and learning processes are considered as constructive, in other words, helping the development of skills and knowledge of the students or the teachers as well. The engagement can be in terms of emotional engagement, cognitive engagement, physical engagement or other forms of engagement which can ensure effective learning. These categories of engagements were defined as “energy in action” and represents the connection between an individual and the activity in which one is involved (Sagayadevan & Jeyaraj, 2012). In Sagayadevan and Jeyaraj’s report, a high level of engagement was also associated with enhanced achievement, effective learning, acquisition of knowledge and skills as well as better emotional function among the teachers and students.

In order to have development of skills and knowledge during classroom interactions, teachers need to design the interactions (Forrest, 2008). The quality of interactions need to be monitored (Bloom, 1976). Therefore experts like teachers play an important role in monitoring the interactions during lessons (Kek & Huijser, 2011). This is to ensure the quality of interactions which should be constructive. Constructive in terms of engaging the mind, the body and the culture where one lives in (Caffarella & Clark, 1999; Clark & Caffarella, 1999). Interactions which are constructive, will help the students to be engaged in the lesson and hence increase their interest in the subject taught (Nijman et al., 2006). Therefore it is put forward in this research that, constructive interaction leads to the SDL readiness.

In the process of encouraging constructive interactions during lessons, teachers in particular, need support from the management and professional training (Hamre et al., 2012) to plan for a conducive environment. Immediate and accurate responses to the students’ inquiries are needed for better development of skills and knowledge among the students. These responses will be constructive interactions at the right time during lessons. These interactions need to be publically performed following a formal method to prevent any meaningless chatting (Chao, Hwu, & Chang, 2011). Hence, teachers need to plan and be alert of how to monitor the interactions during their lessons.

## 2.13 The Delphi Technique

The Delphi technique was introduced in the 1950s and has been used for collecting experts' opinions towards certain issues where judgmental information is indispensable (Linstone & Turoff, 1975). It is basically a procedure for structuring a communication process among a large group of individuals. It has been commonly used in technological forecasting. However, as the development of Delphi continued, it became a technique to acquire experts' opinions in developing instruments' constructs and items. In the history of self-directed learning readiness scales development, many had used the Delphi technique in identifying the constructs and items of the scales from various experts. These include the development of SDLR scales (Guglielmino, 1977), Self-rating scale of self-directed learning (SRSSDL) (Williamson, 2007) and SDLRS for nursing education (Fisher & King, 2010). This technique has been used widely in research. Hence, in the current research the Delphi Technique was also used in the development of the research tools.

Methods of themes identification are crucial for qualitative research validity and reliability (Vanderstoep & Johnston, 2009). The most important part of this method is the selection of experts (Linstone & Turoff, 1975 p 6). Therefore, the expert panel list of this research was selected from the experts of Biology related fields in secondary and tertiary education. Consent was given before the panel list was formed to ensure total participation in the preparation of the research instruments.

Thus, in this research, a group of experts in Biology related education were consulted to identify the constructs of the scales of Self-Directed Learning Readiness Scale for Biology (SDLRSbio), Self-Directed Learning Lesson Readiness for Biology

(SDLeRSbio), the adaptation of Preference of Learning Style for Biology (PLSbio), the preparation of classroom observation protocol and the preparation of the interview protocols.

## 2.14 Working Hypothesis

In the past, when a research was based upon novel assumptions of a phenomenon, the researcher designed and conducted the research with a working hypothesis. This was traced in the research of Chamberlin (1899) and Fanton (2006) where working hypotheses were used in directing the research. In both of the research, the working hypothesis was made based upon some assumptions of an interested phenomenon. The researchers then designed and conducted the research with the working hypothesis proposed in their research respectively.

Cronbach (1975) further explained that a working hypothesis is not a statistical hypothesis which has a null hypothesis to be tested. This working hypothesis is used when there is lack of existing data in finding a solution to the phenomenon (Cronbach, 1975). The working hypothesis is used as a basis for further research and several possible answers exist to be identified. Therefore it is used in exploratory research to identify the possible answers to the phenomenon (Marie, 1997). Further research could then be carried out based upon the finding of the working hypothesis proposed in the exploratory research.

In this current research, the working hypotheses were proposed to understand SDL readiness which could be influenced by constructive interactions. Therefore this research is novel in this way in providing only the initial understanding of SDL readiness with constructive interactions which further future research could work upon.

## 2.15 Chapter Summary

In view of the trend moving toward SDL in tertiary education, it raised the need of preparing students entering tertiary education with SDL skills and knowledge. The aim of this research was to profile the STPM Biology teachers' and students' SDL readiness. This profiling process was done by focusing at determining the level of readiness among teachers and students, identifying the factors influencing the readiness, and describing the constructive interactions happened during lessons. Constructive interactions is believed to be crucial in the teachers' and students' SDL readiness. Additionally, the research also proposed a notion of being SDL readied is independent of learning and teaching styles.

The current research was designed based upon the literature review. The next chapter will discuss the conceptualisation of the current research.

# CHAPTER 3

# CONCEPTUALISATION OF THE STUDY

## 3.1 Introduction

Much research has been conducted to study SDL since the 1970s. These included Guglielmino's Self-Directed Learning Readiness Scale (SDLRS) in 1977, Oddi's Oddi Continuing Learning Inventory (OCLI) in 1986, Murray Fisher's Self-Directed Learning Readiness Scale for Nursing Education in 2001 and Williamson's Self rating scale of SDL (SRSSDL) in 2007. Details of past research are recorded in Table 3.2. These research mainly focused at adult learning and medical related fields. In view of the importance of SDL in tertiary education, many researchers had endeavoured in developing scales to understand the SDL readiness in order to help the planning and developing of curricula.

Attempts of the previous research were focused at studying the level of students' readiness with the scales developed. These self-assessed measurements were used as the rating of SDL readiness in terms of some basic skills in the past studies (Brockett, 1985; Brookfield, 1985; Hoban et al., 2005). However, the actual phenomenon of readiness lacked several aspects such as subject specificity. Hence, appeared the need of a scale to understand the SDL readiness of Biology students which includes the specific Biology skills and knowledge.

According to the literature review, fresh graduates were found incompetent and unprepared for SDL (Belzer, Millar, & Shoemake, 2003; Chakravarthi et al., 2010). Looking into the problem, students were found having difficulties in identifying the depth and breadth of their learning in which SDL were implemented (Belzer et al., 2003; M. Fisher et al., 2001; Hendry & Ginns, 2009; Pepper, 2010). These research seemed to indicate that there were some factors influencing the students' readiness for SDL. Hence, this gap in looking into the factors which influence the readiness for SDL is investigated in the present study.

The present research is proposing a new notion for the SDL readiness and testing it through three (3) working hypotheses. This research could be novel in the attempt of understanding the SDL readiness with constructive interactions. Based upon the proposed definition of SDL by Knowles (p.6) this research anticipated that students and teachers can be readied for SDL regardless of which learning styles and teaching styles they preferred. It is also conceptualised that the SDL readiness is influenced by constructive interactions. Based upon the literature review of past research, the SDL readiness among pre-university students and teachers has not been widely investigated. Since the research tested a proposed notion and "speculated" working hypotheses, this study was considered as "abstract" at this point.

In this chapter, the researcher has conceptualized the gaps of the study related to SDL and has positioned the present research as to how it can contribute to the knowledge of SDL specifically in the SDL readiness. This study aimed to profile the self-evaluated readiness of STPM Biology students and teachers for SDL, to identify the factors influencing the SDLR and SDLeR, and to describe the constructive interactions during lessons. The researcher also looked into the proposed working hypotheses related to the correlation between the SDLR and learning styles, and SDLeR and teaching styles.

### 3.2 Conceptual Framework

In past research, SDL was defined as a process where the students on their own initiative identify their learning goals and work out a way to achieve the goals (Knowles, 1975). Knowles' definition further explained that the approaches the students choose can be with or without the help of others. Hence, it is interpreted in this study that being SDL readied should be independent of the learning styles or teaching styles. Following the steps of Knowles, many researchers had endeavoured to study SDL. The history of investigation into SDL is summarized in Table 3.1.

According to Table 3.1, much research have focused on the development of SDL theories, concepts and the definition. From definitions of SDL some research branched out to understand the SDL readiness. Therefore some attempts have been made to develop scales in measuring the readiness of students' readiness in SDL since the 1970s. Based upon the literature review, SDL readiness was referred to the degree of the attitudes, abilities and personality characteristics an individual possesses for learning (Areewan, Nongkran, Acharaporn, & Sue, 2010). This readiness needed to be specific for the subject matter (Brockett, 1985a). Hence, SDL readiness is the capability of one in setting and achieving the goals of learning, in strategising and allocating the resources, and evaluating the learning outcomes (Stockdale & Brockett, 2010). Therefore according to Bloom's Taxonomy for one to be SDL readied, one needs to possess higher levels of knowledge domains which is metacognitive knowledge (Hagstrom, 2006). Combining the understanding of the SDL and SDL readiness, the current research anticipated that the SDL readiness is independent from learning styles and teaching styles. The readiness is the specific skills and knowledge which one possesses with metacognitive knowledge to increase the potential or capability of one in setting and achieving the learning objectives with the resources available. Based upon this understanding, a notion of SDL readiness was proposed in this research.

Table 3.1 *History of Self-directed Learning Research*

| Researcher | Year | Contribution |
|---|---|---|
| **Cyril Houle** | 1961 | Influencing the explosion of research, thoughts and literature in SDL. Initiate the thought of the way adults prefer to learn. Served as dissertation advisor to Allen Tough and Malcolm Knowles. |
| | 1980 | Extended SDL beyond merely a "process" of learning. |
| **Allen Tough** | 1966 | Continue the blossom of adult learning. Encouraging understanding to adults' learning projects and growing awareness worldwide about SD learners. |
| **Malcolm Knowles** | 1975 | First given definition of SDL. Suggesting andragogy which refers to learners' effort in learning. Known as father of "adult education". |
| **Guglielmino, Lucy** | 1977 | Development of Self-Directed Learning Readiness Scale (SDLRS). It was then refers as Learning Preference Assessment in 2005. |
| | 2006 | Suggested the relationship of SDLR with job performance. |
| **Gibbons at. el.** | 1980 | Continue the growth of literature of SDL in terms of theoretical approach, pedagogical approach, and concept. |
| **Brookfield, S.** | 1984 | Suggested a paradigm shift in SDLR study from quantitative measurement to qualitative study. |
| **Brockett** | 1985 | Suggested the study of SDL to address the political implication. Critics the measurement of SDLRS was much oriented toward learning through books and schooling. Proposed that successful self-directed learner is one who has an awareness of what he wants to learn and knows how to go about learning it. |
| **Caffarella & O'Dannel** | 1987 | Brought the concept of SDL to work related measurement. |
| **Roger Hiemstra** | 1990 | Summarized the study of SDL from Cyril Houle, Allen Trough, Malcolm Knowles, and Huey B. Long. |
| | 2006 | Proposed the development of SDL in distance learning and computer based learning. |
| **Grow** | 1991 | Proposed the matching of teaching style to develop students' SDL skills. |
| **Garrison** | 1992 | Proposed SDL as both personally meaningful and socially worthwhile. Suggested incorporation of critical thinking to the concept of Self-directed learning. |
| | 1997 | Learners will not succeed and prosiest in their learning without cognitive abilities and available strategies. Degree of self-directedness depends upon learner's proficiency in conjunction with contextual and epistemological demands. |
| **Long , Huey B.** | 1986 | Founded an annual international symposium on SDL |
| **Oddi, L. F.** | 1986 | Development of Oddi Continuing Learning Inventory |
| **Murray Fisher at.el.** | 2001 | Development of SDLRS for nursing education. |
| **Gurjeet, S. Shoker** | 2002 | Suggested that learning unpreparedness for SDL was simply due to the lack of opportunities to do so. |
| **Williamson, S.N.** | 2007 | Self-rating scale of Self-Directed learning in undergraduate nursing education. Suggested SDL skills could be developed through careful planning and integration into the curriculum. |
| **Dynan, Linda** | 2008 | Suggested that SDL skills can be instilled with planned curriculum and should be taught much earlier than tertiary education. |
| **Hassan, Murad** | 2008 | Proposed the key principles of SDL. |

From Table 3.2, it can be seen that much past research focused on measuring the SDL readiness among undergraduate nursing students. Furthermore, these past developed scales in measuring SDL readiness focused on medical students. There is also a scale developed by Ayyildiz and Tarhan (2015) in measuring high school students' SDL skills. There seems to be a lack of studies on pre-university students' SDL readiness. However, many researchers have found that fresh undergraduates were incompetent in SDL (Chakravarthi & Haleagajara, 2010). The fresh undergraduates were found incompetent in determining their learning objectives and the way they want to achieve these objectives (Fisher et al., 2001). They also were incapable of identifying the scope for their learning (Belzer et al., 2003; Hendry & Ginns, 2009). Therefore, Dynan et al. (2008) suggested looking into the pre-university students' readiness for better understanding of the SDL readiness.

Hence, the current research aimed to develop a readiness scale for measuring the self-evaluated level of SDL readiness among the pre-university students. The subject in this study was Biology as SDL is implemented for biological fields of study in tertiary education.

From the literature review, it was found that not many studies have been conducted in understanding the readiness of teachers for SDL lessons. Additionally past research has shown that teachers face difficulties being readied for SDL lessons as students have different level of SDL readiness (Cho & Kwon, 2005; Garrison, 1997; Hannafin, Hannafin, & Gabbitas, 2009; Hendry & Ginns, 2009). Therefore, this research also aimed to close the gap in understanding the teachers' SDL readiness for lessons. A scale was also developed to measure the self-evaluated SDL readiness for lessons among the Biology teachers.

Table 3.2 *History of Self-Directed Learning Readiness Scales Development*

| Researcher | Year | Scale | Target Group | Scale development method | Data analysis tool | Constructs | Total of items | Scoring |
|---|---|---|---|---|---|---|---|---|
| **Ayyildiz**<br><br>**Tarhan** | 2015 | Self-Directed Learning Skills | High-school students in Turkey | | CFA<br>EFA | Attitude towards learning<br>Learning responsibility<br>Motivation and self-confidence<br>Ability to plan learning<br>Ability to use learning opportunities<br>Ability to manage information<br>Ability to apply learning strategies<br>Assessment of learning process<br>Evaluation of learning success/results | **40** | |
| **Stockdale, Susan L.**<br><br>**Brockett, R. G.** | 2011 | Personal Responsibility Orientation Model of Self-Directedness in Learning (PRO-SDLS) | College Students | | | Awareness<br>Self-Efficacy<br>Control<br>Motivation | | |
| **Swapna Naskar Williamson** | 2007 | Self-rating scale of Self-directed learning (SRSSDL) | undergraduate nursing students | Delphi Technique | Internal consistency : Chronbach's Coefficient Alpha | Awareness<br>Learning strategies<br>Learning activities<br>Evaluation<br>Interpersonal Skills | 12<br>12<br>12<br>12<br>12 | |
| **Murray Fisher** | 2001 | Self directed learning readiness scale for nursing education | Undergraduate nursing students | Delphi Technique | Varimax rotation, Chronbach's coefficient alpha, Item-to-total correlations | Self-management<br>Desire for learning<br>Self control | 13<br>12<br>14 | |
| **Oddi** | 1986 | Oddi Continuing Learning Inventory (OCLI) | Graduate students in Law, Nursing and Education | | Orthogonally Rotated Four-factor solutions<br><br>Chi-square | Proactive/reactive learning drive domain<br>Commitment/aversion to learning<br>Cognitive openness/ defensiveness. | 11<br><br>7<br><br>6 | |
| | Revised in 2006 | | | | | *Revised version*<br>Learning with others<br>Learner Motivation/Self-Efficacy/Autonomy<br>Ability to be Sefl-Regulating<br>Reading Avidity | <br>6<br>8<br><br>5<br><br>5 | |
| **Guglielmino** | 1977 | Self-directed learning readiness scale (SDLRS) | | Delphi Technique | | Openness to learning opportunities<br>Self concept as an effective learner,<br>Initiative and dependence in learning<br>Informed acceptance of responsibility for one's own learning<br>A love to learn,<br>Creativity<br>Future orientation<br>Ability to use basic study and problem solving skills | | 58 – 176 Low Readiness<br><br>177 – 201 below average readiness<br><br>202 – 226 average<br><br>227 – 251 above average<br><br>252 – 290 High readiness |

The literature review also revealed that there were few studies on the factors influencing the SDL readiness both for the students and teachers. According to past research, SDL behaviours can be developed by proper planning of SDL lessons (Dynan et al., 2008; Kocaman et al., 2009; Williamson, 2007). However, factors which contributed to the readiness were not found in the literature review. Therefore, the current research also aimed to identify the factors which could possibly influence the SDL readiness among the students and the teachers.

From the identified gaps, the current research aimed to work on 3 working hypotheses. Firstly, it was anticipated that SDLR is independent of learning styles. Students can be self-directed readied regardless of which learning styles they preferred. Secondly, it was also anticipated that SDLeR is independent of teaching styles. Teachers can be readied for SDL lessons regardless of which teaching styles they preferred. The third working hypothesis anticipated that constructive interactions contributed to SDLR and SDLeR. The proposed constructive interactions which occur during lessons will engage teachers and students to the lessons. This will in turn trigger interest which can lead to the development of skills and knowledge for SDL needed or the subject.

Figure 3.1 shows the conceptual framework of this study. The figure will help the readers to have a better view of the research concepts.

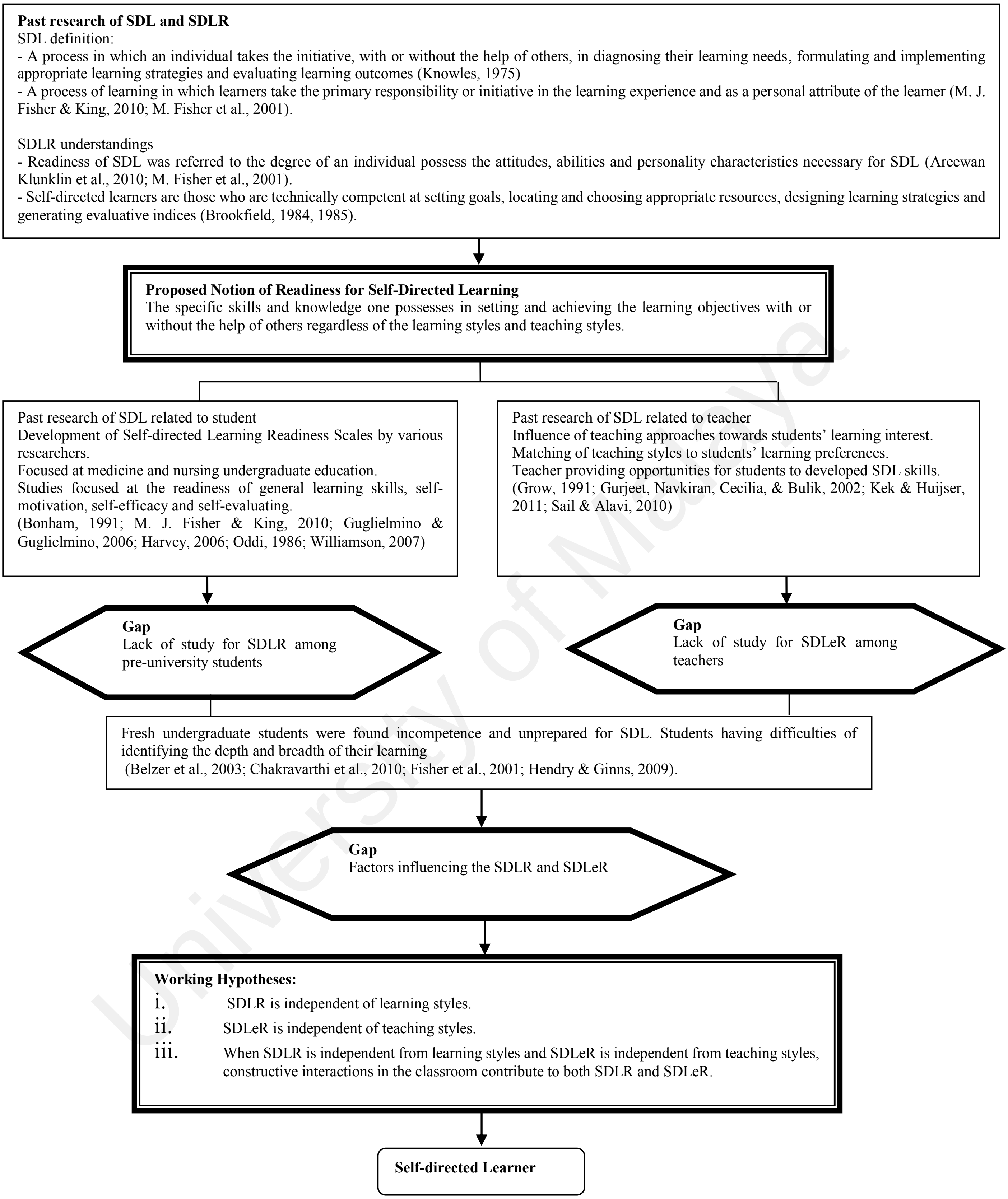



*Figure 3.1* Conceptual Framework

## 3.3 Theoretical Framework

The current research is underpinned by a few theories. In this research the researcher measured the SDL readiness among the STPM Biology students and teachers.

In Figure 3.2 SDL readiness is anticipated to shift along a continuum. The levels of the readiness depend on the degrees of skills and knowledge the individual possesses.

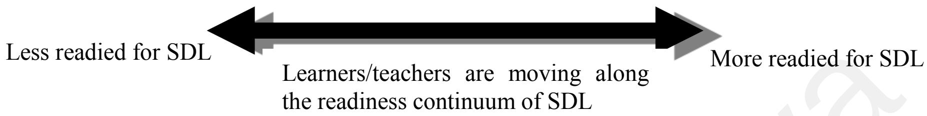



*Figure 3.2* Self-Directed Learning Readiness Continuum

According to the literature review not all individuals will develop the same degree of SDL readiness (Chu & Tsai, 2009; Du, 2012). Therefore, in this research the STPM Biology students' readiness was measured with the SDLRSbio and the STPM Biology teachers' SDL readiness for lessons was measured with the SDLeRSbio. The scores from both scales were plotted on two continua. The result was then used for profiling the readiness of students and teachers respectively.

As stated earlier, in this research, the constructive interactions during lessons are anticipated to contribute to the SDLR and SDLeR. This idea is underpinned by Vygotsky's social constructivism. This social constructivist idea can be interpreted that with proper interactions between teachers and students, and students and students an individual student can develop his or her own learning objectives and plan the strategies to achieve the learning objectives (Schunk, 2012). In addition, the researcher of the current research anticipated that teachers shall be readied for SDL lessons better as opportunities for constructive interactions to take place during lessons are increased. As mentioned by past researchers, SDL readiness can be developed through proper planning and integration of the curriculum (Kocaman et al., 2009; Sail & Alavi, 2010; Williamson, 2007). For example, a teacher can create a teaching and learning environment which encourages constructive interactions between students and between students and teacher. With constructive interactions in a proper and supportive environment (Jiusto & DiBiasio, 2006; Weaver et al., 2010) one will be able to engage with the lessons and continue to develop the skills and knowledge needed for the particular subject. These constructive interactions during lessons will engage both the students and teachers to the lessons. Hence, both students and teachers can be more readied for SDL and also for SDL lessons. Figure 3.3 shows how interactions between teachers and students can shift along the continuum towards being more readied for SDL. Interactions were anticipated to be more constructive as the readiness were moving from "less readied" to "more readied" on the continuum.

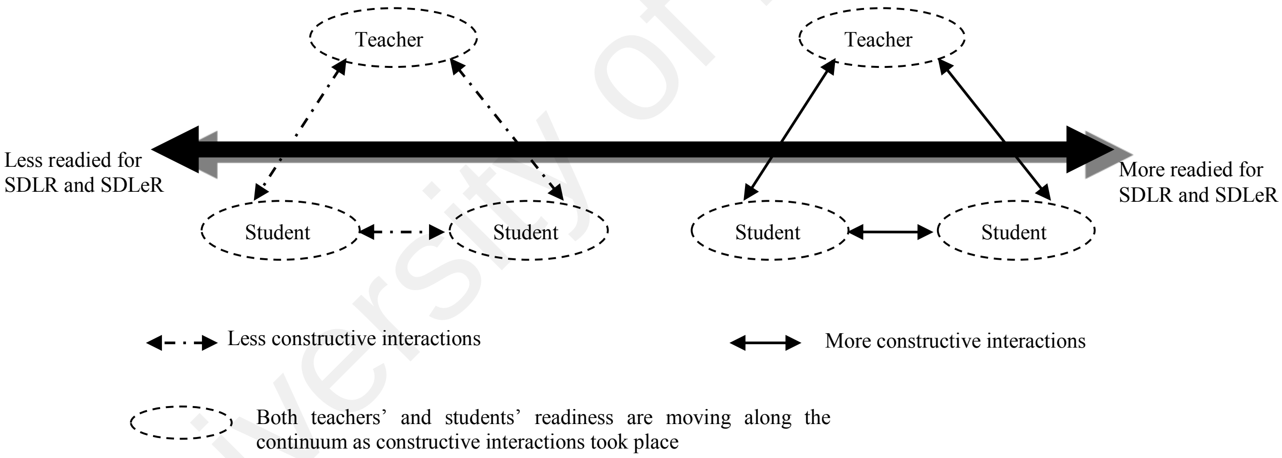



*Figure 3.3* SDLR and SDLeR Based on Vygotsky's Social Constructivism

As mentioned in Vygotsky's concept of Zone of Proximal Development (ZPD), learners will go beyond their capabilities by interacting with more capable adults or experts. The concept of ZPD embeds the meaning of scaffolding students to be self-directed learners (Verenikin, 2008). It is the interaction which is constructive in engaging them to learn more about the subject that contribute to the development of their skills and knowledge in learning the subject. This engagement based on Knowles definition of SDL (p.6) is independent of teaching and learning styles. Hence, it could be that teaching styles and learning styles are not the crucial elements in determining the SDL readiness.

Based upon Jerome Bruner's theory, learning is a continuous process of topping up the learners' existing knowledge which develops spirally (Schunk, 2012). Therefore, in this study SDLR and SDLeR are anticipated to developed spirally or move incrementally being more readied for SDL. Furthermore, in order to engage one to learn, learning must make sense to the learners' life. Learners must have meaningful learning to engage in SDL, as mentioned by Ausubel. The learning of new skills and knowledge is meaningful when integrated with one's cognitive structure of the existing skills and knowledge. (Brookfield, 1985; Hannafin et al., 2009). Only when learners make sense of their learning, will they be engaged to learn. This will then most probably develop self-directedness in their learning process. Possessing the skills and knowledge needed to engage in the subject is essential in motivating the learning process and make it meaningful. (Schunk, 2012). Thus, learners need to be readied in using their skills and knowledge to engage and develop meaning to their learning in order to be self-directed. In addition, Bloom's Taxonomy of skills at the higher levels of evaluation and creation are necessary to be readied for SDLR and SDLeR among the students and teachers as constructive interactions increase. Thus, Figure 3.3 (p 62) can be extended as shown in Figure 3.4 (p 64).

In Bloom's Taxonomy SDL readiness can be reflected by a higher order of cognition and knowledge development (Dynan et al., 2008).These higher order skills and knowledge involve metacognition in transforming the knowledge to daily problem solving skills (Hannafin et al., 2009). Nevertheless, the lower levels of knowledge domains suggested in Bloom's taxonomy are also involved in the specific skills and knowledge for a particular subject. The specific skills and knowledge will slowly develop from the lower level of knowledge domains to the higher levels of Bloom's which will develop the metacognition required for SDL.

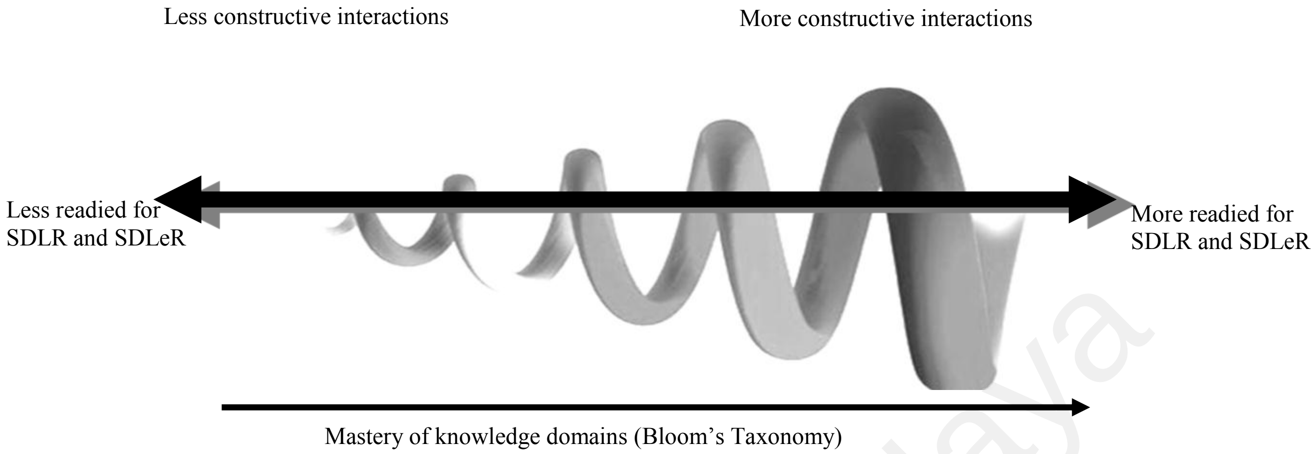



*Figure 3.4* Spiral Development of Skills and Knowledge According to Bloom's Taxonomy and Ausubel's meaningful learning

The above argument for the theoretical framework encompasses the social constructivist ideas of Vygotsky, Bruner's theory of spiral learning, and Ausubel's explanation of meaningful learning which contributes for the students becoming more readied for SDL and the teachers becoming more readied for SDL lessons. In addition, Bloom's taxonomy supports the necessity of acquiring skills and knowledge at a higher level of cognition for becoming more readied for SDL. The skills and knowledge acquisition is proposed to be independent of the teaching and learning environment (teaching styles and learning styles). That is it does not matter whether it is a teacher-centred or a student-centred learning environment as put forward in the study's working hypotheses

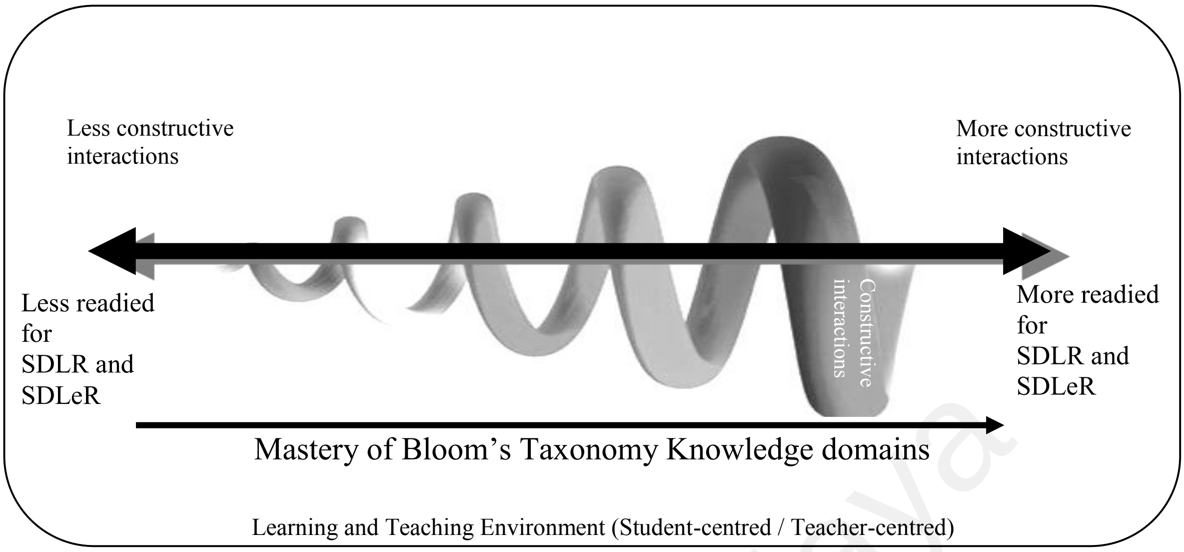
The overall theoretical framework is shown in Figure 3.5 (p 66). This theoretical framework is used to underpin the research development. This research was conducted with the understanding that constructive interactions most probably contributed to SDLR and SDLeR. The research also included the aim to look into the factors which influencing the SDLR and SDLeR.

### 3.4 Chapter Summary

The conceptual framework of the current research has identified the research gaps for this study. The current research was designed in a way to contribute in closing the gaps identified. Based upon the conceptual framework a notion of SDL readiness was proposed. The notion was investigated with three (3) working hypotheses based upon it.

This study was underpinned by various educational theories as illustrated in the theoretical framework showed in Figure 3.5. In addition, the theoretical framework contributed to the understanding of the development of SDL readiness with the help of constructive interactions during lessons.

The current research was designed based upon the conceptual framework and theoretical framework. The research procedures and the development of research tools were also carried out based upon the frameworks projected in this chapter. These will be discussed in Chapter 4.




Brief explanation of theories in the framework

**Ausubel**
Learner/teacher needs to have meaningful learning to engage in SDL.
As they proceed with meaningful learning, the affiliation toward the subject will motivate them for SDL.

**Brunner**
Learners/teachers existing knowledge is developing spirally as they connect new knowledge and skills with prior knowledge and skills towards being more SDL readied.
As the development of knowledge continues, learners/teachers should acquire adequate knowledge and skills for them to be self-directed.

**Bloom's Taxonomy**
Readiness in SDL reflected by the higher levels of cognition (evaluation and creation) and knowledge development
These higher order cognitive levels will lead to metacognition of learners/teachers which in turn will help integrate learning with authentic problem solving which leads to SDL.

**Vygotsky**
**Social-constructivism**
With the support of environmental factors and social interaction, between teachers and students and amongst students, they will develop their own learning/teaching goals. Based upon these scaffolds both teachers and students are expected to be SDL readied more effectively.

*Figure 3.5* Theoretical Framework of Self-Directed Learning Readiness in STPM Biology

# CHAPTER 4

# METHODOLOGY

## 4.1 Introduction

This research was designed to close the gaps identified in the conceptual framework and to test out the proposed notion and working hypotheses underpinned by the theoretical framework. Therefore the research aimed to profile the self-assessed SDL readiness among STPM Biology students and teachers. In addition, the study aimed to identify factors influencing the SDL readiness and also to identify the constructive interactions during lessons.

The research procedures were conducted in three phases. The first phase was the preparation of the research instruments. In this phase two readiness scales (SDLRSbio and SDLeRSbio) were developed. In addition, a scale was adopted and adapted from Honey and Mumford's Learning Styles Questionnaire to Preference of Learning Styles for Biology (PLSbio), and the research also adopted Grasha-Riechamann's Teaching Styles Survey (TSS). A Classroom observation protocol and an Interview Protocol were also prepared for this research. The Delphi Technique was used in the development of the scales, and also for the preparation of the observation protocol and interview protocol. All these research tools helped the researcher in collecting relevant data based upon the research objectives.

Then the research entered into the second phase which is the pilot study. This pilot study was aimed at collecting data for the scales development and to test the feasibility of the research procedures. Data collected from this phase was used to determine the early stage of scales reliably and also for the test of feasibility of the research procedures. Necessary amendments on the research procedures were then made based upon the pilot study results.

The third phase of the research was the actual study. Initially the research was planned confined to the Federal Territory region due to logistics and financial constraints. However, after phase two the researcher was inspired and encouraged to widen the research coverage nationwide. This thought was made possible by the Post-graduate Research Grant (PPP) provided by the University of Malaya.

This chapter discusses the research procedures of this nationwide research in detail. Figure 4.1 illustrates the procedures of the research.

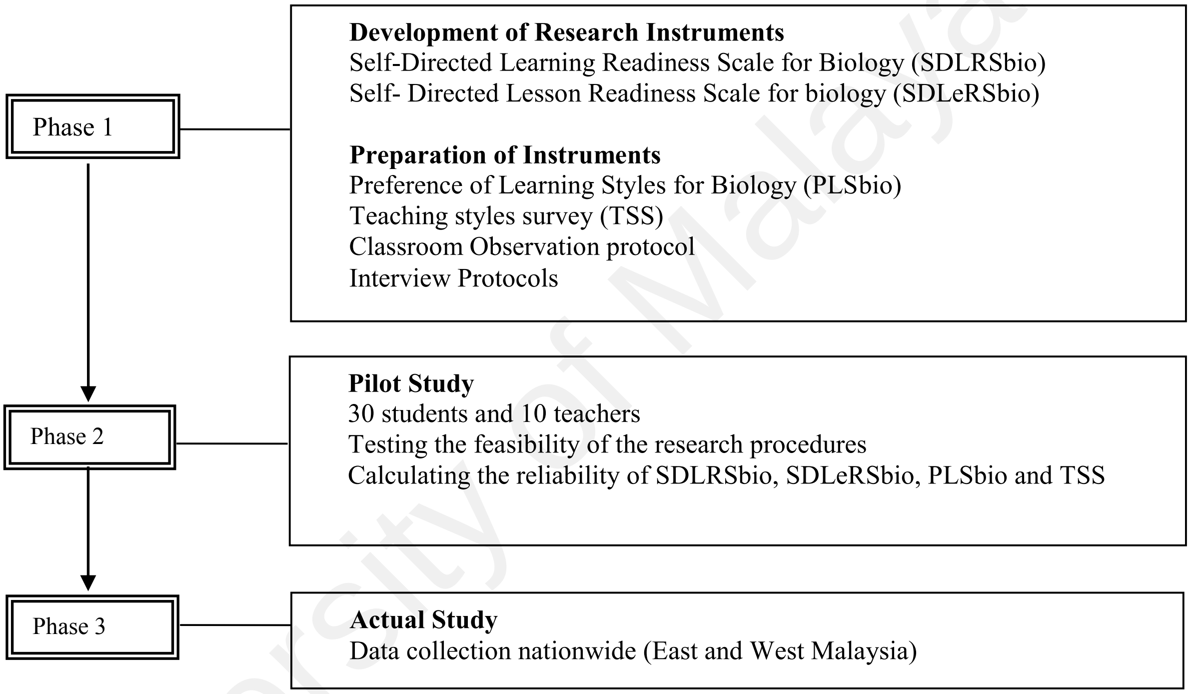



*Figure 4.1*Phases of the Research

## 4.2 The Delphi Technique

The Delphi Technique was used in the development of the SDLRSbio and SDLeRSbio, and also used in the preparation of the classroom observation protocol, the interview protocols, and the adaptation of the Learning Style Questionnaire into the Preference of Learning Styles for biology (PLSbio). Table 4.1 shows the list of panellists in this research and their years of service in the related professions. The selection of the panellists was based upon their expertise in Biology related Education. This included the fields of Biology science, medicine, forestry, medical and nursing education, dentistry, Biology education, and Biology teacher training. Lectures, teachers and trainers of these fields with at least 3 years of experience were contacted and the panel was formed upon their consent and willingness to participate in this research. Out of fifteen (15) lecturers, trainers, and teachers being contacted, eight (8) of them agreed to be in the panel. Therefore, this panel consisted of lecturers in the field of medical education and medicine, teacher training, and also experienced biology teachers. This panel took on the responsibility of validating the scales, observation rubrics (were later changed to be the observation protocol), and interview protocols used in this research in terms of content and language.

Table 4.1 *Panellist for the Delphi Technique*

| Profession | Years of service |
|---|---|
| **Medical Lecturer** | 9 |
| **Education Lecturer** | 14 |
| **Medical education Lecturer** | 3 |
| **Teacher Trainer 1** | 12 |
| **Teacher Trainer 2** | 23 |
| **Biology Teacher 1** | 12 |
| **Biology Teacher 2** | 3 |
| **Science (Biology) Education Lecturer** | 30 |

**4.3 Validity of The Research**

In order to achieve validity for the instruments used in this research, the researcher had adhered to the validity requirements for research. This included an extensive literature research of the topic in identifying the constructs and forming an expert panel for "face validity" (Muijs, 2012).

Expert panel was formed in terms of ensuring the content validity in this research. A carefully selected expert panel, who were involved in various areas in Biology related education, was formed (Table 4.1) to comment on the constructs developed for both the SDLRSbio and SDLeRSbio. The same panel was involved in the adaptation of the

PLSbio, and preparation of the interview protocols and the classroom observation protocol.

Additionally, criterion validity of the instruments was achieved with the relation of constructs with existing educational theories (Muijs, 2012). The theoretical framework of this study underpinned the constructs developed for the SDLRSbio and SDLeRSbio, and also the PLSbio, interview protocols and classroom observation protocol. Lastly, this research also included the determination of construct validity by measuring the factor analysis of the SDLRSbio and SDLeRSbio.

## 4.4 Phase 1: Research instruments preparation

This phase involved the development of two self-assessment scales for SDLR among STPM Biology students and SDLeR among STPM Biology teachers respectively. Additionally, this phase involved also the adaptation of the Preference of Learning Styles for Biology (PLSbio), the adopting of Teaching Styles Survey (TSS), and the preparation of the interview protocols and the observation protocol used in this research.

### 4.4.1 The development of SDLRSbio and SDLeRSbio

Two self-assessment scales (SDLRSbio and SDLeRSbio) were developed in this research. The two scales were used in self-assessing the SDLR among Malaysian STPM Biology students and the SDLeR among Malaysian STPM Biology teachers. The Delphi Technique was used in the development of the scales.

An in-depth literature review was done to identify constructs and items from past research. Literature review was a very essential and crucial part of the process in the development of the two (2) scales. Several existing related scales were identified and used as the initial starting point to begin the development process. Related articles were selected from various databases like EBSCOhost, Education Resources Information Center (ERIC), Emerald, Oxford University Press Journals, ProQuest Education Journals, SAGE Journals, Scopus, Taylor & Francis Online and SpringerLink. Keywords like Self-Directed Learning, Self-Directed Learning Readiness, Readiness, Readiness Scales, Science teaching and learning, were used in identifying the related articles. Some articles were found by referring to the existing articles which the researcher had from the list of references. A thorough review and analysis of the articles were done to identify the constructs and items for the two scales. The predetermined constructs and items were sent for peer review prior to the Delphi rounds.

From the literature review, the researcher listed various items according to the constructs of SDL based on Stockdale and Brockett's Personal Responsibility Orientation Model of Self-Directness in Learning (PRO-SDLS), Murray Fisher's Self-Directed Learning Readiness Scale in nursing education, Williamson's Self-rating scale of self-directed learning (SRSSDL), Oddi's Continuing Learning Inventory (OCLI), and Guglielmino's Self-Directed Learning Readiness Scale (SDLRS). Various reviews about SDLR were also contributing factors to the construct identification process for the development of the two scales used in this study.

Initially both SDLRSbio and SDLeRSbio were combined as one questionnaire, as in Appendix II. However, the scales were separated during the initial peer review session prior to the first Delphi round, as it could be confusing for the students and teachers. Hence, the development process continued with the two scales, SDLRSbio and SDLeRSbio, and the Delphi panel evaluated them as two different scales (p 73 – 78). The developed scales are shown in Appendix III and Appendix IV.

According to past research in self-directed learning readiness scales development, many researchers focused the measurements of "self-management", "self-motivation" and "self-monitoring". Details of the past research in SDLRS is shown in Table 3.2 (p 58).

However, some researchers have raised the concern that the measurements for readiness in the past research were too general and not specific for SDL (Brockett, 1985a; Brookfield, 1985). In order to be specific for SDL for a particular subject, the past researchers believed one must have skills and knowledge specifically readied for that subject (Brookfield, 1985; Hoban et al., 2005).

Keeping the comments of the past researchers in mind, some constructs were predetermined in the development of the SDLRSbio and SDLeRSbio. At the initial stage, some of the constructs and items were adapted from "Self-Directed Learning Readiness Scale for nursing education" developed by Fisher and King (2010). These constructs and items were then refined according to the literature review. The constructs included in the SDLRSbio were "General Cognitive Readiness", "Learning Skills readiness", and "Emotional Readiness". To build the scale specifically to measure SDL readiness for Biology lessons, constructs like "Laboratory Skills Readiness", "Experimental Design Skills Readiness", and "Data Analysis and Interpretation Skills Readiness" were added. Under the "Laboratory Skills Readiness", there were three (3) sub-constructs. They were "Use of Instruments", "Technique", and "Data Collection/Reading Instruments".

For the SDLRSbio there were six (6) predetermined constructs with fifty-eight (58) predetermined items. It was then sent to the Delphi panel for content and language validation. For the SDLeRSbio, another construct "Interacting Skills Readiness" was added, which in total had seven (7) predetermined constructs and sixty-five (65) predetermined items. It was also sent to the Delphi panel for content and language validation. Therefore, the SDLRSbio and SDLeRSbio which were developed particularly for the present study in measuring SDLR among students and SDLeR among teachers included the construct of "biology specific skills".

The predetermined constructs and items which were sent for the first Delphi panel validation is listed in Appendix I. The SDLeRSbio consisted all seven (7) constructs, while the SDLRSbio did not have the "Interacting skills" in the scale. These constructs were arranged as shown in Appendix I and sent to the Delphi panel for content and language validity.

#### 4.4.1.1 First Delphi round

The identified constructs and items were emailed, posted or hand delivered to the panel members. The panel members assessed and commented on the constructs and items independently. They then returned their responses to the researcher for analysis. The researcher then made amendments according to the panel members' responses.

Through the first round of Delphi technique, all the six constructs for SDLRSbio and seven constructs for the SDLeRSbio were accepted by the panel members. However, some of the constructs were modified to make it more appropriate in measuring the SDL readiness for Biology.

The scales were modified according to the suggestions and comments of the experts. First of all, the numbering of the items was requested by the panel members to be made continuous, starting with "1" and continue to the end of all the items, not restarting the numbering for each construct. Therefore, the numbering was not done according to the constructs but was made continuous throughout the scales.

Secondly, the language used in the scale was changed from a question to a statement. Instead of asking the question "How often do you critique others' ideas?" it was changed to "I am able to give comments on other's ideas about biology concepts". Therefore, all the other remaining items were changed to statements instead of questions.

Thirdly, the items were also modified to be more focused upon the Biology context. Some of the constructs were changed to show more specificity to Biology for instance "Learning skills readiness" was changed to "Biology Learning Skills Readiness". This change led the changes to the items under it, by adding more specific words to indicate biology learning skills. These modifications were made to ensure the scales were measuring the SDL readiness for biology.

Hence, the SDLRSbio consisted of the constructs of “Biology Cognitive Readiness”, “Biology Learning Skills Readiness”, “Emotional Readiness in Biology”, “Laboratory Skills”, “Experimental Design Skills”, and “Data Analysis and Interpretation skills”. These constructs were used to profile the students’ SDLR. While for profiling teachers’ SDLeR an additional construct “facilitating skills” was changed to “Interacting Skills Readiness” in the SDLeRSbio.

#### 4.4.1.2 Second Delphi round

After the amendments had been done according to the comments and suggestions of the experts, the scales were sent for the second round of Delphi validation. From the second review by the experts, the constructs were accepted by all experts for both the SDLRSbio and the SDLeRSbio. However, there were some comments on the items which were referred as not suitable for STPM Biology context. Thus amendments were made accordingly. This brought changes to the items 23, 25, and 26 to ensure that the items were related to laboratory skills included in STPM syllabus. For example, for item 25 “*How well do you know the use and function of all reagents to conduct food tests?*” is not in the STPM syllabus. Therefore, the panel suggested that it should be changed to “*I can conduct food tests to identify the classes of food present in a specimen”*.

The panel members also suggested a rearrangement of the constructs according to Bloom’s Taxonomy. This helped in identifying the level of knowledge and skills in the constructs. The panel suggested the allocation of the constructs into the knowledge domains based upon the items within the constructs. Some of the constructs, no doubt, could be fit into different knowledge domains as suggested in Table 4.2. For example “Data analysis and interpretation skills” was allocated at “metacognition knowledge” rather than “procedural knowledge”. This was because the panel agreed that for one to do analysis and interpretation is beyond procedural level which involved the integration of knowledge and skills in metacognition level. Hence, the constructs were allocated into the knowledge domains as showed in Table 4.2. This comment of the panel members tallies with the theoretical framework of the current research. In which being readied for SDL one needed the specific skills and knowledge in setting, achieving, and evaluating the learning objectives. Table 4.2 shows the arrangement of the constructs according to Bloom's Taxonomy and the sample of items belonging to each construct.

Table 4.2 *Arrangement of Constructs and Items in Bloom's Taxonomy*

| Knowledge domains | Constructs | Example of Item |
|---|---|---|
| **Factual knowledge** | - | - |
| **Conceptual knowledge** | Biology cognitive readiness | I usually give comments on other's ideas about Biological concepts |
| **Procedural knowledge** | Biology learning skills readiness | I can use information technology effectively in my Biology study. |
| | Use of instrument | I can use the light microscope to observe my specimen slides. |
| | Laboratory techniques | I can prepare slides for Biology specimens. |
| | Data collection / reading instrument | I can read the measurement accurately from the instruments. |
| **Metacongitive knowledge** | Emotional readiness in Biology | I find it easy to accept other's idea in Biology |
| | Experimental design skills | I can design my own Biology experiment. |
| | Data analysis and interpretation skills | I can discuss and conclude according to the results of Biology experiments. |
| | Interacting skills readiness | I keep an open mind for students' ideas and opinions in Biology. |

Table 4.3 and Table 4.4 show the results of each Delphi rounds. Amendments were made to the items according to the experts' comments and suggestions. After the second round of Delphi validation, the scales were administered in a pilot study to 30 students and 10 teachers.

Table 4.3 *Summary of Delphi Rounds Results for SDLRSbio*

| Round | Total Constructs | Constructs retained | Total items | Items retained | Items amended | Items eliminate |
|---|---|---|---|---|---|---|
| **1** | 6 | 6 | 58 | 35 | 11 | 12 |
| **2** | 6 | 6 | 46 | 43 | 3 | 0 |

Table 4.4 *Summary of Delphi Rounds Results for SDLeRSbio*

| Round | Total Constructs | Constructs retained | Total items | Items retained | Items amended | Items eliminated |
|---|---|---|---|---|---|---|
| **1** | 7 | 7 | 65 | 46 | 11 | 8 |
| **2** | 7 | 7 | 53 | 50 | 3 | 0 |

From the pilot study, the researcher found that it was not easy to have students and teachers willing to be involved in classroom observations and interviews, hence, an open ended question was added to the SDLRSbio and SDLeRSbio in order to obtain more qualitative responses from the students and teachers about the factors influencing the SDLR among students and the SDLeR among teachers. The developed scales are included in Appendix III and Appendix IV.

The process of the scales development through the Delphi technique is shown in Figure 4.2 below. These developed scales are different from the existing scales in the sense that it measured specifically readiness related to Biology skills and knowledge. A comparison of constructs between existing scales with the developed SDLRSbio and SDLeRSbio is shown in Table 4.5 (p 78).

The researcher had endeavoured in a careful process for the development of research instruments. The Delphi technique was used in developing the constructs of the instruments. The panellists of the Delphi technique was chosen from Biology related fields. The development of the instruments went through two Delphi rounds.

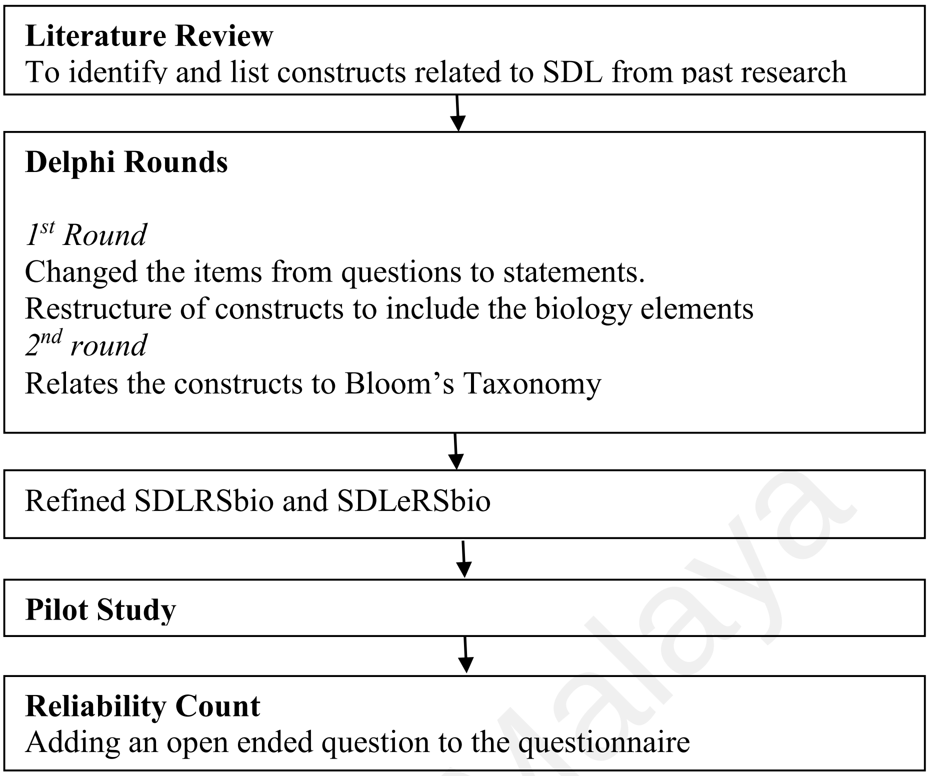



*Figure 4.2* SDLRSbio and SDLeRSbio Development Flowchart

The early stage of reliability of the scales developed was carried out during the pilot study. In the pilot test the SDLRSbio yielded a Cronbach Alpha reading of 0.869 and SDLeRSbio yielded a Cronbach Alpha reading of 0.971. These results indicated the scales have high reliability in measuring SDLR and SDLeR respectively. The reliability results of the developed scales are recorded in the pilot study at phase 2. The reliability test was consolidated with the actual study later. The instruments developed for this research hence were validated and reliable in measuring the STPM Biology students' SDLR and STPM Biology teachers' SDLeR.

Table 4.5 *Comparing the Existing SDLR Scales with SDLRSbio and SDLeRSbio*

| Skills Domains | Research Constructs | | | | |
|---|---|---|---|---|---|
| | **Swapna Naskar Williamson, 2007** | **Murray Fisher, 2001** | **Oddi, 1986** | **Guglielmino,1977** | **Current Research** |
| **Self-management** | Learning Strategies Awareness | Self-management | Ability to self regulating | Future orientation<br><br>Openness to learning opportunities | Biology learning skills readiness |
| **Self-Motivation** | Learning Activities Interpersonal skills | Desire for learning | Learner motivation/self efficacy/autonomy Learning with others | Self concept as an effective learner<br><br>Initiative and dependence in leaning<br><br>A love to learn | Emotional Readiness in Biology |
| **Self monitoring** | Evaluation | Self control | Reading avidity | Informed acceptance of responsibility for one's own learning<br><br>Creativity<br><br>Ability to use basic study and problem solving skills | Biology cognitive readiness |
| **Specific Biology Skills** | - | - | - | - | Laboratory skills<br><br>Experimental Design skills<br><br>Data analysis and Interpretation Skills |
| **Teaching skills** | - | - | - | - | Interacting skills readiness |

Source: Kwan and Daniel (2013)

### 4.4.1.3 Factor Analysis

After the Delphi rounds in identifying the constructs and the related items, factor analysis was conducted to ensure the validity of the constructs identified. The normality tests conducted (p 103) showed that the samples of SDLRSbio are normal and are suitable for factor analysis.

According to Leech, Barrett, and Morgan (2011), factor analysis is not to be done when the number of items is greater than the number of participants. In this case, factor analysis for SDLeRSbio was not able to be conducted in this research since the number of teacher participants was low.

With the normality of sample, Principal Component Analysis with Oblimin Rotation was conducted to assess how the forty-six (46) items were clustered in the SDLRSbio. Eight (8) constructs were requested, based on the fact that the items were designed to index the six (6) constructs where one construct has three (3) sub-constructs.

After rotation, the first construct accounted for 23.3% of the variance, the second construct accounted for 6.3%, the third construct accounted for 5.4%, the forth construct accounted for 4.5%, the fifth construct accounted for 3.2%, the sixth construct accounted for 3.0%, the seventh construct accounted for 2.9% and the eighth construct accounted for 2.6% of the variance. The cumulative percentage of the variance for the 8 constructs was 51.1%. The statistical result is shown in Table 4.6 (p 80) below.

The results of Principal Component Factor Analysis for the constructs in SDLRSbio showed that the Kaiser-Meyer-Olkin Measure of Sampling Adequacy was 0.902, and the Bartlett's Test of Sphericity was significant as showed in Table 4.7 (p 80).

Factor loading over 0.3 and lower than -0.3 are displayed in Table 4.8 (p.81). The reading for between -0.3 to 0.3 were masked for easy reading of the table. According to the pattern matrix, all the eight (8) components include the items which were identified by the panel experts in the earlier Delphi rounds. The allocation was made based on the panel of experts' suggestions for items which seemed to fix into more than one component.

Generally, the Principal Component Factor Analysis indicating that the items were suitable to be allocated in the constructs as suggested by the panel experts. This showed the reliability and validity of the constructs developed for SDLRSbio.

Table 4.6 *Total Variance Explained for SDLRSbio*

| Component (Construct) | Initial Eigenvalues | | | Extraction Sums of Squared Loadings | | | Rotation Sums of Squared Loadings[a] |
|---|---|---|---|---|---|---|---|
| | Total | % of Variance | Cumulative % | Total | % of Variance | Cumulative % | Total |
| 1 | 10.702 | 23.265 | 23.265 | 10.702 | 23.265 | 23.265 | 5.583 |
| 2 | 2.882 | 6.265 | 29.530 | 2.882 | 6.265 | 29.530 | 5.501 |
| 3 | 2.468 | 5.365 | 34.896 | 2.468 | 5.365 | 34.896 | 4.940 |
| 4 | 2.054 | 4.465 | 39.361 | 2.054 | 4.465 | 39.361 | 5.956 |
| 5 | 1.495 | 3.249 | 42.610 | 1.495 | 3.249 | 42.610 | 1.904 |
| 6 | 1.411 | 3.068 | 45.678 | 1.411 | 3.068 | 45.678 | 3.468 |
| 7 | 1.316 | 2.860 | 48.538 | 1.316 | 2.860 | 48.538 | 3.768 |
| 8 | 1.197 | 2.603 | 51.141 | 1.197 | 2.603 | 51.141 | 4.275 |
| 9 | 1.107 | 2.407 | 53.549 | | | | |
| 10 | 1.081 | 2.350 | 55.898 | | | | |
| 11 | 1.057 | 2.299 | 58.197 | | | | |
| 12 | .954 | 2.074 | 60.271 | | | | |
| 13 | .927 | 2.015 | 62.286 | | | | |
| 14 | .899 | 1.954 | 64.240 | | | | |
| 15 | .857 | 1.862 | 66.102 | | | | |
| 16 | .818 | 1.779 | 67.881 | | | | |
| 17 | .782 | 1.700 | 69.581 | | | | |
| 18 | .773 | 1.680 | 71.261 | | | | |
| 19 | .726 | 1.578 | 72.839 | | | | |
| 20 | .703 | 1.528 | 74.366 | | | | |
| 21 | .675 | 1.468 | 75.834 | | | | |
| 22 | .632 | 1.374 | 77.208 | | | | |
| 23 | .627 | 1.363 | 78.571 | | | | |
| 24 | .613 | 1.333 | 79.905 | | | | |
| 25 | .593 | 1.288 | 81.193 | | | | |
| 26 | .580 | 1.260 | 82.453 | | | | |
| 27 | .556 | 1.209 | 83.662 | | | | |
| 28 | .545 | 1.184 | 84.847 | | | | |
| 29 | .532 | 1.156 | 86.002 | | | | |
| 30 | .518 | 1.126 | 87.128 | | | | |
| 31 | .501 | 1.089 | 88.217 | | | | |
| 32 | .472 | 1.026 | 89.243 | | | | |
| 33 | .457 | .993 | 90.235 | | | | |
| 34 | .451 | .980 | 91.215 | | | | |
| 35 | .447 | .971 | 92.186 | | | | |
| 36 | .411 | .893 | 93.079 | | | | |
| 37 | .387 | .842 | 93.921 | | | | |
| 38 | .370 | .804 | 94.725 | | | | |
| 39 | .368 | .799 | 95.524 | | | | |
| 40 | .342 | .745 | 96.268 | | | | |
| 41 | .318 | .692 | 96.960 | | | | |
| 42 | .313 | .679 | 97.640 | | | | |
| 43 | .300 | .653 | 98.293 | | | | |
| 44 | .289 | .628 | 98.920 | | | | |
| 45 | .261 | .568 | 99.489 | | | | |
| 46 | .235 | .511 | 100.000 | | | | |

Extraction Method: Principal Component Analysis.
a. When components are correlated, sums of squared loadings cannot be added to obtain a total variance.

Table 4.7 *KMO Bartlett's Test results for SDLRSbio*

| | | |
|---|---|---|
| **Kaiser-Meyer-Olkin Measure of Sampling Adequacy.** | | .902 |
| **Bartlett's Test of Sphericity** | **Approx. Chi-Square** | 9026.869 |
| | **Df** | 1035 |
| | **Sig.** | .000 |

Table 4.8 *Patern Matrix*

| | Component | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 |
| LabSD34 | .795 | | | | | | | |
| LabSD33 | .784 | | | | | | | |
| LabSD36 | .600 | | | | | | | |
| LabSD35 | .595 | | | -.315 | | | | |
| Lab skill Data collection | .586 | | | | | | | |
| BCogR7 | | .705 | | | | | | |
| BCogR3 | | .654 | | | | | | |
| BCogR5 | | .638 | | | | | | |
| BCogR6 | | .633 | | | | | | |
| BCogR4 | | .611 | | | | | | |
| Biology Cognitive Readiness | | .595 | | | | | | |
| BCogR2 | | .414 | | | | | | |
| LabST30 | | | -.734 | | | | | |
| LabST31 | | | -.666 | | | | | |
| LabST29 | | | -.652 | | | | | |
| LabST28 | | | -.446 | | -.318 | .417 | | |
| Lab Skill Technique | .357 | | -.373 | | | | | |
| LabSI26 | | | | -.688 | | | | |
| LabSI23 | | | | -.653 | | | | |
| Laboratory Skill use of Instrument | .355 | | | -.453 | | | | |
| LabSI25 | | | | -.340 | | | | |
| LabSI24 | | | -.326 | -.104 | | | | .321 |
| EmoR21 | | | | | .717 | | | |
| EmoR20 | | | | | .703 | | | |
| EmoR17 | | | | | .591 | | | |
| EmoR18 | | | | | .523 | | | |
| EmoR16 | | | | | .402 | .349 | -.318 | |
| EmoR19 | | | | | .376 | .308 | | |
| Emotional Readiness in Learning biology | | | | | .302 | | | |
| DatAIS44 | | | | | | .698 | | |
| DatAIS46 | | | | | | .632 | | |
| DatAIS43 | | | | | | .595 | | |
| DatAIS45 | | .311 | | -.332 | | .430 | | |
| Data Analysis and Interpretation skill | | | | | | .367 | | |
| BLrnR14 | | | | | | | -.756 | |
| BLrnR13 | | | | | | | -.725 | |
| BLrnR12 | | | | | | | -.456 | |
| BLrnR11 | | | | | | | -.388 | .357 |
| BLrnR10 | | | | | | | -.366 | |
| BLrnR9 | | .370 | | | | | -.305 | |
| Biology Learning Readiness | | | | | | | -.300 | |
| ExpDS39 | | | | | | | | -.747 |
| ExpDS41 | | | | | | | | -.721 |
| ExpDS40 | | | | | | | | -.680 |
| Exp Design | | | | | .323 | | | -.577 |
| ExpDS38 | | | | | | | | -.564 |

Extraction Method: Principal Component Analysis.
Rotation Method: Oblimin with Kaiser Normalization.
a. Rotation converged in 18 iterations.

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#### 4.4.1.4 Model Fit Analysis

This section discussed about the fit evaluation of the 46 items in the understanding of students' SDL readiness. Due to a small sample size the model fit analysis was not conducted with SDLeRSbio. Based upon the pattern matrix in Table 4.8 (p.82), a model fit analysis was conducted. According to the results generated with AMOS in SPSS software version 20, the model was fitted successfully. Table 4.9 below shows that the model achieved the minimum requirements with $X^2$ = 2995.829 and degrees of freedom of 961.

Table 4.9 *Notes for Model of SDLRSbio*

| | |
|---|---|
| **Computation of Degrees of Freedom (Default Model)** | |
| Number of distinct sample moments | 1127 |
| Number of distinct parameters to be estimated | 166 |
| Degrees of freedom (1127 – 166) | 961 |
| | |
| **Result (Default model)** | |
| *Minimum was achieved* | |
| Chi-square | 2995.829 |
| Degrees of freedom | 961 |
| Probability | .000 |

The model fit analysis also showed that the CMIN = 3.117, CFI = 0.767, RMSEA = 0.60 and PCFI = 0.682. The CFI and PCFI are within the range of tolerable level. The CMIN is not good, but the RMSEA is acceptable. This was because of the large number of student sample which existed 500. However, in general the model fit analysis shows that the model of SDLRSbio with 46 items in 8 constructs (one construct with three (3) sub-constructs) has achieved the minimum requirements of the model fit analysis (Awang, 2014). Therefore, it is suitable to be used in this research. Figure 4.3 below shows the diagrammatic representation of the model fit analysis of SDLRSbio.

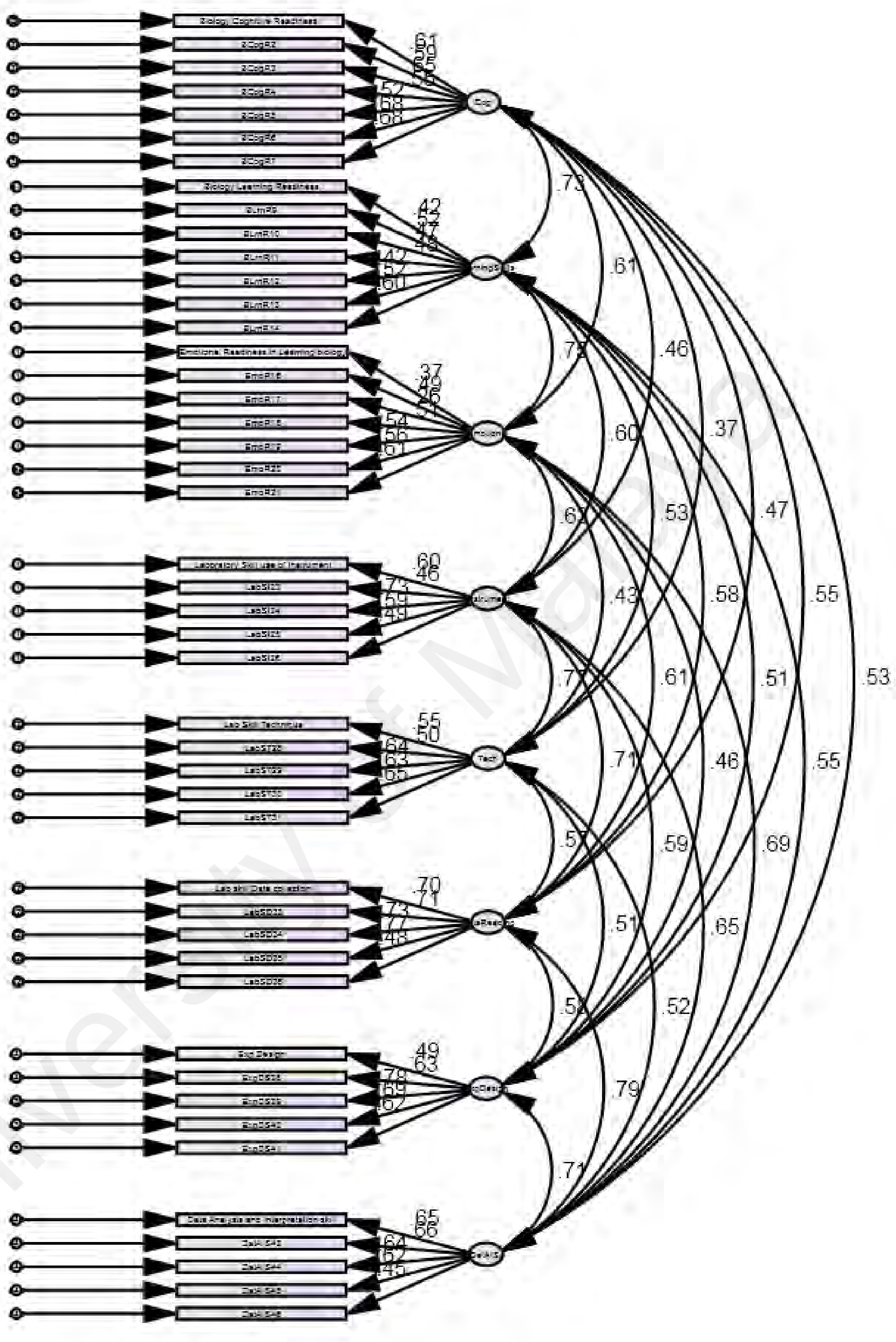

*Figure 4.3* Diagrammatic Presentation of Model Fit Analysis for SDLRSbio

### 4.4.2 The preparation of the Preference of Learning Styles for Biology (PLSbio)

The PLSbio was adopted and adapted from the Learning Styles Survey (LSS) prepared by Honey and Mumford in 2000. The LSS was chosen because it only focused on the measuring of sensory modes of learning but included the measurements of processing information and past experiences. Initially, the researcher intended to adopt the instrument for measuring the learning styles. However, after trying it with an initial group of students during the pilot study the scales yielded a low reliability output. The Cronbach Alpha reading was only 0.335. According George and Mallery, (2003) a Cronbach Alpha reading below 0.5 is unacceptable. Therefore, this reliability output suggested that it was not advisable to continue the usage of the Learning Styles Survey in this research. This concern was brought to the Delphi panel. The panel hence advised to adapt the Learning Styles Survey to measure the learning in the Malaysian STPM context. Therefore, the researcher amended the language of the survey to fit into the Malaysian STPM context. For example, the item "I like to be absolutely correct about things" was first amended into "I would like to be sure and accurate about the thing that I say and write". Another item "I am quite keen on sticking to fixed routines, keeping to timetable etc" was changed to "I prefer strict schedules". The amended survey was then tested with 30 students. However, the reliability was as yet not satisfactory. Hence, the panel suggested adding in the Biology element. Therefore, the item became "I would like to be sure and accurate about the things that I say and write in Biology" and "I prefer to follow strict schedules in learning Biology".

This amended survey was tested again with 30 students. In this round, the PLSbio yielded a much better reliability of a Cronbach Alpha value of 0.705. According to George and Mallery, (2003) Cronbach's Alpha reading between 0.7 – 0.8 is good. This result gave the green light for the administration of PLSbio for the actual study. The sample of PLSbio is given in the Appendix V. Hence, the researcher continued to use the modified version of the PLSbio in identifying the learning styles of students.

### 4.4.3 The preparation of the Teaching Styles Survey (TSS)

The TSS was tested first before being adopted for the present research. The TSS was chosen in this research because it covered both the teaching styles which suited the teacher-centred and student-centred environment. In the TSS being applied to 30 teachers, it showed reliability with a Cronbac Alpha value of 0.625. According to George and Mallery, (2003) Cronbach Alpha readings between 0.6 – 0.7 is acceptable. Hence, the researcher adopted the instrument to be used in the present research. The Delphi panel also agreed to the use of this instrument in measuring the teaching styles preference of STPM Biology teachers. The adopted TSS is shown in Appendix VI.

### 4.4.4 The preparation of the classroom observation protocol

The preparation of the classroom observation protocol started with two classroom observation rubrics. However, it was later amended to be a classroom observation protocol after a few rounds of observations in the pilot study and with the advice of the Delphi panel.

Classroom observations were conducted with the aim to identify the factors influencing the SDL readiness among STPM Biology students and the teachers. The observations also aimed to identify the constructive interactions during lessons.

Initially there were two classroom observation rubrics prepared, one for students and another one for teachers. The rubrics were prepared based on the constructs developed in the SDLRSbio and SDLeRSbio. The first drafts of the rubrics were sent for two (2) rounds of Delphi validation. Then the rubrics were pilot tested. During the pilot testing, the researcher found that the rubrics did not generate sufficient information for the research, and the rubrics did not record the observations in-depth. Hence, after several discussions with the Delphi Panel, the rubrics were replaced with an observation protocol. The descriptions of the measurement were removed from the rubrics after the second Delphi checking. Two observation protocols were redesigned for the current research, one for the classroom observation of teachers and one for the classroom observation of the students. These observation protocols were then pilot tested again.

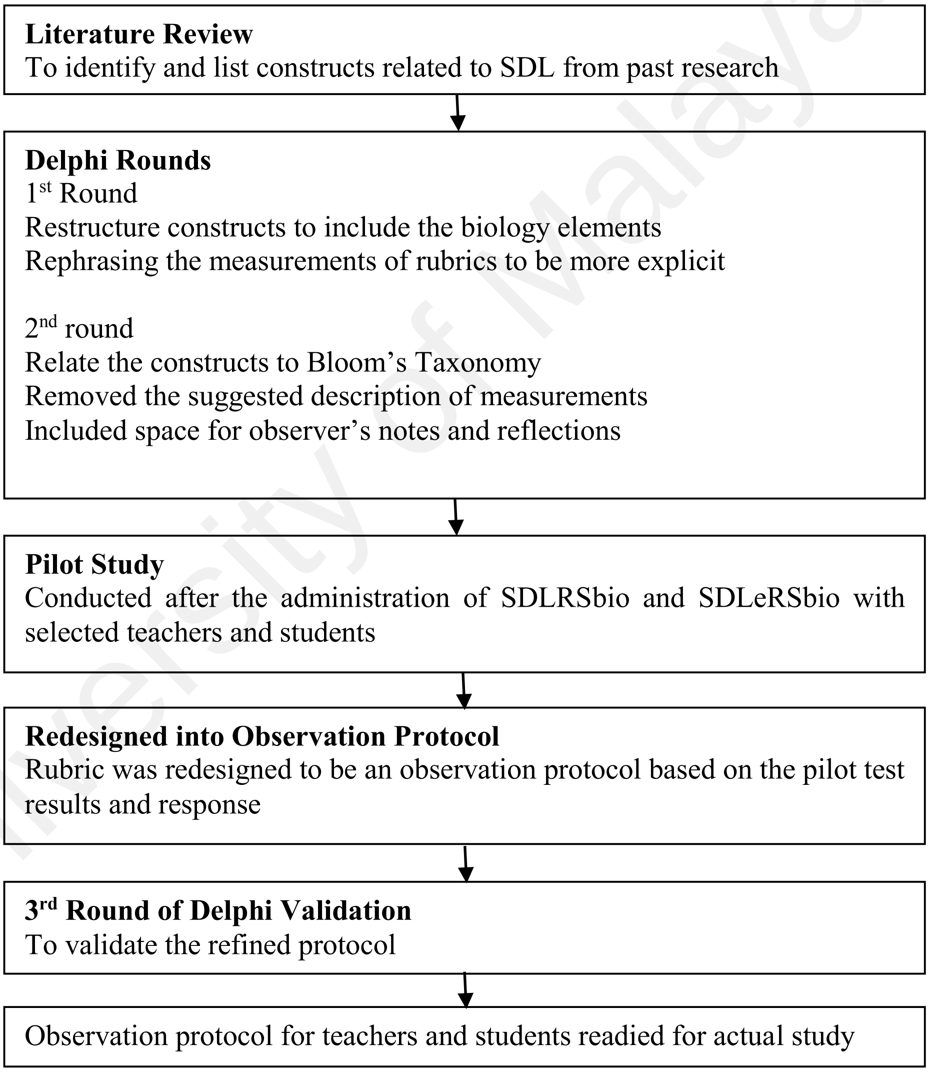


*Figure 4.4* Classroom Observation Protocol Preparation Flowchart

However, after several rounds of observations during the pilot study, the researcher found it more efficient to record the observations for teachers and students with the same protocol. Despite the change in the observation procedures, the aims of the observation were preserved. This prepared protocol consisted of blank columns with time indication for the researcher to record whatever happened during the lessons accordingly. The protocol was then sent to the panel members for the third Delphi validation. All panel members responded positively towards the observation protocol. The process of the classroom observation protocol development is shown in Figure 4.4 (p 87). Sample of the final classroom observation protocol is given in Appendix IX.

### 4.4.5 The preparation of the interview protocols

Interview protocols were first prepared with the aim to identify the factors influencing the students' SDLR and teachers' SDLeR. There were two protocols developed, one for the teachers and another one for the students. These protocols were then sent to the Delphi panel for content and language validation. The process is showed in Figure 4.5.

Amendments were made after the first Delphi round. The language used in the protocols was amended to avoid leading questions. For example the question "What factors do you think hinder you from SDL?" was changed to "What factors do you think will influence your SDL readiness?".

The amended protocols were then sent back to the panel members for a second round of checking. The panel members agreed to the interview protocols with amendments on the language used. Since every interview was unique and different, spontaneous follow-up questions were asked accordingly on the spot. The developed protocols for the semi-structured interview are given in Appendix X.

**Literature Review**
To identify the questions for the protocols

**Delphi Rounds**
1st Round
Content and language validity
Changed the leading questions

2nd round
To validate the amended protocols
Members of the panel agreed to the protocols content and language

**Pilot Study**
To test the feasibility of the protocols

Refined Protocols. Follow-up questions were asked as necessary in addition to the prepared interview questions.

*Figure 4.5* Interview Protocols Preparation Flowchart



### 4.5 Phase 2: Pilot Study

The aim of the pilot study was to test out the feasibility of the research procedures prior to implementing it in the actual study. The pilot study was conducted with STPM Biology students and teachers in the Federal Territory region. The sampling for the pilot study was based on convenient sampling. The convenient sampling was applied to obtain a quick response from the participants (Trochim, 2006). The researcher conducted the pilot test at her school and with her students. Teacher samples for the pilot study were chosen from the STPM Biology teachers from the same school with the researcher and also colleagues of the researcher teaching STPM Biology in the Federal Territory region.

A total of 30 students from 2 schools and 10 teachers from various schools in the Federal Territory region were involved in the pilot study. Prior to entering into the schools for pilot study, approval letters were obtained from the Ministry of Education (MOE) through the Education Planning and Research Department (EPRD), the State Education

Department, and the University of Malaya. The researcher wrote to the respective government departments two months or earlier prior to the commencement of the pilot study. All approval letters were brought by the researcher while meeting the school principals for the pilot study. Procedures of the pilot study are shown in Figure 4.6.

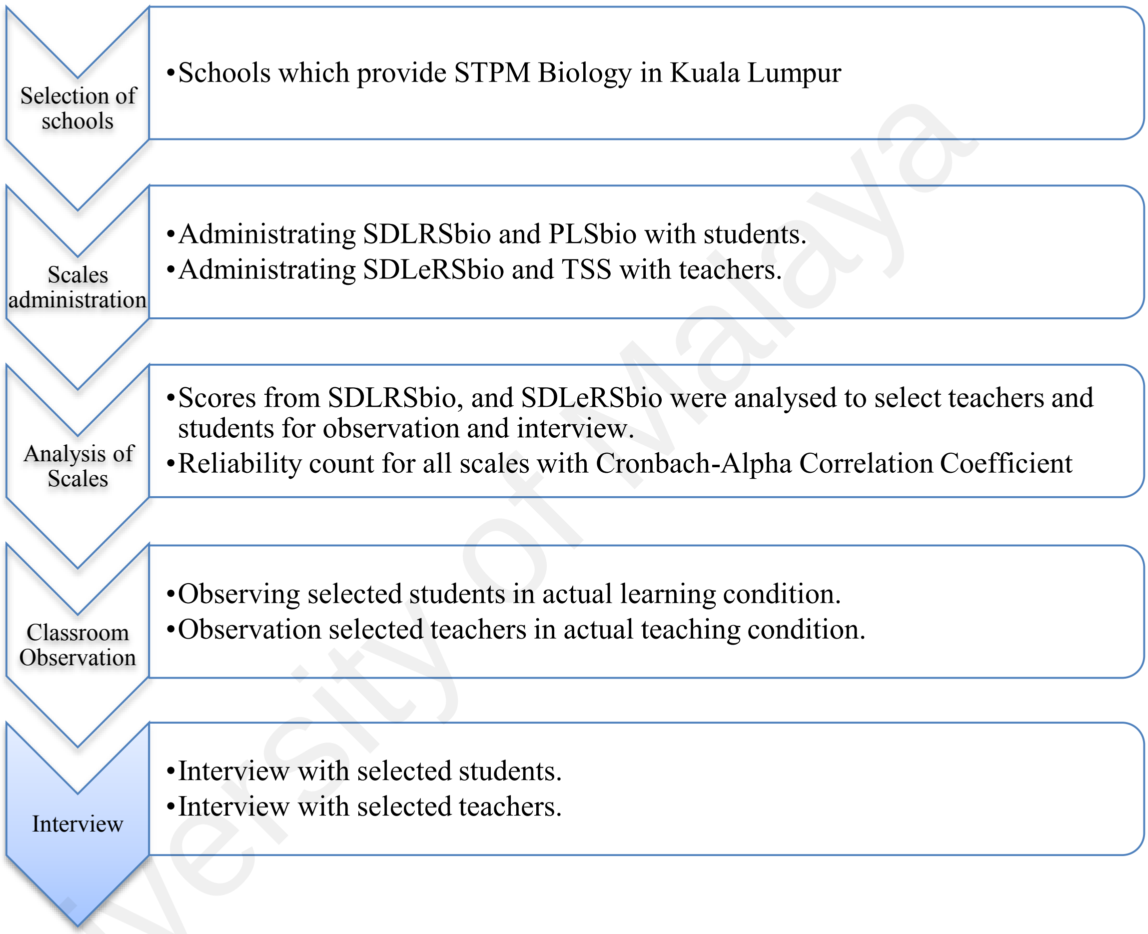


*Figure 4.6* Procedures of the Pilot Study



The pilot study started with the administering of the questionnaires to the selected students and teachers. The researcher administered the questionnaires, carried out classroom observations and interviews only after consent was given by the students and teachers. About 20-30 minutes was taken by the students to complete the SDLRSbio and PLSbio. The researcher was present with the students during the administering of the scales. The presence of the researcher was to provide further assistance to the students if they have difficulty in understanding the statements in the questionnaires.

Meanwhile, teachers were administered with the SDLeRSbio and TSS. Most of the time the researcher left the questionnaires with the teachers and collected it back on the next day with the researcher going back to the school for classroom observations and interviews. Some teachers needed more time to complete the questionnaires. The teachers raised questions about the questionnaires when they saw the researcher the second time.

From the pilot study, the research procedures seemed feasible and can be implemented in the schools. All questionnaires were administered without problems. The students and teachers answered the questionnaires without help from the researcher.

However, the conduct of classroom observations and interviews faced some obstacles. Some teachers were reluctant to be observed, and appointments for interviews were turned down due to many unforeseen reasons, like having emergency meetings, prolonged assemblies, teachers on sick leave, and many other reasons. Therefore, the researcher, with the suggestion of the Delphi panel of this research, decided to put in an open ended question at the questionnaires of SDLRSbio and SDLeRS. This open ended question was added to ask for the opinion of students and teachers about factors influencing the SDLR and SDLeR respectively.

### 4.5.1 Pilot study results for SDLRSbio and PLSbio

Two instruments were tested in the pilot study among students. These instruments included the Self-Directed Learning Readiness Scale for Biology (SDLRSbio) and the Preference of Learning Styles for Biology (PLSbio). Both instruments were administered to 30 students and the reliability of the instruments was calculated with the SPSS software version 20.

From the results of the pilot study, the SDLRSbio was found to have a high Cronbach Alpha value of 0.869. Table 4.10 shows the reliability test for the SDLRSbio. According to Table 4.6 the Cronbach Alpha reliability reading did not change much when any of the item were to be deleted. Hence, all the items were retained and the SDLRSbio items are reliable in the use of this research.

A high Cronbach Alpha reading (Table 4.10) with the support of item reliability statistics (Table 4.11) the researcher was confident in using the two instruments in measuring the students' SDL readiness and preference of learning styles in Biology respectively.

Meanwhile, for the PLSbio, the original adopted questionnaire (Learning style survey, LSS) gave a low reliability with a Cronbach Alpha value of 0.335. Hence the LSS was adapted with Biology elements and went through another Delphi validation round. With the modifications and adaptations to the biology context, the Cronbach's alpha value of the pilot study for the scale improved to 0.705. Result of the reliability is shown in Table 4.12.

Supported with the pilot study results, the research continued the usage of these instruments in measuring students' readiness and learning styles in the actual study phase to other schools throughout Malaysia.

Table 4.10 *Reliability Statistics of SDLRSbio Pilot Study (n=30)*

| **Constructs of the Scale** | **Cronbach's Alpha** | **No. of items** |
|---|---|---|
| **Overall Constructs** | 0.869 | 46 |
| **Biology Cognitive Readiness** | 0.562 | 7 |
| **Biology Learning Skills readiness** | 0.624 | 7 |
| **Emotional readiness in Biology** | 0.609 | 7 |
| **Laboratory skills** | 0.723 | 15 |
| **Experimental Design Skills** | 0.669 | 5 |
| **Data Analysis and Interpretation skills** | 0.746 | 5 |

Table 4.11 *SDLRSBio Items Reliability Statistics*

| Items | Scale Mean if Item Deleted | Scale Variance if Item Deleted | Corrected Item-Total Correlation | Cronbach's Alpha if Item Deleted |
|---|---|---|---|---|
| **Biology Cognitive Readiness** | 156.0762 | 364.438 | .409 | .920 |
| **BCogR2** | 155.5808 | 363.320 | .488 | .919 |
| **BCogR3** | 155.7931 | 362.652 | .443 | .920 |
| **BCogR4** | 155.7568 | 363.512 | .394 | .920 |
| **BCogR5** | 156.2904 | 365.814 | .320 | .921 |
| **BCogR6** | 155.8566 | 361.585 | .493 | .919 |
| **BCogR7** | 155.6062 | 363.392 | .458 | .920 |
| **Biology Learning Readiness** | 155.8621 | 361.814 | .409 | .920 |
| **BLrnR9** | 155.8584 | 362.565 | .374 | .920 |
| **BLrnR10** | 156.0091 | 365.409 | .319 | .921 |
| **BLrnR11** | 155.9528 | 361.223 | .376 | .920 |
| **BLrnR12** | 155.4211 | 363.630 | .347 | .921 |
| **BLrnR13** | 155.7187 | 360.893 | .452 | .920 |
| **BLrnR14** | 155.9201 | 362.517 | .451 | .920 |
| **Emotional Readiness in Learning biology** | 155.8657 | 367.073 | .294 | .921 |
| **EmoR16** | 155.5808 | 362.840 | .382 | .920 |
| **EmoR17** | 156.4701 | 366.857 | .218 | .922 |
| **EmoR18** | 155.9927 | 361.473 | .427 | .920 |
| **EmoR19** | 155.5699 | 360.966 | .432 | .920 |
| **EmoR20** | 155.3866 | 360.867 | .407 | .920 |
| **EmoR21** | 155.2595 | 362.651 | .439 | .920 |
| **Laboratory Skill use of Instrument** | 155.2087 | 360.595 | .508 | .919 |
| **LabSI23** | 156.3321 | 362.557 | .342 | .921 |
| **LabSI24** | 155.4428 | 358.091 | .586 | .918 |
| **LabSI25** | 155.8312 | 359.242 | .478 | .919 |
| **LabSI26** | 156.0363 | 361.479 | .382 | .920 |
| **Lab Skill Technique** | 155.5953 | 358.729 | .490 | .919 |
| **LabST28** | 155.5789 | 362.091 | .366 | .920 |
| **LabST29** | 156.0526 | 360.897 | .420 | .920 |
| **LabST30** | 156.2740 | 361.301 | .409 | .920 |
| **LabST31** | 156.0490 | 358.505 | .459 | .919 |
| **Lab skill Data collection** | 155.1615 | 359.048 | .557 | .919 |
| **LabSD33** | 155.6497 | 357.690 | .532 | .919 |
| **LabSD34** | 155.6806 | 357.931 | .534 | .919 |
| **LabSD35** | 155.6025 | 358.069 | .583 | .918 |
| **LabSD36** | 155.2523 | 362.825 | .429 | .920 |
| **Exp Design** | 156.5717 | 363.823 | .375 | .920 |
| **ExpDS38** | 156.0254 | 358.538 | .503 | .919 |
| **ExpDS39** | 155.9837 | 359.820 | .539 | .919 |
| **ExpDS40** | 155.8403 | 360.702 | .507 | .919 |
| **ExpDS41** | 156.1234 | 361.388 | .441 | .920 |
| **Data Analysis and Interpretation skill** | 155.4701 | 359.733 | .500 | .919 |
| **DatAIS43** | 155.8221 | 359.539 | .547 | .919 |
| **DatAIS44** | 155.3303 | 361.123 | .489 | .919 |
| **DatAIS45** | 155.8004 | 361.360 | .515 | .919 |
| **DatAIS46** | 155.1561 | 366.187 | .315 | .921 |

Table 4.12 *Reliability Statistics of PLSbio Pilot Study (n=30)*

| Constructs of the Scale | Cronbach's Alpha | No. of items |
|---|---|---|
| **Overall Constructs** | 0.779 | 40 |
| **Theorist** | 0.595 | 10 |
| **Pragmatist** | 0.419 | 10 |
| **Activist** | 0.553 | 10 |
| **Reflector** | 0.600 | 10 |
| **Overall Learning Styles** | 0.705 | 4 |

### 4.5.2 Pilot study results for SDLeRSbio and TSS

Two instruments for measuring teachers' readiness and teaching styles were pilot tested with 10 teachers in the Federal Territory region. With the 10 teachers the Conbrach Alpha value was 0.971 for the SDLeRSbio and was 0.939 for the TSS. However, the 10 teachers' results were insufficient for statistical analysis for reliability. The pilot study was positive in indicating the feasibility of the scales for teachers. The 10 teachers could understand the questionnaires and they had a positive impression of the SDLeRSbio and the TSS. This gave the green light to proceed with the use of the instruments in the research to the next phase, the actual study. The researcher calculated the reliability of the instruments when the total sample of teachers reached 30 to ensure the reliability of the instruments. The Cronbach Alpha reading for the SDLeRSbio is recorded in Table 4.13.

Table 4.13 *Reliability statistics of SDLeRSbio Pilot Study (n=30)*

| Constructs of the Scale | Cronbach's Alpha | No. of items |
|---|---|---|
| **Overall Constructs** | 0.952 | 53 |
| **Biology Cognitive Readiness** | 0.894 | 7 |
| **Biology Learning Skills readiness** | 0.744 | 7 |
| **Emotional readiness in Biology** | 0.798 | 7 |
| **Laboratory skills** | 0.912 | 15 |
| **Experimental Design Skills** | 0.798 | 5 |
| **Data Analysis and Interpretation skills** | 0.859 | 5 |
| **Interacting Skills** | 0.778 | 7 |

According to Table 4.14, all the 53 items in SDLeRSbio did not show much difference in the reliability reading when deleted. Hence, the researcher decided to retain all the items in the scale.

The reliability result of TSS is shown in Table 4.15. The TSS yielded 0.931 for the overall construct reliability, hence the researcher decided to proceed with the use of the instrument in the current research in measuring the teaching styles.

Table 4.14 *SDLRSbio Items Reliability Statistics*

| Items | Scale Mean if Item Deleted | Scale Variance if Item Deleted | Corrected Item-Total Correlation | Cronbach's Alpha if Item Deleted |
|---|---|---|---|---|
| **Biology Cognitive Readiness** | 223.5636 | 354.028 | .633 | .949 |
| **BCogR2** | 223.3818 | 354.944 | .638 | .949 |
| **BCogR3** | 223.3091 | 356.255 | .593 | .949 |
| **BCogR4** | 223.3091 | 357.106 | .553 | .950 |
| **BCogR5** | 223.6909 | 356.403 | .461 | .950 |
| **BCogR6** | 223.4364 | 353.102 | .709 | .949 |
| **BCogR7** | 223.3636 | 358.606 | .493 | .950 |
| **Biology Learning Readiness** | 223.5091 | 359.699 | .409 | .950 |
| **BLrnR9** | 223.7636 | 358.999 | .349 | .951 |
| **BLrnR10** | 223.5455 | 357.438 | .566 | .950 |
| **BLrnR11** | 223.6364 | 352.162 | .668 | .949 |
| **BLrnR12** | 223.5636 | 363.362 | .144 | .952 |
| **BLrnR13** | 223.5636 | 354.991 | .517 | .950 |
| **BLrnR14** | 223.6182 | 357.870 | .427 | .950 |
| **Emotional Readiness in Learning biology** | 223.7273 | 361.387 | .252 | .951 |
| **EmoR16** | 223.6545 | 363.786 | .240 | .951 |
| **EmoR17** | 224.2000 | 355.830 | .380 | .951 |
| **EmoR18** | 223.6182 | 358.463 | .444 | .950 |
| **EmoR19** | 223.6000 | 357.133 | .492 | .950 |
| **EmoR20** | 223.6182 | 358.426 | .373 | .950 |
| **EmoR21** | 223.3455 | 356.156 | .607 | .949 |
| **Laboratory Skill use of Instrument** | 223.0182 | 358.796 | .495 | .950 |
| **LabSI23** | 223.7455 | 346.527 | .513 | .950 |
| **LabSI24** | 223.1273 | 356.039 | .640 | .949 |
| **LabSI25** | 223.0909 | 352.862 | .622 | .949 |
| **LabSI26** | 223.3455 | 343.971 | .741 | .948 |
| **Lab Skill Technique** | 223.1636 | 355.547 | .659 | .949 |
| **LabST28** | 223.0364 | 358.517 | .584 | .950 |
| **LabST29** | 223.1818 | 352.929 | .610 | .949 |
| **LabST30** | 223.7091 | 341.395 | .740 | .948 |
| **LabST31** | 223.5273 | 347.809 | .610 | .949 |
| **Lab skill Data collection** | 223.0182 | 359.574 | .490 | .950 |
| **LabSD33** | 223.2000 | 358.274 | .462 | .950 |
| **LabSD34** | 223.2364 | 353.628 | .608 | .949 |
| **LabSD35** | 223.1455 | 356.608 | .512 | .950 |
| **LabSD36** | 223.3273 | 357.743 | .470 | .950 |
| **Exp Design** | 223.6545 | 349.230 | .576 | .949 |
| **ExpDS38** | 223.3455 | 353.675 | .547 | .950 |
| **ExpDS39** | 223.1455 | 359.015 | .457 | .950 |
| **ExpDS40** | 223.1091 | 356.729 | .538 | .950 |
| **ExpDS41** | 223.2727 | 348.498 | .730 | .949 |
| **Data Analysis and Interpretation skills** | 223.1455 | 354.867 | .586 | .949 |
| **DatAIS43** | 223.2364 | 355.554 | .583 | .949 |
| **DatAIS44** | 223.1636 | 357.213 | .576 | .950 |
| **DatAIS45** | 223.2727 | 354.795 | .620 | .949 |
| **DatAIS46** | 223.4182 | 355.692 | .485 | .950 |
| **Facilitating Skills** | 223.6182 | 355.759 | .490 | .950 |
| **FacSR48** | 223.3455 | 356.638 | .521 | .950 |
| **FacSR49** | 223.2182 | 359.581 | .404 | .950 |
| **FacSR50** | 223.3273 | 357.298 | .489 | .950 |
| **FacSR51** | 223.4909 | 357.329 | .379 | .951 |
| **FacSR52** | 223.6182 | 358.352 | .375 | .950 |
| **FacSR53** | 223.6000 | 357.948 | .336 | .951 |

Table 4.15 *Reliability statistics of TSS Pilot Study (n=30)*

| | Cronbach's Alpha | No. of items |
|---|---|---|
| **Overall** | 0.931 | 40 |
| **Teaching styles** | 0.896 | 5 |

With the results of the reliability readings for a sample of 30 teachers, the researcher was able to utilise the instruments in measuring SDLeR and teaching styles to a wider scale in the nationwide study.

### 4.5.3 Pilot study for classroom observations

The aim of the pilot study for the classroom observation was to test out the feasibility of the observation procedures. Hence, the analysis of the study focused on the procedures of the classroom observation. Initially the sample for observations was selected from those who had the lowest score in SDLRSbio or SDLeRSbio. During the pilot test, the researcher found that not many students and teachers who fell into this category were willing to be observed. Hence, this problem was brought to the Delphi panel during the preparation of the observation protocol. In view that one of the objectives of the research was to identify the factors influencing the STPM Biology students' SDLR, teachers' SDLeR, and the constructive interactions occurring during lessons, the Delphi panel suggested that the observations being carried out with willing samples.

Since not many teachers and students were willing to be observed, therefore, the pilot study of the classroom observation was conducted with 1 teacher and 2 students from the same class. The observation was conducted separately with the teacher and the students. Initially, the classroom observation was conducted with the guide of the observation rubrics. During the early stage of the pilot study, the observation was conducted separately for the teacher and students. The plan was to only observe either the teacher or the student at any one time. In terms of the feasibility of the procedures, the researcher found that teacher and students were reluctant to be observed. The teacher especially, did not find it comfortable with the presence of the researcher in the classroom while he/she was teaching. Meanwhile the presence of the researcher also caused the students to be distracted initially. Hence, the researcher made amendments in the procedure of the classroom observation to note down comments in observing both teacher and students concurrently. From the pilot study, the researcher found that observing both teacher and students at the same time was more appropriate for the research procedures. This was because most teachers did not allow the researcher to observe their class more than twice.

During the first few observations, the researcher found that the initially prepared rubrics failed to allow the researcher to capture the constructive interactions occurring during lessons. The rubrics also had limited the recording of the occurrences during the lessons. Hence, the researcher had to note down comments during the observations besides using the rubrics. The concern of the observation rubrics' limitation was brought to the Delphi panel. Consequently the observation rubric was redesigned to be an observation protocol. Details of the observation protocol development were recorded in the previous session of this chapter. For the consequent observations, the researcher recorded the observations into the observation protocol as shown in Appendix IX. At the end of the observation, expanded field notes were written to elaborate the incidences which happened during lessons with the aim to identify the factors influencing the students' SDLR and teachers' SDLeR, and also the constructive interactions which happened during lessons.

Photographs and video recordings of the lessons were taken with the permission of the teachers and students. The Photographs and video recordings were used for the preparation of the expanded field notes recording of the incidences during the lessons. The observation of the teachers and students for the pilot study took around two months.

After the pilot study, the classroom observation protocol was amended to observe both teachers and students at the same time in the actual study. However, the aim of the classroom observations still remained in identifying the factors influencing the students' SDLR and teachers' SDLeR, and the constructive interactions during lessons.

### 4.5.4 Pilot study for the interview protocols

The aim of the pilot test interview was to test out the feasibility of the interview procedures. Similar to the observations, in the pilot study itself, the researcher had faced the problem of having teachers and students being unwilling to be interviewed. According to the advice of the Delphi panel the researcher conducted the pilot study interview with any teacher and student who were willing.

The interview was conducted separately for teachers and students. It was done before or after the classroom observations depending on the interviewee's convenience. Each interview was audio recorded for transcription later. Interview protocols were used as guidelines for the interviews. The interview pilot test was conducted with 1 teacher and 2 students based on willingness. The interview was conducted separately with the teacher and the students.

The pilot study revealed that students would prefer to be interviewed during school hours as they were tied up with co-curricular activities and tuition after school hours. The teachers also seemed reluctant to be interviewed more than once. In view of this and after discussion with the expert panel the researcher decided to add an open-ended question to the SDLRSbio and SDLeRSbio, in order to elicit opinions about the factors that could influence the SDLR among students, and SDLeR among teachers. It was decided that a second interview will be conducted if the students or teachers gave consent.

## 4.6 Phase 3: Actual Study

The pilot study contributed in completing the preparation of the research instruments and to refine the research procedures. Hence, after the pilot study of the research procedures with the developed instruments, the research proceeded at a nationwide level. The actual study sample covered schools which offered STPM Biology from East and West Malaysia. This was the core task of the research and it took 18 months to complete the data collection nationwide. The researcher had to travel around Malaysia to collect data and much effort was made in arranging the interviews and observations with the students and teachers at different states.

Initially the actual study targeted data collection in the Federal Territory region. However, due to receiving a Postgraduate Research Grant (PPP) provided by University of Malaya the researcher decided to expand the actual study to a wider scale. Hence, the actual study involved data collection from both East and West Malaysia.

The research did not apply the random sampling method. The sampling was purposive which targeted only the STPM Biology teachers and students. A list of the schools which offered STPM Biology curriculum was provided by the Ministry of Education. The researcher obtained the list of all the schools which offered STPM Biology curriculum and went down the list in contacting them. The researcher contacted the selected school principals for permission to conduct the research with the teachers and students. Prior to that, approval letters were obtained from the University of Malaya, state education departments, and EPRD. These approvals were shown to the school principals together with a letter of request for the permission to conduct the research in the school. The researcher brought all the letters by hand to the school principals during each school visit in each state. In most cases, consent from the principal, teachers and students were obtained on the spot. However, some schools rejected the request. Most rejections were due to school examinations during the period of visit. Hence, a further arrangement had to be made if the researcher wanted to continue the research in the selected school.

Once a school agreed, the STPM Biology teachers and students in the schools were automatically the targeted samples for the administration of the four questionnaires (SDLRSbio, SDLeRSbio, PLSbio and TSS). After the administration of the questionnaires, the classroom observations and the interviews were conducted with the students and teachers based upon their willingness. The researcher had to spend about one week in each state to conduct the research. Revisits to some states were conducted when the observations and interviews were not completed during the first visit. Hence, the researcher spent about 18 months in travelling around Malaysia to collect the data for the current research.

Table 4.16 (P 100) below shows the number of schools involved in this research. A tight schedule was planned for the school visits. This included the consideration of school events like school holidays, schools examinations, sport days, and other important school events when the researcher was not permitted to enter the school for research

### 4.6.1 Sample Selection for quantitative data collection

As mentioned earlier, this research did not apply random sampling. Hence, the researcher contacted all the schools which offer STPM Biology curriculum from the list provided by the MOE at the Education Planning and Research Division (EPRD). According to the MOE records, there were 261 schools providing STPM Biology in Malaysia. All STPM Biology teachers and students in the schools who agreed to the research, automatically became the samples of the study. However, consent from the teachers and students were obtained prior to the commencement of the research.

Based on to the list of schools provided by the EPRD the calculation of the sample size needed were done with Yamane's formula. The calculation is as shown below.

$$n = \frac{N}{1 + Ne^2}$$

$n$ = sample size

N = Population size

$E$ = confidence level

Table 4.16 *Records of Actual Study*

| States | Number of schools covered | Duration of visit | Number of schools revisited | Duration of revisit | Number of schools where interviews were conducted | Number of interviews done | Number of schools where observations were conducted | Number of observations done |
|---|---|---|---|---|---|---|---|---|
| **Sabah** | 3 | 1 week | - | - | 1 | 1 (teacher) | - | - |
| **Sarawak** | 2 | 1 week (Miri) | - | - | - | - | - | - |
| | 4 | 1 week (Kuching) | - | - | 1 | 1 (student) | - | - |
| **Perlis** | 1 | 2 days | - | - | - | - | - | - |
| **Kedah** | 3 | 1 week | - | - | - | - | - | - |
| **Pulau Pinang** | 4 | 1 week | - | - | - | - | - | - |
| **Perak** | 4 | 1 week | 2 | 1 week | - | - | 1 | 1 |
| **Selangor** | 6 | 5 weeks | 2 | 2 weeks | 2 | 1 (teacher)<br>1 (student) | 3 | 7 |
| **Kuala Lumpur** | 6 | 6 weeks | 4 | 4 weeks | 4 | 2 (teachers)<br>3 (students) | 3 | 13 |
| **Melaka** | 4 | 2 weeks | - | - | 1 | 1 (teacher) | 1 | 2 |
| **Negeri Sembilan** | 3 | 2 weeks | 2 | 2 weeks | - | - | - | |
| **Johor** | 4 | 1 weeks | - | - | 1 | 1 (student) | - | |
| **Kelantan** | 4 | 1 weeks | - | - | - | - | 2 | 2 |
| **Terengganu** | 4 | 1 weeks | - | - | - | - | 1 | 1 |
| **Pahang** | 3 | 1 weeks | - | - | - | - | - | - |
| **Total** | 55 | 25 weeks 2 days* | 10 | 9 weeks | 10 | 11 | 11 | 26 |

Note*: This table recorded only the duration when the research was conducted in school. Time of arranging and preparing for the school visit are not shown. The research progress was much influenced by the school holidays and school's events. Hence, the total research duration was about 18 months.





100

The confidence level tells how true the results can be. It is the range of values statistically consistent with the value actually observed in the study. It is expressed as a percentage (Kelly & Roger, 1997). By knowing the population size according to the EPRD's data, this formula helped in determining the sample size of both the student and teacher participants for this research..

### 4.6.2 Sample size calculation for students

According to the record provided by EPRD, the total number of students enrolled for STPM Biology study was 8124, for the year of 2012/2013. Hence, this figure was made as the population size for the study. With the confidence level of 95% the calculation of the sample size for the students was done as below.

$$n = \frac{8124}{1+(8124)(0.05)^2}$$

$$= 381$$

As the researcher went through the list of schools, the researcher also adhered to the requirements of the minimum sample size as calculated above. However the number of students who actually participated in the current research was 586.

### 4.6.3 Sample size calculation for teachers

Similarly the sample size of teachers was determined according to the total population of teachers teaching STPM Biology. From the EPRD record in the year 2013/2014 a total of 338 teachers were teaching STPM biology. Hence, the total sample size of teachers for this research was calculated as below.

$$n = \frac{338}{1+(338)(0.05)^2}$$

$$= 77$$

However as the research proceeded, the number of teachers did not reach the required minimum sample size 77. The researcher managed to get the agreement of only 55 teachers to participate in this research. This was due to various factors. The most common reason was that the teachers in the schools were involved in meetings, trainings, or on duty at other places. Hence, they were not in the schools during the period when the research was proposed to be carried out in the schools. Secondly, some teachers were on medical leave during the period of research. Thirdly, some teachers refused to participate in the research. Despite various rejections and unforeseen circumstances in the data collection process, the 55 teachers had yielded sufficient and saturated data for the research analysis.

### 4.6.4 Total participants for the quantitative data collection

Table 4.17 shows the total participants for each questionnaire administered in the actual study.

Table 4.17 *Total Participants for SDLRSbio, SDLeRSbio, PLSbio and TSS*

| Type of questionnaires | Total participants approached | Returned questionnaires | Spoilt questionnaires | Total questionnaires available for statistics calculation |
|---|---|---|---|---|
| **SDLRSbio** | 648 | 586 | 35 | 551 |
| **PLSbio** | 648 | 586 | 20 | 566 |
| **SDLeRSbio** | 55 | 55 | 0 | 55 |
| **TSS** | 55 | 55 | 13 | 42 |

### 4.6.5 Normality test of quantitative samples

Numerical and graphical methods were used in the normality test of the quantitative samples. Table 4.18 shows the result of the normality test for the teacher samples for the self-rating SDLeR. In the Kolmogorov-Smirnov Test and the Shapiro-Wilk Test the p-value was greater than 0.05 (P>0.05), hence, it indicates a normal distribution of the teacher sample for SDLeR. In addition, the histogram in Figure 4.7 shows a normal curve for the SDLeR. This further indicated a normal distribution of teacher samples for SDLeR.

Table 4.18 *Kolmogorov-Smirnov and Shapiro-Wilk Tests for Normality Distribution of Teachers*

| | **Kolmogorov-Smirnov[a]** | | | **Shapiro-Wilk** | | |
|---|---|---|---|---|---|---|
| | **Statistic** | **Df** | **Sig.** | **Statistic** | **Df** | **Sig.** |
| **Teachers Readiness** | 0.101 | 55 | 0.200 | 0.964 | 55 | 0.101 |

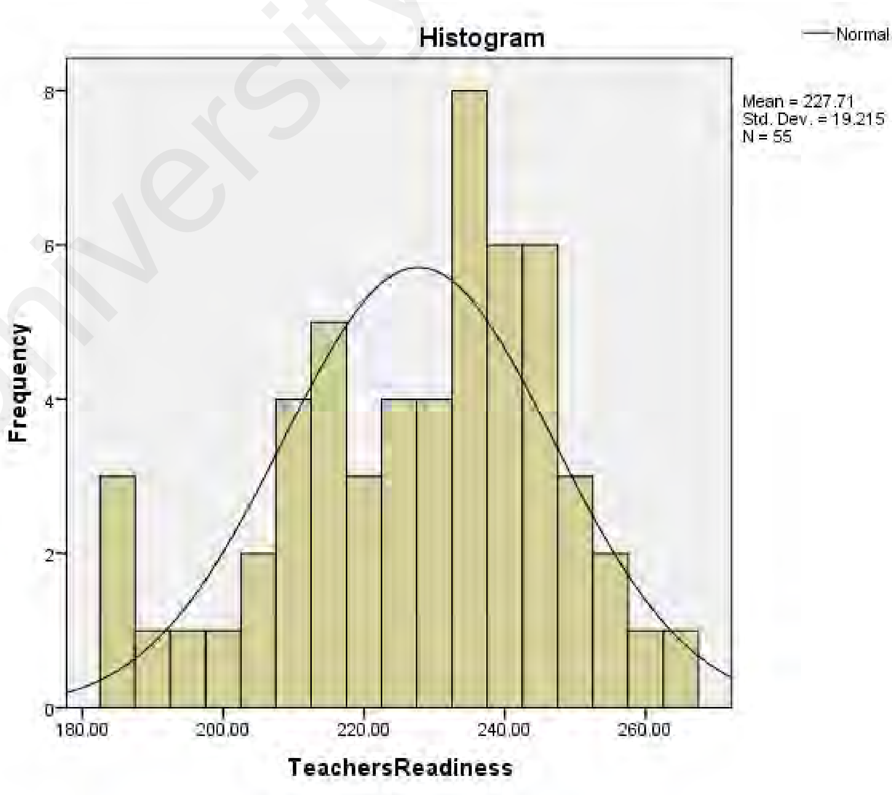


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*Figure 4.7* Histogram of Teacher Sample for SDLeR

In the case of the student sample for SDLR shown in Table 4.19, both the Kolmogorov-Smirnov Test and the Shapiro-Wilk Test show significance lower than 0.05 ($P<0.05$). This indicates a violation of the assumption of normality and it is common for a large sample (Pallant, 2011). In this case, the graphical method was referred. From Figure 4.8 the histogram shows normal distribution of the student samples for SDLR. Additionally this was supported by the inspection of the normal Q-Q plot (Figure 4.9, p 107) which shows a reasonably straight line suggests a normal distribution.

Table 4.19 *Kolmogorov-Smirnov and Shapiro-Wilk Tests for Normality Distribution of Students*

| | Kolmogorov-Smirnov[a] | | | Shapiro-Wilk | | |
|---|---|---|---|---|---|---|
| | **Statistic** | **Df** | **Sig.** | **Statistic** | **Df** | **Sig.** |
| **Students Readiness** | 0.51 | 551 | 0.002 | 0.982 | 551 | 0.000 |

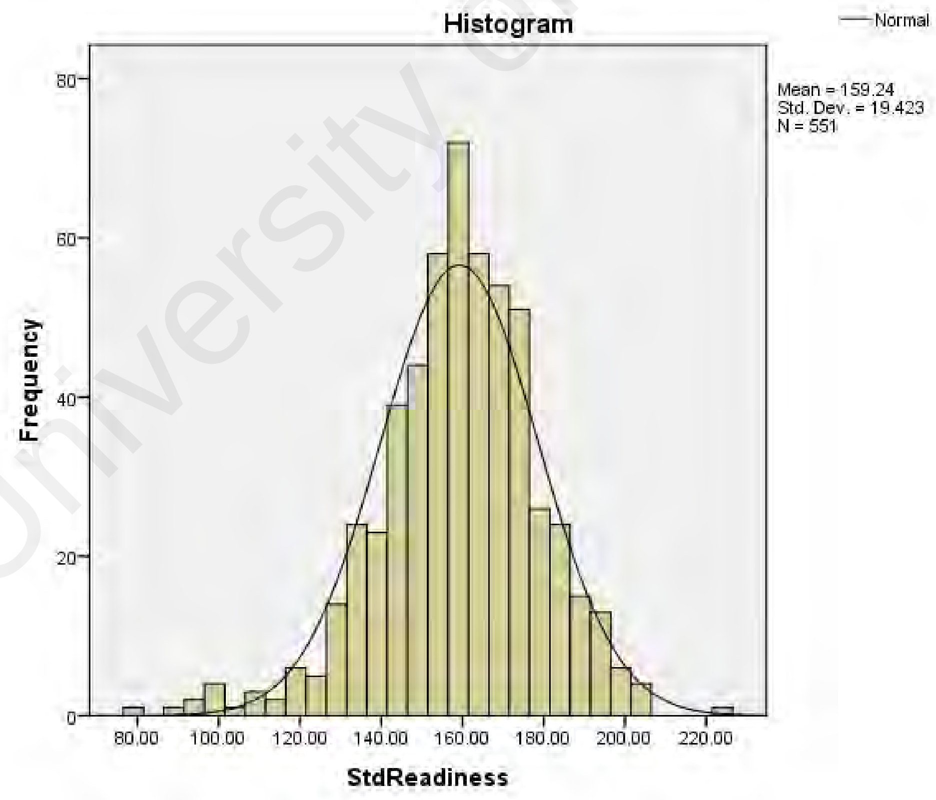



*Figure 4.8* Histogram of students' Readiness

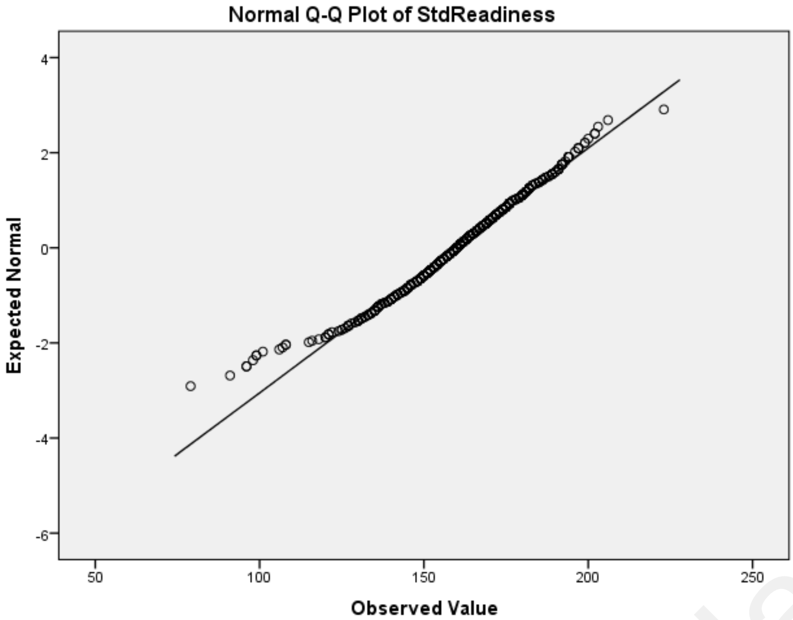



*Figure 4.9* Normal Q-Q Plot of Student Sample for SDLR

The homogeneity of the teacher sample of SDL lesson readiness was tested with the Levene's test of homogeneity of variances. According to Table 4.20 significance of the Leneve's test was 0.424 (more than 0.05). Therefore the analysis followed the first line the "Equal variances assumed". The reading of significance (2-tailed) was 0.762 (more than 0.05). This indicated that there was no statistical significant difference in the mean of teachers' readiness. This indicated homogeneity in terms of the teacher sample for SDLeR.

The homogeneity of the student sample of SDL readiness is shown in Table 4.21. The significance of the Leneve's test was 0.004 (less than 0.05). Therefore the analysis followed the second line the "Equal variances not assumed". The reading of significance (2-tailed) was 0.450 (more than 0.05). This indicated that there was no statistical significant difference in the mean of students' readiness. This indicated homogeneity in terms of the student sample for SDLR.

Table 4.20 *Leneve's Test of Homogeneity of Teacher Sample for SDLeR*

| | Levene's Test for Equality of Variances | | t-test for Equality of Means | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | F | Sig. | T | Df | Sig. (2-tailed) | Mean Difference | Std. Error Difference | 95% Confidence Interval of the Difference | |
| | | | | | | | | Lower | Upper |
| **Equal variances assumed** | .648 | .424 | .305 | 53 | .762 | 2.06667 | 6.77470 | -11.52165 | 15.65499 |
| **Equal variances not assumed** | | | .259 | 11.530 | .800 | 2.06667 | 7.97068 | -15.37873 | 19.51206 |

Table 4.21 *Leneve's Test of Homogeneity of Student Sample for SDLR*

| | Levene's Test for Equality of Variances | | t-test for Equality of Means | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | F | Sig. | t | Df | Sig. (2-tailed) | Mean Difference | Std. Error Difference | 95% Confidence Interval of the Difference | |
| | | | | | | | | Lower | Upper |
| **Equal variances assumed** | 8.318 | .004 | .828 | 549 | .408 | 1.50066 | 1.81348 | -2.06154 | 5.06287 |
| **Equal variances not assumed** | | | .756 | 252.938 | .450 | 1.50066 | 1.98532 | -2.40921 | 5.41053 |

Both the test of normality and homogeneity indicated that the samples of teacher and student involved in this study were normal and homogeneous. Hence, the researcher proceeded with the analysis of the data collected from the questionnaires.

### 4.6.6 Demographic Analysis of Student Participants

Demographic information of the students is given in Table 4.22 and Table 4.23. SDLRSbio was administered to 648 students. However, only 586 forms were collected back by the researcher. This was due to the fact that some students were absent from school on the next day when the researcher went to collect back the forms. In addition, some of the students misplaced the forms, and some teachers did not help in distributing the questionnaires as scheduled. Hence the researcher did not manage to collect back all the distributed questionnaires. However, among all the 586 collected questionnaires, 35 of the questionnaires were incomplete and were not included. Therefore, a total of 551 questionnaires were available for correlation analysis.

From the 586 student sample, 70% of them were female students. This could be an indicator that more female students were interested in Biology compared to the male students. However, the reason of this phenomenon was not the focus of this study and was not investigated in this research.

Since the targeted group of students were STPM students, their age ranged from 17 to 20 years old. This was due to the extra one year spent by some students in the remove class prior to entering Form 1 for those coming from vernacular primary schools as they entered the secondary schools. Some of the students in the sample were 20 years old, as their birthday was in the early part of the calendar year.

Table 4.22 *Gender Analysis of Student Participants*

| Gender | Frequency | Percentage, % |
|---|---|---|
| **Male** | 176 | 30 |
| **Female** | 410 | 70 |
| **Total** | 586 | 100 |

Table 4.23 Age Analysis of Student Participants

| Age | Frequency | Percentage, % |
|---|---|---|
| **17** | 8 | 1.4 |
| **18** | 172 | 29.4 |
| **19** | 402 | 68.6 |
| **20** | 4 | 7 |
| **Total** | 586 | 100 |

### 4.6.7 Demographic Analysis of Teacher Participants

Among the 55 teachers who participated in the research, only 10 of them were male teachers. This is a normal situation in Malaysian government schools which indicates that the teaching profession is dominated by female teachers. This result is shown in Table 4.24.

As one of the pre-university programmes in Malaysia, STPM teachers are selected from the veteran teachers. Hence, in Table 4.25 the age range of teachers who participated in the research mostly falls between 41 – 50 years old which represented 41.9% of the participants. In fact, 63.7% or 35 out of 55 participants were aged 41 and above. Additionally, 65.4 % or 36 out of 55 participants had served more than 16 years in teaching. The result shown in Table 4.26 indicates that the STPM Biology teachers were veteran teachers.

Table 4.24 *Gender Analysis of Teacher Participants*

| Gender | Frequency | Percentage, % |
|---|---|---|
| **Male** | 10 | 18.5 |
| **Female** | 45 | 81.5 |
| **Total** | 55 | 100 |

Table 4.25 *Age Analysis of Teacher Participants*

| Age Range | Frequency | Percentage, % |
|---|---|---|
| **26 – 30** | 6 | 10.9 |
| **31 – 35** | 5 | 9 |
| **36 – 40** | 9 | 16.4 |
| **41 – 45** | 12 | 21.9 |
| **46 – 50** | 11 | 20 |
| **51 – 55** | 9 | 16.4 |
| **56 – 60** | 3 | 5.4 |
| **Total** | 55 | 100 |

Table 4.26 *Year of Service Analysis of Teacher Participants*

| Year Range | Frequency | Percentage, % |
|---|---|---|
| **1 – 5** | 3 | 5.5 |
| **6 – 10** | 9 | 16.4 |
| **11 – 15** | 7 | 12.7 |
| **16 – 20** | 16 | 29.1 |
| **21 – 25** | 12 | 21.9 |
| **26 – 30** | 4 | 7.2 |
| **31 – 35** | 4 | 7.2 |
| **Total** | 55 | 100 |

### 4.6.8 Sample selection for the qualitative data collection

The selection of the sample for qualitative data collection was based on the willingness of the STPM Biology students and teachers. Due to the problem which the researcher faced in selecting participants for interviews and observations, the number of participants involved in the qualitative data collection was not fixed by the researcher. The researcher tried to observe as many of the teachers and students who were willing. At the end of the research there were 16 out of 32 teachers approached and appointments made for observations and 5 teachers for interviews, and 6 out of 29 students approached and appointments made for observations and 10 students for interviews. At the end of the data collection process there were 5 out of the 16 teachers observed who were willing to allow the researcher to observe their lessons twice. There were 3 teachers who allowed the researcher to observe their lessons more than three times. As for the rest of the teachers the researcher only managed to observe their lessons once. Table 4.27 shown the number of participants for the classroom observation and interview.

Table 4.27 *Total Participants for Classroom Observations and Interviews*

| **Types of qualitative research** | **Total participants** | |
|---|---|---|
| | Students | Teachers |
| **Classroom Observations** | 6 | 16 |
| **Interviews** | 10 | 6 |

Due to the difficulties in getting teachers' permission for the classroom observations separately, the researcher decided to combine the teachers' and students' classroom observations. The researcher conducted the observations for teachers and students simultaneously as explained earlier in the chapter. For each and every classroom observation the researcher recorded the interactions in the classroom between both teachers and students and students and students as accurately as possible.

The researcher met great challenges in observing and interviewing teachers and students. With teachers, many of the set appointments were not kept due to ad hoc staff meetings, call for duties by the MOE, medical leave, prolonged assemblies and other errands which ate up the time of the teachers. Therefore, the researcher was not able to meet up with the teachers to conduct observations and interviews at the set time. Hence, new appointments had to be made for the observations or interviews. In some cases, the researcher had to extend her stay in other states just to ensure that the observations and interviews were conducted at the appointed date and time with the teachers. As the researcher needed to schedule her travels nationwide, this situation interrupted the travel schedule tremendously. Therefore the duration for data collection in total was 18 months.

Another challenge was that some teachers were very reluctant to be observed as they had very negative thoughts of being observed. To them, any form of observation was meant for reporting their faults in teaching. Despite the researcher having explained clearly that the observation was meant only for the current research purposes and not for reporting their teaching, at times the researcher reached the school as scheduled, some teachers turned down the observation session at the last minute. Hence, the researcher had to seek another teacher for observation in the particular state or district. This situation also caused many problems to the researcher in identifying the participants for observations and interviews.

A similar situation happened among the student participants. Appointments were made with the students, however most of the time the appointments were turned down due to a tight schooling schedule and ad hoc assemblies and activities of the school. Some of the students also find it difficult to have time for interviews out of schooling hours as they were rushing home for their tuition classes and other self-development lessons like piano and art classes. Hence, the researcher had to seek for chances in between the schooling hours to have the students' interviews.

Table 4.28 and Table 4.29 show the records of the observations and interviews. The observations were done in the authentic lessons situation without any intervention. Meanwhile the interviews were conducted during the teacher's free time based on appointment, and after school when students are waiting for their transport to go home.

Table 4.28 *Observation records*

| Observation | Teacher | Scores in Readiness Scales | Pedagogy | Total students in class | Learning Environment |
|---|---|---|---|---|---|
| **SFN1** | A | 231 | Lecture | 19 | Teacher Centred |
| **SFN2** | B | - | Lecture | 25 | Teacher Centred |
| **TFN1** | A | 231 | Lecture | 23 | Teacher Centred |
| **TFN2** | Z | 239 | Lecture | 7 | Teacher Centred |
| **TFN3** | Z | 239 | Lecture | 29 | Teacher Centred |
| **TFN4** | E | 239 | Lecture | 9 | Teacher Centred |
| **TFN5** | N | 259 | Lecture | 45 | Teacher Centred |
| **TFN6** | J | 202 | Field Work | 25 | Student Centred |
| **TFN7** | Z | 239 | Lecture | 23 | Teacher Centred |
| **TFN8** | Z | 239 | Lecture | 8 | Teacher Centred |
| **TFN9** | I | 181 | Lecture | 10 | Teacher Centred |
| **TFN10** | Z | 239 | Lecture | 30 | Teacher Centred |
| **TFN11** | J | 202 | Experiment | 28 | Student Centred |
| **TFN12** | J | 202 | Field Work | 28 | Student Centred |
| **TFN13** | J | 202 | Lecture | 45 | Teacher Centred |
| **TFN14** | E | 239 | Lecture | 10 | Teacher Centred |
| **TFN15** | E | 239 | Experiment | 10 | Teacher Centred |
| **TFN16** | F | 249 | Lecture | 2 | Teacher Centred |
| **TFN17** | F | 249 | Lecture / Experiment | 3 | Teacher /Student Centred |
| **TFN18** | Q | 221 | Lecture | 2 | Teacher Centred |
| **TFN19** | Q | 221 | Lecture | 2 | Teacher Centred |
| **TFN20** | H | 250 | Lecture | 19 | Teacher Centred |
| **TFN21** | D | 240 | Group Presentation | 5 | Student Centred |
| **TFN22** | G | 212 | Lecture | 17 | Teacher Centred |
| **TFN23** | S | 216 | Lecture | 16 | Teacher Centred |
| **TFN24** | K | 192 | Group Presentation | 29 | Student Centred |
| **TFN25** | M | 233 | Lecture | 6 | Teacher Centred |
| **TFN26** | T | - | Lecture | 15 | Teacher Centred |
| **TFN27** | W | 251 | Lecture | 15 | Teacher Centred |
| **TFN28** | W | 251 | Lecture | 8 | Teacher Centred |

Table 4.29 *Interview records*

| Interview | Participants | Scores in Readiness Scales |
|---|---|---|
| **TI1** | Teacher 1 | 231 |
| **TI2** | Teacher 2 | 239 |
| **TI3** | Teacher 3 | 239 |
| **TI4** | Teacher 4 | 249 |
| **TI5** | Teacher 5 | 221 |
| **SI1** | Student 1 | 140 |
| **SI2** | Student 2 | 185 |
| **SI3** | Student 3a, 3b | 146, 167 |
| **SI4** | Student 4 | 191 |
| **SI5** | Student 5 | 144 |
| **SI6** | Student 6a, 6b, 6c, 6d | 165 |

## 4.7 Data analysis method

In order to answer the research questions put forward, two types of data were collected. Quantitative data were collected from four questionnaires; the Self-Directed Learning Readiness Scale for Biology (SDLRbio), the Self-Direacted Learning Lesson Readiness Scale for Biology (SDLeRSbio), the Preference of Learning Styles for biology (PLSbio) and the Teaching Style Survey (TSS). Qualitative data were collected from interviews, classroom observations and an open ended question added to the SDLRSbio and SDLeRSbio.

The data collected from the SDLRSbio, SDLeRSbio, PLSbio, and TSS were also used to calculate the reliability of the respective questionnaires. The reliability of all the four (4) questionnaires were calculated with Cronbach Alpha Coefficient using the SPSS software version 20.

## 4.8 Analysis of quantitative data

The SPSS software version 20 was used for statistical analysis. The quantitative data were used to answer the research questions 1 and 2. Hence, it is used to test out the proposed SDLR notion and working hypotheses by looking into the correlation between the SDLR and learning styles, and SDLeR and teaching styles. Additionally, the quantitative data were also used to profile the SDLR and SDLeR. In this section the analyses methods are discussed in detail.

### 4.8.1 The correlation between SDLR and Learning styles, and SDLeR and teaching styles

The data collected from the SDLRSbio and the PLSbio were analysed to determine the correlation between SDLR and learning styles. Meanwhile, the data collected from the SDLeRSbio and the TSS were used to determine the correlation between SDLeR and teaching styles.

Non-Parametric statistics refers to statistics that do not assume that the data or population have any characteristic structure or parameters. It is normally used to identify the correlation between a discrete data and a nominal data (Creswell, 2012). In this research, there were two types of quantitative data collected. Firstly, the readiness data which was continuous data. Secondly, the teaching styles and learning styles data which were discrete data. In order to study the correlation of both types of data it was suggested to use the non-parametric statistics (Balnaves & Caputi, 2001; Creswell, 2012; Muijs, 2012). Hence, Spearman's rho correlation was used in the study. Table 4.30 shows the types of analysis according to the types of data collected.

The correlation generated from the data was used to test out the proposed SDLR notion and working hypotheses which postulated very minimum variation in the correlation between SDLR and learning styles, and SDLeR and teaching styles.

Table 4.30 *Bivariate Statistics*

| | **Nominal** | **Ordinal** | **Continuous** |
|---|---|---|---|
| **Nominal** | Cross-tabulation + Chi square + Phi | Cross-tabulation + Chi square + Phi | Two nominal groups: t-test |
| **Ordinal** | Cross-tabulation + Chi square + Phi | Cross-tabulation + Chi square + phi<br><br>or<br><br>Spearman's rho | Spearman's rho |
| **Continuous** | T-test (two groups) + Cohen's d | Spearman's rho | Pearson's r |

Sources: Muijs (2012)

### 4.8.2 The profile of SDLR and SDLeR

The SDLR and SDLeR profiling was done in 3 steps. The first step involved the generation of two continua, one for SDLRS and another for SDLeR. The second step further refined the two continua into four categories of readiness. The third step went in-depth into the readiness of domains within the SDLR and SDLeR. Each will now be discussed in turn. Besides displaying the data into the continua and categories of readiness, the quantitative data were also used for the analysis of the correlation between the variables.

#### 4.8.2.1 Step 1: The general continuum

Figure 4.10 below shows an example of locating the individual scores of A, B, or C on a continuum based on the total marks scored from the SDLRSbio and SDLeRSbio respectively. This continuum displays the distribution of readiness according to the scores the individual scored from the readiness scales. For better understanding of the readiness, the continuum was further categorized into 4 categories of readiness. This is discussed in the following section.

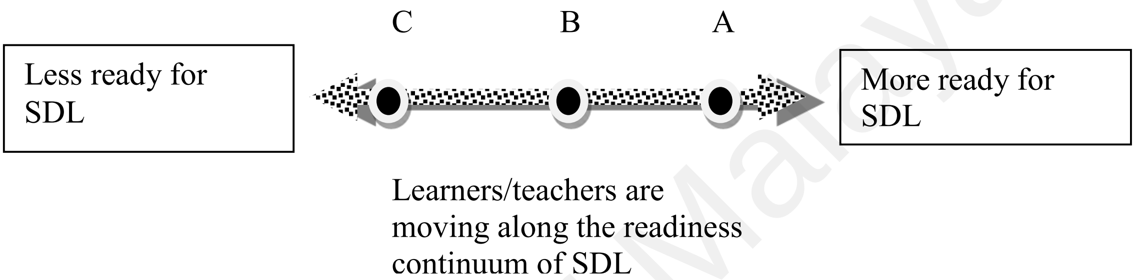



*Figure 4.10* Profiling of Readiness on the Self-Directed Learning Readiness Continuum

#### 4.8.2.2 Step 2: The categories of readiness

The data were categorized to 4 categories of readiness according to quartiles. This was based on Balnaves and Caputi's (2001) approach for better discussion and interpretation of large amounts of data. Thus, 4 categories have been put forward and verified by the Delphi panel. Hence, each continuum was divided into 4 quartiles based on the total score of the scales. For SDLRSbio, the total score of the scale was 230 and the lowest score of the scale was 46. The quartiles were based on the score in the range of 25% (score range from 46 – 92), 50% (score range from 93 – 138), 75% (score range from 139 – 184), and 100% (score range from 185 – 230). Similarly, the SDLeRSbio was divided into the 4 quartiles. The score range of each quartile is shown in Table 4.31. The frequency was counted for each quartile to determine the distribution of readiness categories for SDLR and SDLeR. The quartiles were verified by the same Delphi panel.

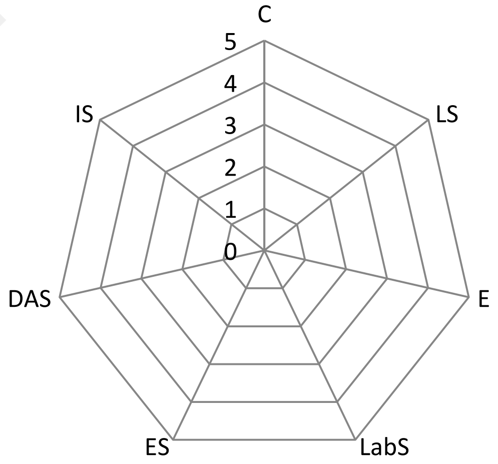
Table 4.31 *Readiness Categories for SDLR and SDLeR*

| **Readiness scales** | **Categories of readiness (Score range for SDLRSbio and SDLeRSbio)** | | | |
|---|---|---|---|---|
| | **Low Readiness** | **Average Readiness** | **Above Average Readiness** | **High Readiness** |
| **SDLRSbio** | 46 – 92 | 93 – 138 | 139 – 184 | 185 – 230 |
| **SDLeRSbio** | 53 – 106 | 107 – 159 | 160 – 212 | 213 – 265 |

**4.8.2.3 Step 3: The readiness of domains**

After the general categorisation was determined for SDLR among students and SDLeR among teachers, the next level of analysis was carried out. For the SDLR there were six (6) domains. Data were analysed for each domain to portray the distribution of domains within each of the categories of readiness. The analysis involved the calculation of the median of each domain in the SDLR. The median was used as it reflected the middle category of the distribution (Muijs, 2012) which represents the respondents choices more accurately for each domain of readiness compared to the mean.

The SDLeR had seven (7) domains. The same analysis approach was used to portray the distribution of the SDLeR scores within each of the four categories of readiness. Figure 4.11 shows a sample layout of the level of readiness of domains. A sample distribution of the readiness of domains is shown in Figure 4.12.

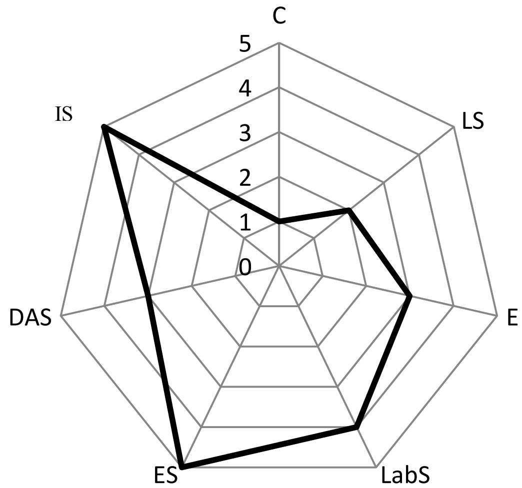



**Readiness of Domains**

General Skills Readiness
C = Cognition
LS = Learning Skills
E = Emotional

Specific Biology Skills Readiness
LabS = Laboratory Skills
ES = Experimental Skills
DAS = Data Analysis Skills
IS = Interacting skills

*Figure 4.11* Readiness of Domains Distribution Layout




**Readiness of Domains**

| General Skills Readiness | Median value |
|---|---|
| C = Cognition | 1 |
| LS = Learning Skills | 2 |
| E = Emotional | 3 |
| **Specific Biology Skills Readiness** | |
| LabS = Laboratory Skills | 4 |
| ES = Experimental Skills | 5 |
| DAS = Data Analysis Skills | 3 |
| IS = Interacting skills | 5 |

*Figure 4.12* Sample of Readiness of Domains Distribution
Note: Median values are plotted

## 4.9 Analysis of qualitative data

The qualitative data were collected from the prepared classroom observations, interviews, and an open ended question added in the SDLRSbio and SDLeRSbio. Analysis of the qualitative data using the constant comparative method across the different types of data collected. Several matrices were constructed for comparison and triangulation. Three (3) rounds of peer reviews were done to finalise the themes for both the factors influencing SDLR and SDLeR, and the constructive interactions. Peer review of these themes was conducted to ensure the validity of the themes.

During the classroom observations the researcher recorded the incidences and simultaneously noted the researcher's feelings and thoughts into the observation protocol. Photograph records and video records were taken only when consent was given by the teachers and students during observations. All the data from the observation protocols, researcher field notes, video and photograph records were then expanded into expanded field notes, and analysed by segments and transcribed.

All interviews were audio recorded. The audio records were then used for transcribing the interview verbatim. The interview transcripts were also written with page line numbering for easy analysis. The data collected from interviews were transcribed within 24 hours after the completion of the interview. Samples of observation field notes and interview transcripts are given in Appendix XII and Appendix XIII.

### 4.9.1 Answers from the open ended question in SDLRSbio and SDLeRSbio

An open ended question, "What factors do you think would influence your self-directed learning readiness?", was added to the questionnaire in order to obtain more information about teachers' and students' opinion of factor influencing their self-directed learning readiness. The teachers and students answered the question as they completed the questionnaire. The answers given by teachers and students for the open ended question (given in the questionnaire) were compiled carefully in sequence for easy analysis. A list of the answers was prepared for triangulation with the other qualitative data later. Table 4.32 (P 118) shows some of the answers given by the students and teachers in the open ended question. This answer list was analysed with the observation field notes and interview transcripts to answer research questions 3 and 4.

### 4.9.2 Factors influencing the SDLR and SDLeR

Prior to the triangulation of the qualitative data, early coding was done upon the data collected. A matrix was used to record the excerpts from the observation field notes and the interview transcripts against the emerging codes and the early codes respectively (David, 2001). The early codes from each interview and observation were further collapsed into themes through the content comparative technique. Table 4.33 (119) below shows the sample of the excerpts and the early coding from one data source of a teacher's interview.

Table 4.32 *Answers List of the Open Ended Question in the Questionnaires*

| **Answers** | |
|---|---|
| **Students** | **Teachers** |
| parents encouragement | parents encouragement |
| fiends help | - |
| peer pressure | - |
| friends and family | friends and family |
| Friend | Friend |
| Family | - |
| Social | Social |
| Environment | Environment |
| examinations results | examinations results |
| pressure of further study | pressure of further study |
| Examination | Examination |
| communication with parent | communication with parent |
| Health | Health |
| eating while studying | - |
| information available | information available |
| reference books | reference books |
| wrong info in reference book | - |
| weak edu sys | weak edu sys |
| pack examination schedule | pack examination schedule |
| too many procedure | too many procedure |
| free and easy to learn | - |
| Time | Time |
| sleeping time | sleeping time |

Note: A table showing the frequency of the answers is shown in Appendix XIV for interest – although the frequency of the answers are not required to answer the research questions in this study.

All the observation expanded field notes, interview transcriptions and the answers list of the open ended question were triangulated to identify the factors influencing the STPM Biology students' SDLR and STPM Biology teachers' SDLeR. The terms found in the open ended question were used as the early codes for the factors influencing the SDLR and SDLeR. The themes were then collapsed to identify the factors influencing the SDLR and SDLeR. Some of the themes were adopted from the SDLRSbio and SDLeRSbio. These themes were the "Biology cognitive readiness", "Biology learning skills readiness", "Emotional readiness in Biology", "Laboratory skills", "Experimental skills", "Data analysis skills" and "Interacting skills". Table 4.35 (p 120) shows how the early codes were collapsed into themes.

Table 4.33 *Sample Matrix for Early Coding of Teacher's Interview 1(TI1) Verbatim Transcript*

| Row No. | Sample excerpts | Codes | | | | |
|---|---|---|---|---|---|---|
| | | **Knowledge of biology** | **Examination oriented** | **Syllabus** | **Time** | **Maturity of student** |
| 22 | I think the first factor is the basic knowledge | Basic knowledge | - | - | - | - |
| 24 | They just learned to pass the examinations | - | Examination oriented | - | - | - |
| 26 | Form 6 syllabus is too wide | - | - | Wide syllabus | - | - |
| 46 | I don't have the pleasure of explaining clearly | - | - | - | Lack of time for explanation | - |
| 53 | I just don't have enough time to go into detail | - | - | - | Lack of time | - |
| 85 – 88 | Syllabus is too wide for me to teach. Sometime I conducted extra class for helping students to drill some examination questions. In the new modular system I have only one week for this, after that, is examination. One week is not enough. So how could I help them (students)? | - | - | Wide syllabus | Lack of time | - |
| 101 – 102 | You may think that Form 6 students are mature. But in fact, they are not. You just need to push them to work. | - | - | - | - | Lack matured |
| 106 – 108 | To do research they have to search from the internet for material, and they need to think which is the best for them based on the syllabus. | - | - | - | - | Capability of discerning. |

All the three rounds of peer review were conducted with the same group of peers. There were three peers involved in the peer review rounds. One peer is a science teacher with 10 years of teaching experience, another one peer is a biology teacher with 15 years of teaching experience, and the third peer is a English and Mandarin teacher with 10 years of teaching experience. Table 4.34 below shows the details of the peer review panellists. Consent was given by the peers before the peer review rounds were conducted. The purpose of using the same group of peers in the peer review is to ensure in-dept discussion in the process of themes identification.

Table 4.34 *Panellists for Peer Review*

| Panel | Profession | Year of Service |
|---|---|---|
| **Panel 1** | Science Teacher | 10 |
| **Panel 2** | Biology Teacher | 15 |
| **Panel 3** | Language Teacher (English and Mandarin) | 10 |

Table 4.35 *Sample of Themes for Factors Influencing SDLR and SDLeR*

| Themes | Early Codes | Excerpts from various data sources (audit trail) |
|---|---|---|
| **Examination Oriented mindset** | Examination Oriented | They (students) just learned to pass the examinations. (TI 2 R24)<br>Last time they used to drill with the answers and everything. So when come to form six, they feel that the teacher is suppose to give everything to them (TI 4 R85 – 87) |
| | Evaluation | The work that is given must carry some weightage of marks (TI 5 R30) |
| | Expectation | We don't really know what is expected from the marking scheme and stuff like that. So, is quite troublesome and quite confusing. Because like based on what you know you only know this this this… but there are many other things which you have to more specific and there is an answering technique. So all these other factors would actually make it quite difficult. (SI 4 R 69 – 73) |
| | Goal setting | … So when we have a goal to reach, like you want to get at least better result you may push yourself… (SI 5 R 61 – 63)<br>. |
| **Time** | Lack of Time | S3: Not enough time.<br>R: Yah, not enough time.<br>S2: Because the remaining hours just enough for us to complete our homework. Then after homework… already…<br>S1: Very tired<br>S2: yah (SI 6 R271 – 278) |
| | Time wasting | For example, we always walking up and down, and the time all spend on the walking. (SI 6 R260 – 261) |
| | Time to teach and learn | No enough visual or not enough detail explanation. Rushing to finish the syllabus ( SI 4 R 77)<br>Teacher rushing to finish the syllabus. No time to discuss… (SI 6 R 298)<br>Cannot study much in the group discussion. Because the time also short. (SI 6 R226 – 227) |
| | Last minute assignment | We need to complete the assignments within 2 weeks. When doing the assignment we don't have time to study, and doing homework or others. (SI 6 R 315 – 317)<br>Teacher always put at the last hour (SI 6 R305) |

The themes collapsed from the early coding were sent for the first round of peer review. First round of the peer review was conducted to validate the excerpts with the early codes and themes generated. In the first round of peer review, all the three peers agreed to the codes and themes generated from the excerpts. Hence, the second round of peer review with the same panellists was conducted to collapse the themes. Table 4.35 (P 120) shows some samples of the factors influencing SDLR and SDLeR.

In the second round of peer review, in-depth discussion and collaboration of ideas were conducted between the peers and the researcher. In the process, the peers finalized the themes. Some of the themes were collapsed to be one. For example the themes "parents' encouragement", "family", "communication with parents" and "friends and family" were collapsed/ reduced into the final themes of "family". Hence, with the in-depth discussion between the peers the finalized themes list was generated. This is shown in Table 4.36.

Table 4.36 *Peers Review Sample of Theme for One Factor Influencing the SDLR and SDLeR*

| **Original Themes** | **Peer 1** | **Peer 2** | **Peer 3** | **Final Themes** |
|---|---|---|---|---|
| **Parents' encouragement** | Family and friends Influence | Family and friends Support | parental involvement | Family |
| **Family** | Family and friends Influence | Family and friends Support | Family support | |
| **communication with parents** | Family and friends Influence | Family and friends Support | Communication skills | |
| **friends and family** | Family and friends Influence | Family and friends Support | Peers influence/pressure | |

From the second round of peer review, the themes were collapsed into final themes as suggested by the peers accordingly. These themes were then sent for the third round of peer review with the same group of peers. All peers agreed to the final themes in the third round. Hence, the themes were used as the factors influencing the SDLR and SDLeR.

### 4.9.3 Capture of constructive interactions

A similar process was used in the identification of constructive interactions from the qualitative data. The same group of peers were involved in the peer review rounds in identifying the constructive interactions.

Prior to identifying the interactions as constructive, numerous interactions were captured during the classroom observations. However, not all these interactions may be constructive. The interactions were considered as constructive only when it managed to engage the students or teachers to the lessons. The engagement can be in terms of emotional engagement, cognitive engagement or physical engagement. Table 4.37 shows some examples of interactions found during the classroom observations. The early codes for the types of interactions were obtained by triangulating the qualitative data from the observation field notes which was written based upon the classroom observations, and the photographs and the video recordings during the observations. These early codes were sent for peer reviews and the final themes emerged.

Consequently, the constructive interactions were identified based upon the interactions captured during classroom observations. The interactions which managed to engage students and teachers to the lessons were captured and recorded by triangulating the observation field notes and interview transcriptions.

Basically there were three types of engagements which were observed. First, was emotional engagement where attentiveness, laughter and happiness were observed on facial expression, or in the communications. Second, was cognitive engagement which could be inferred during question and answer and brainstorming sessions in class. Third was the physical engagement when active kinaesthetic involvement in class activities occurred when searching for answers from textbooks or other resources were conducted. Table 4.38 (p 124) shows the different engagements captured in the observations field notes. The final themes of engagements were consolidated with the peer reviews. The list of interactions observed during classroom observations can be found in Appendix XVI.

Table 4.37 *Examples of Interactions Between Teachers and Students During Classroom Observations*

| Final Themes | Explanations/Descriptions | Sample of Excerpts |
|---|---|---|
| **Encouragement** | Words like, good, good try, great, what do you think, can you explain more, were used in encouraging the students to participate in the conversation | Teacher kept giving encouragement to students' response… (Perak, TFN24 R35 – 36) |
| **Asking Question** | Teacher asked questions and students answer was the common practice in most of the observed classes. | A lot of questions were asked during lessons… (Kuala Lumpur, TFN4 R88 – 89) |
| **Guidance** | Teacher provided guidance verbally to help the student in completing the task given. | Hints will be given to help students in getting the answers (Kuala Lumpur, TFN3 R33 – 34) |
| **Calling names** | Teacher called out students to give answer to her questions | Teacher called out name to answer her questions.(Kuala Lumpur, TFN2 R39) |
| **Praising** | Teacher praising the students for their efforts, correct answers, and attempts | The whole class was enlightened while the teacher started praising the student for being able to answer the questions. (Kuala Lumpur, TFN7 R23 – 25) |
| **Discussion** | Teacher having discussion with students | Discussion happened among teacher and students very often. Teacher attended to each student well. (Kuala Lumpur, TFN6 R47 – 48) |
| **Private talk** | Teacher went to the student and have private talking to one particular student | Teacher answered the questions only to the particular student. Most of the students behind were left unattended. (Kuala Lumpur, TFN5 R41 – 42) |
| **Focus group teaching** | Teacher went to the group of students and guide the group in their assignment | Students working in pairs to conduct the presentation. Teacher is helping and guiding beside closely. (Selangor, TFN25 R89 – 90) |
| **Prohibition** | Teacher stopped the student interacting with each other | Teacher prohibited the students from talking… teacher instructed the students to seat apart from each other, to avoid copying and discussion. (Kuala Lumpur, TFN10 R34 – 36) |
| **Humiliation** | Teacher openly humiliated the students by using word like "Why you cannot understand this?" | Teacher raised her voice and humiliated the students for not able to master the concepts… (Kuala Lumpur, TFN8 R44 – 45) |

Table 4.38 *Types of Engagement Observed During Classroom Observations*

| Excerpts (audit trails) | Actions | Types of engagement |
|---|---|---|
| Students' names were mentioned when the teacher asking questions. Therefore, students were actively engaged and following her lessons. (Melaka, TFN23 R60 – 62) | Attentiveness / following lessons | Emotional/Physical |
| Students asked a lot of questions at the end of the lessons. (Melaka, TFN23 R68) | Asking questions | Cognitive / Physical |
| Whole class seemed happier and enlightened when teacher praise the students who answered the questions correctly. (Kuala Lumpur, TFN7 R23 – 25) | Seem happier / enlightened | Emotional |
| When students were conducting laboratory work, teacher was walking around to give guidance when necessary (Kuala Lumpur, TFN6 R46 – 47) | Conducting laboratory work | Physical / Cognitive |
| | Walking around to give guidance | Physical / Cognitive |

Table 4.39 *Sample of Themes for Constructive Interactions*

| Final Themes | Early codes | Excerpts from various data sources (audit trail) |
|---|---|---|
| **Calling names** | Calling names | Pn M called out students' name to answer questions (Kuala Lumpur, TFN 2 R39) |
| | Called out names | She gave some questions verbally and called out names of the students to give answers. (R 27 – 28)… in the 20th min teacher asking students to define "speciation". She called out names for the answers, and guided the students to refer to their textbook for the definition. (R 35 – 37)… in the 30th min, teacher gave an essay question. Teacher called out the students' names for answer. However, she gave guidance along the way while the student attempt to answer the question. (Selangor, TFN14 R 43 – 47) |
| | Called out students | Teacher kept referring to the students' name list to call out students. (Kelantan, TFN 20 R 80) |
| | Mentioned names | Students' names were mentioned when the teacher asking questions. Therefore, students were actively engaged and following her lesson. (Melaka, TFN 23 R 60 – 62) |
| **Encouragement** | Encourage | I encourage them to use the internet, because I use the internet as well. (Kuala Lumpur, TI2 R143 – 144) |
| | Encourage | Students were encouraged and confident to elaborate from their answer to make it more precise. (Kuala Lumpur, TFN2 R42 – 43) |
| | Encourage | So I actually encourage the student to go on internet and then get all the information. (Sabah, TI4 R72 – 73) |

After analysing the engagements, the analysis proceeded with the capture of the constructive interactions. Table 4.39 (p 124) shows the final themes for constructive interactions through triangulation of the observation field notes and the interview transcriptions.

The early codes for constructive interactions were sent for the first peer review with the three (3) peer review panellists. During the first peer review, the peers only looked into the excerpts with the early codes generated. In the first round, the peers agreed to the early codes generated from the excerpts. Hence, the researcher proceeded with the second round of peer review with the same group of peers. In the second round of peer review, the three (3) peer review panellists commented on early codes and give suggestions to collapse some early codes with similar themes. By looking at the excerpts provided, the peers collapsed some themes like "Mutual trust", "Collaboration", "Team working" were final themes of "Mutual trust". This was done because the peers believed that it was the best word to describe the condition reviewed in the actual situation based upon the transcripts. Hence, the researcher did the amendments accordingly. The third round of peer review was then carried out to finalize the themes for constructive interactions with the same group of peers. In the third round of peers review, all collapsed themes were given to the peers for comments. After the third round peers review, a list of the final themes for constructive interactions was generated. These final themes of constructive interactions were then used for further discussion about the influence of the constructive interactions on SDLR and SDLeR which is found in Chapter 6.

Figure 4.13 shown the process of qualitative data analysis carried out in this research. It shows how the themes were generated from various sources of qualitative data. The list of constructive interactions were generated and finalised with the three rounds of peer reviews by the same group of peers.

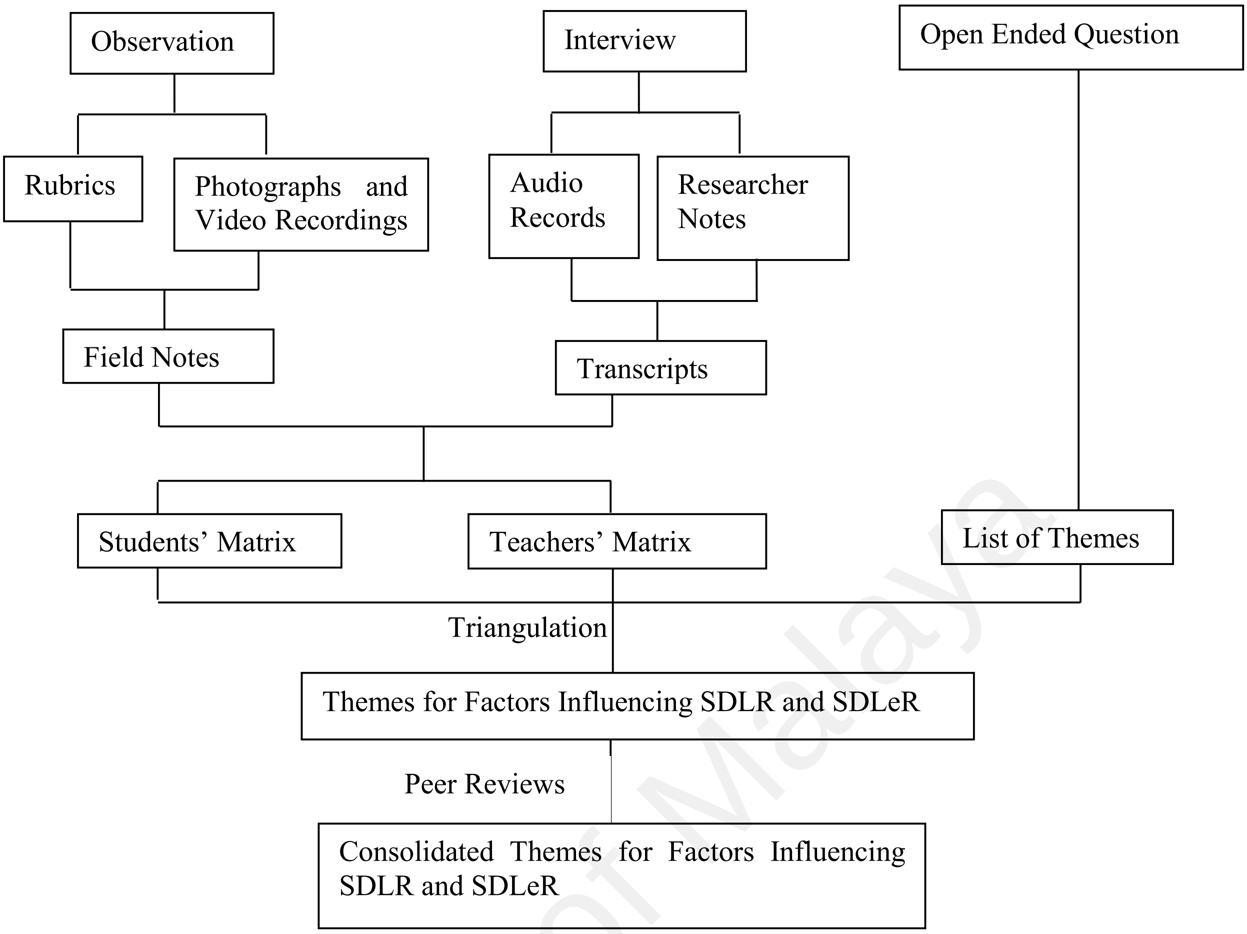



*Figure 4.13* Qualitative Data Analysis Flowchart

## 4.10 Chapter Summary

This research was conducted in three phases. It started with phase one (1) for the preparation of instruments used in this research. In this first phase the SDLRSbio and the SDLeRSbio were developed. Additionally, the PLSbio was adapted and the TSS was adopted for the use of the research and also the preparation of the interview protocols and the preparation of the observation protocols. A group of Delphi expert panellists was formed to validate the instruments used in this research.

The research then continued with phase two (2). The pilot study in phase two aimed to test out the feasibility of the research procedures. Some amendments were made to the procedures in order to conduct the research smoothly. For example, the classroom observations were conducted simultaneously with teachers and students. This was due to the researcher most of the time was not allowed to observe more than once by the teachers. The changes in the procedures helped in ensuring the accuracy and reliability of the data collection process, especially for the qualitative research data collection.

Following this, the research entered the third (3) phase, the actual study. The actual study was carried out according to the procedures developed during the pilot test. The quantitative data were collected nationwide in Malaysia. Meanwhile the qualitative data were collected from most of the states of Malaysia and was dependent upon the willingness of the teachers and students. Details of the research procedures are illustrated in Figure 4.14. This figure also shows how the research objectives and research questions were addressed as the research progressed.

With these research procedures the researcher carried out the research and collected the data for analysis. The complete results and discussion of the research is recorded in Chapters 5, 6, and 7.

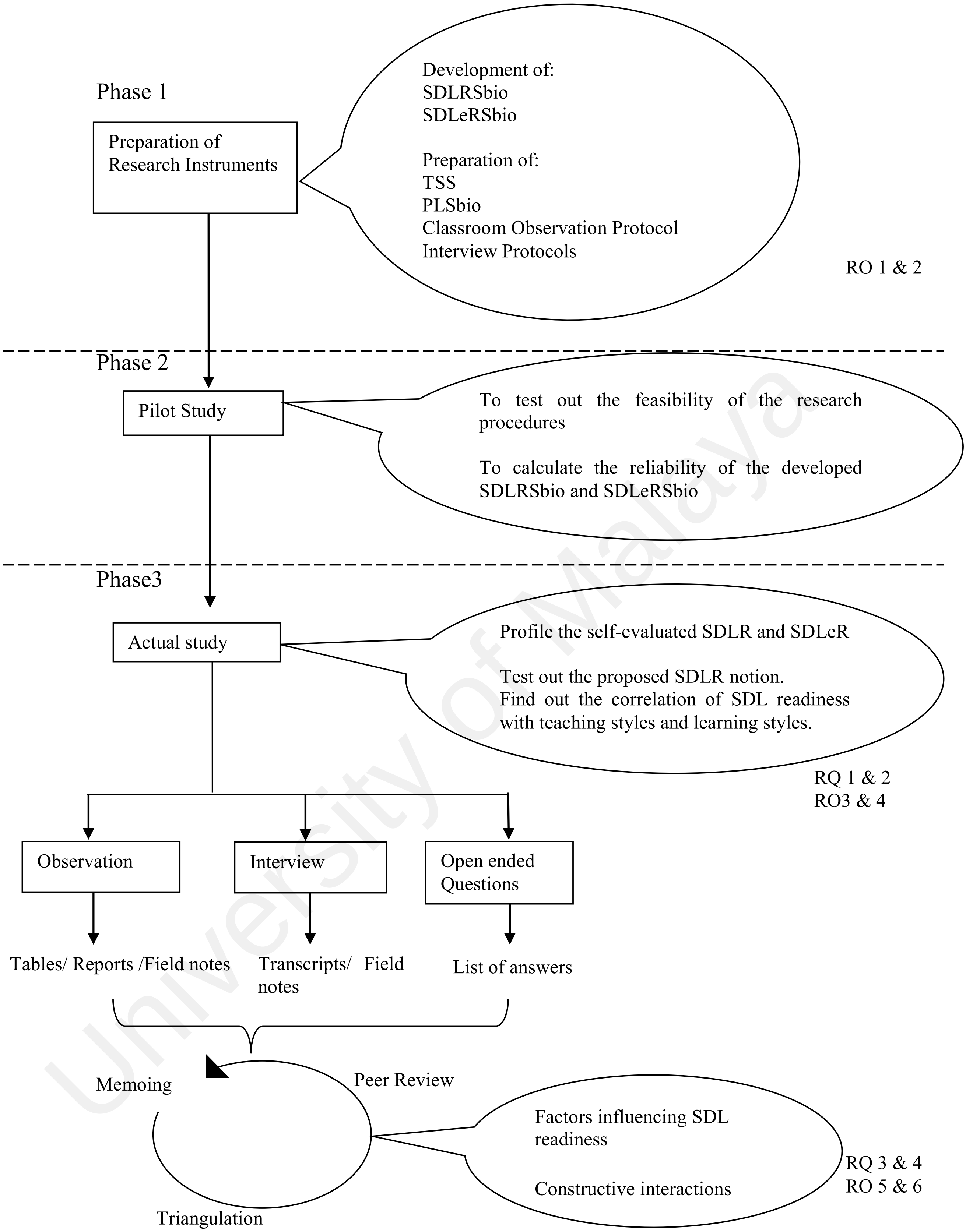



*Figure 4.14* Overall Research Procedures

# CHAPTER 5

# SELF DIRECTED LEARNING READINESS AMONG STPM BIOLOGY STUDENTS AND TEACHERS

## 5.1 Introduction

The present study set out to establish the self-assessed SDL readiness among STPM Biology students and teachers. Both the SDLRSbio and SDLeRSbio were used in rating the students and teachers SDL readiness. Self-directed learning readiness is essential as these pre-university students are actually being prepared for learning at a higher level once they complete their STPM examination successfully. Nevertheless, many students of Biology when they enter tertiary institutions find themselves in a dilemma as they may lack the relevant skills (Ozan et al., 2005; Pepper, 2010). How then is the profile of Malaysian STPM Biology students as they are being readied for SDL in the next level? How then is the profile of Malaysian STPM Biology teachers in their SDL readiness for lessons? This is what the first research question in the current study tries to answer. This section of the discussion answered research question one (1) and supported the first part of the proposed notion in saying that the SDL readiness is specific in skills and knowledge for a particular learning discipline.

This chapter focuses on profiling the self-assessed Self-Directed Learning Readiness (SDLR) among Malaysian STPM Biology students and the self-assessed Self-Directed Learning Lesson Readiness (SDLeR) among the Malaysian STPM Biology teachers. The data were collected from 586 students 55 teachers nationwide.

The analysis was done in three (3) steps. First, a general continuum was identified for SDLR and SDLeR where scores obtained by the students and teachers were plotted. Second, the continuum was divided into 4 categories. Thirdly, the domains of the readiness were analysed for each category. The profiles help us to understand the self-assessed readiness among teachers and students of STPM Biology as a whole in Malaysia.

### 5.2 Profile of STPM Biology students' self-assessed SDLR

The SDLRSbio was administered nationwide in Malaysia. Out of 648 distributed questionnaires 586 were collected back from the students. Among the returned questionnaires 35 were discarded. Thus, 551 questionnaires were used in the final analysis. The results were keyed in to the SPSS software version 20 for analysis manually by the researcher. The total score of each student for self-assessed readiness was calculated and was used to profile the level of readiness of the students.

Figure 5.1 (p 132) shows the profile of the nationwide sample of Malaysian STPM Biology students' self-assessed SDLR for Biology in a continuum. The self-assessed scores from the students ranged from 79 to 223. From the continuum, students' SDLR seems to be distributed from low readiness to high readiness with more students (79.3%) who self-assessed themselves at the "above average readiness" category.

The scores obtained from the SDLRSbio were further analysed to indicate the categories of readiness as shown in Table 5.1. Details of how the categories were identified are found in Chapter 4 (p 117). The categories of students' readiness were found to range from "Low readiness" to "High readiness". The distribution of readiness categories among the STPM Biology students was compared with the findings of Du (2012), Hendry and Ginns (2009) and Chu and Tsai (2009), who mentioned that each student has their own level of readiness towards SDL. Therefore, the results obtained for the present study showed that the STPM Biology students have their individual level of SDL readiness before they enter the universities.

This profile helps in understanding the STPM Biology students' SDL readiness at the pre-university level. It also provides an overview of the readiness of domains at each category of readiness which indicates that students need to master specific skills and knowledge when they are getting more readied for SDL.

Table 5.1 *STPM Biology Students' SDLR Categories*

| **Readiness (Readiness Score)** | **Categories of Readiness** | | | | **Total** |
|---|---|---|---|---|---|
| | **Low Readiness (46 – 92)** | **Average Readiness (93 – 138)** | **Above Average Readiness (139 – 184)** | **High Readiness (185 – 230)** | |
| **N** | 2 | 65 | 472 | 47 | 551 |
| **Percentage** | 0.4 | 11.7 | 79.3 | 8.6 | 100 |

Although the students' self-assessed readiness could be plotted along the continuum, about 79.3% of the students' scores fell in the category of "Above average readiness". Only a total of 12.1% of students' scores were in the categories of "Low readiness" and "Average readiness". This indicated that the majority of Malaysian STPM Biology students self-assessed themselves to be readied for SDL in Biology.

In Figure 5.1, the distribution of readiness for each domain is also shown. This distribution of readiness for each domain illustrates the mastery of different skills and knowledge in the different categories of readiness among the students. Generally in the low readiness category, the readiness of each domain was low. In the high readiness category the readiness of each domain was high. The distribution and mastery of the readiness of each domain will be discussed in more detail.

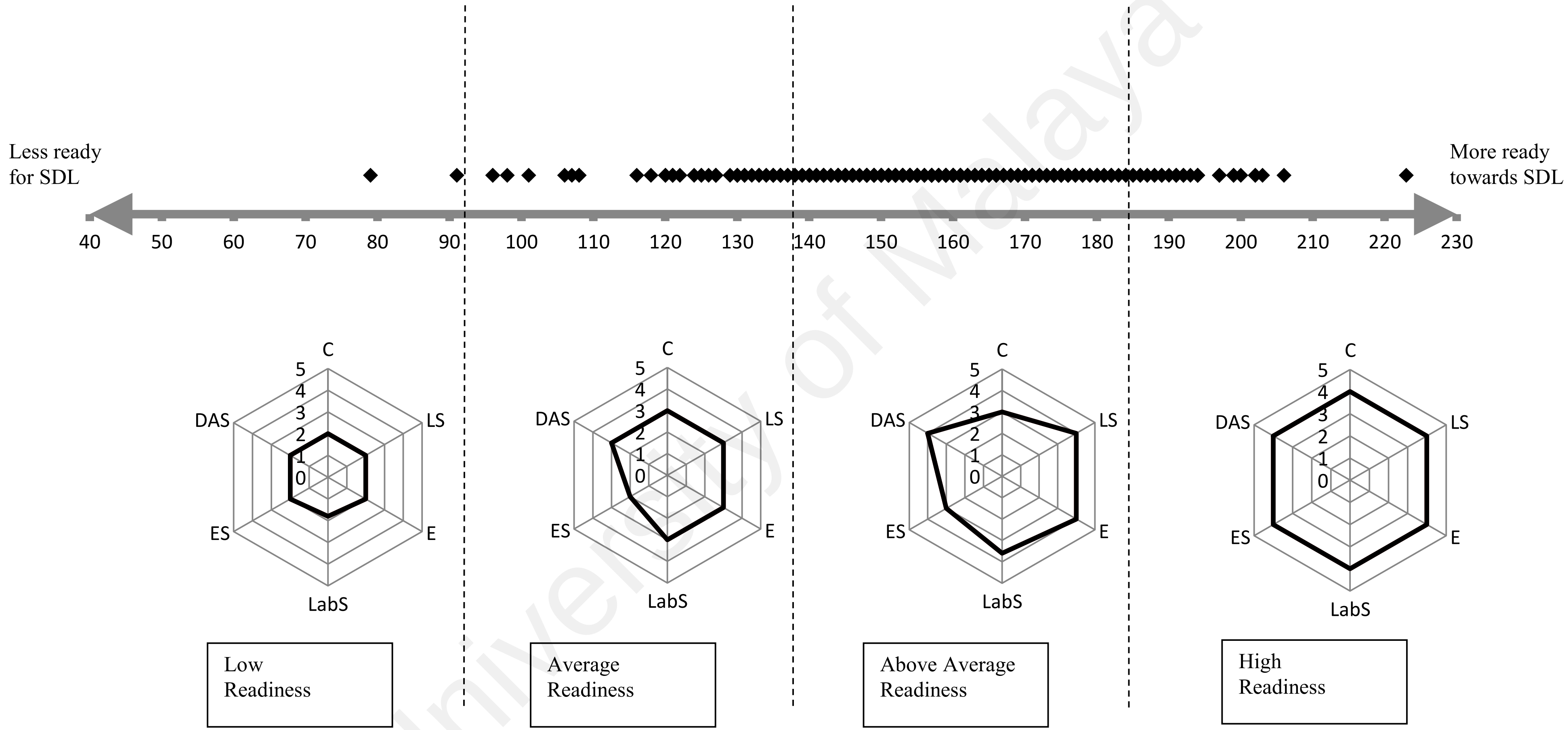



*Figure 5.1* Profile of STPM Biology Students' SDLR (n=571)

**Readiness of Domains**
C = Cognition
LS = Learning Skills
E = Emotional
LabS = Laboratory Skills
ES = Experimental Design Skills
DAS = Data Analysis Skills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### 5.2.1 Readiness of Domains in SDLR among STPM Biology Students

This section discusses about the distribution of readiness of domains among STPM Biology students within the different categories of SDLR. The domains were identified according to the constructs of SDLRSbio which was used in identifying the self-assessed SDLR among the students.

According to the SDLRSbio the domains were separated into two types of skills and knowledge which include the "General skills" which encompasses the "Biology Cognitive Readiness", "Biology Learning Skills Readiness" and "Emotional Readiness", and the "Biology Specific Skills and Knowledge" which include "LaboratorySkills", "Experimental Design Skills" and "Data Analysis and Interpretation Skills". As mentioned in the theoretical framework, SDL readiness needed to be specific to the subject. In this case it is the Biology context. According to Bloom's Taxonomy, readiness in SDL is reflected by a higher level of cognition and knowledge development. Hence, the students are expected to have better mastery of the readiness domains when they move from the lower categories of readiness to the higher categories of readiness. Figure 5.1 shows the distribution of readiness domains in different categories. The details of the distribution are discussed below.

#### 5.2.1.1 Low readiness Category

In this category, the median of the students' scores for each domain is 1 out of 5 in the 5 point Likert-Scale for every domain of readiness. This result can be taken to indicate that students in this category seemed to have low readiness in the mastery of learning skills, laboratory skills, experimental design skills and data analysis skills. In addition their domains of cognition and emotion also appear to be at a low level. As can be seen in Figure 5.1 very few (0.4%) students self-assessed themselves into this category.

However, the skills and knowledge increased gradually as the students' readiness categories increased. This is shown in the following categories of readiness.

#### 5.2.1.2 Average Readiness Category

When moving from the "low readiness" category to "average readiness" category the readiness for each domain seemed to increase. The results showed that students have a median of 2 in each domain except for the "experimental design skills" which still remained at 1. This seems to indicate that students at the average category of readiness may still lack readiness in the mastery of experimental design skills.

#### 5.2.1.3 Above Average Readiness Category

The readiness for each domain increased in the "Above average" category. The median of the score for SDLRSbio increased to 3 for the domains of "Cognition" and "Experimental Design Skills". Therefore, the readiness for these two domains have generally increased. The median for the domain of "Laboratory skills" increased to about 3.8. As for the domains of "Learning Skills", "Emotional" and "Data Analysis Skills" the median was 4.

This result seemed to indicate that the readiness for the six domains was slowly but surely increasing. From Figure 5.1, the majority of students are in this category.

#### 5.2.1.4 High Readiness Category

For the high readiness category it can be seen that readiness for all the six domains is high and balanced at a median of 4. This can be interpreted as the students in this category have most probably acquired readiness for the specific skills and knowledge for Biology.

A balanced readiness in all domains is needed as found by Dynan (2009), where, as the level of readiness increased for SDL, a balanced all round mastery of skills and higher knowledge domains is expected. According to the theoretical framework of this research, one is anticipated to have mastered the higher level of knowledge domains in Bloom's Taxonomy. The profile of students' readiness showed that the skills and knowledge were developing from general to specific as students moving along the readiness continuum. Hence, it seemed to support the notion proposed in the current study. Du (2012) also mentioned that students needed specific skills and competences to engage in SDL lessons. Hence, the notion proposed in this research saying that SDL readiness is specific to skills and knowledge one possesses for particular learning discipline is acceptable. The insight from the qualitative data will now be discussed.

## 5.3 Description of the readiness of domains

The readiness of domains recorded in the statistical form above was further complemented via discussion and analysis of the qualitative data. The qualitative data collected from interviews and classroom observations gave deeper insight of the domains. It helps us to have a better understanding of the actual readiness among the students.

The descriptions below show the challenges in different readiness of domains that the students face. This also explained how the students could be readied for the skills and knowledge involved in each domain in the real learning process.

### 5.3.1 Students' emotional readiness for SDLR

For "Emotional Readiness", the profile showed that students' score increased from in the range of two (2) as the mean value to four (4) along the continuum of students' SDL readiness.

Due to the decrease in intake for STPM Biology, most students were having lessons in small groups (only 2 to 5 students in a class). This condition appeared to have demotivated the students as shown in the excerpt below;

T1: In our school actually they *(students)* have no problem *(in getting readied for SDL)* because we have a lot of books and everything. In the library also we have a lot for the STPM students. But I think because they *(students)* become demoralized when they are in a small group like this *(currently only 2 students in the class, suppose to be 3. One was absent).* So when they are demoralized they feel like do not want to… lack of interest to start.

*(Kuala Lumpur, TI4 R34 - 40)*

Furthermore, some of the students were apparently "lazy" in their studies. As commented by some teachers during their interviews.

T5: … the students tend to be lazier compared to last time. Last time when we gave them group work, they will prepare and present. But over the years, when you give them group work, they don't prepare so well anymore…

*(Melaka, TI5 R5 - 10)*

This "laziness" phenomenon could possibly be the result of the tight schedule and heavy study load which the STPM Biology students face. Due to their tiredness, the students could possibly tend to be "lazy" when they reached home. Students' comments appeared to support what the teachers have said. For example;

S5: If for me, I think most possibly laziness. Cause sometimes when we reach home, we are all tired. So I would prefer skipping all the revision and just go for other entertainment. *(Johor, SI5 R42 - 44)*

This "laziness" emotion seemed to be the result of tiredness as mentioned in the previous section. When the students felt tired after school, they tend to withdraw themselves from any learning activities. This withdrawal was perceived as "lazy" by the students themselves and teachers apparently.

In other situations, some students needed much moral support and encouragement from family and friends. If this is lacking, the students seem to be demotivated to study. In other words, students seem to have difficulty in engaging emotionally with the lessons.

T5: It is all depends on their inner motivation… They have this inner motivation even from the start their parents already guide them instilled in them this type of motivation ... *(Kuala Lumpur, TI5 R60 - 62)*

Some students were emotionally not prepared for being at the STPM level. They were not aware of the changes that they would have to make when entering the STPM or pre-university level. This unpreparedness had caused them to be emotionally unprepared for the challenges they might face in the process of learning at the STPM or pre-university level. For example;

S6a: I think that because the students still maintained in SPM *(Form 5)* level. We still think we can attend tuition classes to cover the syllabus. What teacher taught will then come out in the examination. So we never really work hard to study or do revision everyday. Or do research ourselves. We just think that by finish reading the textbook then we can score in the examinations. *(Kuala Lumpur, SI6 R9 - 14)*

T5: The tendency is most students preferred not to do much work. They just want to come and listen to your delivery of knowledge. That's all. *(Melaka, TI5 R24 - 25)*

Therefore, despite the students' self-assessed emotional readiness being "Above average" in the actual learning process they seemed to lack being readied emotionally. From an emotional aspect our STPM Biology students lack preparation for the changes that they face in STPM. In order to have better SDL readiness among the students, preparing students emotional readiness might be crucial. This also explained the increase in "Emotional readiness" as profiled in the readiness of domains for "High readiness" category which is needed for students to be readied for SDL.

### 5.3.2 Students' Biology cognitive readiness for SDLR

In terms of Biology cognitive SDL readiness, the students seemed to have discontinuity of content knowledge from the Form 4 and 5 levels to the STPM level. Despite the self-assessed readiness students' cognitive readiness apparently gradually increase for the categories of readiness moving from low to high readiness. This helps in explaining the situation reported by past researchers, like Ozan et al. (2005) and Pepper (2010) about Malaysian students being incompetent in pursuing tertiary education.

This was captured from the interviews and classroom observations. From the excerpts recorded, students appeared to have difficulty in transferring their knowledge from Form 4 and Form 5 level to STPM (Form 6) level. Or rather they do not have sufficient basic knowledge of Biology to further study at pre-university level. For example, a student stated;

S4: I think another issue is because we do not really know the subject well. So based on what we have learned *(in Form 4 and Form 5)* coming here STPM *(Form 6)* is a bit blur. *(Kuala Lumpur, SI4 R68-69)*

R: What do you think you have learned in Form 4 and 5 for Biology?
S4: Aahh… in Form 4 and 5… they do help la. To certain extent to aid us in this thing *(learning Biology)*. But sometimes they go in like very details.
R: Very detail?
S4: In Form 6. So that's why it is quite blur. Certain terms, certain terminology, certain processes are different from what we learned in Form 4 and 5. And… I mean basically for other subjects too. You know, like certain wrong theories, or things which are too simplified *(in Form 4 and Form 5)*, which in STPM (Form 6) they are actually something different. So what happened is what we tend to like, sort of like eliminate some of the things that we learned in Form 4 and 5 and just absorb new things in Form 6.
R: That means you find that there is difference between Form4 and 5 Biology syllabi to STPM Biology syllabus?
S4: Yes. Like discontinue. *(Kuala Lumpur, SI4, R123 – 140)*

In addition, the concern of teachers about students being not able to transfer their content knowledge from Form 4 and Form 5 to STPM (Form 6) was also revealed in the interviews.

T4: The students don't understand, they are still like in Form 5 where they are provided everything (R82 – 83)… they don't know where to start… (R84)
*(Sabah, TI4 R82-83, R84)*

In terms of the level of cognitive readiness, teachers found that the students were getting weaker in their basic content compared to previous years. Teachers found that students were weak in their knowledge content, as shown below.

T2: I think the basic thing is the basic knowledge (R22)… Their *(students)* knowledge is not really that deep (R32)… the students are not ready, they are very weak (R219) *(Kuala Lumpur, TI2 R22, 32 and 219)*

T5: … The students are generally weaker … *(Melaka, TI5 R91)*

This gap in the cognitive readiness among students was obvious during classroom observation, as indicated below.

Teacher showed the stoichiometry equation on the board precisely while explaining it. *(the teacher wrote each and every chemical equations on the board).* Teacher also tried to link the concept learned in amino acids structure to the application. However, students were not able to relate. *(Students showed puzzled faces, and couldn't answer any questions that the teacher asked).* *(Kuala Lumpur, TFN8 R27 – 31)*

In the 65$^{th}$ minutes of the observation, students were unable to relate their knowledge of enzymes learned in Form 4 and Form 5 with the current lesson content. The teacher asked the question "How structures of enzyme influenced it's functions?". All students were quiet and none of them were able to answer the questions even when their names were called. The teacher was frustrated and raised her voice. However, she *(teacher)* repeated her point and tried to relate the concepts for the students. *(Selangor, TFN18 R66-72)*

Teacher did some cross disciplines links with chemistry when discussing the chemical structure of chloroplast. But students seemed not able to do the link themselves. *(The students' facial expression and body language showed that they did not understand)*
*(Selangor, TFN 19 R34-35)*

From the above excerpts, often during the observations, the researcher found that, teachers did the disciplinary linkage of knowledge between the educational levels. Meanwhile students were waiting for the teachers to provide answers for them to jot down in the notes. Obviously there were problems with the students in transferring their prior knowledge to a higher level of education. This phenomenon was observed during the classroom observations and interviews.

### 5.3.3 Students' Biology learning skills readiness for SDLR

The major skills of learning observed during classroom observations among the students were jotting notes, highlighting points on their reference books or textbooks, and questions and answers during lessons. Figure 5.2 shows a student sitting and jotting down notes as the teacher teaches.

This phenomenon occurred repeatedly during the classroom observations. Indeed the students also mentioned their actions in learning Biology during the interviews, as shown below.

*Figure 5.2* Note Taking

Note: Students basically sitting and listening to a teacher's lecture while referring to their textbooks and reference books. They jotted notes and highlighted points in their books

*(Selangor, TFN14 R31-33)*

S3: During teacher's teaching, I'll just jot down what teacher is teaching. For me, I'll jot down what I think is important. So that go back I can refresh back. Sometimes will write some short notes for myself *(Selangor, SI3 R19-21)*

Students started to jot down their own notes and also referred to their textbook and reference books when teacher explaining the facts. *(Kuala Lumpur, TFN3 R29-30)*

Apparently jotting down notes is one of the learning skills which the students developed in learning Biology. Besides jotting down notes, some students memorized the facts from textbooks and reference books as a skill to learn Biology.

S5: Actually that is not many ways besides memorizing so far. Because it is all words (R169)… Memorizing is the way, making notes is also will be fine. Making notes while reading the books. As for me, but sometime I'm lazy. So I just read the book better than making notes. *(Johor, SI5 R174-176)*

The data showed that students basically mastered the learning skills of jotting notes, listening to teachers' explanation, referring to textbooks and reference books, and also memorizing facts in learning Biology. Obviously, this had contributed to the SDLR among the STPM Biology students. While jotting down notes, the students can be said to be engaged physically with the lessons. Through the attentiveness showed by the student from Figure 5.2, and the way they jotted down the notes, students seemed to engage emotionally and physically with the lessons. These engagements are important in triggering the interest to learn during lessons. The students seemed to answer teachers' questions by making their own notes and completing their assignments when they were requested by the teachers during lessons.

Other learning skills were not observed during the classroom observations. This result supports the notion proposed that the students can be readied for SDL regardless of which learning styles they preferred. Hence, although most of the students being observed preferred to jot down notes, inactively sitting and listening to teachers' lectures, yet they can be readied for SDL as reflected from the self-assessed results from SDLRSbio.

### 5.3.4 Students' data analysis and interpreting skills readiness for SDLR

In terms of "Data analysis and interpreting skills", students tend to follow whatever the teachers instructed.

S4: I'll see how the teacher list down the objectives. Like how she explained each topic, so the same way I'll put my answer. So I am able to know this is what I'm supposed to do, so I'll just follow that steps. And then I'll just use those steps to answer la. *(Kuala Lumpur, SI4 R82-85)*

This might be due to the examination oriented mindset (please refer to p 229) for more detail). Indeed much of the learning processes of students were geared towards examination. Students pay too much attention to the marks obtained from each of their reports and their assignments according to the marking scheme.

During the observations, students basically showed that they can analyse and interpret the data by themselves. This is shown in Figure 5.3 and the excerpts below.

*Figure 5.3* Data Analysis and Interpretation Skills
Note: Students were referring to textbooks, reference books, charts, and samples found in the laboratory for more information in analysing and interpreting the data collected for insect preservation.
*(Kuala Lumpur, TFN11 R65-67)*

In another observation, students were analysing and interpreting the samples collected from the quadrat in group. This is shown in Figure 5.4. These data showed that students were able to analyse and interpret the data collected.

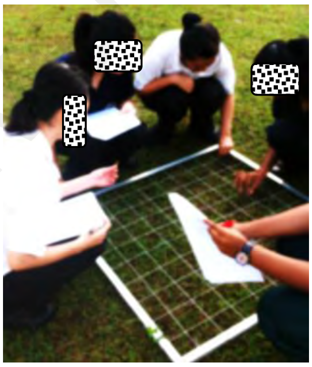


*Figure 5.4* Group Discussion
Note: Students having a group discussion on how to analyse and interpret the species they had collected.

However, during the observation, teachers were impatient to allow more time for students to do their own analysis and interpretation. During one of the classroom observations, one teacher asked questions and answered the questions herself when the students were not able to answer it in the first attempt. This was recorded as below.

Teacher asked a question, “What will happen if the environment changed to a stabilized population?” However, students seemed to have difficulty in answering the question.
T: Could you *(called out a student by name)* tell me what will happen?
S: *(kept quiet and shake his head)*
T: Well, none of you can give me the answer?
Immediately, the teacher gave answer to her own questions. All the students busy copying the answer given by the teacher. *(Kuala Lumpur, TFN7 R58-66)*

In some cases teachers actually did the analysis and interpretation for the students. The students were copying and following the teacher’s instruction to complete their work, as shown in the excerpts below.

15 minutes before the end of the lesson, teacher explained the laboratory work and showed the results of the work. Students were asked to copy the results as stated by the teachers. *(Kuala Lumpur, TFN6 R66-68)*

*(While asking the students to analyse the data collected)* The teacher drew a table on the whiteboard. Then she instructed the students to fill in their results to the table as compilation of the groups’ results. Teacher was dominating the process of combining and comparing the data from different groups.
T: Ok see what we have in the results from different groups. Please calculate the population like this *(teacher was using the data collected from each group to start calculating the population with the formula she wrote on the whiteboard)*
Students just acted according to her instructions. Students merely filling in their raw data to the table accordingly. Then they copied the data from the table to their handout. The students also copying the calculation as the teacher was showing the calculation.
(Selangor, TFN15 R35-39)

During the classroom observation, it was found that some students were able to analyse and interpret the data collected. However, in some cases, the teachers interfered with the marking scheme and the students’ ways in analysing and interpreting the data. Hence, students were somehow prohibited from doing the analysis and interpretation in their own way. This was what the researcher observed according to the data shown above.

### 5.3.5 Students' laboratory skills readiness for SDLR

From the interviews, students seemed to appreciate the laboratory sessions which they had gone through. Although they learned the techniques and methodology in conducting experiments, as yet they do not understand nor seem to realise the importance of all these skills and knowledge in pursing their study. Some students also think that the practical session did not help them in the examination.

S4: I think that practical is not that useful, because we cannot understand the theory also. Not that deeply la. Just like playing like that.
*(Kuala Lumpur, SI4 R349 – 351)*

R: Do you think it (practical) helps you in learning biology?
S6a: I don't think so… I mean the practical, the experiment also, just like we can learn the technique how to do it. Like preservation, we know how to preserve already. But then, because we usually just read preservation, we don't know how to *(do it in practical)*. But then, it didn't help us in… (S6c : memorizing the facts…) the examination. *(Kuala Lumpur, SI6 383 – 390)*

Despite the students apparently not appreciating the laboratory sessions, it is undeniable that they did learn much from the sessions. Students master the techniques and understand the concepts of Biology better with the help of the laboratory sessions, as shown below.

R: What do you think about the laboratory session you just had?
S6a: Ok lah.
R: Do you learn anything from it?
S6b: Yah learn all the techniques and methods.
S6a: Yah, we got learn the techniques. Because usually in Form 5, I also don't know why we did not do experiment that much. After coming to Form 6 we really do it ourselves. *(Kuala Lumpur, SI6 R371 – 382)*

Figure 5.5 and the excerpts below further illustrate the situation that students were emotionally attentive, cognitively active in learning, and physically working on the experiment which they were engaged to. The laboratory skills were mastered gradually.

*Figure 5.5* Laboratory Skills
Note: Students were conducting the experiment all by themselves. They appeared to master the skills gradually

Students were doing the preservation of insects all on their own. They handled the oven, the life samples, and laboratory apparatus for preservation all by themselves without the help of the teachers.
R: Do you know what you are doing? *(pointing to the insect specimen)*
S: Yes, I'm following the instruction written in the handout.
*(Kuala Lumpur, TFN11 R35 – 39)*

In the 40th min of the lesson, work *(fieldwork)* were in progress properly. Students were all well discipline and engaged to their work. Students seems to get better in mastering the technique of Quadrat sampling. They started to know how to count the sample…
R: How are you doing now?Better?
S1: Yah, I know what to count and what not to count in the quadrat.
S2: Teacher just came over and showed us the way just now.
*(Kuala Lumpur. TFN12 R39 – 46)*

However, in the interview students revealed that, they do not have enough opportunities to conduct laboratory work.

S6a: Usually in Form 5, I also don't know why we did not do experiment that much. After coming to Form 6 we really do it ourselves. But not all the time also.
*(Kuala Lumpur, SI6 R379 – 381)*

In one of the observations, the students' mastery of laboratory skills were observed where the students know that they need to clean up and put back their apparatus into the respective shelves and cupboards.

> Students were finishing the preservation experiment in groups and started cleaning up the laboratory without any instruction from the teacher.
>
> *(Kuala Lumpur, TFN11 R65 - 67)*

Students seemed to enjoy their laboratory sessions during the classroom observations. Therefore, in order to be readied for SDL in biology, mastery of laboratory skills is important. From the excerpts above, students seemed being more engaged to the lessons emotionally, physically, and cognitively when they were conducting the experiment, which could most probably help them in mastering the skills.

### 5.3.6 Students' experimental design skills readiness for SDLR

During the classroom observations not many teachers conducted experiments. Therefore this skill of experimental design was not easily observed. However, the researcher managed to get a group of students who actually did their own designed experiment while doing their work on insect preservation.

Figure 5.6 shows how students gathered together and discussed about designing their experiment out of their own initiative. One of the students voluntarily became the leader and delegated different duties to the members. The others were giving their input to the discussion as to how they could collect the samples and record the findings. Good team work was observed.

*Figure 5.6* Experimental Design Skills

Note: In the field, students were well disciplined and they knew what they were supposed to do with the quadrat. They spread themselves in the field and started their work immediately (R34-35)…some took up the leadership position initiatively to conduct the group work and distributing the task among the members. *(Kuala Lumpur, TFN12 R40-42)*

From the observation data collected, the researcher found that some students were readied and can design their experiment accordingly. However, in terms of teachers' readiness in allowing the students to develop their skills in designing their own experiment, the researcher found that it may not be satisfactory.

In some of observations the teacher actually demonstrated the experiment before the students were allowed to conduct the experiment. In this way, the teacher had directly interfered and could have probably prohibited the opportunity of students to develop their skills.

At the 10th minutes of the lesson, teacher started her lesson. She asked the students to come to her in group, as she would like to explain the experiment procedures to them in group. *(Kuala Lumpur, TFN10 R17-19)*

At one time a teacher actually instructed that the student must submit work which must be up to her expectation in order to get marks for the examination. She gave the instruction on how she wants the work to be, and students must adhere to her instructions in order to gain marks for the work, as given below.

At the 20th minutes, after the teacher's explanation, students went back to their place and complete their Dichotomous key. Meanwhile, teacher wrote on the whiteboard to show how the 'key' should be.

While writing on the board, teacher kept instructing "Please copy the "key" like this", "You must include these words in your "key" so that can get marks according to the marking scheme". *(Kuala Lumpur, TFN10 R27-32)*

These excerpts and photos show the actual situation of readiness of each of the domains among the students. As shown in the self-assessed readiness, about 79.3% of students rated themselves as "Above Average" in terms of SDL readiness. However, in the real situation students seemed to face many challenges in being readied for SDL.

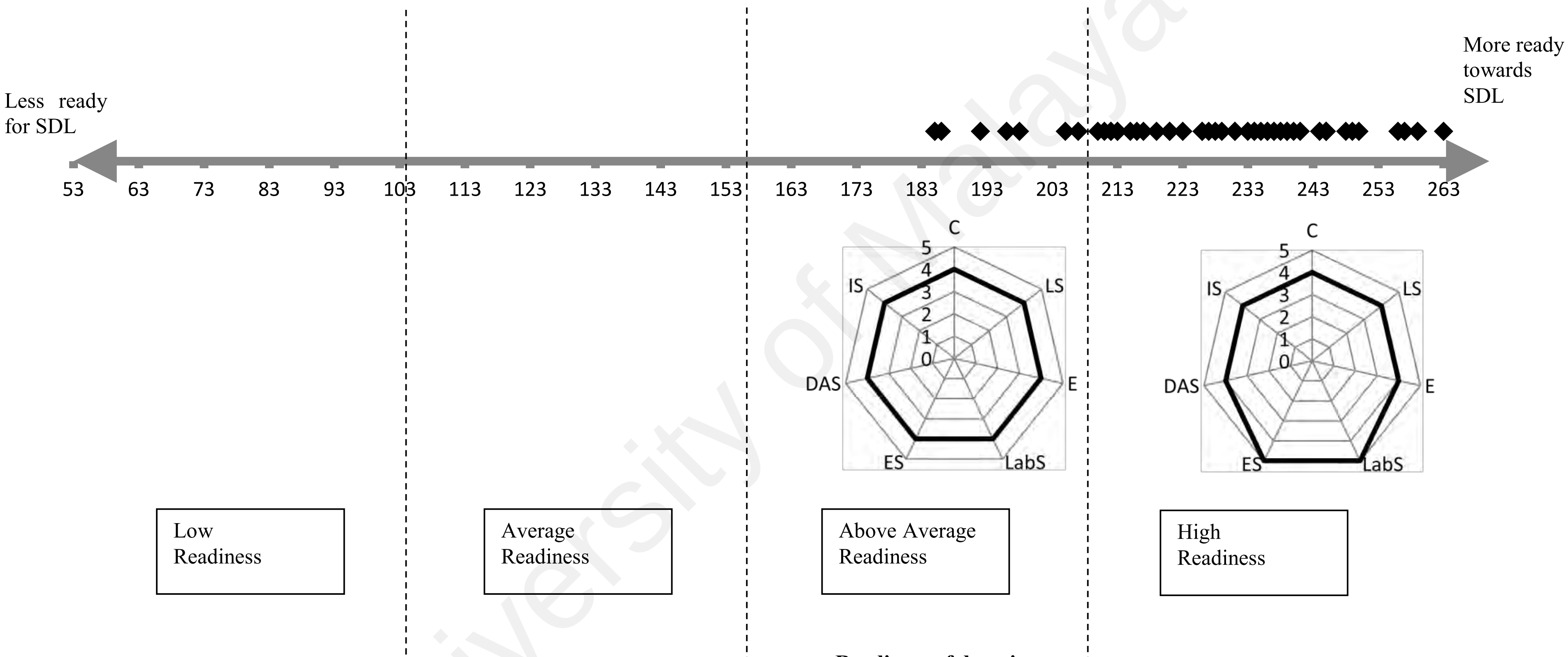
The analysis of the real situation in each domain gives us a clearer picture on how students get readied for the skills and knowledge in each domain. To master the skills and knowledge for each domain, the students need to engage with the lessons and make sense of their learning.

## 5.4 Profile of STPM Biology teachers' SDLeR

The SDLeRSbio was administered nationwide in Malaysia. There were 55 teachers who participated in the research. Data collected from SDLeRSbio was keyed in to the SPSS software version 20 for analysis. The total score of each teacher's self-assessed readiness was calculated and was used to profile each teacher's SDL readiness in a continuum. The continuum shows the profile of the nationwide sample of Malaysian STPM Biology teachers' SDLeR for Biology. The self-assessed scores from the teachers ranged from 185 – 263 (Figure 5.7). These scores obtained from the SDLeRSbio were further analysed to indicate the categories of readiness as shown in Table 5.2. This put the teachers' SDLeR in the categories of "Above average readiness" (21.8%) and "High readiness" (78.2%). This seemed to indicate that the majority of Malaysian STPM Biology teachers self-assessed themselves to be readied for SDL for Biology. None were found to be in the "Average Readiness" and the "Low Readiness" categories.

In Figure 5.7 (p 150), the distribution of readiness for each domain is also shown. This distribution of the readiness of each domain illustrates the mastery of different skills and knowledge at different categories of readiness among the teachers. Generally, teachers scored a median of 4 (out of 5 point Likert scale in SDLeRSbio) in every domain of readiness in the category of "Above average". The median value increased to 5 in the category of "High readiness". Each category will now be discussed in turn.

According to the results, teachers appear to be readied for SDL lessons in STPM Biology. Based upon the theory of this research, teachers are anticipated to be readied for SDL lessons in order to encourage the interactions during lessons to be constructive. As suggested in the concept of ZPD, students will go beyond their capabilities only when interacting with more capable adults or experts.




**Readiness of domainss**
C = Cognition
LS = Learning Skills
E = Emotional
LabS = Laboratory Skills
ES = Experimental Design Skills
DAS = Data Analysis and Interpretation Skills
IS = Interacting skills

*Figure 5.7* Profile of STPM Biology Teachers' SDLeR (n = 55)




150

Table 5.2 *STPM Biology Teachers' SDLeR Categories*

| Readiness (Readiness Score) | Categories of Readiness | | | | Total |
|---|---|---|---|---|---|
| | Low Readiness (53 – 106) | Average Readiness (107 – 159) | Above average Readiness (160 – 212) | High Readiness (213 – 265) | |
| **N** | 0 | 0 | 12 | 43 | 55 |
| **Percentage** | 0 | 0 | 21.8 | 78.2 | 100 |

### 5.4.1 Readiness of Domains in SDLeR among STPM Biology Teachers

This section discusses about the distribution of readiness of domains among STPM Biology teachers within different categories of SDLeR. The domains were identified according to the constructs of SDLeRSbio which was used in identifying the self-assessed SDLeR among the teachers.

According to the SDLeRSbio, the domains can be separated into two types of skills and knowledge which include the "General skills" that consists of the "Biology Cognitive Readiness", "Biology Learning Skills Readiness" and "Emotional Readiness", and the "Biology Specific Skills and Knowledge" that consists of the "Laboratory Skills", "Experimental Design Skills", "Data Analysis and Interpretation Skills" and "Interacting Skills".

As mentioned in the theoretical framework, SDL readiness needed to be specific to the subject. In this case it is the Biology context. According to Bloom's Taxonomy, readiness in SDL is reflected by the higher level of cognition and knowledge development. Hence, the teachers are expected to have better mastery of the readiness domains when they moving from lower categories of readiness to the higher categories of readiness.

Figure 5.7 (p 150) shows the distribution of readiness domains in different categories. The details of the distributions is discussed as below.

#### 5.4.1.1 Above Average Readiness Category

In this category of readiness, teachers were well readied with a median of 4 as an indicator of readiness for every domain. This indicates that, being readied for SDL lesson, the teachers needed to master both the "General skills readiness" (Cognitive readiness, Learning skills readiness, Emotional readiness) and the "Specific Biology skills readiness" (Laboratory skills, Experimental design skills, Data analysis and interpretation skills).

#### 5.4.1.2 High Readiness Category

In the high readiness category, the median score for the domains of "Experimental Design Skills" and "Laboratory Skills" increased to 5. This showed that, for teachers to be more readied for SDL lessons, teachers need to master the Specific Biology Skills, like the "Experimental Design skills" and "Laboratory skills". The notion proposed in this research suggested that the SDL readiness needed to be specific for the subject. Hence, the results showing teachers needed mastery of specific skills for Biology when reaching higher category in readiness indicating that the notion is acceptable.

## 5.5 Description of the readiness of domains

The above discussion gives the statistical profile of the teachers' SDLeR. Some further insight captured during classroom observations and interviews are discussed below. The statistical records for readiness of domains was further discussed and analysed with the qualitative data. This qualitative data collected from interviews and classroom observations provided deeper insight about the domains. It helps us to have a better understanding of the actual readiness among the teachers. The discussion below may not cover all the readiness of domains illustrated in the statistical profile, as the discussion discussed only the captured incidences which gives insight into the related readiness of domains.

The descriptions below show the actual situation and the challenges within the different readiness of domains that the teachers face. This also explained how the teachers get readied for the skills and knowledge involved in each domain in the real teaching processes.

### 5.5.1 Teachers' emotional readiness for SDLeR

During the interviews and classroom observations, it was found that there seems to be a strong sense of guilt among the teachers when they ask students to conduct some learning on their own. This was related to how SDL was perceived by teachers, as in the excerpt below. (Perceptions of SDL among teachers are recorded in Chapter 7 p 215)

T2: It is unfair for me to ask them *(students)* to read something which to them is very very hard (R138)… to me it is unfair, the students have other things in their life… to me is unfair. So pressurize them. Even now I give them a few topics *(to conduct self-study and do presentation later)* is pressurizing them… so is unfair…
*(Kuala Lumpur, TI2 R190 - 199)*

Meanwhile in some situations, teachers felt bad as they were not able to contribute in helping students to be better readied for SDL. This is because the teacher believed that he or she had prohibited the students' initiative in learning. The excerpt below indicates this.

T5: When I finished it *(the syllabus)*. I do a lot of examination questions and drill them that's all. So this one is actually also I know is not good. It is all the teachers' heart to drill them, but it is not from them. It is not from themselves. Where they do something and then they have question they come and ask. It is the other way you know. I am preparing the things for them to drill them give this give that. I actually prefer if they go and read a lot of books, they ask me over what they have read. That will show more of a SDL when they do a lot of drilling themselves. Actually we are sad to say we are actually preparing them for examination, so not teaching them these skills as SDL. *(Melaka, TI5 R106 - 114)*

However, some teachers were emotionally not prepared for changes in teaching pedagogy. This seemed to influence their SDLeR as can be seen in the excerpt below.

T3: That is only so much we can have. We get very frustrated. We are doing everything we can. We have been teaching the same… teachers have been teaching students for the last 20 years. With the same teaching style we could do so well before. And now with what we do, we find the students are not doing well anymore. *(Selangor, TI3 R236 - 239)*

Practicing the same pedagogy over the years and expecting the students to be equally excellent in their studies was a sign that the teachers were not ready in a changing world. As recorded in Halawah's (2011) findings, that teachers are challenged in embracing and coping with the changes brought by SDL. Hence, the emotional readiness for changes is very important for teachers to be readied for SDL lessons.

### 5.5.2 Teachers' Biology cognitive readiness for SDLeR

Teachers' cognitive readiness was observed during the classroom observations. It was reflected by the way and accuracy of teachers' responses towards students' questions.

In some observations, teaches showed mastery of the content knowledge by attending to students' questions promptly and precisely. For example;

Active interactions were observed between students and teachers.During the lesson, students kept asking questions, for example, "Teacher, why must we preserve the insect in this way?". The teacher always able to answer the questions and she also attended to students who came to her immediately. *(Kuala Lumpur, TFN10 R46-49)*

In another classroom observation, the teacher managed to link the content knowledge with science history. Hence, the students seemed very interested and engaged to the lesson.

The teacher was relating speciation to evolution and C.Darwin's work. She told the story of how Darwin travelled and found out the speciation and evolution concept. Students were all attentive and were excited to her teaching. *(The facial expression of teacher and students showed that they were enjoying the lesson) (Selangor, TFN14 R67-69)*

In some observations, when teachers did not handle the students' questions well, the students seemed to lose confidence in the teacher and became disengaged from the lessons. In this situation, most of the time, the students will sleep in the class. For example;

During the lesson, one of the students asked "is disulphide bond a single bond or double bonds?" Teacher I did not give answer immediately. Instead, Teacher I referring to the powerpoint slides which showing the disulphide bond of an amino acid and using the diagram to find out the answer for the student's question.

I: "You can see from the diagramme, the bond is here and the bond is formed with another amino acids" (*Apparently the teacher failed to answer the question. She was pointing to the diagramme and showing where the bonds were formed).*

The student who asked the question then slept on the bench without saying a word.

*(Kuala Lumpur, TFN9 R25 - 35)*

When the students cannot get answers for their questions, they seemed disappointed and choose to keep quiet and sleep through the lessons. In the same classroom observation with Teacher I, some other students did ask questions and were not getting any precise and solid answers from the teacher. The excerpts below showed the responses of the students.

In the 30th minute of the lesson another students asked a question, "what is the function of Alpha and Beta amino acids?". However, Teacher I did not able to give a solid answer to it. *(Some of the students were sleeping in the class, and some were chatting in their groups. Students seemed dismay during the lessons when teacher cannot provide them answers for their questions) (Kuala Lumpur, TFN9 R35 – 40)*

The situation became drastic when teacher I intentionally prohibited students from asking questions. The dismay and disappointment of students were observed from the students' reactions and facial expressions. As the lesson proceeded, teacher I continued to show low mastery of content knowledge. Students seemed to become disengaged from the lesson by sleeping through the lesson.

During the lessons teacher I kept asking questions, and expected the students to response to her questions. At one time, teacher I asked “What is a disulphide bond?”. When the student responded, “teacher, I actually don’t understand the text. What is it all about?”. Immediately teacher I rebuked “Cikgu Tanya you, you Tanya balik cikgu? Soalan simple macam ini pun you tak boleh jawab?” *(Teacher asked you, and you ask me back? Question simple as this you cannot answer?).* Student then set down and kept quiet. The whole class was in silence for a moment. *(Kuala Lumpur, TFN9 R41 – 48)*

A similar situation was recorded in an interview. The students sounded demotivated when they become aware that their teachers were not able to help them in their problems in the process of learning.

R: Did your teacher help to solve your problem *(problem found in learning biology)?*
S2: Actually no...
R: You mean your teacher didn’t help you to solve your problem?
S2: I asked her questions, she discussed with me. But the questions haven’t solved yet until now.
*R:* Why?
S2: Teacher said she don’t know. *(seemed annoyed from her tune and facial expression)* *(Sarawak, SI2 R43-50)*

As some teachers failed to answer the students’ questions, or to guide the students in getting the answers, the students seemed to be disengaged from the lessons. The students had low confidence in the teacher, they were not cognitively engaged with the teacher’s teaching, which in turn, seemed to influence their emotional engagement and physical engagement to the lessons. The excerpts in an observation recorded this.

S: What is the function of lipid? Why must it appeared in so many forms?
T: You can read it. Refer to the textbooks. You can also refer to the internet.
Student who asked the questions seemed shocked to hear the teacher’s answer. She turned to ask her friends for help. (R31 – 37). *(Few more students asked questions and the teacher did not able to answer the questions).* During the 20$^{th}$ minutes of the lesson, 2 girls started their own conversation at one corner of the classroom and some students were sleeping at their places. (R45 – 46)
*(Kuala Lumpur, TFN4 R31-37 and R45 – 46))*

In another observation, the students also seemed to lose their interest in learning when the teacher showed low mastery of content knowledge. This was recorded in the excerpt below.

Typos were found in the teaching slides, for example “nangroup” (as for “non-group”) and “genera” (as for “general”). At one time, teacher also named the animal wrongly and was corrected by students.
Teacher taught by reading from the slides. At one point of the lesson, some wrong concepts were given to students, for example “-ae” is referring to “family”. In the 50th minute of the lesson, only 4 students at the front row were still actively communicating with the teacher. The rest of the students were talking among themselves.
*(Kuala Lumpur, TFN5 R55-66)*

These observations about teachers’ cognitive readiness which were reflected in the way the teacher handled the students’ questions, the answers provided by the teachers to students’ questions, and the mastery of the content knowledge, revealed the importance of teachers’ readiness in engaging students to the lessons. Teachers being less readied in the domain of cognitive readiness seemed to disengage students from the lessons.

### 5.5.3 Teachers’ Biology learning skills readiness for SDLeR

In terms of Biology learning skills readiness, the teachers seemed to lack mastery in the usage of electronic devices like, computers, projectors and microphones. These are the learning skills which teachers need to master in order to be readied for SDL. Most of the time classes were delayed as the teacher spent much time to set up the electrical devices for the lessons.

Teacher entered to the classroom on time to set up the computer and LCD projector for the lesson. However, she was not able to do so, and need help from the student who came in later that time.… *(Kuala Lumpur, TFN5 R19-22)*
Teacher entered to the classroom on time to conduct the lesson. However, the class was yet delayed due to the setting up of the projector. The teacher did not manage to get the projector to function. At the end, the researcher was asked to help in fixing the problem by the teacher. Then lesson started. *(Selangor, TFN18 R23-26)*

During the classroom observation, the use of new electronic devices in teaching seemed to influence the smooth flow of the lesson, to the extent that some teachers requested help from the researcher to handle the devices.

In the 20mins of the lesson when the teacher started to used her audio-visual presentation for the lesson. The audio player was not functioning well. The teacher asked the researcher to help in fixing the problem. *(Selangor, TFN19 R21 – 24)*

In an era of digital technology where digital devices are essential in improving knowledge effectively, teachers need to grasp the use of technology in their pedagogical approaches. The study showed that many times teachers had problems in the use of digital devices to teach.

Teachers' readiness in learning skills appeared to "turn" students' attentiveness. Excerpts below indicate that learning skills of teachers can help students to be more attentive during lessons.

R: How do you prefer you teacher to teach you?
S2a: Honestly, when teacher read on the textbook I feel a bit boring…
S2b: Teacher should prepare some other material for us… (R22 – 23)
R: So you prefer your teacher to prepare some other material. What kind of material do you think is helpful?
S2b: Like extra notes, other than from the textbook. Like video.
R: The video will help a lot is it?
S2a: Ya
S2b: Ya (R31 – 35) *(Selangor, SI2 R22 – 23, R31 – 35)*

Similar comments were found in the interview with a teacher. Teachers thought that, mastery of new learning skills helps the students in understanding the Biology concepts better.

R: Besides questioning technique, what other method you used in attracting the students to your lesson?
T1: Sometimes if the lesson is too hard to understand then I'll show some video recordings and animations to let them *(students)* see how it actually happened.
*(Kuala Lumpur, TI1 R24 – 26)*

Indeed during the classroom observation, teachers were able to engage students to the lessons more effectively when the teacher was able to manage the electronic devices.

Teacher showed a video recording before ending the lesson for better understanding of the theories. The teacher gave explanation when the video recording was playing. Teacher is monitoring and controlling the flow of the video for better presentation and ensuring the understanding of the students. *(Students seemed to pay full attention again to the lesson.)* *(Selangor, TFN25 R131 – 136)*

In the literature review, Sail and Alavi (2010) noted that teachers need to polish up these technological skills and knowledge for effective teaching. Therefore the current data gives insight in understanding the challenge which the teachers would face when they engaged in SDL.

### 5.5.4 Teachers' Biology laboratory skills readiness for SDLeR

During the classroom observation, teachers' laboratory skills were observed when teachers demonstrated the experiments. The excepts below recorded the incidence.

Teacher J demonstrated the way to prepare microscope slides when she found out the students were not able to do so while monitoring students' work in their group.

J: Students, please come over to my place. I'll show you the slides preparation.

*(All students walked over to the teacher's bench. The teacher then demonstrated the way to prepared the slides)*

J: After putting the specimens onto the slides, you should put the cover slip slowly. Make sure no bubbles were trapped. Otherwise you have to remove the bubbles before you can observe the clear image.
Now, go back to your place and do it again.

After the demonstration, all students seemed to be able to prepare the slides by themselves and were very happy to be able to observe the image of the cells under the light microscope.

Sa : Wow! The cells are seen! Haha, very nice woh!

Sb : Ya, see mine! This is very interesting. Cuba lagi *(Let's try again).*

*(Kuala Lumpur, TFN6 R51 – 65)*

This incidence showed that teachers must first master the skills in order to give proper guidance to ensure development of students' skills and knowledge in learning biology. Students seemed to engage with the lesson when they can conduct the work given. Hence, the mastery of laboratory skills among the teachers in order to be able to provide guidance and teaching when it is needed is essential for being readied for SDL lessons.

### 5.5.5 Teachers' interacting skills readiness for SDLeR

In some of the interviews, students revealed that teachers were not interacting with them.

R: How do you find your interactions with your teacher?
S1: Teacher doesn't really have interaction with students. Usually she just goes on with the slides while teaching. *(SI1 R90 – 91)*

However, some teachers find it important to interact with students in order to ensure the students interest in the lessons. In an interview, one of the teacher also mentioned that interaction is a skill he needed to polish in order to attract the students' attention to his lesson.

R: What do you normally communicate with the students?
T1: Things related to the lessons. To keep them interested.
R: How do you find your interactions with your students?
T1: I think it is a skill I need to polish. It is important for me to attract their *(the students')* attention during lesson. *(Kuala Lumpur, TI1 R15 – 18)*

From the classroom observations and interviews, the researcher found that, teachers who are able to build a rapport through interacting with the students can keep the students more alert during the lessons.

R: How do you think your interactions with the students?

T3: It is an important way to make them *(students)* love the subject. I'll try to make them interested in the subject by asking them whether they understand or not, and try to make them interested. When they are interested they will tend to do it better. *(Selangor, TI3 R221 – 224)*

Teachers' interacting skills seemed to be a skill which can be used to attract students' interest during lessons. Hence, it is important for teachers to master the skill in interacting with the students to be more readied for SDL lessons.

## 5.6 Chapter Summary

This research has profiled the self-assessed SDLR among Malaysian STPM Biology students and the self-assessed SDLeR among the Malaysian STPM Biology teachers. These profiles help to illustrate the readiness of the different domains into different categories. Hence, it helps to display the readiness for easy understanding in planning and designing the Biology curriculum for pre-university level.

The profile showed that being readied for SDL needed mastery of Specific Biology skills like "Experimental Design skills" and "Laboratory skills" among both the students and teachers. This seemed to support the first part of the readiness notion proposed in this research which saying that SDL readiness is the specific skills and knowledge one possesses for particular subject. Hence, specific skills and knowledge for Biology need to be enhanced for one to be readied for SDL in Biology.

Furthermore Malaysian STPM Biology students and Malaysian STPM Biology teachers need to develop various domains of readiness in order to be readied for SDL and SDLeR. Many challenges or factors would influence the mastery of the readiness of these domains. This indicates that being readied for SDL, one needs not only being readied in terms of cognition, emotional, and physical aspects, but also metacognition for manipulating the skills and knowledge one possesses. This finding is comparable with Dynan's (2008) finding which stated that being readied for SDL one should possess skills and knowledge at a high level domain of knowledge in Bloom's Taxonomy.

# CHAPTER 6

# NOTION OF SDL READINESS AND CONSTRUCTIVE INTERACTIONS.

## 6.1 Introduction

This chapter of the thesis discusses the investigation of the second part of the proposed notion of SDL readiness. This part of the proposed notion was investigated with the three (3) working hypotheses of SDL readiness put forward by the current research. The first two (2) working hypotheses were examined by looking into the correlations between SDLR and learning styles and between SDLeR and teaching styles. These first two (2) working hypotheses suggested that the SDL readiness, which means both the students' Self-Directed Learning Readiness (SDLR) and teachers' Self-Directed Learning Lesson Readiness (SDLeR), shall be independent of learning styles and teaching styles. In other words, there should be no particular learning styles or teaching styles which contribute significantly to the SDL readiness or SDLeR.

Furthermore, the third hypothesis of the present research has suggested that constructive interactions contribute to the SDL readiness. Hence, this research aimed to explore more about and how the constructive interactions contribute to SDL readiness. Classroom observations were conducted to identify how constructive interactions occur during lessons. From the classroom observations the researcher has tried to describe the interactions which are constructive and to identify the characteristics of the constructive interactions.

The results of the study suggest that constructive interactions have the characteristics of engaging teachers and students to the lessons from cognitive, emotional and physical aspects. These engagements appear to trigger the interest to study and to teach the subject better which in turn influences the SDL readiness. Various interactions were identified during the classroom observations, and the researcher had identified those which contribute in engaging the teachers and students to the lessons.

## 6.2 Testing of the Proposed Notion with the Working Hypotheses

The current research proposed that SDL readiness is *"the specific skills and knowledge one possesses in setting and achieving the learning objectives with or without the help of others regardless of the learning styles and teaching styles"*. This proposed notion was further tested with three (3) working hypotheses in the research. This involved the study of the correlations between learning styles and SDLR, and the correlations between teaching styles and SDLeR. Lastly, the research proceeded to explore how constructive interactions during lessons contribute to the SDL readiness.

### 6.2.1 Correlations between learning styles and SDLR

The aim to identify the correlations between learning styles and SDLR was to find out if SDLR is independent from learning styles as proposed in the readiness notion in this research. In order to identify the learning styles of the STPM Biology students, the Preference of Learning Styles for Biology (PLSbio) was adapted from the Learning Styles Questionnaire (LSQ). Details of the adaptation process are recorded in Chapter 4 (p 84). This adapted PLSbio identified the STPM students' preference of learning styles for Biology.

From the data collected, each student seemed to learn in many different ways. In other words, the students had various types of learning styles. However, each of them have a dominant learning style in learning Biology. The result is showed in Figure 6.1.

Figure 6.1 shows the STPM Biology students' inclination of learning styles. From the data, "Reflector" was the most preferred learning style which was found among 30.8% of the sample. This seems to indicate that Malaysian STPM Biology students tend to learn through observation and description of processes better. "Activist" seemed to be the least preferred which was found among 18.7% of the sample. In other words, the Malaysian STPM Biology students do not appear to enjoy challenges and new experiences, seem not to like collaborating with others in role playing and assimilation, and tend not to make decisions intuitively as illustrated by the learning styles of “Activist”. Nevertheless, the distribution of learning styles preference shows that, Malaysian STPM Biology students have a range of learning styles in Biology. However, it is proposed in the first working hypothesis that there will probably be minimum variation between the learning styles in correlation with the students’ SDLR. It was also put forward that no particular learning style would be more significantly correlated with students’ SDLR.

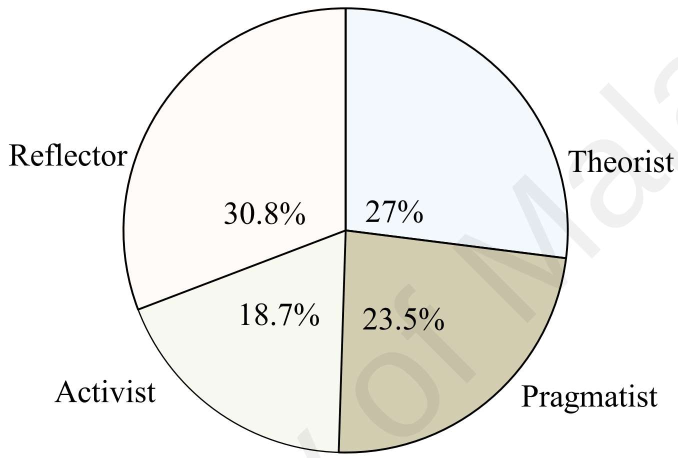



*Figure 6.1* Learning Styles of STPM Biology Students (n = 566)

In the analysis of the correlations, the researcher used the records of students’ learning styles preferences and correlated with their SDL readiness using Spearman Rho’s correlation using the SPSS software version 20. The result is shown in Table 6.1. According to Table 6.1, the correlations between SDLR and learning styles appeared weak. The readings of the correlations for all learning styles fell in the range of 0.2 – 0.4. The correlations which fall in this range are weak as indicated in Table 6.2. The correlation values of each learning style showed minimum variation with each other. This seems to indicate that there is no particular learning style indicated by the students, which is more significant in its correlations with the students’ SDLR. Thus, the first working hypothesis which anticipated that minimum variation in the correlation between SDLR and the different learning styles indicating that the students' SDLR is independent of the learning styles can be accepted.

Table 6.1 *Spearman's Rho Correlation of Students' SDLR and Learning Styles*

| | Theorist | Pragmatist | Activist | Reflector |
|---|---|---|---|---|
| **Correlation Coefficient** | .219** | .244** | .241** | .317** |
| **Sig. (2-tailed)** | .000 | .000 | .000 | .000 |
| **N** | 437 | 437 | 437 | 437 |

** Correlation is significant at the 0.01 level (2-tailed)

Table 6.2 *Correlation Strength with Spearman's Rho Correlations*

| R | Strength of Correlation |
|---|---|
| **0.0 – 0.2** | Very weak and negligible correlation |
| **0.2 – 0.4** | Weak correlation |
| **0.4 – 0.7** | Moderate correlation |
| **0.7 – 0.9** | Strong correlation |
| **0.9 – 1.0** | Very strong correlation |

Source: O'Neill, Hambley, Greidanus, MacDonnell, & Kline (2009)

### 6.2.2 Correlations between teaching styles and SDLeR

The aim to identify the correlations between teaching styles and SDLeR was to find out if SDLeR is independent of teaching styles as proposed in the readiness notion in this research. In order to identify the teaching styles of the STPM Biology students, the Teaching Style Survey (TSS) was adopted. The TSS can be found online at *longleaf.net/teachingstyle.html*.

From the data collected, each teacher seemed to teach in many different ways. In other words, the teachers had various types of teaching styles. However, each of them has a dominant teaching style in teaching Biology. The teaching styles among the Malaysian STPM Biology teachers were investigated with the TSS. Figure 6.2 shows the results of the teaching styles of STPM Biology teachers.

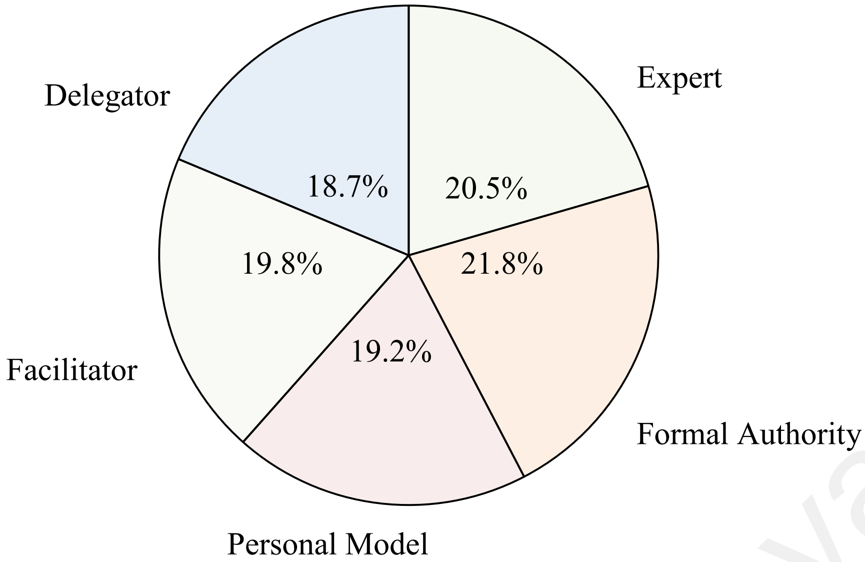


*Figure 6.2* Teaching Styles of STPM Biology Teacher (n= 42)

According to the results in Figure 6.2, there were no significant differences between the preferences of teaching styles among the teachers. However, from the data, “Formal Authority” style was found among 21.8% of the sample teachers. The least preferred teaching style was the “Delegator” which was found among 18.7% of the sample teachers. Fleet (2006) reported that most biology teachers tend to prefer more traditional autocratic teaching styles. This seemed to support the findings of the current research which showed that the teaching style “Formal Authority” involved teachers who have a standard way of doing things and provide the students with a structure they need to learn.

The correlations of SDLeR and teaching styles were calculated by using Spearman’s Rho correlation. Teacher’s SDLeR was measured with the SDLeRSbio and teachers’ teaching styles was measured with TSS. The results are as shown in Table 6.3.

Table 6.3 *Spearman’s Rho Correlation of SDLeR and Teaching Styles*

| | **Expert** | **Formal Authority** | **Personal Model** | **Facilitator** | **Delegator** |
|---|---|---|---|---|---|
| **Correlation Coefficient** | .591* | .508** | .569** | .606** | .480* |
| **Sig. (2-tailed)** | .000 | .001 | .000 | .000 | .001 |
| **N** | 42 | 42 | 42 | 42 | 42 |

** Correlation is significant at the 0.01 level (2-tailed)

According to Table 6.3 the correlations between teaching styles and SDLeR show moderate correlation. This result indicates that all the teaching styles had moderate correlations with the SDLeR and showed minimum variation with each other. In the constructivist theories' framework of this research, teachers are indeed anticipated as the guide for students to be readied for SDL. This view that teachers are a crucial element in helping students to become self-directed learners was also found in Finucane's (2009) and Neville's (1999) research. However, despite the moderate correlations found among the teaching styles and SDLeR, these correlations are almost the same between all the teaching styles. This result seems to support the notion proposed in this research, that SDL readiness is independent of teaching styles. The current research's results indicating that the SDL readiness is independent of the learning styles and teaching styles. Therefore, the proposed notion of SDL readiness is acceptable in which the SDL readiness is independent of learning styles and teaching styles.

### 6.2.3 Constructive interactions

The present study has thus far profiled SDLR among Malaysian STPM Biology students and SDLeR among Malaysian STPM Biology teachers nationwide. Furthermore, the findings seem to point to the fact that the readiness is independent of learning and teaching styles. This supports the first two (2) working hypotheses put forward in the study. Therefore, the current research proceeded with investigating the third working hypothesis on constructive interactions which is believed to be the contributory factor in SDL readiness among the students and teachers of STPM Biology.

In the current research, numerous interactions were observed during the lesson. In the classroom observations, the constructive interactions were identified when emotional engagement was captured as emotional expressions like happiness, attentiveness, and laughter were observed during the lessons; cognitive engagement was captured through actions like answering questions and contribution of ideas; and physical engagement was captured though actions like taking part in the class activities and searching for answers in books. These interactions were captured during the classroom observations through the researcher's observation notes, some photographs and videos which were recorded when consent was given. The researcher later transcribed the observations into expanded field notes for analysis.

The observation data indicate that teachers and students tend to engage in the lessons when constructive interactions occurred. These engagements appeared to create the interest to teach (for teachers) and learn (for students) which eventually could enhance the skills and knowledge (of the various readiness of domains already discussed in chapter 5) among the students and teachers specific for Biology. Hence, with better skills and knowledge it is believed that both the STPM Biology teachers and students could be more readied for SDL.

From the results of the current research, constructive interactions seem to occur during lessons in any teaching and learning environment (either student-centred or teacher-centred). Basically, these interactions give rise to three (3) types of engagements as stated earlier. However, these three types of engagements during lessons appeared not to be correlated to the teaching styles or learning styles. This is because the constructive interactions can take place in any learning and teaching environment as shown in the results of this research.

Apparently, what is important is that teachers need to create the opportunity for interactions and monitor the interaction to minimize meaningless interactions during lessons. Findings by Chakravarthi and Haleagajara (2010), Gurjeet, Navkiran, Cecilia and Bulik (2002) and Jiusto and DiBiasio (2006) showed that students were found to lack exposure to interactions in the various teaching and learning approaches. Hence, the findings of the present study supported the proposition that students and teachers should interact with each other in order to be readied for SDL and SDLeR as underpinned by the research's social-constructivist theoretical framework.

The classroom observations were conducted with 16 teachers. Five (5) out of the 16 teachers allowed the researcher to observe their lessons twice. There were 3 teachers who allowed the researcher to observe their lessons more than three times. As for the rest of the teachers, the researcher only managed to observe their lessons once. The themes of the interactions were emerged and have been discussed in Chapter 4 (p. 122).

Table 6.4 shows the types of interactions observed in both teacher-centred and student-centred learning environments. Although some of the interactions were captured only in a specific teaching and learning environment, however, it is believed that the interactions should occurred in the other teaching and learning environments too. Amongst the observed interactions some seemed to be non-constructive as they disengaged teachers and students from the lessons. The following discussions focused upon the types of interactions which are constructive, and how the interactions contributed to the readiness of SDL. Table 6.4 shows the overall observed interactions during the classroom observations.

Table 6.4 *Interactions Observed During Classroom Observations*

| **Teacher-centred Learning Environment** | **Student-centred Learning Environment** | **Examples of Excerpts (audit trail)** | **Descriptions** |
|---|---|---|---|
| Question and answer | Question and answer | Throughout the lesson, students raise many questions. Each question was attended by the teacher with respect. Teacher answered the questions seriously and helped the students to acquire the answers as much as possible. (Kuala Lumpur, TFN3 R65 – 68)<br><br>Teacher threw questions to the students and expecting the students to answer *(teacher got frustrated when students failed to answers the questions)*(Kuala Lumpur, TFN9 24 – 25) | This interaction most of the time is constructive, as it helped in engaging teachers and students to the lessons. Immediate and accurate responses from the teachers seemed to engage students more effectively to the lesson.<br><br>However, sometime the interaction will be non-constructive if the teachers did not give response to the students' answer in a positive manner or humiliated students when wrong answers were given. |
| Encouragement | Encouragement | Students were encouraged and confident to elaborate their answer to make it more precise. (Kuala Lumpur, TFN2 R42 – 43)<br><br>Teacher kept encouraging the student… (Perak, TFN24 R35) | Students generally being more engaged to their work when they felt encouraged. |
| Eye contact | - | Teacher asking questions in between of her lecture and students responded to her questions. (This was the main interaction observed between the students and teachers. Frequent eye-contact, which helped to keep the students attentive during lesson, were also observed).(Selangor, TFN19 R30 – 33)<br><br>Students were easily distracted by the appearance of the laboratory assistance although she was just walking at the side of the classroom. Apparently the students did not even have eye contact with the teacher. (Kelantan, TFN20 R58 – 62) | Eye contact between teachers and students helped the students to be more alert to the teachers' teaching. Hence being more engaged to the lessons. |
| Discussion | Discussion | There will be discussion among the group members whenever they faced difficulties in their work. (Kuala Lumpur, TFN12 R50 – 51) | Discussion between teacher and students or among students helped to engage teachers and students in the teaching and learning processes. |





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| Teacher-centred Learning Environment | Student-centred Learning Environment | Examples of Excerpts (audit trail) | Descriptions |
|---|---|---|---|
| | | Teacher mostly conducted discussion with the students during lesson. (Selangor, TFN18 R46 – 47) | |
| Mutual trust | Mutual trust | Teacher gave much freedom to the students in conducting their practical. Students were allowed to leave and enter the classroom freely in conducting their practical session… students behaving well and conducting their work with good discipline. (Kuala Lumpur, TFN11 R28 – 33)<br><br>Teacher gave her phone number to the students to call her when they have problem in conducting their work. The students did called to the teacher for help when they have problem. (TFN 12 R56 – 59) | Mutual trust among teachers and students were observed to contribute in students' confidence. Students seemed to be more confidence and more responsible in their work when teachers provided them with opportunities to conduct their work alone with trust. |
| - | Focus group teaching | Students were preparing the presentation in their groups respectively. Teacher gave some comments along the way. Teacher helped in enhancing the presentations by projecting some questions to the group. (Kelantan, TFN21 R23 – 25)<br><br>When students were conducting their work, teacher visited group by group to give instruction or guidance when it was needed. (Kuala Lumpur, TFN11 R23 – 26) | Teacher teaching small group of students seemed to engage that group of students to their learning process.<br><br>However, when teachers put too much focus on only one or two groups the rest of the class will be left unattended and seemed to be disengaged from the lessons. Non-constructive interactions will then being observed as students started to talk among themselves about other topics. |
| Guidance | Guidance | Teacher gave guidance along the way when the student attempted to answer the question… the students were busy writing down teacher's guided answers onto their notebooks or textbooks. (Selangor, TFN14 R44 – 46)<br><br>When students were conducting their work, teacher walking around to give guidance when necessary (Kuala Lumpur, TFN6 R46 – 47) | Proper and immediate guidance given by teachers contributed to engage students to the lessons. |





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| Teacher-centred Learning Environment | Student-centred Learning Environment | Examples of Excerpts (audit trail) | Descriptions |
|---|---|---|---|
| | | Teacher gave help and guidance to the students when needed (Selangor, TFN17 R50 – 51)<br><br>Teacher gave guidance along the way, while the students attempted to answer the questions. (Selangor, TFN 14 R 36 – 47) | |
| Calling names | - | Teacher always called out the names of the students to answer her questions. Therefore students were actively engaged and following her lesson. (Melaka, TFN23 R60 – 62)<br><br>In 30th minute, teacher gave an essay question and called out the students to provide the answer. (Selangor, TFN14 R27 – 43 – 45) | When names were called, students will be more engaged to the lessons and being more alert. |
| Praising | Praising | Teacher applause for the correct answers given by the students. This made the students being proud of themselves and being more encouraged and eager to be called for answering questions. (Kuala Lumpur, TFN3 R37 – 39)<br><br>When the student finished the drawing requested by the teacher, the teacher immediately started to teach with the diagram *(not even a word of "thanks")* (Kuala Lumpur, TFN4 R72 – 76) | Praising is one of the interactions which seemed to make students happier and delighted to work harder during lessons.<br><br>However, when students were not praised accordingly, they seemed to felt discourage and eventually disengaged to the lesson. |
| Demonstration | Demonstration | Teacher demonstrated the way of putting the cover slip in preparing the slide sample. *(Students seemed engaged to the lesson after the demonstration).* (Kuala Lumpur, TFN6 R51 – 52) | Teachers and students seemed to engage in lesson better when teacher demonstrated the experiments or laboratory work. |
| Appreciation | Appreciation | Teacher never fails in thanking the students from giving their point of views. (Kuala Lumpur, TFN3 R35 – 36) | Students seemed to be happier when they were appreciated by the teachers. Students apparently paid more attention during lessons. |



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| Teacher-centred Learning Environment | Student-centred Learning Environment | Examples of Excerpts (audit trail) | Descriptions |
|---|---|---|---|
| Warning | Warning | Teacher disregard the students' work and warned the students to follow instruction in providing another chart. (Kuala Lumpur, TFN10 R71 – 73) | Students seemed to be less happy when they were warned from doing things. Most of the time students ignored the teachers when they felt that they were threaten by the teachers in the warning. |
| Humiliation | - | Teacher raise her voice and humiliated the students for not able to master the concepts *(teacher said something like "how can you not know what you have learned?, "this is so easy and you all don't know?")* (Kuala Lumpur, TFN8 R42 – 45) | Teachers who humiliated the students seemed to have lesser students following her lesson. Students seemed to ignore the teacher most of the time.<br><br>When humiliation happened during lessons, the environment seemed to be tenser and lesser interactions happened during the session. |
| Challenge | Challenge | One of the student challenged the teacher and asked "is disulphide bond a single bond or a double bond?". The teacher seemed to be scared and couldn't able to provide an answer… The student who asked the question then leaned on the bench and slept without saying a word *(showing disrespect to the teacher)* (Kuala Lumpur, TFN9 R32 – 35) | Challenge that observed in this research seemed to destroy rapport between teacher and students. Hence, is non-constructive. |
| Prohibition | - | Teacher advised the students not to talk much during lesson, the reason given was they (students) will gain better grade if they talk less and pay more attention. (Kelantan, TFN20 R90 – 92)<br><br>Teacher scolded students from walking around and prohibiting them from communicating among each other. (Kuala Lumpur, TFN 10 R51 – 52) | Prohibiting students to interact apparently reducing the frequency of constructive interactions. Hence, this needed to be avoided if constructive interactions were to be encouraged during lessons. |



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#### 6.2.3.1 Interaction: Question and Answer

During the observations, lecturing interspersed with questions and answers was the most common teaching method the teachers applied in teaching STPM Biology. From the excerpts in one of the observations, it was clear that, the teacher dominated the lessons.

Teacher Z has continued talking for 25 minutes nonstop (R41)… Overall, the lesson was dominated by the teacher. She kept talking for 70 minutes nonstop… (R92 – 93)

*(Kuala Lumpur, TFN7 R41 and 92 – 93)*

As shown in Figure 6.3, teacher Z conducted the lesson in a very teacher centred manner. The researcher observed teacher Z‘s five lessons in the duration of one month. In all the five observed lessons, teacher Z dominated the lessons using lecture teaching styles. Figure 6.3 shows the typical situation during teacher Z’s lessons.

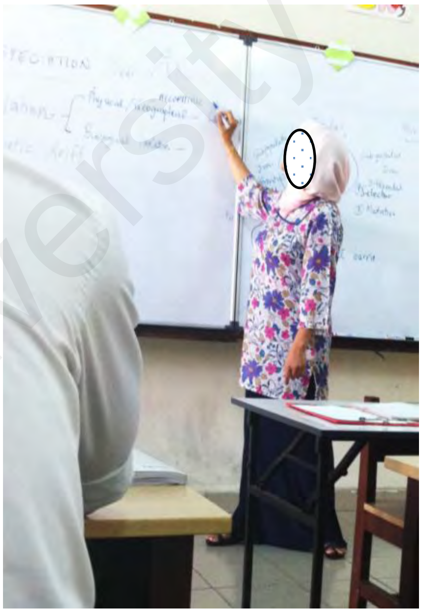

*Figure 6.3* Lecturing
Note:Teacher Z conducted her lessons by writing and drawing on the board. Students were mainly sitting back and jotting down notes or referring to their textbook

*(Melaka, TFN22 R27 – 28)*

During her lecture, teacher Z actively interacted with the students and involved the students in her lessons although the lessons was conducted in an “Expert”, “Formal authority” and “Personal Model” teaching styles as stated in the TSS (Grasha & Yangarber-Hicks, 2000). Students seemed to follow and enjoy the lesson as they were discussing about the questions asked by the teacher and as they responded to the teacher promptly. These interactions during question and answer seem to indicate that the students were cognitively and physically engaged in the lessons. This showed that constructive interactions through questions and answer can occur in a teacher-centred environment. The excerpt below shows that students were following the lesson.

Z: Hans, can you please read the text?
Hans: yes, *(he continue reading the paragraph as instructed)*
Z: Right! Please take note that the Dichotomous key lead to the organism at the end.

While the students developing their Dichotomous Key, teacher Z kept giving instructions and discussed about all the characteristics of the organism along the way *(teachers asked a lot of questions while the students were actively referring to their texts).* Students were referring to their books and discussing among themselves to build the Dichotomous Key.
*(Kuala Lumpur, TFN10 R27 – 34)*

Similar interactions were found in a student-centred environment which also contributed to the physical, emotional and cognitive engagements of students and teachers to the lessons. This incidence was observed in teacher K’s lesson. During the lesson, the students were presenting their assignments. Teacher K prompted a lot of questions during students’ presentation. This is shown in the excerpt below.

K: What do you think about the habitat?
Sa: The place would turned into empty. All animal are gone when trees gone.
K: Good! How to know that the animals are getting lesser?
Sb: Count their numbers.
K: How?
Sa: Quadrat?
K: How?
Sc: Like what we did. We use quadrat to count the number.
K: Maybe. How do you think quadrat can count the number of animal?

*(Teacher K kept prompting questions during the presentation until the students understood the concepts correctly).* The rest of the students (other than the three presenters) seemed to be paying attention to the conversations. They were actively jotting down notes and occasionally helped their friends to answer the questions prompted by the teacher. Very active interactions between teachers and students were observed in the sessions. *(Perak, TFN24 R29– 43)*

The incidences above showed that constructive interactions through questions and answers in the classroom helped engaging students and teachers with the lessons. These constructive interaction took place in both a teacher-centred environment and a student-centred environment.

#### 6.2.3.2 Interaction: Demonstration

Demonstrations seemed to be another way through which teachers interact constructively with the students. Figure 6.4 shows the situation observed as teacher Z was demonstrating the experiment. Teacher Z in Figure 6.4 conducted the laboratory session using the lecture approach. She demonstrated the experiment after after the students were called to front to observe the experiment. Students were excited and interested to know more and they kept going forward to the teacher while the teacher was demonstrating the experiment.

*Figure 6.4* Interaction Through Demonstration
Note: Teacher was demonstrating how the experiment should be conducted

In another observation with teacher J, she managed to conduct the laboratory session in a more student-centred manner. Teacher J instructed the students to observe the onion cells under the light microscope. During the laboratory session, students were conducting the experiment all by themselves with reference to the experiment handouts provided by the teacher.

At one time, teacher J needed to demonstrate the way to prepare the microscope slide for observation. After the demonstration, the students were able to conduct the experiment with more confidence. This incidence was recorded in the excerpt below.

J: After putting the specimens onto the slides, you should put the cover slip slowly. Make sure no bubbles were trapped. Otherwise you have to remove the bubbles before you can observe the clear image. Now, go back to your place and do it again.

After the demonstration, all students seemed to be able to prepare the slides by themselves and were very happy to be able to observe the image of the cells under the light microscope.

Sa : Wow! The cells are seen! Haha, very nice woh!

Sb : Ya, see mine! This is very interesting. Cuba lagi. *(Let's try another one.)*

*(Kuala Lumpur, TFN6 R57 – 65)*

The excerpts above seemed to indicate that demonstrations could engage students to the lessons. Both teacher Z and teacher J managed to engage the students to the lessons by demonstrating the experiment, although both of them conducted demonstration lesson with different teaching styles. These results indicate that constructive interaction through demonstration can occur in different teaching and learning environments.

### 6.2.3.3 Interaction: Encouragement

Encouragement given on time and accurately was another type of constructive interactions observed in the classroom. Upon receiving the encouragement, the students seemed emotionally happier and cognitively more alert to the lessons.

The excerpt below was taken from the observation of teacher K who conducted her lessons by asking students to make presentations. The excerpt show that the students were actively responding to her questions while they were presenting their work. With the teacher's encouragement the students seemed to be more active and more confident in providing their answers.

K: Very good! You got the answer!
Sg: Thank you teacher.
K: All of you please jot down the answer. It is important for you to know how to count the animals' population with the "catch-mark-release and catch again" method. Thank you Sg for given us the answer. Good job.
*(Teacher kept giving encouragement when students attempted to answer her questions. Although no names were mentioned, and sometime students gave wrong answers. The teacher often responded to the students' answers as "yes!", "yah, correct!", "good". Students seemed happier and more attentive to the lesson.) (Perak, TFN24 R35 – 39)*

In addition, students also showed physical and cognitive engagements to the lesson when they were encouraged to take part in the lesson. The excerpt below shows an incidence which the students were encouraged to participate in the learning process in a lecturing session conducted by teacher B.

B: Could you please tell me how the enzymes function?
Sa: It has specific sites.
B: Good! How does this specific site help in the functions?
*(The conversation continued with the teacher kept asking questions and students provide answers. Teacher kept encouraging the students to answer by calling different students by name and with words like "good", "thank you", :try again")*
Students were well guided to provide answers. Students were encouraged all the time to give their point of views, although it may not be accurate.
*(Kuala Lumpur, TFN2 R44 – 48)*

The incidence recorded above showed that with encouragement, students seemed to be engaged to the lessons and be more attentive during lessons. Interacting through giving encouragement was observed in different lessons where different teaching methods were practised. Hence, the constructive interactions through encouragement maybe considered independent of the teaching and learning environment.

### 6.2.3.4 Interaction: Eye contact

During the observations, eye contact was found to be another way which teacher Q used in interacting with her students to ensure their attentiveness. Figure 6,5 shows that teacher Q often looked at her students when she was lecturing. To do so, teacher Q, walked around and stayed close to the students all the while when she was lecturing. The eye contact she had with the students seemed to keep the students alert throughout her lesson.

*Figure 6.5* Teacher Interacting With Eye-contact.
Note: Figure 6.5 shows that teacher was having frequent eye contact with the students to ensure the students' attentiveness during her lesson.

With the eye contact that teacher Q had with the students, the students responded to her promptly whenever she asked questions. The students will either nod or shake their heads in response. However, verbal interactions between teachers and students were not frequent. Nevertheless, constructive interactions were obvious as the students were kept attentive and responsive to the teacher during the lessons. The incidence was recorded below.

After explaining the enzyme technology, the teacher took out a packet of flour to let the students touch it. She then proceeded to ask the students "How could this flour being made into sugar?". After that teacher Q looked at one of the student and the student stood up to answer her question. *(Selangor, TFN18 R32 – 37)*

In another observation with teacher H, students seemed less engaged when they had less eye-contact with the teacher. Teacher H conducted her lessons in a lecture style. She was positioned at the front of the classroom all the time, and kept a distance from the students. The students were observed to be attentive during the lesson. However, their participation during lessons seemed to be less. Both students and teachers had very minimum interactions during the lesson.

Figure 6.6 shown that teacher H lectured chalk and talk method in one of her lessons without even looking at the students. In this way, the students seemed to be less engaged to the lessons.

*Figure 6.6* Teacher H lecturing with chalk and talk
Note: While Teacher H was teaching, the two boys behind were talking among themselves. Another student was leaning on the table as shown in the photo on the left.

In another observation with teacher H, she conducted her lecture by sitting in front of the class as shown in Figure 6.7. Again, she had less eye contact with the students. In this observation, once again very minimum interactions were observed between the teacher and the students. The excerpts below illustrated the incidence.

*Figure 6.7* Lecture with powerpoint slides

Note:Teacher H was lecturing with powerpoint slides. She sat at her place all the time when she was teaching by managing the powerpoint slides. Very limited eye-contact with the students. Students were attentive at the beginning, and jotting notes at their textbooks and note books. Some were talking softly. (R29 – 33)… Students were very quiet but attentive (R41)… Most students were reading their textbooks without looking at the teacher at all. *(The researcher was not sure if they were paying attention to the teacher) (R54 – 55)*…Students did not even have eye-contact with the teacher. (R61) *(Kelantan, TFN20 R29 – 61)*

From the observations discussed above, eye contact with the students seemed to be a way to engage the students to lessons. Therefore, maintaining eye contact with students is a constructive interaction to engage both the teacher and student to the lesson.

#### 6.2.3.5 Interaction: Discussion

In some of the observations, teachers taught by initiating discussions with the students. In the observation with teacher M, he conducted a lesson in the form of a discussion. This is shown in Figure 6.8 and Figure 6.9.

During the lesson, teacher M was discussing the topic (transportation in plants) with the students. In the middle of his discussion, he always gave chances for the students to help him in explaining the topic further.

*Figure 6.8* Interacting Through Discussion

Note: Figure 6.8 shows that the teacher M had successfully created an environment conducive enough for the sharing of ideas among students and among teacher and students with discussion. This was conducted in a classroom setting

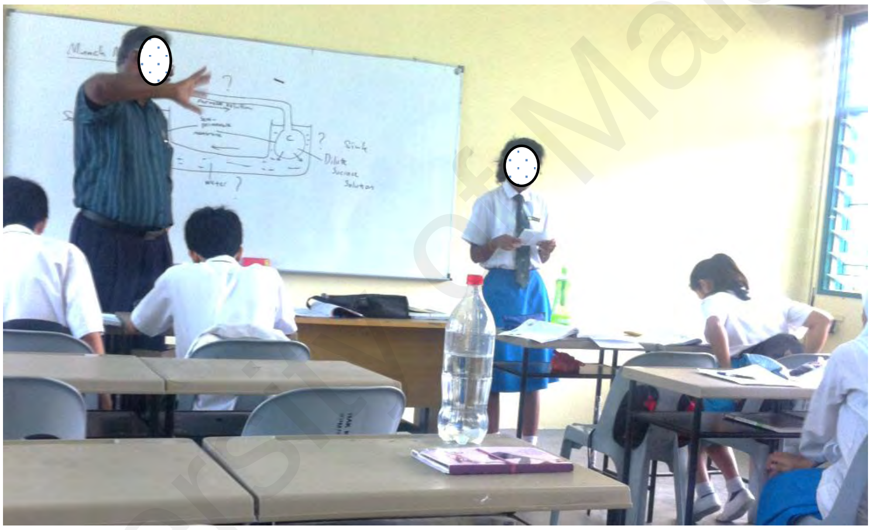

*Figure 6.9* Interaction of Teacher M and Students with discussion

Note: Figure 6.9 shows that the teacher M had successfully created an environment which encouraged interactions between teachers and students with discussion in a classroom setting.

The excerpts below show how the interactions took place during teacher M's teaching. During the lessons, the students responded to him and gave their opinion openly without fear.

Teacher M asked "How the plants transport water from the root to the shoot?". One of the student responded "through xylems", another student "xylems". Students were responding at their seats. The students were also actively referring to their textbooks and reference books for answers. Meanwhile some students were also discussing with each other. They were interacting to each other in a quiet way. Then one of the students answer

"With the xylems, and the water pressure created by the xylem, the water was transported up to the shoot.". *(Selangor, TFN25 R45 - 52)*

As they discussed about the topic, Teacher M gave many opportunities for the students to present their ideas in front of the class. The students seemed very happy as can be seen from their facial expressions as recorded in the excerpts below.

After presenting their ideas confidently, the student smiled and thanked the class for listening to him. The rest of the students were participative and attentive by asking a lot of questions. *(Selangor, TFN25 R119 - 120)*

Teacher M's lesson showed that discussion is one of the constructive interactions which could engage teachers and students to the lessons. This way of interaction can be conducted in a classroom situation with teacher dominating and directing the discussion.

However, in another observation of Teacher K, a similar discussion was also used in her teaching, but in a very student-centred manner. In the observation with teacher K, she had a classroom discussion. During the classroom observation, the researcher found that discussion was the interaction which helped teacher K to engage the students in the lessons. The students appeared to be very emotionally and cognitively engaged to the lesson as they were actively sharing their ideas and put forward various questions. Physical engagement also was observed when they actively searched for answers from their textbooks during their group discussion. The situation where Teacher K conducted a discussion with the students in one of the groups is shown in Figure 6.10. During the lesson, the students were grouped and conducted their own group discussion to find out the answers for the topic the teacher gave. After that, the teacher walked around the classroom and joined the group discussions.

*Figure 6.10* Group discussions

Note: The discussion was students dominating, they asked various of questions and the teacher answered them. “Teacher K, why should be calculate the population with this?”, “Why the quadrat only used with the plants? Can we used it with the small animals which not running fast?”. “You may refer to the textbooks and read what the text says.”. With the instruction from Teacher K, one of the group member said “Teacher, we had referred to the books, but could not find the answers”. “try harder, what do you think the limitation of the quadrat would be?”.. *(the discussion goes on with Teacher K leading the students to get their answers. Which the students were actively asking questions and referring to the references they had to find out their answers). (Perak, TFN24 R27 – 33)*

By having constructive interactions like discussions, the teachers and students seemed to engage cognitively, physically and emotionally to the lessons. More active interactions could take place when the discussion involved both teachers and students providing their ideas. This could take place in both situations where either the teachers dominate the discussion or the students dominate the discussion. The importance of discussion is that everyone has the opportunity to give their ideas and to learn.

**6.2.3.6 Interaction: Mutual trust**

During the classroom observations, the researcher found that, in most of the situations, the students and teachers had developed some kind of teaching and learning pattern which reflected collaboration and teamwork among themselves. This is believed to be a form of mutual trust between the teachers and the students.

The mutual trust observed during classroom observation between teachers and students seemed to engage both parties in the lessons. The teacher seemed to trust the students in conducting their learning diligently, while the students trusted the teacher in preparing for the lessons and to provide guidance when needed.

During Teacher J's lesson, she seemed to trust her students in conducting their insect collection in the field without her supervision. Meanwhile, she continued to conduct the lesson with the other students who stayed back in the laboratory to preserve the insects in the laboratory. Students were working in groups and going in and out of the laboratory. Everyone in the class seemed working together as a team trusting each other. The students seemed very active and carried out their experiments full of initiative.

Teacher J instructed the students to collect the insect samples. "Students, please go collect your samples like what we discussed yesterday. I'm sure you are big enough and will do your work properly in the field. Please come back to the lab, and I'll be here to help others in preserving them.". After the teachers' instruction, the boys all went out to the field and collect the insects while left the girls in the lab to preserve what they have had got yesterday. *(Kuala Lumpur, TFN11 R28 - 32)*

In another observation with Teacher J during field work, she also seemed to allow her students to work in the field all by themselves. Figure 6.11 below shows Teacher J going from group to group in the field to help her students when the students needed her. The students also seemed to trust that the teacher would attend to them as and when they need help.

*Figure 6.11* Interaction with Mutual Trust
Note: In the 45th minute in the field, the students in one group telephone called teacher J *(Since the students were scattered around the field, the researcher decided to stick to one group during the observations).* Teacehr J then came to the group in 5 minutes after received the phone call *(Teacher J was at the other corner of the field with another group of students while she received the call. She was walking on the field to provide helps when the students called her)* *(Kuala Lumpur, TFN12 R63 – 65)*

Additionally, this kind of mutual trust between teachers and students was also observed when there was a form of pattern which both the teachers and students developed. For examples;

Students entering laboratory in groups lead by the teacher.
(Kuala Lumpur, TFN6 R20)

Teacher setup all the electronic devices and readied for the lessons which waiting for the students to enter the laboratory *(Selangor, TFN19 R14 – 15)*

Teacher entered to the class on time. All students were well prepared and readied for the lesson. *(Melaka, TFN22 R18 – 29)*

In the observations, most of the time, students will line up outside the classroom before the teacher arrives; teachers will setup the electronic devices before the commencement of lessons; Students will be at their particular seats and jotted down notes automatically without teacher giving instructions. These seemed to be some mutual trust among the teachers and students which contributed to the engagement in the lessons. The students and teachers seemed to have developed a pattern of how the lessons should be conducted. This pattern was one of the trust between both parties when the lessons were in progress. Hence, trusting each other is one form of interaction which is constructive as it helped both the teachers and the students to engage in the process of teaching and learning.

#### 6.2.3.7 Interaction: Focus group teaching

Observations also indicated that, interaction through focus group teaching was constructive and engaged the students and teachers to the lessons. During Teacher J's lessons, the students were also frequently interacting with each other to find ways to complete their assignments in their respective groups. A lot of interaction occurred during the lessons conducted by Teacher J in the field *(During the observation, Teacher J conducted a insects collection session at the school field)*. Students were very much physically engaged during the lessons in collecting the insects, and emotionally enjoying the lessons with laughter and excitement. Cognitively the students were kept busy with how they could catch the insects, as well as analysing and recording the characteristics of the insects. Emotionally the students were engaged as they were happy and excited while collecting the insects.

The following excerpt shown that students were emotionally engaged with the lessons. The students seemed to be excited and happy with their work in catching the butterfly.

Student A "We should get that butterfly! It looks pretty with the wings colour", Student B " Yah!, HAHA! I want that too!" They were totally engaged to their work. *(Students were all working together and interacting happily with each other in group).*

*(Kuala Lumpur, TFN12 R39 – 40)*

Cognitive engagement was observed when students were frequently sharing their ideas and asking questions. Physical engagement was observed when students were actively collecting samples and recording their work in the field.

The students worked closely within their group. One was elected as the leader and leads the group to work harder.

Sk: I think we should now go to the shaded place", Student M, "Yes, I think we can get more insects there. Let's go!"

Sm: Yah, I think we can get more insects there.

Sb: Let me finish the record first. Can you guys help giving some characteristics on this insects? 2 more (characteristics) to write. *(While pointing to the grasshopper she had in the jar)* *(Kuala Lumpur, TFN12 R68 – 74)*

In another observation with Teacher B, students seemed to be engaged physically to the lesson as she helped the students in their group presentation.

B: Can you discuss more about your findings? How do you know the change of habitats would cause the speciation?

Sa: Ok, teacher. But how? Do we need to present the whole story of speciation?

B: Well, I think at least you have to let us know how speciation takes place. What do you think?

Sc: So we tell how the speciation take place in different condition?

*(Students were preparing the presentation in their groups respectively. Teacher gave some comments along the way. Teacher helped in enhancing the presentations by having group discussion with the students on their presentation).*

*(Kelantan, TFN21 R23 – 26)*

According to the theory of social-constructivism, students and teachers need to have social interaction which helps them to develop their learning and teaching goals. The focus group interactions seemed to contribute to the engagement of teachers and students in the lessons.

#### 6.2.3.8 Interaction: Guidance

In the observation with Teacher F, she was conducting a lecture then proceeded with an experiment. During her lesson she kept giving instructions while her students were conducting the experiment after her lecture.

F: Students you must now get the chemicals provided on the table. Read the label and see which one you should use to preserve the plants. Not all chemicals can be used to preserve the plant.
*(Students doing their plant preservation by following teachers instructions)*
F: And now, please close the jar tight. You must make sure it is not leaking.
F: Now, proceed to do the same for the other. I'll go to your place and see later.
*(Teacher gave instructions and helps to the students when needed. Not much of verbal communication but guidance was adequate. Students seemed to be engage to the experiment as they follow the teachers' instructions.)* The students were conducting the experiment as instructed. *(Selangor, TFN17 R50 – 54)*

A similar situation was observed in Teacher E's class. Teacher E conducted a teacher-centred lecture session in which close guidance was also provided to the students. Students seemed to obtain the answers for the questions and appeared contented with the teachers' guidance and help.

*(Teacher E gave guidance along the way when the student attempted to answer the question. While the students stood up to answer the question, the teacher kept giving hints to guide the students in answering the question).*
E: How does the enzyme binds to to substrate? J what do you think?
J: Teacher, it is the active sites which they binds.
E: Very Good! How about why they (enzyme and substrate) are specific?
J: The bonds formed are specific. The bonds between the enzymes and the substrate are specific
The other students were busy writing down teacher's guided answers onto their notebooks or textbooks. *(Selangor, TFN14 R44 – 47)*

Similar interactions were also observed in a student-centred classroom where students were doing group work in the field to collect insect specimens. Teacher J walked to the students who were conducting the experiment and gave guidance along the way. This is captured in the excerpt below. .

The groups made phone call to the teachers when they need help, and the teacher J went to them for help.

J: How was it?
Sn: Teacher, how do we record this? *(pointing to the insects)*
J: What characteristics you want to record?
Sn: What are the characteristics which we need to record?
*(Teacher J continued to give more guidance to the record of the characteristics to the group).* *(Kuala Lumpur, TFN12 R34 – 38)*

According to Vygotsky's concept of ZPD, students will enhance their skills and knowledge when they have proper guidance. Hence, this result seemed to fit into the theory of the current research. The results showed that the occurrence of constructive interactions is not confined to any type of teaching and learning environments. As was discussed above, guidance can be given when Teacher E was conducting her lecture and experiment in a laboratory in a teacher-centred lesson. Guidance can also be given by Teacher J when she was conducting her lesson in the field in a student-centred lesson.

From the classroom observations, the researcher found that constructive interactions can take place through any form of teaching style or learning style. This indicates that the SDL readiness is most probably independent of learning styles and teaching styles. It also indicates that constructive interactions contribute to SDLR and SDLeR. This is because the interactions observed contributed in engaging the teachers and students to the lessons.

The engagements in turn trigger the teachers' interest in the teaching process and trigger the students' interest in the learning process. This interest appears to help teachers and students to acquire the skills and knowledge for the teaching and learning of Biology. Hence, students and teachers will be more SDL readied. In other words, the constructive interactions during lessons appear to influence the SDL readiness among students and teachers. Based on the results, the working hypothesis three (3) which stated that the constructive interactions contribute to the SDL readiness seems acceptable.

As put forward by the theoretical framework, if the teaching and learning environment provides vast opportunities for constructive interactions, students and teachers can be readied for SDL. The above discussion has demonstrated that whether the environment is teacher-centred or student-centred, constructive interactions offer the scaffolding necessary for teaching and learning as stated in Vygotsky's social constructivist theory.

Since, the results appeared to support the assertion that constructive interactions influencing SDL readiness, it is also necessary to understand how these constructive interactions contribute to SDLR and SDLeR. In the following section of this chapter the researcher attempts to answer the research question 3 (b); *how do the identified constructive contribute to SDL readiness*?

**6.3 Constructive Interactions: How does it contribute to SDL readiness?**

In this section, the researcher analysed and interpreted how the identified interactions contribute to SDL readiness. In the early section of this chapter, it was stated that constructive interactions helped engage students and teachers to the lessons. This was supported by Kek and Huijser's (2011) findings that SDL readiness is influenced by the engagement in classroom activities. The current study further explains the findings of Carolinda and Morris (2014) engagement to learning and teaching process. These engagements (cognitive, emotional, and physical) appear to be increasing the interest of the students and teachers in pursuing their learning and teaching processes. It is these interests being triggered by constructive interactions which most probably contribute to the acquisition and development of skills and knowledge which helps the students and teachers be SDL readied.

### 6.3.1 Acquisition and development of skills and knowledge through engagements

As the students engage themselves in the lessons, they seemed to master the skills and knowledge needed for the lessons. This mastery of skills was also observed when they interacted with each other. The excerpts below show that students gradually master the skills and knowledge needed as they engage to the lessons.

Students were preserving the insects all by themselves. They gradually mastered the skills to handle the oven, life samples, and laboratory apparatus for preservation…
*(Kuala Lumpur, TFN11,R35 – 37)*

J: How now? Counted the number?
Sg: Yes, got it! *(smiling at the teacher)*
*(Students seemed to get better in mastering the technique of Quadrat sampling. They started to know how to count the sample)* *(Kuala Lumpur, TFN12 R45 – 46)*

In one of the interviews with Teacher B, he mentioned that by making the students interested in the lesson, the students would be assisted in mastering the skills and knowledge needed.

R: As a teacher, how do you help your students to develop their skills and knowledgee for SDL?
B: Make it interesting at their level. Start them at the topic they are interested enough. They will then learn by themselves. *(Selangor, TI3 R332 – 336)*

Therefore, it appears that interest created for learning is vital in ensuring the development of skills and knowledge of students in Biology. Kek and Huijser (2011) stated that students should engage in the learning through active participation in the lessons in order to be SDL readied. Hence, when students are engaged physically to the lessons by conducting practical or actively searching for information during the lessons, they will be able to acquire the skills and knowledge to pursue the subject better (Liu, 2005).

Similarly, when teachers engage with the lesson, they will have the interest and passion to enhance their skills and knowledge to teach.

F: I felt that I have to do a lot of reading first then only I can explain. If not very difficult for me to explain. (R169 – 171) … I think the thing *(SDL)* is suppose to come from your own heart, right? You must be interested (R207)
*(Sabah, TI4 R169 – 171 and 207)*

T: When I found a problem during my teaching, I'll try to improve myself for the next lessons I must enjoy the lessons first. *(Kuala Lumpur, TI1 R36 – 37)*

When the students are more engaged to the lessons, and teachers seem more engaged to teach, this seems to contribute to the SDLeR of the teachers.

T: When I see the students were not readied for study that day, I try to get them ready by telling them some stories related to the lesson. Then the students seemed happier. Then I'll start my lessons. *(Kuala Lumpur, TI1 R116 – 118)*

The result seems to fit into the theoretical framework of this research where the acquisition of skills and knowledge is spirally built up upon the existing knowledge as suggested by Brunner. The students and teachers as they engaged in the lessons, with the current skills and knowledge they have, their interest was most probably triggered. This could have led to the development of new skills and knowledge which they needed to pursue learning or teaching. How could constructive interactions trigger interest? This is discussed in the following section.

#### 6.3.1.1 How: Providing immediate responses

An immediate response seemed to contribute in creating the interest of teachers and students to the lessons. Students seemed to grasp the concepts and ideas much faster when teachers responded to their questions and doubts immediately and professionally.

Furthermore, immediate responses from the peers also seemed to contribute to trigger the interest in learning.

In the observations of Teacher K's lessons, she managed to provide immediate response to the students during their presentations. Teacher K's responses seemed to help the students to grasp the concepts of "population size". This is shown in the incidence recorded below.

K: Now how do you count the number of the population? Could you please show us on the board?
Sb: Ok, teacher. Let's see how it is… *(showing the calculation on the board)*
*(As the students were presenting, their classmates pay full attention and gave support to the presenters by clapping their hands, or by asking questions. Teacher K asked questions when she needed more explanation, or when the students were not getting the correct concepts. Her interruption during the presentation had helped the students in gaining better understanding of the topic to both the presenters and the audience).*
*(Perak, TFN24 R44 – 52)*

A similar situation was also observed in Teacher D's class. She gave immediate response which appeared to help the students to carry out their presentations better and to learn more.

D: Good presentation. Students do you know how the speciation occurred?
*(The students noted their heads)*
S6: Yes, thank you teacher. My group now knew that we have to notice about the environmental changes which caused the adaptation of the animals.
S8: The food supply changes too.
S5: More la… We need to look at the soil quality too.
D: Good, there are many things we have to look into. Go ahead and continue your presentation.
*(the other students were jotting their notes while the presenting group members were answering teachers' questions).*
*(The teacher's comments and feedbacks during and after each presentation helped the students (both the presenters and the audiences) to understand the topic better).*
*(Kelantan, TFN21 R35 – 41)*

In the above situation when the presenting students had the immediate feedback from their peers and teacher, they seemed to be interested in their presentations. The other students also started to jot down notes in their books as the teacher interrupted and gave short explanations during the presentations.

In another observation with Teacher M, after his lecture he gave some short assignment handouts to the students. Once the students completed the assignments, Teacher M marked the work immediately and called the students to him for further explanation of the assignment.

Teacher immediately marking students' assignments and give feedbacks when students completed the work given in the handout.
M: K please come over. *(After marking K's paper Teacher M called him out to him)*
K: Yes, teacher? *(K walked to his teacher)*
*(Teacher M then gave personal guidance and explaining the assignments to M. He helped him by pointing out his mistakes and showing him how to answer the questions)*
(Selangor, TFN25 R144 – 148)

In another observation, the teacher gave immediate response as the students read from the text.

*(While Student 2 was reading the text as instructed by teacher E, Teacher E would interrupt her reading and highlighted some keywords along the way. Teacher E also gave explanation to the text while Student 2 was reading to the class)*
E: Yes, please highlight the word "mutual consumerism". This is important when the organism interacting with each other in the habitats.
*(Students highlighted the word on their text while Student 2 continued reading the text)*
E: Well, the text said the organisms would interact with each others. Yes, they are interacting when they need food, mate… *(Teacher E continued her explanation. Meanwhile the students were busy jotting notes at their textbooks.)*
*(Selangor, TFN14 R72 – 74)*

In Teacher E's lessons, the students were more alert as they took note of the key words. Some of them even came to the teacher and asked questions later towards the end of the lesson when Teacher E gave them short assignments. This immediate response from the teacher helped the students to take note of the content learned and appeared to increase interest.

Teacher Q and Teacher T provided explanations while showing a video clip to the students during their class. Students seemed more interested and appeared to understand better when the teacher explained the video.

*(In this lesson the teacher showing a video of enzyme mobilization. Student P suddenly asked a question).*
Sp: What was it on the video? Which is the enzyme and which is the substrate?
Based upon this question, Teacher Q gave some explanation along the way as the video presentation is on. Teacher Q explained how the enzyme immobilization worked with the animation of the video. Students were quiet, jotting notes, and nodding their head.
*(Selangor, TFN18 R40 – 44)*

*(While watching the animation of enzyme immobilization, the students were actively discussing among themselves and started to ask a few questions.)*
S5: How the enzyme entered to the block? What is the block?
S6: That is the immobilizer; it can be anything which can hold the enzymes.
S4: How the enzyme entered? How the enzyme entered and binds with the substrate?
*(Students kept interacting with each others as Teacher T showing the animation of hormone reaction).*
T: Please look at the immorbilizer's biding sites…
*(Meanwhile, Teacher T tried to explain the process when the video was continuing. He responded to the students' questions immediately with the help of the animation from the video he showed).* *(Terengganu, TFN26 R26 – 35)*

Students seemed to understand the content much faster when the teacher gave prompt responses or explanations during the lessons. As the teacher explained the animation, the students also interacted with each other to have a better understanding of the video content.

The above incidences show that immediate responses in constructive interaction appear to help the students and teachers to engage in the lessons which in turn increase interest to proceed with the teaching and learning processes.

**6.3.1.2 How: Providing accurate responses**

When teachers gave accurate responses to the students, the students seemed to be more focused in their work. In Teacher D's lessons, she corrected the students' presentation immediately and requested the students to do their corrections immediately which seemed to help the students in understanding the topic better.

D: S5 please take note that your group had missed out the discussion of human interruption on the balance of the ecosystem. And also the concept of speciation, please rewrite it as what I showed you just now.
S5: Ok, we will submit the report next week. Thank you teacher.
*(At the end of the students' presentation, teacher highlighted the missing information, and corrected some misconceptions students made.)* *(Kelantan, TFN21 R42 – 44)*

A similar situation was observed in Teacher Z's class. Teacher Z responded to her students accurately and helped the students to understand the topic better during her lecture.

Z: How would I know if the plant cells in growing?
Sd: Measuring it size.
Z: Good! How?
Sd: Like we observed under the microscope, then we measure.
Z: Yes, very good. *(Teacher continue to show how the measurement of cells in done with the microscope on the board)*
Students started to jot down notes as the teacher explaining the way to measure the cells.
*(Kuala Lumpur, TFN8 R68 – 73)*

In Teacher B's lessons, the students found it encouraging when teacher B gave them accurate response.

B: Very Good! Sf, you are right. Could you please proceed to tell us more?
Sf: I think that, the protein structures contributed to its function because… *(S7 continued to explain his idea)*
*(Teacher B's accurate and encouraging responses seemed to encouraged Sf in developing his idea.)* *(Kuala Lumpur, TFN2 R64 – 66)*

When teachers responded to the students accurately, the students seemed to be more engaged to the lessons cognitively with ideas and questions, emotionally more attentive and physically involved in the lessons. Hence, accurate responses are constructive interactions which could possibly engage the students and teachers to the lessons as well as increase interest.

#### 6.3.1.3 How: Increasing confidence in learning and teaching

Students seemed to be more confident through constructive interactions. They appeared to be engaged cognitively to provide answers confidently. This apparently contributes in widening the knowledge of the students, for example;

B: Good try. Perhaps Sa you can help? Thank you Sd for your answers.
Sa: I think the enzyme works when it met its substrate. When they binds together, the enzymes will lower the activation energy...
B: Great! Yes. Sd can you explain to us more? Perhaps Sa has given us some hints.
Sd: Ok, I think I got it teacher, the energy was lowered then the enzyme-substrate reacted faster and turned to products faster. So the reaction was accelerated.
B: Superb! Great work Sd. You got it absolutely right!

*(Kuala Lumpur, TFN2 R40 – 46)*

In Teacher B's lecture, the students were getting more confident in their answers as Teacher B kept encouraging and responding accurately to their answers. This confidence was seen when the students were developing their ideas and became more participative during the process of questions and answers with Teacher B.

In the observation with Teacher J, her students also seemed to be confident in conducting their laboratory work. Teacher J kept encouraging them and trusting them in doing their work which seemed to have given the students much confidence. Figure 6.12 show that students were conducting their research confidently in Teacher J's lesson.

*Figure 6.12* Students Conducting Laboratory Work Confidently
Note: Figure 6.12 shows that students were conducting the laboratory work all by themselves confidently.

The excerpts below show how Teacher J encouraged her students to be confident in their work.

J: Ok Dears, Please do your work now. I'm sure you can do the work all by yourself today. Please go collect your specimens, and do the preservation.
S3: Ok, we are readied
J: Good, S3 please lead your group to the field. Come back on time, please.
S3: Yes, Ma'am
J: The rest of you please conduct the preservation. I'll be walking around. To help if you need me. No worry.
S5: Teacher, we can do the preservation. No worry. I think I can clear the stomach of the insect now… *(one of the student in the laboratory showing his specimen to the teacher and confidently renouncing that he know how to preserve it.)*
J: Ok S5. Continue with your work. Please help me to coach your friends when you are done. Thank you.
S5: Sure, Ma'am… *(laughing happily)*
*(while some students leaving to the field, Teacher J was going group by group in the laboratory to help the students in doing the preservation.)*

*(Kuala Lumpur, TFN11 R15 – 25)*

Being confident in learning is very important as it helps in the acquisition and development of skills and knowledge in association to SDL (Gyawaii et al., 2011; J. D. Hoban et al., 2005). Constructive interactions between teacher and students seemed to help the students being confident in themselves. As the students became more confident about themselves, this in turn appeared to help the teachers to be more confident in their teaching too. This also appeared to lead to greater interest in the teaching-learning process.

#### 6.3.1.4 How: Relating to daily matters of common interests

In an interview, Teacher E mentioned that in order to keep the students attentive during lessons he asked some questions related to their daily lives.

E: Normally, I'll ask some casual questions like "how are you today?", "Are you ready to learn?" and some questions which related to the daily life, to get the students' attention before I starts my lesson. *(Kuala Lumpur, TI1 R20 – 23)*

Additionally, students seemed to be more alert when teachers tried to relate the lessons to daily matters. When this happened, students seemed to be more interested and started to pay more attention to the lesson. For example,

*(Teacher S related speciation with Darwin's travelling)*
Sf: Is the speciation still taking place nowadays?
T: When the environment has drastic change theoretically speciation would take place. This need also a very long time for it to happen.
Sh: So we cannot see it?
T: Not really can witness the change in the short period of time.
Sf: Why?
*(Interactions between teacher and students being more active when the teacher related her teaching to the daily activity).* *(Melaka, TFN23 R30 – 35)*

*(Students seemed to be excited and being more alerted when Teacher E related the lesson to life example)*
E: Can you think of a way how the enzymes are used in our daily life?
S3: Teacher, the washing powder that stated "bio-active" is it enzyme?
E: Good! That is one of it. So what are the instructions when you are using the washing powder?
S4: Oh! Is it? We put enzymes in the washing powder? I thought that was chemical!
S5: It is so impressive to know that enzyme was used in our daily life.
*(The conversation continued with the teacher showing how the enzymes were used in daily life from food productions to other industries)* *(Selangor, TFN14 R62 – 63)*

The excerpts above show that relating the lessons to daily matters of common interest, seemed to help the students and teacher to make more meaning of the learning and teaching as stated in Ausubel's meaningful learning. With meaningful learning students and teachers seemed to be more interested in the process of learning and teaching.

### 6.3.1.5 How: Relating to examinations

Due to the examination oriented mindset among teachers and students (this is captured in Chapter 7 in p 223), they seemed to be more physically, emotionally and cognitively engaged in interacting with each other when the content of the interaction was about examination. For example;

G: Well students, now this is something will come out in your examinations.
*(Students seemed more alert as they sat up straighter and getting readied to copy the notes)*
G: Please take note of how the words you used in the examination *(Teacher G continued with showing how the marking scheme of the essay and how the students should answer the essay question)*
*(Students seemed more alert when teacher was talking about something related to the examinations)* *(Melaka, TFN 22 R66-67)*

In the observation with Teacher W, she managed to gain the students attention at the end of the lesson when she gave them some assignments related to the examinations.

At the end of her lesson, Teacher W gave some questions from the past year examinations. *(The class seemed livelier with the students started to ask some questions)*.
Sd: Teacher, we have to give points according to the marks allocation there?
W: Yes, please take note of the marks allocations at each questions.
Sc: Those are marks given for the questions in the examination?
W: Yes
Sd: Each point one mark
Sc: Teacher if we cannot give that many points?
(The students continued to ask more questions about the assignment). *(The class suddenly being very lively when the teacher gave these questions, before this the students were extremely quiet without responding to the teacher but merely jotting notes at their textbooks)* *(Selangor, TFN28 R 33 – 39)*

Generally students will be more alert, attentive and be more interested when teachers relate the lessons to the examinations. In some of the researcher's observations, students started to take notes or changed their sitting positions when teachers mentioned about examinations in their lessons. An example is the observation with two students Y and G, who seemed to be more alert when Teacher A highlighted the examination questions given in the textbook. The excerpts below lend support to this.

A: Please look at page 52, there you can see the questions which came out in the examination before about this topic.
Both Y and G took up their pens and started to circle the questions. They changed their sitting positions and lean forward. They seemed to pay more attention and reading the questions quietly. *(Kuala Lumpur, SFN1 R39 – 41)*

In the observation of Teacher J, students started to write their reports as an immediate response when Teacher J showed the examination marking scheme to the students for their experiment report.

(At the 15th minutes before the class end. Teacher J showed how she expected the experiment report should be).
J: Students, this is how you should report in your report. *(While talking the teacher started to write on the whiteboard how the experiment report should be)*
(All students paying attention to the teacher and started to copy the report. The class suddenly became silent everyone was attentive and writing their reports).
*(Kuala Lumpur, TFN 6 R66 – 68)*

From the incidences above, relating lessons to examinations seemed to engage the students and teachers to lessons. However, being too focused on examinations might cause a drawback from being SDL readied as it confined the learning and teaching objectives. Hence, as reported by Pepper (2010) teachers have to design and conduct their lessons to encourage learning for its own sake and not just for examinations.

#### 6.3.1.6 How: Improving teacher-student rapport

Constructive interactions seemed to improve rapport between students and teachers In the observation of Teacher J, the researcher found that Teacher J had developed good rapport with the students. This rapport seemed to engage both Teacher J and her students to the lessons. Figure 6.13 shows teacher J working closely with the students in the field. Active interactions between Teacher J and the students reflected their rapport.

*Figure 6.13* Interaction with Good Rapport
Note: Figure 6.13 shows that teacher and students were working together at the field. The students were interacting with the teachers. Good rapport between teacher and students were observed.

In the field, the students called Teacher J whenever they had problems with their work. Teacher J attended to her students every time when she was needed. Both Teacher J and her students seemed to have good rapport. They worked closely with each other during the process of teaching and learning.

Sk: I think we should call teacher over la.
(Sm made a phone called to Teacher J. Teacher J was at the other corner of the field with another group of students. About 5 minutes Teacher J came to the group.
J: Alright dears, how are you doing?
Sm: Teacher, how do we know which plant to count? They all look the same!
Sk: Can we pick only one?
J: Choose those with similar characteristics. We count one by one
(Teacher J proceeded her teaching in showing which plant has similar characteristics with the students. All the students in the group were working together with Teacher J. Finally they counted the population for more than 5 species within the quadrat)
*(Kuala Lumpur, TFN12, R50 - 58)*

In another observation of Teacher J, the researcher also found once again that Teacher J and her students had good rapport. The relationship seemed to help both Teacher J and her students in working together.

J: Sp, can you handle the oven from now on?
Sp: Yes teacher, we can do it now. Thank you.
Sq: I have started the stop watch.
J: Ok, so I think I can leave you guys alone, and go to another group. Come to me if you still have any problem.
Sr: Ok, teacher. I think we can do it now.
*(Teacher was actively walking around and visiting each group to help the students when needed)* *(Kuala Lumpur, TFN11 R39 – 45)*

With good rapport, teachers and students were eager to help each other in the process of teaching and learning. The students also seemed to be more confident in their process of learning. This apparently enhanced the skills and knowledge related to the lessons, which in turn contributes to SDL readiness.

## 6.4 Non-Constructive Interactions

As reported earlier many interactions were observed during the classroom observations. However, not all the observed interactions were constructive. Some of the interactions were found to be non-constructive in the sense that these interactions prohibited teachers and students from engaging in the lessons. Some of the non-constructive interactions are discussed in this section.

### 6.4.1 Interaction: Humiliation

In one of the observation with Teacher Z, the students seemed to disengage themselves from the lesson and slept in the classroom when the teacher openly humiliated them. This incidence was recorded as below;

*(Teacher Z got frustrated after the students did not manage to answer her questions a few times.)*

Z: How come you all cannot answer this? (Teacher Z raised her voice)
This is so easy and you all don't know?

(All students kept quiet. The students who tried to answer the questions was still standing and look brash). *(Kuala Lumpur, TFN8 R42 – 45)*

The students who were humiliated kept quiet and refused to answer the questions raised by Teacher Z from that point onwards. Hence, the students seemed not to have the interest to follow the lesson.

Z: Who else can answer the questions? Come on!

(All students kept quiet. Some was leaning on the table pretend to be asleep)

Z: You all are in Form Six now. You think you are still in Form 4 and 5? Come on, you must work for yourself. How come these kind of easy questions also you all cannot answer!

(Students were silent, and no one look at the teacher. Some were talking among themselves softly) *(Kuala Lumpur, TFN8 R47 – 52)*

In another observation of Teacher I, in the early part of the observation, students were answering the teacher's questions. However, the situation seemed to change once the teacher humiliated the student who failed to provide correct answers after a few attempts;

Students frustrated and answered "teacher, I actually do not understand the text. What is it all about?" The teacher rebuked "I'm asking you a question, how could you question me back? Question simple as this you could not answer?" The student then sat down in dismay. *(Apparently, the student did not response to teacher anymore from then.)*
*(Kuala Lumpur, TFN9 R26 – 30)*

This action of humiliating the students appears to break down the rapport between teachers and students. From the observations, the students seemed to disengage from the lessons and also appear demotivated.

### 6.4.2 Interaction: Challenge

In the observation with Teacher I, those students who were humiliated appeared to challenge the teacher;

One of the students challenged Teacher I and asked “is disulphide bond a single bond or a double bond?”. However, Teacher I couldn’t answer the question. *(Teacher I was looking at her powerpoint slides seemed like looking for answer)*
The student who asked the question then leaned on the bench and slept without saying a word *(showing disrespect to the teacher. So did the rest of the class)*

*(Kuala Lumpur, TFN9 R32 – 35)*

The challenge put forward by the student and the slow uncertain response of the teacher seemed to break down the rapport between the teacher and the students. Apparently the interaction had disengaged the students from lessons when some of the students chose to sleep in the classroom. This obviously contributes to non-constructive interactions.

### 6.4.3 Interaction: Prohibition

In some observations, the students were hindered from interacting among each other. The teacher did this with the purpose of maintaining students’ attentiveness during lessons. However, it turned out that this teacher action appeared more to obstruct students from constructive interactions and prohibit students’ acquisition of skills and knowledge. Some of the excerpts below captured this.

Z: I want you all to sit alone. No one beside you. So you would not copy from your friends.
(Students then sit apart from each other) (R34 – 35)
(In the 50th min, Teacher Z scolded the students from walking around)
Z: Sx, why are you walking around? All of you who are standing, sit down! You cannot talk to your friends. Focus at your own work!
(All the students go back to their respective places at once) (R51 – 52)

*( Kuala Lumpur, TFN10 R34- 35,.and 51 – 52)*

In another observation with Teacher H, she also prohibited students from talking during her lessons. This is because she believed that if the students pay more attention during her lessons without talking, the students will get better grades in their examination.

H: Please don't talk! Pay attention.
(Students were discussing about the topic among themselves as they were flipping the textbooks and looking at their notes while talking.)
H: Jot down the notes when I'm teaching, don't talk. If you talk you are not paying attention. If you pay more attention you will have better grade in your exams.
(Students then stopped talking, and started to jot down the note Teacher H putting on the whileboard) *(Kelantan, TFN20 R90-94)*

From the excerpts above, teachers seemed to prohibit students' acquisition of skills and knowledge through interacting with each other. This appear to limit the chances for constructive interactions to take place among the students.

Besides the prohibition of communicating with each other during lessons, due to the examination oriented mindset, the cognitive and physical engagements were somehow prohibited too. In Teacher H's lesson, the content knowledge was confined by the syllabus, and the involvement of students in the learning process was prohibited as the teachers focused too much on giving correct answers according to the examination scheme, as in the following excerpt.

As Teacher H teaches she showed the students how to gain marks in the essay examination (R41 – 42)… After each session of her explanations, the Teacher H highlighted the way of answering questions in the examination. She taught the students the ways to write and the terms to use in gaining marks for the examination (R 69 – 71)… Teacher kept referring students to their results. She even advised the students not to talk much during lesson, the reason was they will gain better grade if they talk less and pay more attention. *(Kelantan, TFN 20 R41-42, R69 – 71, R96 – 98)*

The above interactions were non-constructive in the sense that confining students' learning to achieving good results. In other words, it has limited the occurrence of constructive interactions.

## 6.5 Teachers' role in encouraging constructive interactions

In view of how constructive interactions contribute to SDLR and SDLeR as discussed above, teachers appeared to be the crucial element in constructive interactions. Chao, Hwu and Chang (2011) suggested that classroom interactions should be monitored by teachers in order to avoid meaningless chatting. Example of meaningless chatting is shown in Figure 6.14, where two boys were talking among themselves during a lesson. The interaction between the two boys did not appear to be engaging them to the lesson. The excerpt below explains further.

*Figure 6.14* Casual Interaction

Note: In the 45th minute, students were sitting and looking at the slides while teacher was talking and explaining. Most of the students looked tired and bored. Less notes talking among the students, some students started to engage in their own conversations *(the two boys were laughing and kept talking about something related to the movie they watched yesterday)* and some leaning on their chairs.

*(Kuala Lumpur, TFN13,R44 – 47)*

However, much time was wasted in communication when they were communicating on issues other than the Biology topic that was being taught. Figure 6.15 also shows students communicating among themselves about other matters.

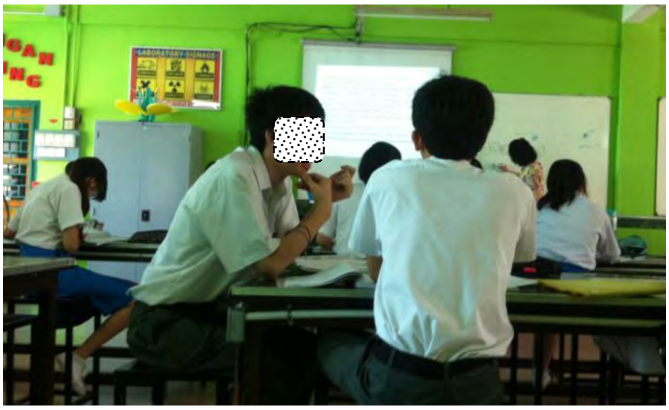

*Figure 6.15* Non - constructive Interaction
Note: At the back of the class *(near to where the research was sitting),* there were two boys talking among themselves. They were talking and laughing. They seemed to share about where they are planning to go after school. *(Selangor, TFN27 R 36 – 38)*

Interactions on issues not relevant to content knowledge, could have helped a lot in developing relationships and building rapport. However, it can be considered as wasted time for the students to develop their skills and knowledge for biology.

Hence, it is essential that teachers should be more alert to ensure constructive interactions during their lessons. This result is supported by the findings of Finucane et.al.(2009), Mohamad et.al. (2009), Pepper (2010), and Halawah (2011) who stated that teachers are the key factors in determining the success of SDL. This is because in both teacher-centred and student-centred environments, teachers need to create the opportunities for constructive interactions.

Regardless of which teaching styles a teacher adopt, the role of creating more opportunities for interactions is important. More constructive interactions can contribute to the acquisition of skills and knowledge for the students and teachers to be SDL readied in Biology.

### 6.6 Chapter Summary

Constructive interactions occur through learning styles and teaching styles. This result is supported by the findings of Gyawaii et.al. (2011) saying that SDL can occur in a variety of situations in a formal setting. Hence, the notion proposed in this research that

Readiness for Self-Directed Learning is independent of learning styles and teaching styles appears to be acceptable. Additionally, the working hypothesis three (3) of this research saying that constructive interactions are contributing to the SDL readiness also seems acceptable supported by the data.

The theoretical framework underpinning the current research has been refined with the findings. Constructive interactions contribute to SDL readiness in engaging students to the learning process and teachers to the teaching process. These engagements include physical engagement, emotional engagement and cognitive engagement to the lessons which tend to trigger the interest to teach and learn Biology among the teachers and students. According to Ausubel's meaningful learning, constructive interactions would trigger the interest when it brought meaning to the learning and teaching processes. This interest appears to trigger students and teachers to sharpen their skills and knowledge for learning and teaching Biology. The results are supported by Bruner's theory, which is adopted in the current research, that with better acquisition of related skills and knowledge the students and teachers appear to be getting more SDL readied. Figure 6.16 illustrated how constructive interactions contribute to SDL readiness.

The skills and knowledge acquired specific in learning Biology as it was triggered with the interest to learn and teach Biology. As mentioned by Bloom's Taxonomy, specific skills and knowledge were needed for one to be more readied in learning. Sargeant's (2010) research also found that teachers needed skills and knowledge acquisition to shift from a more didactic teaching role to a more interactive learning role. Therefore, teachers and students need to be equipped with the skills and knowledge which can enable them to be more readied for SDL. This acquisition of skills and knowledge for SDL can be enhanced by constructive interactions during lessons.

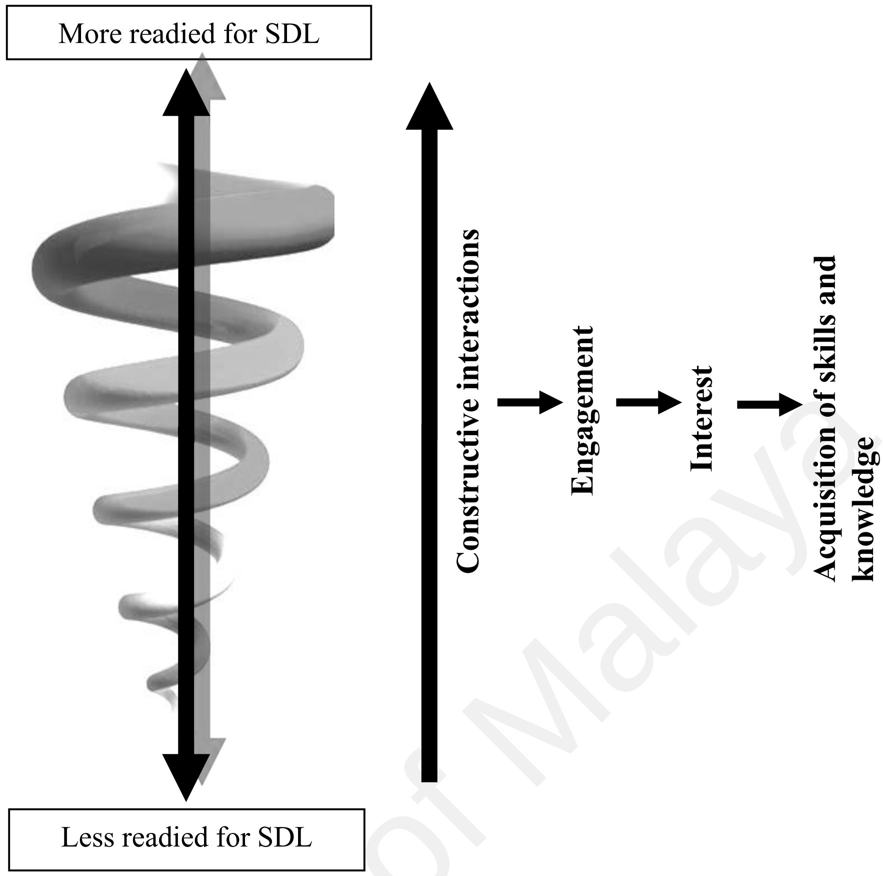


*Figure 6.16* Constructive Interactions

# CHAPTER 7

# FACTORS INFLUENCING SELF DIRECTED LEARNING READINESS

## 7.1 Introduction

The fourth research question focuses on the factors influencing SDLR and SDLeR. The data obtained from interviews, classroom observations and the open ended question was analysed to determine the factors.

The self-assessed readiness obtained through the open ended question in the SDLRSbio and SDLeRSbio revealed the potential of being SDL readied among the STPM Biology students and teachers. However, during the classroom observations the actual phenomenon observed seemed contradictory with the self-assessed readiness levels. Hence, the factors influencing SDL readiness also need to be investigating in understanding the situation further.

The identified factors may influence the readiness positively or negatively or both. In the current research the aim was to identify the factors and its influences. There were no attempts to determine the degree of the factors in influencing the SDL readiness. This chapter discusses the themes in detail with the excerpts from the interviews and classroom observations.

## 7.2 Factor influencing SDLR and SDLeR

From the profiles of SDL readiness among STPM Biology teachers and students, the researcher found that the STPM Biology teachers and students generally rated their SDL readiness at the categories of “Above average” and “High”. However, during the classroom observations and interviews the situation seemed contradictory with the results.

The vast difference of readiness between students may be contributed by different factors. These factors could have been influencing the SDL readiness among teachers and students in different ways. From the data collected in this research, the factors could have contributed in enhancing or prohibiting the SDL readiness among STPM Biology teachers and students. The identified factors are shown in Table 7.1.

Table 7.1 *List of Factors Influencing SDLR and SDLeR*

| **Students (SDLR)** | **Teachers (SDLeR)** |
|---|---|
| Time | Time |
| Environment | Environment |
| Self-Efficacy | Self-Efficacy |
| Interest | - |
| Examination Oriented Mindset | Examination Oriented Mindset |
| Syllabus | Syllabus |
| Interpretation of SDL | Interpretation of SDL |
| Learning Sources | Learning Sources |
| Friends | - |
| External Influences | - |
| Family | - |
| Electronic Technology | Electronic Technology |
| - | Management support |

Note: Frequency of each factor is shown in Appendix XV for interest - although the frequency is not required to answer the research questions in this study.

### 7.2.1 Understanding of SDL

A proper conception eventually influenced the success of learning and teaching (Schunk, 2012). Students will learn according to the concept of learning they believed (Bruner, Goodnow, & Austin, 1956). Similarly, teachers will teach according to the concept of teaching they believed in. From the data collected, the STPM Biology teachers and students seemed to have a concept of SDL which influenced their actual practice of SDL during teaching and learning processes. This phenomenon is discussed below.

#### 7.2.1.1 Students' SDL understanding

From the qualitative data collected, students seemed to think that they were not self-directed in learning because they do not know what SDL was. Indeed, students appeared puzzled with the term SDL during the interviews. From the excerpts below, obviously students were not aware of SDL.

R: What do you know about SDL?
S2: What is that? Study by myself? *(Kuala Lumpur, SI 2 R78-79)*

R: How much do you know about SDL?
S3a: Not really…
S3b: Me too, not really know about SDL.
R: You mean before this, you don't even know what SDL is?
S3a: Ya, it is a new term
S3d: Ya. (Selangor, SI3 R70-75)

Due to the unawareness of SDL, students may not understand if they were indeed self-directed in learning. Students' perceptions on their ability to learn will influence their learning objectives and the strategies to achieve the objectives (Wigfield, Tonks, & Eccles, 2009). Hence, the understanding of SDL plays a role in how students perceive their own SDLR.

Besides the low awareness of what SDL is, some students indeed had misconceptions of SDL. Students perceived that SDL is an informal education which will help them to gain more information in order to pass their examinations. They basically thought that SDL is conducted as they do their revision after schooling hours. The excerpts below indicate this.

S4: SDL is basically sort of like self-study where we will read up our own material and search the internet and based on whatever we had gather and we will just maybe form a conclusion from there… *(Kuala Lumpur, SI 4 R15 – 17)*

S5: SDL is like after school, after class, you go back home and you have time so you take out the books and you revise what you have learned. Is like you are directing yourself to know more about what you have learned during the class.
(Johor, SI 5 R 8 – 11)

Some students interpreted SDL as self-study which supplemented the mainstream education. Some also thought that SDL is an extracurricular activity which they have to follow outside their schooling hours, as indicated below.

S5: …What I meant is by self-directing can be an addition of what we have learned from teacher.
R: It is an addition?
S5: It is like an extracurriculum.
R: Extra from the school curriculum that we have?
S5: (Head nodding) Ya. *(Johor, SI5 R28 – 37)*

Some students also think that SDL is not something related to school. It is something outside of the school system. SDL is perceived as something which the students themselves are solely responsible for their own study. The self-study concept was connected by the students to SDL, as shown below;

S6a: Self-learning means we just need to read the books… *(Kuala Lumpur, SI6 R100)*

S6a: SDL is like learning at home or no need to go to school. Find resources of research just own self. At home, no need to go to any tuition or teachers…
R: What do you think *(this was a group interview with 4 students)*
S6b: also the same.
R: That means?
S6b: That means just repeat reading and try to understand what's the meaning of it.
R: Anyone has any other ideas about SDL?
S6d: Study through the group discussion. Like study group.
*(Kuala Lumpur, SI6 R206 – 217)*

From the above excerpts, students seemed to perceive SDL as an extra effort in getting knowledge. In addition, students also perceived SDL as a revision activity which helps them to gain more information in the related subject. No doubt these activities can be part of SDL, but not all of SDL. Hence, the main idea of SDL among the students was an activity done by themselves in addition to the formal lessons. Loyens et al. (2006) reported that students' perceptions serve as a frame of reference which influenced their learning process. Hence, the concepts of SDL influence the students' SDL readiness.

Therefore, this explained why students (79.3%) self-assessed themselves at the category of "Above average" SDL readiness but the observation and interview seemed provided contradictory results. Apparently, students may not fully understand what SDL is. Hence, they may not perceived the activities they conducted as SDL or they have had misinterpreted some activities as SDL.

#### 7.2.1.2 Teachers' SDL understanding

One of the factors which the researcher found that could probably influence teachers' SDLeR is the teachers' understanding of SDL. According to the results of interviews and classroom observations, there were two different concepts about SDL among the teachers. In addition, the teachers perceived that there were two functions teachers should play in SDL.

Firstly, teaches think that SDL is a student-centred approach in which teachers should be totally absent in the process of learning. It is the student's responsibility for their own learning. As found in the interview, teachers did think that SDL is referring to the students (self) to study themselves. Therefore, SDL is perceived as the students' sole responsibility in implementing it, without the guidance or involvement of teachers. This concept of SDL is reflected by the excerpts of interviews below.

T2: In SDL they *(students)* should study on their own. *(Kuala Lumpur, TI2 R145)*

T4: From the term itself, SDL like they *(students)* all doing their own study. Maybe, because from the term self-directing that means maybe they do on their own study and everything… *(Sabah, TI4 R9-11)*

T3: SDL, I suppose to be learning by yourself beyond the textbook and what we *(teacher)* teach in class. To attracts their *(or students')* interest and knowledge.
*(Melaka, TI3 R94-96)*

In line with the concept above, some teachers also think that SDL can only be performed by mature students. Mature in the sense that students were able to discern the information and ways of getting the information by themselves. SDL apparently is only suited to students who are readied metacognitively with the ability to make own choices in their study. This is reflected in the excerpts below.

T2: SD students, mature student… they know what to do. They know what they want from the teacher. I could not teach all. They have to do research. They have to surf the internet to choose all the material, and they should think which one is the best for them based on the syllabus. *(Kuala Lumpur, TI2 R101-108)*

Secondly, during the interview teachers also thought that they should play an active role throughout the learning process of SDL to ensure its success. Teachers thought that SDL is a kind of team work where teachers give instructions for the students to prepare for team presentations of a topic. They felt that, teachers should control the process of teaching and learning so that the students will be able to achieve the targeted aim for that lesson. In addition, these teachers feel that students will never be able to achieve the lesson objectives if work were given for students to complete without teachers' supervision. This can be seen in the excerpts below.

T2: …SDL is team work. That means you *(teacher)* assign a student one topic. So that let them *(students)* go and find out certain things to present.
*(Kuala Lumpur, TI2 R169-171)*

T3: I think would get better SDL in class with teacher in control. If go back home then it is definitely… I don't know… I think it is lost.
*(Selangor, TI3 R94-96)*

Thus, teachers seemed to have two different concepts of SDL, one towards total student-centred learning and another towards total teacher-centred learning. Firstly, teachers thought that SDL is equivalent to student-centred learning where students take full responsibility for the learning process. Secondly, teachers think that SDL is related to students' team work and project work which should be conducted under the tight supervision of teachers. If the definition of SDL by Knowles is referred, SDL is not confined by teaching styles and learning styles. Hence, whether the students are in control of their learning or the teachers are in total control of the lessons, in both situations SDL can take place. Most probably these two perceptions of SDL influence teachers' SDLeR. Hence, the concepts of SDL the teachers hold would influence their SDL readiness. This result seemed to agree to the findings of Maggioni and Parkinson (2008) who suggested that teachers' perceptions will influence the way teachers teach.

### 7.2.2 Examination oriented mindset

In past research such as that of Lee (1999) and Chakravarthi et. al. (2010) the point raised is that Malaysian students are too examination driven, to the extent of overemphasising examination results as being equivalent to academic achievement. This phenomenon was also observed in the current research which seemed to have influenced the teachers' and students' teaching and learning objectives.

From the data collected, teachers and students seemed to pay much attention to examinations. The examination oriented mindset appeared to influence the setting of teaching and learning objectives, and the strategies to achieve the objectives. This mindset is further discussed in the following sections.

#### 7.2.2.1 Students' examination oriented mindset

The examination oriented mindset seemed to influence the students' learning objectives and strategies. According to the interviews, students found that by focusing on the examination they could easily set their learning objectives and thus motivates them in strategising to achieve the academic achievements set.

S4: …so when we have a goal to reach, like you want to get at least better result you may push yourself (R61-63)…because like examination is part of the goal that I would reach. Maybe that is one of the catalyses for me to conduct SDL.
*(Kuala Lumpur, SI4 R224 – 226)*

Additionally, students also agreed that setting goals in learning is very important to be self-directed in learning.

R: how do you think a person can be readied for SDL?
S5: First you need to have a goal. When you have a goal you will achieve it…
*(Johor, SI5 R84-88)*

Hence, students will strategize their learning according to the objectives set with the examination oriented mindset.

M: They *(the students)* just learned to pass the examinations.
*(Kuala Lumpur, TI2 R24)*

Students' efforts in study were much driven by the examination results and examination content. Their effort at study simply was generated to obtain high marks in the examinations.

S4: We don't really know what is expected from the marking scheme and stuff like that… *(Kuala Lumpur, SI4 R69 – 70)*

S6a: We must do it, because the mark is counted *(Kuala Lumpur, SI6 R 305)*

A similar finding was reported by both Lee (1999) and Chakravarthi et. al (2010) saying that Malaysian examination oriented habits in the secondary school had caused a lack of opportunity to cultivate students' SDL readiness. In this current research the researcher would like to add to the results of Lee's and Chakravarthi's in that the examination oriented mindset could be influencing SDL readiness among students in a positive way in which it helps the students to set goals and strategize themselves to achieve the goals. However, that this mindset had limited the students from the learning content is undeniable. Raidal and Volet (2008) mentioned that over emphasises on performance and grades can be detrimental to learning. Therefore, when the learning goal was set only for examination achievement, this limited the potential for a greater level of SDL readiness among the students.

Thus, instead of helping them to become better SDL readied, this mindset had probably hindered the students from developing skills and knowledge for SDLR. This explained the contradictory phenomenon of the self-assessed level of readiness with the actual practice of SDL among the students.

#### 7.2.2.2 Teachers' misconception of SDL

Results also showed that the examination oriented mindset seemed to dominate the teachers' option of pedagogy and teaching objectives.

T3: … At the end of the day, they *(students)* are our clients. They are expecting to do well at the end of the term. They are expecting their "A". It is not fair to teach so much and then find that they don't know how to answer examination questions… *(Selangor, TI3 R251-255)*

Helping students to achieve higher grades in examination became the dominating objective of teaching among the teachers.

T3: As much as I want to help them enjoy, but eventually it comes to examinations *(Selangor, TI3 R155-156)*

T5: Actually I'm helping them to prepare for examinations(R 106)…Actually we are sad to say we are preparing them (students) for examinations, so not teaching them these skills for SDL. *(Melaka, TI 5 R 114)*

From the excerpt above, the teacher seemed to be emotionally disturbed as she felt sad in confining her teaching in preparing the students for examination.

In order to achieve better examination grades teachers seemed to alter their pedagogy to suit the needs of the examination. As the teachers lecture they also demonstrate some answering techniques to the students.

T2: So what I am trying to do now, as I teach I try to teach them (students) the answering technique as well. *(Kuala Lumpur, TI2 R63-64)*

While preparing the students for examination, teachers often chose to lecture. This is because teachers believe that it is the best way they could cover the requirement of the syllabus and get the students readied for the examination.

T5: We need to conduct more lectures as we are struggling to finish the syllabus in order to prepare the students for examination… *(Melaka, TI5 R11 – 12)*

It was also observed that during lessons, teachers used “examination” to attract students’ attention during lessons. This is shown in the excerpt below.

The interaction between teacher and students became livelier when the teacher talked about the trial examination. When teacher said “This is important for examination” or “exams always asked questions like this”, the students seemed to be more alert by jotting the points down when they know it was related to examinations..

*(Melaka, TFN22 R66 – 69)*

The examination oriented mindset seemed to influence teachers’ SDL readiness in terms of setting the teaching objectives and option of pedagogy. This mindset helps the teachers and students to engage emotionally towards the lessons with both teachers and students being more attentive and alert to the lessons which related to examinations.

Additionally, this mindset influences the readiness in a negative manner too. The teachers indirectly confined the teaching context which restricted the opportunity for students to learn beyond the examination requirements. Excerpts from the observations field notes below shows how teachers prohibited students from getting the answers themselves.

In the 55th min, teacher wrote an example of the classification *(classification of animals)* on the board, while students are busy completing their task. Teacher also highlighted the marks for the laboratory report. Teacher kept highlighting how the students should present their lab report in order to gain the marks as following the marking scheme.

T: You need to include the table in this way *(while drawing the table on board)* so that you will get marks for this section.

Marks given for each sessions of the report was also highlighted. Students seemed to be confined to the expectation of the marking scheme in presenting their answers.

T: Please take notes that you need to have the word "species" so that you can get marks for this. The lines also has to be drew to indicate the connection between the categories/classes in order for the examiners to understand your work.

*(Kuala Lumpur, TFN10 R 56 – 62)*

Teacher gave sample examination questions on the board, asking students to attempt the questions. While students were trying to answer the question, teacher showed an example answer and asked students to jot down the answer.

T: Please jot down the answers *(while pointing to the board where she wrote the answers)*

Students then stopped the attempts of answering but busy copying the teacher's provided answers. *(Kuala Lumpur, TFN4 R49 – 55)*

In another classroom observation, the teacher was dominating the discussion and the students were merely following her delivery and did not ask any questions. Additionally, the teacher also prohibited the students from communicating with each other. This was because the teacher wanted students to be attentive during the lessons. Students were busy jotting down notes. The field notes excerpts and Figure 7.1 show the incidence.

*Figure 7.1* Discussion
Note: Teacher dominating the discussion section while students were merely jotting down points.

T: "Don't talk too much, please focus on your own work. I do not want anyone to copy from friends. Please do your work alone and sit apart from each other."
Teacher prohibited the students from talking, as she did not want them to copy from each others' work. Therefore, the teacher instructed the students to seat apart from each other, to avoid copying and discussion of work *(R34 – 37)…*
T: "Why are you walking around?" *(Meanwhile pointing to the students who were standing beside his friends).* "You should work at your own work and please go back to your seat!"
In the 50th minute, teacher scolded students from walking around, and prohibited them from communicating among each other again. Students followed the instructions and sat back to their own seats *(R51 – 54).* *(Kuala Lumpur, TFN10 R34 – 37 and 51 – 54)*

Researchers like Lee (1999) and Chakravarthi at.el. (2010) had also raised their concerns of examination oriented habits clearly engraved in Malaysian education which was thought to have caused the low mastery of soft-skills among the Malaysian students (Effandi Zakaria & Zanaton Iksan, 2007). This factor also seems to have influenced the readiness of teachers for SDL. The examination oriented mindset seems not only to have prohibited the cognitive engagement of the teachers in the lessons by confining the teaching objectives and the lessons contents of the subject, it seems to have also influenced the teachers' emotions in preparing for the lessons. In Lee's (1999) research, she also mentioned about the examination mindset which had brought the teachers to confine themselves for certain teaching and learning strategies like spoon-feeding strategies which may not be suitable for a fast developing society like Malaysia. Hence, this examination oriented mindset seemed to influence the teachers' SDL readiness for conducting lessons.

Hence, although teachers in the student self-assessed themselves as highly readied for SDL, but in actual practice they appeared to be not able to be self-directed. They were confined by the examination which seemed to influence their setting of teaching goals and also the strategies of achieving them. The mindset also seemed to prohibit the opportunities for students to obtain skills and knowledge.

### 7.2.3 Time

In many occasions, time was mentioned by the students and teachers as the factor influencing their learning and teaching. Students generally think that they spend too much time in the school to the extent they have no enough time to engage to in actual study. Meanwhile, teachers generally think that they have not enough time to engage in teaching. Indeed during the classroom observations, the researcher found that much time was wasted during the transition periods of classes and due to prolonged assemblies, meetings, and other ad hoc duties for the teachers and students. This is discussed in detail below.

#### 7.2.3.1 Students' lack of time for SDLR

Besides the examination oriented mindset, many STPM Biology students mentioned during the interviews that they were striving to have more time for their study. Students seemed to have difficulties in engaging themselves emotionally for their study. This was because they always felt tired and exhausted after the long schooling hours, as indicated below;

R: Do you have a study group?
S6a: Previously we got. After many times, we find not much we can learn in the group discussion. Time allocated for it also short. We did it after school…
S6b: Tired

S6c: Very Tired
R: What caused you tired?
S6a: Because the long period of schooling.
R: Long schooling hours?
S6a: Ya, long schooling hours.
S6c: Too long already
R: Too long means from when to when?
S6a: 7 morning…
S6c: Until 3.30… we don't think we need so much time in school. We can spend the time at home to study ourselves it would be better. I think.
S6a: Usually our class like many many students right, we also, when we go home… everyone also go back home and sleep one. (S6c: oh, too tired). Seriously, too tired. Go back home just sleep… sleep until the night.

*(Kuala Lumpur, SI6 R223-251)*

R: So is there anything else will influence your learning of biology?
S6c: Not enough time.
S6b: Because the remaining hours *(after schooling hours)* just enough for us to complete our homework. Then after homework already….
S6a: very tired (S2: Ya!) *(Kuala Lumpur, SI6 R268-278)*

Apparently students think that schooling hours are too long for them. They cannot continue to learn after school due to tiredness. They easily felt tired after school and have no energy for other activities. In an interview, as shown below, a student raised his concern of tiredness after school which had caused him not to be able to revise his work.

S5: Besides from study, when after school when we are travelling home that is actually quite tiresome for some who drive. For me I took 20 – 30 minutes to drive home. It needs concentration during driving to prevent accident. When we get back home, we will feel a bit tired. So we prefer resting more than revising.

*(Johor, SI5 R51-56)*

From the results, tiredness after long schooling hours was one of the factors which could have hindered students from further engaging themselves in their learning process after formal schooling hours. Apparently, students engagement to their learning will be influenced by time, let it be during the lessons in the classroom or outside. The students seem to need time to rest before studying, thus indicating that the students' interest in study is influenced by the time they spend in schools.

Students also seem to have a very tight schedule for homework and assignments. This also could have hindered the students from engaging with the lessons better. Without engagement with the lessons, the students appear to lack the opportunities to develop their skills and knowledge for SDL. The excerpts below indicate this.

S6a: Yah, sure! Got homework, tutorial (SI6d: Maths).. Yah, Maths has many homeworks (all students: hahaha…). Yah, seriously got many homework. Then go back home, after finishing the homework is about 10 to 11pm. If you still study then will be until 12 or 1. Then the next day, we will come to school like blur blur.
S6d: Further more now we got assignment. When assignment that time ah, the period, the week la… we will all like, spending time until the night. We go one person home and we spend all the day with the assignment.
R: What assignment is that?
S6d: Now, every subject also we have..
S6b: Because of this modular system
R: Is it the project? (All students nodded their heads)

*(Kuala Lumpur, SI6 R282 – 301)*

S6c: We need to complete the work within 2 weeks. When doing that assignment we don't have time to study, and doing homework or others.

*(Kuala Lumpur, SI6 R315 -316)*

In fact from the observations, many students were found to be wasting time in moving from one classroom to another classroom for their lessons, as shown below;

Class was delayed for 10 minutes as the students took time to walk from their classroom to the laboratory *(both located quite far from each other)*

*(Selangor, TFN16 R26-27)*

R : What you all will be doing from 7am to 3pm *(schooling hours)*?
S6d : *(Attending)* lectures and tutorial. (SI63: Yah!)
S6c : *(Attending)* lectures. We need to go upstairs, and then go downstairs again. (S6d: and then go laboratory)... and then go up and go downstairs again. So like always going up and down, and the time all spend on walking. Hahaha…
R : Are there only lessons and lectures from 7 to 3?
S6a : Yah! Includes like 3 periods of laboratory like today… include everything…

*(Kuala Lumpur, SI6 R253 – 265)*

Most of the time, students were found to be late coming into the class for a few reasons. Firstly, it was due to a delay in ending the previous lesson, as the following excerpts indicate.

Class delayed 10 minutes as the previous lesson ended late. Students were waiting outside the laboratory for the previous lesson to end prior to be able to start theirs.
*(Selangor, TFN3 R25-26)*

Students entering the lecture room 20 minutes late from previous lesson. They came in one by one gradually. *(Selangor, TFN13 R20-21)*

Secondly, at times due to the extended assembly, recess, or other activities before the lesson commenced, as shown by the excerpts below.

The lesson was after recess. Students came in late for 10 minute and the teacher was late for 15 minutes. *(Kuala Lumpur, TFN8 R12-13)*

Students were late for 10 minutes as the lesson was scheduled after recess. Students took time to walk back from the canteen to the classroom.
*(Kelantan, TFN20 R17)*

When bell rang (recess over), students gradually entering the classroom. It took about 5 minutes for the students to enter the class. *(Kuala Lumpur, TFN4 R21-22)*

There was a career fair conducting in the school. Hence, students visited the career fair during recess and were delayed to enter the class. They came back from the recess after the visit to the career fair. About 15 minutes late *(Selangor, TFN15 R17-19)*

Teacher waited at the laboratory for long *(about 30 minutes)* before the lecture could start. Students were detained at the assembly for more than 30 minutes due to extra announcement for the Six Formers *(Kuala Lumpur, TFN2 R23-26)*

Thirdly, students were on duty, especially as prefects or librarians. The students will have to complete their duty or have their recess after their duty before entering class.

Two prefects joined the lesson only after 25 minutes.

*(Kuala Lumpur, TFN5 R34)*

From the above excerpts, students seem to lack time in engaging with the lessons due to many reasons like tiredness, assignments and homework, entering class late and prolonged assemblies or tied up with duties. These time management issue seemed to be one of the factors with influence the engagement of students with the lessons.

**7.2.3.2 Teachers' lack of time for SDLR**

Another factor which apparently contributed to SDLeR is the time factor. Teachers who participated in the research, complained much about their duties and time allocated to complete them. Many teachers mentioned that the time given to them to conduct lessons was not enough to cover the content knowledge as required in the syllabus. Hence, apparently teachers did not have time for SDL lessons. The excerpts below reflect this.

T3: Time maybe. It is just not enough of time (R144)… Syllabus is good. I mean topics are good. Time not enough. We (teachers) love to discuss and enjoy the topic. But we cannot. (R149-150)

T3: The next thing would be the time. You don't have the time to follow up to see if they (students) have done anything or not (R102-104)... and now we have to strictly look at the syllabus and look at the learning outcome, and sometime we have to limit ourselves to what is there (the syllabus) (R246-248)

R: What makes you think that you have to limit to the syllabus?

T3: No time, yes! And students' grades also. At the end of the day, they are our clients. They are expecting to do well at the end of the term. They are expecting their A. it is not fair to teach so much and then find that they don't know how to answer examination questions. Eventually it come out to answering examinations questions. As much as we love to teach them we go strictly by examination syllabus. We cannot go beyond. *(Selangor, TI3 R249-256)*

T2: I don't have the pleasure of explaining clearly. I just don't have enough time to go into detail, and then I don't have enough time for revision (R45-54)… The time is the limiting factor, yes. *(Kuala Lumpur, TI2 R223)*

In some incidences teachers were tied up with duties other than teaching. Teachers also find that this disturbs and affects their teaching profession. Teachers felt frustrated and helpless when they were required to accomplish duties which were totally irrelevant to their teaching role. This seemed to influence the teachers' SDLeR as their emotional engagement in the lessons was disturbed.

Once the teacher entered to the class she started to manage the class chaos.

T: Students please come over to check your personal details on the name list. Please come and check the sports houses allocations if you do not have any sports houses please let me know. And also come and pay your school fees.

Before starting the lesson, the teacher spent about 10 minutes managing the class chaos. These included the records of students' personal details, allocations of students' sports houses, collection of school fees. *(Kuala Lumpur, TFN 4 R24 – 30)*

Lesson was scheduled right after weekly assembly. Students came in on time, but teacher was tied up with assembly duties and late for 10mins. When the teacher entered to the class he apologized to the researcher.

T: I'm have to be on duty for the assembly today. Sorry for being late to the class.

*(Selangor, TFN 25 R20 – 22)*

T4: We don't have time, we have a lot of work to do

*(Sabah, TI4 R189)*

From the interviews and classroom observations, teachers seemed to struggle with time in completing the syllabus. This condition seems to be influence the teachers' creativity in conducting their lessons. In turn, it influenced the teachers' SDL readiness for lessons.

### 7.2.4 Accessibility to the learning facilities

Students mostly responded in the open ended questions that "environment" was the main factor which influenced their SDLR. The "environment" referred to was the accessibility to computers and internet facilities, textbooks and reference books and other forms of learning facilities. This matched with the research by Horng (2011) who mentioned students will master their study better with better accessibility to computers. In addition, the accessibility to library and other facilities like zoos and museums was also reported by Thair and Treagust (1997). Hence, the “environment” mentioned here was not only how the school’s set up is in general, but the accessibility of students to the necessary learning tools and experts. Some of the excerpts given below support this;

T3: Number one I think is internet. Always had problem of internet service in school… *(Selangor, TI3 R37-38)*

T3: I think the biggest problem would be this textbook would never enough. Internet will be the best source. And our wifi and internet service would be a big problem… *(Selangor, TI3 R45-47)*

T3: We do have a computer lab. But I think it is not enough for students *(Selangor, TI3 R89-90)*

R: Besides reading textbooks, what else will you do to make you understand Biology?
S2: Online searching for answers. *(Sarawak, SI2 R71 – 72)*

S2: Provide a good laboratory, everyone has their own apparatus. *(Sarawak, SI2 R112)*

R: How can you get all those materials when you are doing your self-study?
S4: Mostly from reference books, next would be the internet. Sometime if we have other teachers, and other friends who seems to have better understanding we will seek help from them. *(Kuala Lumpur, SI4 R23 – 28)*

The excerpts above indicate that, with the accessibility to the internet and other resources (let it be living or non-living) students will be more engaged to the lessons (Alvarez & Cuesta, 2011; Doolittle, 2014; Schunk, 2012). Students can engage better cognitively to the lessons when they can access the resources themselves with better facilities. In SDL students need to access to use the resources provided to gain the related skills and knowledge for the process of learning (Aminuddin Hassan et al., 2011; Kocaman et al., 2009)

Many of the students also referred only to their textbook or the recommended reference books by their teachers. These were the books which their teachers used during lessons, as indicated below.

R: Normally how do you study Biology?
S2: Reading textbook. *(Sarawak, SI2 R58 - 59)*

R: Books, you mentioned about books. What kind of books you are referring to?
S4: Aaah… reference books. Like for instance for Biology we have Longman, Oxford,(*Name of the reference books' Publishers which the students used)…* *(Kuala Lumpur, SI4 R56 – 58)*

R: How many books you have read?
S5: I have read my textbook.
R: Your textbook?
S5: Textbook and reference books. *(Johor, SI5 R178 – 185)*

R: When teachers asked you to go home and search for the answers yourself. What normally you will do?
S6c: Normally what I will do …. I'll find books only…
R: Refers to books?
S6c: Yah, refers to books only.
R: What about you? What would you do? *(turning to other students in the group)*
S6d: Also refers to the book… *(Kuala Lumpur, SI6 R64 – 75)*

In addition, many of the students also found that they lacked the ability to discern the content or information which they obtained from the internet or other resources. Much information was contradictory and telling different stories compared to the textbooks or references books that they were using. Hence, the students found it difficult to understand. This prohibited them from obtaining further information about Biology. In other words this had hindered them from a deeper cognitive engagement in their learning of Biology. The excerpts below show this;

S4: Basically there were contradictions between the book and the internet information. Sometimes the book tells you something, and the internet tells you another. Or sometimes some terms were used differently. I mean that they *(books and internet resources)* used different terms *(in referring to the same thing).* That can be quite confusing. *(Kuala Lumpur, SI4 R51 - 54)*

S6c: But if we go internet la. Like over… like out of the… maybe of the syllabus, we also don't know whether we are doing the wrong or right one.

*(Kuala Lumpur, SI6 R77 – 79)*

According to the data above, it seems that students should have better access to the internet and other sources of knowledge like the library to better master the subject matter. These results are supported by the theoretical framework of the student in that social constructivism encourages students in the process of learning Biology and triggers the interest to learn more (Alvarez & Cuesta, 2011; Vygotsky, 1978). This is then anticipated to be influencing the students to develop their skills and knowledge in learning Biology.

### 7.2.5 Syllabus

From the interviews and classroom observations, there seemed to be a gap between the syllabi of Form 4 and Form 5 with that of Form 6. Often students were unable to transfer their knowledge from Form 4 and Form 5 to STPM (Form 6). The excerpts below reflect this.

S4: Based on whatever we had learned, coming here *(Form 6)*, is a bit blur.

*(Kuala Lumpur, SI4 R 68 – 69)*

Basically students were attentive and attempting to answer the questions in the handout given last week. But they seemed to be not clear about the answers. Meanwhile, teacher tried hard to relate the concept learned in Form 4 and 5 to answer the questions, but students just cannot figure out the relationship. Since students failed to relate previous learned concepts from Form 4 and 5 to current lesson, teacher got frustrated with the low mastery of concepts among the students…

T: What have you learned in Form 4 and Form 5? You all have at least a B in Biology and now you cannot tell me what are the effects of the proteins' structures on its functions? *(Students kept quiet, all looking at their textbooks)*

T: Go home and read up the text! *(voice was raise).*

*(Kuala Lumpur, TFN8 R35 – 48)*

Therefore, in the teachers' point of view, students were basically not readied and weak in content knowledge.

T2: I think the first factor is the basic knowledge. The students when they come from Form 5 level, their knowledge in Biology is not in depth, they just learned to pass the examination... some of them got very good results A+ *(In the Form 5 public examination),* but when they come here *(Form 6)*... they are lost. This is because, when they see the Form 6 *(STPM)* syllabus is so wide and so much in depth. For example they cannot explain, they are not able to explain properly. They just know one word only. They do not know how to elaborate. That is their problem. Because in Form 6 *(STPM)* level, they need to answer, structure and essay *(examination questions),* they have to elaborate their points. That's what I think as a factor. Their knowledge is not really that deep. *(Kuala Lumpur, T12 R22 – 32)*

T2: …the students are not ready, they are very weak *(in terms of content knowledge)* . *(Kuala lumpur, TI2 R219)*

T5: …The students are generally weaker… *(Melaka, TI5 R 91)*

Hence, students seemed to be not fit for SDL as they were weak in their content knowledge. The discontinuity of syllabi (between the Form 4 and Form 5 syllabus, and The STPM syllabus) apparently failed to prepare students for STPM. This discontinuation of syllabi could indirectly limit the cognition readiness of the students. Hence, this might have contributed in reducing the cognitive engagement of students in the process of learning. In addition, it might also cause the teachers' emotions to be disturbed as the students cannot follow their lessons. As a result both SDLR and SDLeR are affected.

Besides the gap, the STPM syllabus also seemed to be too wide. It covered too much content for the 18 months duration of study for the STPM teachers and the students. Due to the wide content of the syllabus, students did not seem to be able to focus and appeared to be carried away by the examination oriented mindset. Students focused only on the completion of the syllabus and only studied the content in the syllabus which will be included in the examinations.

Many teachers conveyed their concern of time constraint in completing the syllabus as required, including veteran teachers who had served more than 20 years in teaching. The STPM syllabus was considered too wide and difficult for teachers to achieve what it demanded in 18 months. This phenomenon had forced the teachers to convey the syllabus in the way they think will help the students to gain more marks in their examinations, as seen from the excerpts below.

T3: So at the end of the day, it is just like "Okay, I have taught you this much. Now let's do an essay to answer the examination questions" It has to be that way. We cannot afford not to do it that way.
R: Oh?
T3: So it has to be examination based again.
R: It has to be examination based again?
T3: Right! Definitely, definitely! *(Selangor, TI3 R156-166)*

T2: The Form 6 *(STPM)* syllabus is so wide and so much in depth (R26)… The syllabus is very wide *(Kuala Lumpur, TI2 R26 and 40)*

This situation related to the wide STPM syllabus may affect the motivation to learn among the students and the satisfaction of teaching among the teachers.

The lecturing pedagogy most often utilized, according to the teacher, was because teachers were rushing to complete the syllabus and it was the most effective way of conveying the content knowledge to the students. Many teachers chose their teaching styles based on the syllabus need.

T3: Now we have to strictly look at the syllabus and look at the learning outcome. And sometime we have to limit ourselves to what is there.
*(Selangor, TI3 R 246 – 248)*

S4: And sometime teacher didn't really explain that in Form 5, because teacher said this is out of syllabus that you *(student)* don't really need to cover. You just cover what you need to cover *(to pass the examinations).*
*(Kuala Lumpur, SI4 R156 – 158)*

In the excerpts above, teachers seemed not only to confine themselves to the syllabus while teaching. They also seemed to limit the students' learning content to the syllabus. This was a worrying phenomenon. Many of the teachers interviewed or observed did confine their teaching content to the syllabus. Continuation of this habit may influence the development of interest in learning and teaching biology. As a result, it could then influence the SDLR and SDLeR of students and teachers respectively.

### 7.2.6 Learning resources

During the classroom observations, the researcher found that most of the teachers teach by referring to the textbook or reference books. They also requested the students to purchase the same books. During the lessons, teachers will refer to the textbook and discussed the content accordingly. Students were asked to highlight some sentences in the books and jotted down notes accordingly. Some teachers even read from the textbook directly. Assignments were also given to the students from the textbook.

In some situations, the learning resources helped the teachers in delivering the lessons very well. When the teacher used the textbook properly in aiding her lesson, students can follow the lesson more closely and enjoyed the lesson.

Along her teaching, the teacher refers to the textbook and most of the time she will called out the students to read out the text. Hence, all the students were following the textbook throughout the lesson. With the help of the textbook, the teacher was introducing the terminologies step by step. This made the concepts delivered in a very clear manner. This was made better with good examples given by the teacher *(R53-59)*… Teacher explained the text as she called students to read it. She highlighted the keywords to students as they read out the text. Students then take note on those keywords in their textbook.

*(Selangor, TFN14 R53 – 59 and 72-74)*

Meanwhile in some situations, when the teacher did not manage to examine and prepare the content of the text prior to conducting their lesson, the resources became a source of confusion to the students. The excerpt below demonstrate this.

Some of the information given in the teaching aid was not tally with the textbook or reference books. Teacher tried to explain the differences to the students. However, the teacher continued her lecture with the teaching aid. The students seemed a bit confused with the mismatching of information. *(Selangor, TFN19 R49-52)*

In STPM Biology lessons, teachers seemed to confine themselves only to using the textbook and reference books. Although textbook and reference books are tools of teaching, in this era teachers need to prepare their lessons with other available learning resources. Better mastery of the varied learning resources may increase the interest of learning among the students and the interest of teaching among the teachers which will influence the SDLeR and SDLR.

**7.3 Chapter Summary**

The interpretation of SDL of students as extra effort needed and revision activities to help them in gaining more knowledge appeared to have affected students' SDLR. Meanwhile, teachers interpreted SDL as student-centred learning for example as project work under tight supervision could have also influenced the teachers' SDLeR. These understandings of SDL seemed to explain why the students and teachers were rejecting Self-Directed Learning lessons as reported in the past research of Pepper (2010). Apparently teachers and students perceived SDL differently from its definition.

In addition, teachers often confined their teaching content to the syllabus which in turn affected teaching pedagogy. This was most probably due to the examination oriented mindset. With the fear of not completing the syllabus before the STPM examinations, teachers did not seem to enjoy the teaching process. This could have influenced the teacher's SDLeR. Similarly, students limited their study to content related to examinations. Students seemed to be tired preparing for examinations and completing their assignments only to gain better grades. Hence, the interest for learning among the students was affected. This seemed to influence the SDLR among students. That Malaysian education is geared towards examination oriented is not a new finding. In Lee's

(1999) and Chakravarthi, Haleagajara, and Judson's (2010) research the same phenomenon was found. Other factors like time, syllabus, learning resources, and accessibility to learning facilities also seemed to affect the SDLR and SDLeR by influencing the interest of the students to learn and the interest of teachers to teach. Table 7.2 shows a summary of the factors discussed in the present chapter.

Table 7.2 *Summary of Factors Influencing SDLR and SDLeR*

| Factors | Findings | | Inferences |
|---|---|---|---|
| | **Students** | **Teachers** | |
| **Interpretation of SDL** | Students generally perceived that SDL is a supplementary education which done outside the schooling hours. Some students also think that SDL is something they accomplished outside the schooling hours. | Two dominating views from teachers<br>i. Teachers not needed as students solely doing their study themselves.<br>ii. Teachers need to give thorough instruction and close planning for the SDL lesson. | Students and teachers do not understand what SDL is. Hence, may have caused them not knowing how to get readied for SDL<br><br>Students and teachers were distracted by the word “self”. They perceived that it was the learner sole responsibility in learning. Indeed, SDL is independent of teaching styles and learning styles. |
| **Accessibility to learning facilities** | Lack of access to the internet, and learning resources like library and experts were the concern of the students.<br>No significant differences were observed in any learning and teaching environment setup in influencing the students’ learning process. | - | Accessibility to internet, library, or experts will help students and teachers to be readied for SDL. |
| **Time** | Students basically had a very tight schooling schedule. Long schooling hours and many co-curriculum activities. Thus made the students fully occupied daily. Not much time left for the students for other things. | Teachers find that they do not have ampler time in delivering the syllabus. | Students are basically tired after school. Hence lost interest in their study.<br>Teachers need time to design and plan for their lessons. Teachers are rushing to finish the syllabus so that students are readied for examination.<br>This seems to influence the SDL readiness among students and teachers. |
| **Examination Oriented mindset** | Students geared their learning objectives based on the examination requirements. Students’ learning is confined by the examination oriented mindset. | Teachers’ teaching methods influenced by the examination oriented mindset.<br>Teachers basically think that lecturing is the most effective way to achieve the examination requirements. | The desired of passing and scoring in the examination had triggered the SDL desire among the students.<br>Teachers readiness in SDL lessons was jeopardized by the examination oriented mindset. Teachers may lose the interest to endeavour in any other teaching but to the fastest way which helps them to complete the syllabus. |



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| | | | |
|---|---|---|---|
| **Syllabus** | Syllabus content is too wide for 18 months of study. Students only focused on the examination content in learning Biology | A wide syllabus was to complete in 18 months. Teachers were confined to the syllabus in content delivery duet o time constraint. To the extent, the teachers will interrupt and prohibiting students from developing their knowledge and skills more than the syllabus requirement. | Students seemed to fail in identifying their learning focus, and caused a draw back from SDL. Hence, influence their SDL readiness. The wide syllabus had affected the teachers' choice of pedagogy and the focus of content knowledge. Hence, influence the students' and teachers' interest in learning and teaching. This is believed will influence their SDL readiness. |
| **Learning Resources** | Students lost interest in the midst of searching for information. Students had problem in identifying the information gathered from various learning resources that they had. Not able to discern which info they should apply had cause much trouble in keeping their interest of learning. | Teachers were aided with plenty learning and teaching resources. However, teachers mostly rely only on the textbook or reference books they used in conducting their lessons. When teacher failed to master the learning and teaching resources, they fail to guide the students to better understanding of the content knowledge. Hence, students lost their interest in the lessons. | Students losing interest in learning. Teachers failed to engage the students to their lessons. Both students and teachers seem to lose interest in the process teaching and learning process. Hence influence their SDL readiness. |


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# CHAPTER 8

# SUMMARY, IMPLICATIONS AND CONCLUSION

## 8.1 Introduction

This thesis focused upon a nationwide study related to STPM Biology students' and teachers' SDL readiness in Malaysia. The scales developed to measure the SDL readiness were administered in all the 13 states. Nevertheless, the interviews and classroom observations were conducted with teachers and students who willingly participated in the study, although the interviews and classroom observations did not include all the states. The researcher visited schools in all the 13 states to collect data. About 18 months were spent in collecting the research data.

A proposed notion of SDL readiness with three (3) working hypotheses was investigated in this research. Results show that the three working hypotheses for the proposed notion of SDL readiness are acceptable. This notion of SDL readiness is novel and has not been investigated as far as the researcher's literature review revealed. According to the notion of this study, one can be self-directed readied in any learning and teaching environment. In order to be SDL readied, one needs to have constructive interactions with others to acquire the specific skills and knowledge needed for a particular area of study.

This research also contributed in developing two scales in measuring the self-assessed SDL readiness of STPM Biology students and teachers respectively. This chapter summarizes the research results, discussed the implications of the research results and concluded the research.

## 8.2 Summary

The current research aimed to achieve six (6) objectives and to find out the answers for four (4) research questions. With the research methodologies described in

Chapter 4 this research has successfully developed two scales (SDLRSbio and the SDLeRSbio) in measuring the SDL readiness among the STPM Biology students and teachers respectively. With the development of the scales the current research achieved its' first two objectives.

This research also has profiled the SDL readiness among STPM Biology students and teachers onto two continua respectively. The SDL readiness profiles were described from the aspects of readiness of the domains distribution to illustrate the mastery of skills and knowledge at the different categories of readiness. With this profiling the research objective three (3) was achieved and research question one (1) was answered. It was clearly shown that in being SDL readied one must possessed the related skills and knowledge for the subject.

Furthermore, the current research also achieved its' research objective four (4) and answered the research question two (2) by correlating the SDLR and learning styles, and SDLeR and teaching styles. The correlations obtained appeared to support the SDL readiness notion proposed, and also the working hypotheses one (1) and two (2) put forward in this research. Both the notion and the hypotheses suggested that SDL readiness is independent of learning styles and teaching styles.

In addition, research objectives five (5) and six (6) were achieved, and research questions three (3) and four (4) were answered with data from the classroom observations, interviews, and the open ended question in the SDLeRSbio and SDLRSbio. The research results appear to support the working hypothesis three (3) which hypothesised that constructive interactions contribute in engaging the students and teachers to the lessons. This involved the physical, cognitive and emotional engagements of students and teachers to the lessons. These engagements consequently triggered interest among students and teachers to acquire the skills and knowledge needed to pursue Biology. Hence, in turn through constructive interactions the students and teachers became more readied for SDL.

Therefore, the research results seemed to indicate that the proposed notion of SDL readiness as *"the specific skills and knowledge one possesses in setting and achieving the learning objectives with or without the help of others regardless of the learning styles and teaching styles"* made in this research seemed to be acceptable. Figure 8.1 shows the theoretical framework of the research results.

This proposed notion for SDL readiness is a novel contribution to the literature. Based upon the notion of SDL introduced by Knowles (1975), SDL is referred to the ability of one in setting, strategizing and evaluating their learning objectives which could be achieved with or without the help of others. The current proposed notion further explained the readiness for SDL as the specific skills and knowledge one possesses to achieve the learning goals. The current proposed notion also suggested that the SDL readiness is independent of learning styles and teaching styles, as it was understood from Knowles' definition that SDL could be achieved with or without the help of others. Hence, this notion for SDL readiness is providing a platform for further understanding of the SDL readiness.

The theoretical framework explains the notion of SDL readiness identified in this research. There are 7 readiness of domains studied in this research. The domains are skills and knowledge specific in learning Biology. With the acquired specific skills and knowledge to learn in certain discipline, one is anticipated to be more readied for SDL in that discipline. Hence, to be readied for SDL, one needs to master the specific skills and knowledge needed for the discipline. While the accumulation of specific skills and knowledge are in progress, one is anticipated getting more readied for SDL. Many factors were identified as influencing one's SDL readiness in this research. Among all the identified factors, constructive interactions were identified as contributing to the SDL readiness. With the constructive interactions students and teachers would engage in lessons to develop the respective skills and knowledge needed for SDL in different disciplines. Nevertheless, the results indicate that SDL readiness is independent of learning styles and teaching styles.

Lastly, this research has contributed to the better understanding of SDL readiness among students and teachers of STPM Biology. It is the hope of the researcher that, the findings of the research will be used for the development of the teaching and learning of Biology at the pre-university level and help in the development and preparation of the tertiary education for Biological fields.

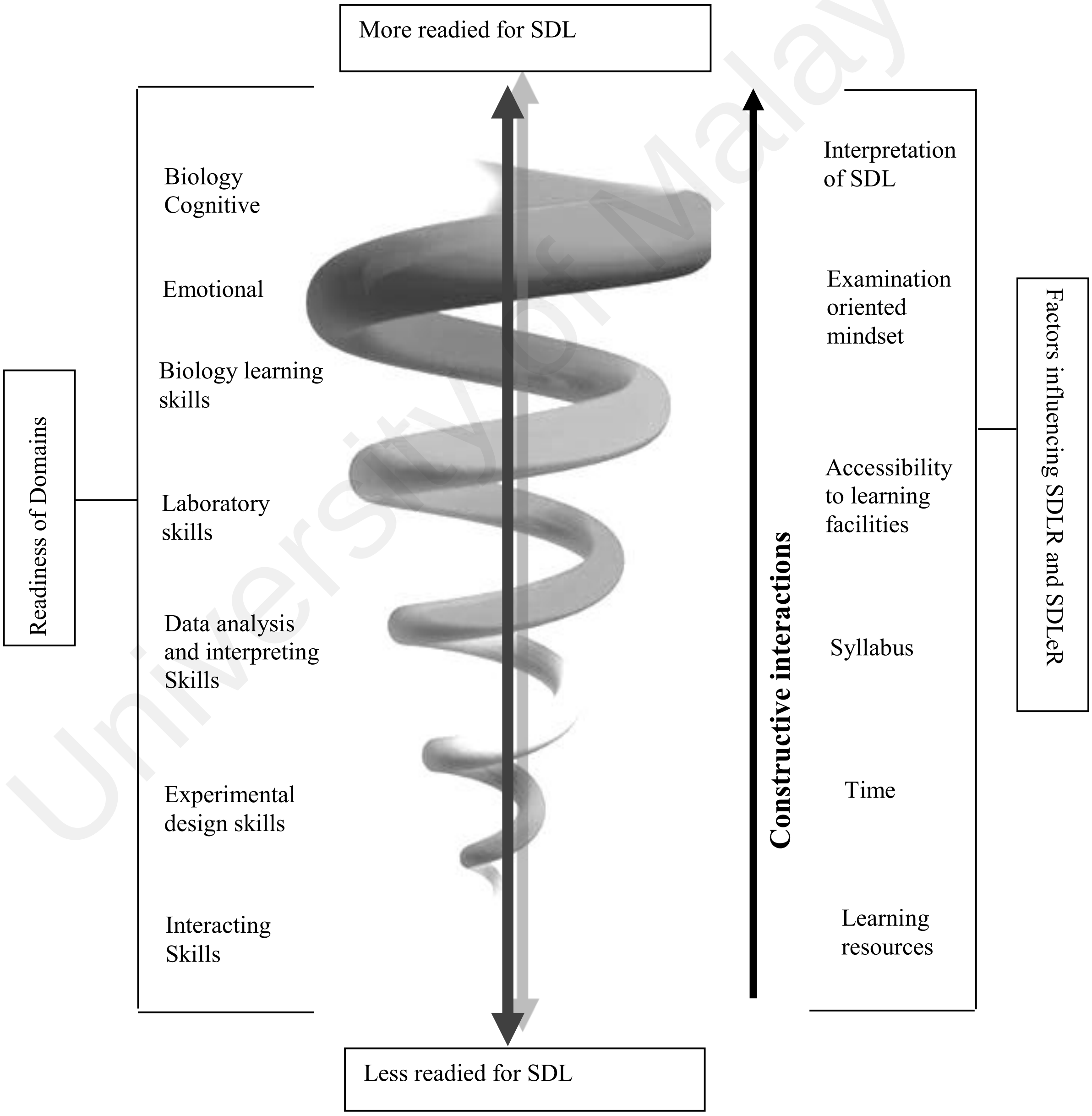


*Figure 8.1* Readiness for Self-Directed Learning

## 8.3 Implications of the study

Based upon the findings of the study four (4) main implications can be put forward namely; (i) Implication for SDL research, (ii) Implication of curriculum development, (iii) Implication for teacher training, and (iv) Implication for school management. Now each of these will be discussed in turn.

### 8.3.1 Implication for SDL research

Due to its significant contribution in life-long learning, research related to SDL has been overwhelming in the past few decades. Although many had endeavoured into the measurement of SDL readiness, there is as yet a lack of definition of SDL readiness. Hence the current research had contributed by adding a different dimension to the understanding of SDL readiness.

The notion of SDL readiness proposed in the current research is a significant contribution to the SDL study. From the literature review this is a gap in literature related to SDL which the current research aspired to fill.

In this study, three (3) working hypotheses were proposed for SDL readiness among STPM Biology students and teachers. These working hypotheses implied that SDL readiness was independent from learning styles and teaching styles. Hence, students and teachers can be readied for SDL in any teaching and learning environment with constructive interactions. Therefore, teachers should create opportunities to encourage constructive interactions during their lessons.

In addition, the development of the SDLRSbio and SDLeRSbio are two scales which contributed to the measurement of SDL readiness specifically for Biology related fields. According to the literature review thus far, there were no scales developed specifically measuring the SDL readiness specifically for a particular subject with specific skills and knowledge related to it.

### 8.3.2 Implication for curriculum development

The developed SDLRSbio and SDLeRSbio have significant implications in measuring the SDL readiness. The scales measured specifically SDL readiness in Biology for both teachers and students. The use of the scales contributed to the understanding of the level of SDL readiness among teachers and students. This had significant implications in curriculum development. Curriculum can be designed according to the level of readiness of the students and the teachers in order to achieve its objectives especially with reference to constructive interactions.

Furthermore, since specific skills and knowledge are needed for being SDL readied, hence, the curriculum should focus in the development of the skills and knowledge which is specific for the subject matter besides focus on the general skills and knowledge which applies to all disciplines of study.

### 8.3.3 Implication for teacher training

Although STPM biology teachers show a high level of self-assessed SDL readiness in this research, as yet the classroom observations did not lend much support to this. The results seemed to suggest that the teachers lack a clear understanding of SDL. Hence, there is a need to make aware and infuse SDLeR for Biology among pre-service teachers. Pre-service teachers can be made more aware of what is SDL and about how constructive interactions can enhance SDL readiness.

### 8.3.4 Implication for school management

One of the factors influencing the SDL readiness was “time”. This indicates that students and teachers find it difficult to engage with their daily learning and teaching processes, due to the time factor. This implies that school management should seriously look into managing the activities conducted during school hours, especially in the lesson planning for students and distribution of duties for teachers. Students need more time to engage with their learning. There should be time for discussion or time for students to look into resources and for reading. Hence, the school programmes should be designed in a way which helps students to complete their school activities within the allocated schooling hours. In order words, curriculum and co-curriculum activities should be confined to schooling hours.

The management should encourage teachers to plan and design their lessons which encourage constructive interactions. The school management can help teachers in planning and designing their lessons by providing good facilities and resources like library and internet access. In addition, the duties for teachers should be confined to curriculum and co-curriculum activities. Teachers should not be burdened with other duties like fees collecting, writing meeting reports or other errands which can be done by the school administration staff. Hence, the school management should be involved in helping the teachers to be readied for SDL lessons. Allowing the teachers to engage with their lessons through constructive interactions with good school management could be an area of future study.

## 8.4 Suggestions of future study

This research covered only the STPM Biology students' and teachers' readiness towards SDL. Hence, it covered only one type of pre-university programmes provided in Malaysia. Future studies should be carried out with other pre-university programmes available in Malaysia. In addition the research also can be conducted for other disciplines. Adaptations can be made to the SDLRSbio and SDLeRSbio for future studies. By covering different pre-university programmes and different disciplines, the profile of pre-university students' and teachers' SDL readiness will be more comprehensive. A better understanding can be obtained in relation to various disciplines with these further studies.

Longitudinal research could also be conducted by investigating students who move from pre-university to the university or college level to trace if there are changes to their SDLR.

In this study, the knowledge domain in relation to SDL was investigated (factual, conceptual, procedural, and metacognition as shown in Table 4.2 at p.78). Future studies can focus upon the thought processes involved as constructive interactions occurs to deliver deeper into how cognitive, emotional and physical engagements can be more meaningful.

## 8.5 Conclusion

The present study conducted was a nationwide study. The sample of STPM Biology students and teachers were selected from every state. The research developed two scales to measure SDLR and SDLeR for STPM Biology students and teachers respectively. Therefore, the national profile for SDLR and SDLeR was established through the quantitative approaches utilised in the study and complemented by qualitative data, which indicates a range of readiness for both students and teachers of STPM Biology. Although, a range exists, the novel finding is that the SDLR and SDLeR of students and teachers for STPM Biology respectively appeared to be above the influence of any particular learning and teaching style.

These findings question the understanding that equates student-centred learning strategies and environments with SDL. It appears that to perhaps be truly SDL readied, where students are able to set and manage their own learning objectives no matter how they like to learn; and where teachers are able to engage students physically, cognitively, and emotionally in a more meaningful manner within any learning styles and teaching styles they may follow, interactions between teacher and students as well as among students could be the key. In other words the study points to the fact that what is needed to boost SDLR and SDLeR are constructive interactions in the STPM Biology classroom.

Thus, taking into account the various teaching and learning styles that will continue to exist among STPM Biology students and teachers, perhaps it is time to focus more on the techniques of enhancing constructive interactions (which already is occurring in the classrooms, but perhaps not really given emphasis) with each of the teaching and learning styles as well as within a teacher-centred or a student centred environment. This view can perhaps also be researched into within other areas of science learning.

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**Appendix I** The Initial Constructs and Items for SDLRSbio and SDLeRSbio

| Predetermined Constructs and Items | | |
|---|---|---|
| **General Skills Readiness items**<br>**(Some of the items at this domain adapted from SDLRS for nursing education developed by Dr. Murray Fisher)** | | |
| **Constructs** | | **Items** |
| Cognitive readiness | | 1. How often do you critic on others' ideas? |
| | | 2. How often you can understand others' ideas and presentations fully? |
| | | 3. How often can you recall the ideas or presentations you just received? |
| | | 4. How often do you apply the others' ideas or presentations in your own way? |
| | | 5. How often do you question about the others' ideas or presentations? |
| | | 6. How often do you make changes to the ideas and presentations of others? |
| | | 7. How often do you gather facts before making decision? |
| Learning skills readiness | | 8. How well can you conduct experiment without helps of others (teachers)? |
| | | 9. How well can you utilize the laboratory's utilities? |
| | | 10. How well can you design your own experiment? |
| | | 11. How often you use internet to search for desired information? |
| | | 12. How often do you use computers or related devices to do your assignment? |
| | | 13. Do you always have enough time to complete your work? |
| | | 14. Do you always complete your work on time? |
| | | 15. Do you always keep your assignments or work in order? |
| | | 16. Do you always have a record of your work? |
| | | 17. Do you always able to find your notes and work without problems? |
| | | 18. How often you prioritize your work? |
| Emotional readiness | | 19. Do you always find it easy to accept others' ideas? |
| | | 20. Do you always find it easy to accept critics? |
| | | 21. How often do you discuss your work with others (teacher/friend)? |
| | | 22. How often do you reward yourself? |
| | | 23. How often do you praise others? |
| | | 24. Do you always find it easy to share your ideas with others? |
| | | 25. Do you always find it easy for others to talk to you? |
| **Specific Biology skills readiness towards SDL** | | |
| Laboratory skills | Use of Instruments | 26. How well do you manage the use of light microscope? |
| | | 27. How well do you manage the use of centrifuge machine? |
| | | 28. How well do you manage the use of oven? |
| | | 29. How well do you understand the use and function of the chemicals provided all the time? |
| | | 30. How well do you know the use and function of all reagents to conduct food tests? |
| | Techniques | 31. How well can you sterilize your instrument? |
| | | 32. How well can you prepare slide? |
| | | 33. How well can you conduct dissection? |
| | | 34. How well can you conduct fermentation? |
| | | 35. How well can you prepare agar nutrient? |
| | | 36. How well can you handle and prepare life specimen? |
| | Data collection / reading instrument | 37. How well can you read the measurement from pippet/measuring cylinder? |
| | | 38. How well can you identify and record the observation from slide? |
| | | 39. How well can you label and draw diagram? |
| Experimental Design skills | | 40. How well can you design your own experiment? |
| | | 41. How well can you identify the procedures and techniques used in your experiment? |
| | | 42. How well can you prepare a written report for your experiment? |
| Data Analysis and interpretation skills | | 43. How well can you transfer data collected into other readable format? (graph, chart, diagram, table etc) |
| | | 44. Do you always describe the observation accurately in form of number, diagram or written report? |
| | | 45. Do you always make your own discussion and conclusion according to the results? |
| Facilitating skills | | 46. How often do you conduct group work / SDL (student-centered learning) in your lessons? |
| | | 47. How often do you conduct lecture (teacher-centered learning) in your lessons? |
| | | 48. Do you always allow ampler time for students to give their ideas? |
| | | 49. Do you always help your students in their assignment? |
| | | 50. To what extent do you agreed that teacher should be facilitator? |
| | | 51. To what extent do you agreed students can conduct learning by themselves? |
| | | 52. Do you always set targets and goals for your students? |
| | | 53. Do you always encourage students to conduct their own research? |

## **Appendix II** Initial developed SDLRSbio and SDLeRSbio

This survey is carried out to understand the readiness of students and teachers toward self-directed learning. Self-directed learning is a learning approach which adopted by many local and foreign universities. It is an approach where students engage to learning by achieving their own designed objectives and pace.

Please kindly put a ( ✓ ) to your answers at respective column. It is ensured that, all your particulars and answers provided will be kept secret for the use of research only.
Should you need further information, please kindly contact Kwan Siew Wai, at 012 3683919, or kwansiewwai@yahoo.com

Your cooperation and serious participation in the survey are highly appreciated.

**Part A: Personal information**

Name:__________________________ School:_________________________
Class : _________________________ Age:___________________________
Year of service (for teacher only): __________ Male/Female:__________________________

**General instruction:**
**Student please answers PART B only. Teacher please answers PART B and PART C.**

**Part B: Self-Directed Learning Readiness Scale in Biology Study survey form**
**Instruction**
This part of the survey fills up by both Biology teacher and student. Please refer to the 5-point Likert scale for the description. Put a ( ✓ ) as your answer at the respective column for each items. Please answer all the items.

1= disagree strongly, 2= disagree, 3= neutral, 4= agree, 5= strongly agree

| **Self-Directed Learning Readiness Scale in Biology Study (SDLRSbio)** | | | | | | |
|---|---|---|---|---|---|---|
| **General Skills Readiness in Biology Study** | | **1** | **2** | **3** | **4** | **5** |
| Biology Cognitive readiness | 1. I usually give comments on other's ideas about biological concepts. | | | | | |
| | 2. I usually can understand the biological concepts proposed by others. | | | | | |
| | 3. I am able to recall the biological concepts when I need to apply them. | | | | | |
| | 4. I can apply the biological concepts in my own way. | | | | | |
| | 5. I can make changes on other's ideas about biological concepts. | | | | | |
| | 6. I usually refer to the biological concepts which I learned before making any conclusion. | | | | | |
| | 7. I can relate most of the biological concepts which I come across. | | | | | |
| Biology Learning Skills Readiness | 8. I can use information technology effectively in my biology study. | | | | | |
| | 9. I always keep a note of my ideas, reflections, and new learning in biology. | | | | | |
| | 10. I can self-evaluate my learning outcomes in biology study. | | | | | |
| | 11. I can identify the areas for further study in my biology study. | | | | | |
| | 12. I always seek for helps when I faced problems in learning biology. | | | | | |
| | 13. I can complete my biology assignments on time. | | | | | |
| | 14. I keep track of my biology learning progress | | | | | |
| Emotional readiness in Biology | 15. I find it easy to accept other's idea in biology. | | | | | |
| | 16. I always discuss my biology assignments with others (teacher/friend). | | | | | |
| | 17. I always reward myself when I successfully completed my biology assignments. | | | | | |
| | 18. I always share my biology concepts or ideas with others. | | | | | |
| | 19. I appreciate when my biology assignments can be peer reviewed. | | | | | |
| | 20. I find both success and failure inspire me to further learning in biology. | | | | | |
| | 21. I keep an open mind on others' ideas in biology study. | | | | | |
| **Specific Biology skills readiness towards SDL** | | | | | | |
| Laboratory skills — Use of Instruments | 22. I can use the light microscope to observe my specimen slides. | | | | | |
| | 23. I can use the centrifuge machine for biology experiment. | | | | | |
| | 24. I can use the chemicals provided for biology experiment. | | | | | |
| | 25. I can conduct food tests to identify the classes of food present in a specimen. | | | | | |
| | 26. I can sterilize my instruments for biology experiments. | | | | | |
| Laboratory skills — Techniques | 27. I can prepare slides for biology specimens. | | | | | |
| | 28. I can dissect the life specimens given. | | | | | |
| | 29. I can conduct fermentation for biology experiments. | | | | | |
| | 30. I can prepare agar nutrient for biology experiments. | | | | | |

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| | Data collection / reading instrument | 31. I can handle or prepare life specimens for biology experiments. | | | | | |
| | | 32. I can read the measurement accurately from the instruments (pippet/measuring cylinder). | | | | | |
| | | 33. I can identify and record the image from slides under microscope observation. | | | | | |
| | | 34. I can draw and label diagrams and figures accurately for biology experiments. | | | | | |
| | | 35. I can record observation accurately for biology experiments. | | | | | |
| | | 36. I can gather records of observations from different groups for biology experiments. | | | | | |
| Experimental Design skills | | 37. I can design my own biology experiment. | | | | | |
| | | 38. I can conduct biology experiments independently. | | | | | |
| | | 39. I can describe the procedures and techniques used in biology experiment. | | | | | |
| | | 40. I can prepare a written report for my biology experiment. | | | | | |
| | | 41. I can make changes in my biology experiment according to the specimens given. | | | | | |
| Data Analysis and interpretation skills | | 42. I can transfer data collected into other readable format (graph, chart, diagram, table etc). | | | | | |
| | | 43. I can describe the observation for biology experiment accurately in form of number, diagram, figure or written report. | | | | | |
| | | 44. I can discuss and conclude according to the results of biology experiments. | | | | | |
| | | 45. I usually discuss with others to make generalization in my observations of biology experiments. | | | | | |
| | | 46. I usually compare my data with others before making any conclusion on my results for biology experiments. | | | | | |

**Part C: Self-Directed Learning Lessons Readiness Scale in Biology Study**

This part of the scale fills up only by Biology teacher.

| Self-Directed Learning Lessons Readiness Scale in Biology Study (SDLeRS) items | | | | | | |
|---|---|---|---|---|---|---|
| Items | | 1 | 2 | 3 | 4 | 5 |
| Facilitating skills readiness | 47. I usually conduct student centered learning during my biology lessons (for example: group work). | | | | | |
| | 48. I keep an open mind for students' ideas and opinions in biology. | | | | | |
| | 49. I usually encourage students to share their biology concepts and ideas. | | | | | |
| | 50. I usually facilitat my students in completing their biology assignment. | | | | | |
| | 51. I act as a facilitator while conducting my biology lessons. | | | | | |
| | 52. I encourage students to set their own learning targets or objectives during my biology lessons. | | | | | |
| | 53. I usually allow ample time for my students to conduct their biology experiments. | | | | | |

-----------------------------------------------End of survey-------------------------------------

Thank you very much for your time and patient in completing the survey thoroughly.

## **Appendix III** The Final Self-Directed Learning Lesson Readiness Scale for Biology (SDLeRSbio)

Dear Sir/Madam, Mr/Ms/Mrs;

This research is carried out to understand the readiness of teacher towards self-directed learning (SDL) in biology. Self-directed learning is adopted in many local and foreign universities as an approach to help students in setting, achieving and planning their own learning objectives.

By participating in this survey, you will contribute to the understanding of teachers' readiness toward SDL in biology. This is very important for the planning and developing of biology curriculum in future.

Please kindly check ( ✓ ) your answers at respective column. It is ensured that your personal details and answers provided will be kept confidential for the use of research only. Your kind cooperation and serious participation in the research is highly appreciated.

Please kindly email the completed form to kwansiewwai@yahoo.com. Should you need further information, please do not hesitate to contact me at kwansiewwai@yahoo.com, or 012 368 3919.

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### Self-Directed Learning Lesson Readiness Scales in Biology (SDLeSbio)

| **Part A: Demographic Detail** | |
|---|---|
| 1) | Name |
| 2) | Gender (1) ☐Male (2) ☐Female |
| 3) | Age |
| 4) | Year of service |
| 5) | Job designation |

**Part B : Self-directed Learning Lesson Readiness Scale in Biology**

**General Instruction:**

Please refers to the 5-point Likert scale for the description of answers. Put a ( ✓ ) to your answer at the respective column for each items. Please answer all the items.

1= Strongly disagree, 2 = disagree, 3 = neutral, 4 = agree, 5 = strongly agree

| **General Skills Readiness** | | **1** | **2** | **3** | **4** | **5** |
|---|---|---|---|---|---|---|
| **Biology Cognitive Readiness** | 1. I am able to comments on other's ideas about biological concepts. | ☐ | ☐ | ☐ | ☐ | ☐ |
| | 2. I am able to understand the biological concepts proposed by others. | ☐ | ☐ | ☐ | ☐ | ☐ |
| | 3. I am able to recall relevant biological concepts when I need to apply them. | ☐ | ☐ | ☐ | ☐ | ☐ |
| | 4. I am able to apply biological concepts in my daily life. | ☐ | ☐ | ☐ | ☐ | ☐ |
| | 5. I am able to convince others to change their ideas about biological concepts. | ☐ | ☐ | ☐ | ☐ | ☐ |
| | 6. I am able to interpret biological concepts which I have learnt in making conclusions. | ☐ | ☐ | ☐ | ☐ | ☐ |
| | 7. I am able to relate biological concepts which I have learnt. | ☐ | ☐ | ☐ | ☐ | ☐ |
| **Biology Learning Skills Readiness** | 8. I can use information technology effectively when studying biology. | ☐ | ☐ | ☐ | ☐ | ☐ |
| | 9. I always keep notes of my ideas, reflections, and new learning in biology. | ☐ | ☐ | ☐ | ☐ | ☐ |
| | 10. I can self-evaluate my learning objectives when studying biology. | ☐ | ☐ | ☐ | ☐ | ☐ |
| | 11. I can identify the areas for further study when studying in biology. | ☐ | ☐ | ☐ | ☐ | ☐ |
| | 12. I always seek for help when I face problem in learning biology. | ☐ | ☐ | ☐ | ☐ | ☐ |
| | 13. I can complete my biology assignment on time. | ☐ | ☐ | ☐ | ☐ | ☐ |
| | 14. I keep track of my biology learning progress. | ☐ | ☐ | ☐ | ☐ | ☐ |
| **Emotional Readiness in Biology** | 15. I find it easy to accept others' ideas in biology. | ☐ | ☐ | ☐ | ☐ | ☐ |
| | 16. I always discuss my biology assignment with others. | ☐ | ☐ | ☐ | ☐ | ☐ |
| | 17. I always reward myself when I successfully completed my biology assignment. | ☐ | ☐ | ☐ | ☐ | ☐ |
| | 18. I always share my biology concepts or ideas with others. | ☐ | ☐ | ☐ | ☐ | ☐ |
| | 19. I appreciate my biology assignment being check by others. | ☐ | ☐ | ☐ | ☐ | ☐ |
| | 20. I find both success and failure inspire me to continue my study in biology. | ☐ | ☐ | ☐ | ☐ | ☐ |
| | 21. I keep an open mind about ideas of others when studying biology. | ☐ | ☐ | ☐ | ☐ | ☐ |
| **Biology Skills Readiness** | | | | | | |
| **Laboratory Skills – Use of Instruments** | 22. I can use light microscope to observe specimen. | ☐ | ☐ | ☐ | ☐ | ☐ |
| | 23. I can use centrifuge machine for biology experiments. | ☐ | ☐ | ☐ | ☐ | ☐ |
| | 24. I can use chemical provided for biology experiments. | ☐ | ☐ | ☐ | ☐ | ☐ |
| | 25. I can conduct tests to identify the classes of food present in a specimen. | ☐ | ☐ | ☐ | ☐ | ☐ |
| | 26. I can sterilize instruments for biology experiments. | ☐ | ☐ | ☐ | ☐ | ☐ |

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| | Techniques | 27. I can prepare slides for biology specimen. | ☐ | ☐ | ☐ | ☐ | ☐ |
| | | 28. I can dissect life specimens. | ☐ | ☐ | ☐ | ☐ | ☐ |
| | | 29. I can conduct fermentation for biology experiments. | ☐ | ☐ | ☐ | ☐ | ☐ |
| | | 30. I can prepare agar nutrients for biology experiments. | ☐ | ☐ | ☐ | ☐ | ☐ |
| | | 31. I can prepare life specimens for biology experiments. | ☐ | ☐ | ☐ | ☐ | ☐ |
| | Data collection / Reading Instrument | 32. I can read the measurement accurately from laboratory instruments (pipet/measuring cylinder). | ☐ | ☐ | ☐ | ☐ | ☐ |
| | | 33. I can identify and record image from slides under microscope. | ☐ | ☐ | ☐ | ☐ | ☐ |
| | | 34. I can draw and label diagrams and figures accurately for biology experiments. | ☐ | ☐ | ☐ | ☐ | ☐ |
| | | 35. I can record observations accurately for biology experiments. | ☐ | ☐ | ☐ | ☐ | ☐ |
| | | 36. I usually share and collaborate experiments' results and observations with friends. | ☐ | ☐ | ☐ | ☐ | ☐ |
| Experimental Design Skills | | 37. I can design my own biology experiment. | ☐ | ☐ | ☐ | ☐ | ☐ |
| | | 38. I can conduct biology experiment independently. | ☐ | ☐ | ☐ | ☐ | ☐ |
| | | 39. I can describe the procedures and techniques in biology experiments. | ☐ | ☐ | ☐ | ☐ | ☐ |
| | | 40. I can prepare a written report for biology experiments. | ☐ | ☐ | ☐ | ☐ | ☐ |
| | | 41. I can modify the experiment procedures according to the specimens given. | ☐ | ☐ | ☐ | ☐ | ☐ |
| Data Analysis and Interpretation Skills | | 42. I can transfer data collected into other readable formats (graph, chart, diagram, table etc). | ☐ | ☐ | ☐ | ☐ | ☐ |
| | | 43. I can describe observation for biology experiment accurately in written reports. | ☐ | ☐ | ☐ | ☐ | ☐ |
| | | 44. I can discuss my results in biology experiments with others. | ☐ | ☐ | ☐ | ☐ | ☐ |
| | | 45. I can make general comments with the observations I get in biology experiments. | ☐ | ☐ | ☐ | ☐ | ☐ |
| | | 46. I usually compare my data with others' before making conclusion. | ☐ | ☐ | ☐ | ☐ | ☐ |
| Interacting skills readiness | | 47. I often pay attention to student's learning objectives rather than my planned teaching objectives. | ☐ | ☐ | ☐ | ☐ | ☐ |
| | | 48. I keep an open mind for students' ideas and opinions in biology. | ☐ | ☐ | ☐ | ☐ | ☐ |
| | | 49. I often encourage students to share their biology concepts and ideas. | ☐ | ☐ | ☐ | ☐ | ☐ |
| | | 50. I often facilitate my students in completing their biology assignments. | ☐ | ☐ | ☐ | ☐ | ☐ |
| | | 51. I preferred to act as a facilitator while conducting my biology lessons. | ☐ | ☐ | ☐ | ☐ | ☐ |
| | | 52. I often encourage students to set their own learning targets or objectives during my biology lessons. | ☐ | ☐ | ☐ | ☐ | ☐ |
| | | 53. I often allow ample time for my students to conduct their biology experiments. | ☐ | ☐ | ☐ | ☐ | ☐ |
| Please total the points from question 1 to 53 | | | Total points: | | | | |
| What factors do you think would influent your self-directed learning readiness? | | | | | | | |

------------------------------------------ End of Survey ---------------------------------------------------

Thank you very much for your time and patient in completing the survey thoroughly.

Upon completion of this survey, please kindly return the form by emailing to kwansiewwai@yahoo.com

**REMARKS:**

**Scale developed by Kwan Siew Wai. Usage of the scale for other study should acquire consent from the author of the scale. Please acquire written consent from the author prior to administering the scale for research, test or other personal's or company's objectives.**

## **Appendix IV** The Final Self-Director Learning Readiness Scale for Biology (SDLRSbio)

Dear Sir/Madam, Mr/Ms/Mrs;

This research is carried out to understand the readiness of students toward self-directed learning (SDL) in biology. Self-directed learning is adopted in many local and foreign universities as an approach to help students in setting, achieving and planning their own learning objectives.

By participating in this survey, you will contribute to the understanding of students' readiness toward SDL in biology. This is important for the planning and developing of biology curriculum in future.

Please kindly check ( ✓ ) your answers at respective column. It is ensured that your particular and answers provided will be kept confidential for the use of research only. Your kind cooperation and serious participation in the research is highly appreciated.

Please kindly email the completed form to kwansiewwai@yahoo.com. Should you need further information, please do not hesitate to contact me at kwansiewwai@yahoo.com, or 012 368 3919.

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**Self-Directed Learning Readiness Scales in Biology (SDLSbio)**

| **Part A: Demographic Detail** | |
|---|---|
| 1) | Name |
| 2) | Gender (1) ☐Male (2) ☐Female |
| 3) | Age |

**Part B : Self-directed Learning Readiness Scale in Biology**

**General Instruction:**

Please refers to the 5-point Likert scale for the description of answers. Put a ( ✓ ) to your answer at the respective column for each items. Please answer all the items.
1= Strongly disagree, 2 = disagree, 3 = neutral, 4 = agree,5 = strongly agree

| **General Skills Readiness** | | | **1** | **2** | **3** | **4** | **5** |
|---|---|---|---|---|---|---|---|
| **Biology Cognitive Readiness** | | 1. I am able to comments on other's ideas about biological concepts. | ☐ | ☐ | ☐ | ☐ | ☐ |
| | | 2. I am able to understand the biological concepts proposed by others. | ☐ | ☐ | ☐ | ☐ | ☐ |
| | | 3. I am able to recall relevant biological concepts when I need to apply them. | ☐ | ☐ | ☐ | ☐ | ☐ |
| | | 4. I am able to apply biological concepts in my daily life. | ☐ | ☐ | ☐ | ☐ | ☐ |
| | | 5. I am able to convince others to change their ideas about biological concepts. | ☐ | ☐ | ☐ | ☐ | ☐ |
| | | 6. I am able to interpret biological concepts which I have learnt in making conclusions. | ☐ | ☐ | ☐ | ☐ | ☐ |
| | | 7. I am able to relate biological concepts which I have learnt. | ☐ | ☐ | ☐ | ☐ | ☐ |
| **Biology Learning Skills Readiness** | | 8. I can use information technology effectively when studying biology. | ☐ | ☐ | ☐ | ☐ | ☐ |
| | | 9. I always keep notes of my ideas, reflections, and new learning in biology. | ☐ | ☐ | ☐ | ☐ | ☐ |
| | | 10. I can self-evaluate my learning objectives when studying biology. | ☐ | ☐ | ☐ | ☐ | ☐ |
| | | 11. I can identify the areas for further study when studying in biology. | ☐ | ☐ | ☐ | ☐ | ☐ |
| | | 12. I always seek for help when I face problem in learning biology. | ☐ | ☐ | ☐ | ☐ | ☐ |
| | | 13. I can complete my biology assignment on time. | ☐ | ☐ | ☐ | ☐ | ☐ |
| | | 14. I keep track of my biology learning progress. | ☐ | ☐ | ☐ | ☐ | ☐ |
| **Emotional Readiness in Biology** | | 15. I find it easy to accept others' ideas in biology. | ☐ | ☐ | ☐ | ☐ | ☐ |
| | | 16. I always discuss my biology assignment with others. | ☐ | ☐ | ☐ | ☐ | ☐ |
| | | 17. I always reward myself when I successfully completed my biology assignment. | ☐ | ☐ | ☐ | ☐ | ☐ |
| | | 18. I always share my biology concepts or ideas with others. | ☐ | ☐ | ☐ | ☐ | ☐ |
| | | 19. I appreciate my biology assignment being check by others. | ☐ | ☐ | ☐ | ☐ | ☐ |
| | | 20. I find both success and failure inspire me to continue my study in biology. | ☐ | ☐ | ☐ | ☐ | ☐ |
| | | 21. I keep an open mind about ideas of others when studying biology. | ☐ | ☐ | ☐ | ☐ | ☐ |
| **Biology Skills Readiness** | | | | | | | |
| **Laboratory Skills** | **Use of Instruments** | 22. I can use light microscope to observe specimen. | ☐ | ☐ | ☐ | ☐ | ☐ |
| | | 23. I can use centrifuge machine for biology experiments. | ☐ | ☐ | ☐ | ☐ | ☐ |
| | | 24. I can use chemical provided for biology experiments. | ☐ | ☐ | ☐ | ☐ | ☐ |
| | | 25. I can conduct tests to identify the classes of food present in a specimen. | ☐ | ☐ | ☐ | ☐ | ☐ |
| | | 26. I can sterilize instruments for biology experiments. | ☐ | ☐ | ☐ | ☐ | ☐ |
| | **Techniques** | 27. I can prepare slides for biology specimen. | ☐ | ☐ | ☐ | ☐ | ☐ |
| | | 28. I can dissect life specimens. | ☐ | ☐ | ☐ | ☐ | ☐ |
| | | 29. I can conduct fermentation for biology experiments. | ☐ | ☐ | ☐ | ☐ | ☐ |
| | | 30. I can prepare agar nutrients for biology experiments. | ☐ | ☐ | ☐ | ☐ | ☐ |
| | | 31. I can prepare life specimens for biology experiments. | ☐ | ☐ | ☐ | ☐ | ☐ |

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| | **Data collection / Reading instrument** | 32. I can read the measurement accurately from laboratory instruments (pipet/measuring cylinder). | ☐ | ☐ | ☐ | ☐ | ☐ |
| | | 33. I can identify and record image from slides under microscope. | ☐ | ☐ | ☐ | ☐ | ☐ |
| | | 34. I can draw and label diagrams and figures accurately for biology experiments. | ☐ | ☐ | ☐ | ☐ | ☐ |
| | | 35. I can record observations accurately for biology experiments. | ☐ | ☐ | ☐ | ☐ | ☐ |
| | | 36. I usually share and collaborate experiments' results and observations with friends. | ☐ | ☐ | ☐ | ☐ | ☐ |
| **Experimental Design Skills** | | 37. I can design my own biology experiment. | ☐ | ☐ | ☐ | ☐ | ☐ |
| | | 38. I can conduct biology experiment independently. | ☐ | ☐ | ☐ | ☐ | ☐ |
| | | 39. I can describe the procedures and techniques in biology experiments. | ☐ | ☐ | ☐ | ☐ | ☐ |
| | | 40. I can prepare a written report for biology experiments. | ☐ | ☐ | ☐ | ☐ | ☐ |
| | | 41. I can modify the experiment procedures according to the specimens given. | ☐ | ☐ | ☐ | ☐ | ☐ |
| **Data Analysis and Interpretation skills** | | 42. I can transfer data collected into other readable formats (graph, chart, diagram, table etc). | ☐ | ☐ | ☐ | ☐ | ☐ |
| | | 43. I can describe observation for biology experiment accurately in written reports. | ☐ | ☐ | ☐ | ☐ | ☐ |
| | | 44. I can discuss my results in biology experiments with others. | ☐ | ☐ | ☐ | ☐ | ☐ |
| | | 45. I can make general comments with the observations I get in biology experiments. | ☐ | ☐ | ☐ | ☐ | ☐ |
| | | 46. I usually compare my data with others' before making conclusion. | ☐ | ☐ | ☐ | ☐ | ☐ |
| Please total the points from question 1 to 46 | | | Total points: | | | | |
| What factors do you think would influent your self-directed learning readiness? | | | | | | | |

------------------------------------------ End of Survey --------------------------------------------------------

Thank you very much for your time and patient in completing the survey thoroughly.Upon completion of this survey, please kindly return the form by emailing to kwansiewwai@yahoo.com

**REMARKS:**
**Scale developed by Kwan Siew Wai. Usage of the scale for other study should acquire consent from the author of the scale. Please acquire written consent from the author prior to administering the scale for research, test or other personal's or company's objectives.**

**Appendix V** Preference of Learning Styles for Biology (PLSbio)
(Adapted from LSQ by Honey and Mumford)
This survey will help to identify your learning styles preference in learning biology which developed over the years. By doing this will help you to make decision in selecting learning experiences which best suit your style for learning biology.

This survey will probably take 10 – 15mins. Circle the number of the statements which you agree more than disagree, and cross the number of the statements which you disagree more than agree. Make sure you mark all the items.

| | **Statements** |
|---|---|
| 1 | I would like to be sure and accurate about the things that I say and write in biology |
| 2 | I prefer simple, straightforward things rather than something complicated in biology |
| 3 | I take risks when necessary |
| 4 | I am careful about making conclusions without strong evidence. |
| 5 | I prefer to use a step by step approach in solving problems related to biology |
| 6 | The would apply the biology knowledge I learn in my daily life |
| 7 | I often do things related to biology just because I feel like it rather than thinking about it first. |
| 8 | I make careful decisions after considering all the possibilities. |
| 9 | I don't easily make assumptions before checking on it. |
| 10 | When I hear about new idea related to biology I immediately start to think of how I can try it out. |
| 11 | I actively seek and try out new things related to biology. |
| 12 | I prefer to think things through before coming to a conclusion |
| 13 | I prefer to follow strict schedules in learning biology. |
| 14 | I go straight to the point during discussion related to biology. |
| 15 | I like trying something new and different in biology because it challenged me. |
| 16 | I prefer as much information as possible about a situation related to biology, the more information the better. |
| 17 | I prefer things fits into some sort of pattern rather than having things unanswered. |
| 18 | I tend to judge other people's ideas on how they work in practice |
| 19 | I prefer to act upon situations as it comes along rather than to have a planned action. |
| 20 | I prefer to make decision based on facts rather than just because I feel that it is right. |
| 21 | I find it tough to spontaneously create wild ideas related to biology. |
| 22 | I can contribute workable ideas in a discussion related to biology. |
| 23 | I can contribute many ideas in a discussion related to biology. |
| 24 | I like to analyse problems from various angles before solving them. |
| 25 | I am a perfectionist. |
| 26 | Quite often I can work out more practical ways of doing things related to biology. |
| 27 | Usually I talk more than I listen. |
| 28 | I make several drafts for my work related to biology before deciding on the final version |
| 29 | To me logical thinking is necessary for solving problems related to biology. |
| 30 | To me wild ideas are not very practical. |
| 31 | I feel that rules and plans take the enjoyment out of things |
| 32 | I like to consider all the alternatives before making my mind up |
| 33 | I like to find how things related to biology work. |
| 34 | To me as long as we get something to work, the process does not matter. |
| 35 | I am usually the center of attention at any party. |
| 36 | It is best to think twice before you act |
| 37 | I like to have meetings and discussion about biology problems conduct in a proper order. |
| 38 | I do my best to accomplish the job given. |
| 39 | I don't mind things get into unusual situations. |
| 40 | I usually do more listening than talking when learning biology. |

NAME: ____________________________

**SCORING**

In this scoring chart, circle the number of the statements which you had circled. Add up the circles at each column to see which learning styles you preferred the most.

| | | | |
|---|---|---|---|
| 1 | 2 | 3 | 4 |
| 5 | 6 | 7 | 8 |
| 9 | 10 | 11 | 12 |
| 13 | 14 | 15 | 16 |
| 17 | 18 | 19 | 20 |
| 21 | 22 | 23 | 24 |
| 25 | 26 | 27 | 28 |
| 29 | 30 | 31 | 32 |
| 33 | 34 | 35 | 36 |
| 37 | 38 | 39 | 40 |
| | | | |

**Appendix VI** Teaching Styles Survey
Name: ______________________________

**Teaching Style Survey (Grasha-Riechmann)**
The following is a Grasha-Riechmann teaching style survey. Respond to each of the items below in terms of how you teach.

If you teach some courses differently than others, respond in terms only of one specific course. Fill out another survey for the course(s) that you teach in a different style. Try to answer as honestly and as objectively as you can. Resist the temptation to respond as you believe you should or ought to think or behave, or in terms of what you believe is the expected or proper thing to do.

Respond to questions below by using the following rating scale:
**1 = strongly disagree | 2 = moderately disagree | 3 = undecided |**
**4 = moderately agree | 5 = strongly agree**



| | | |
|---|---|---|
| 1. | Facts, concepts, and principles are the most important things that students should acquire. | **Response:** ☐ |
| 2. | I set high standards for students in this class.. | **Response:** ☐ |
| 3. | What I say and do models appropriate ways for students to think about issues in the content. | **Response:** ☐ |
| 4. | My teaching goals and methods address a variety of student learning styles. | **Response:** ☐ |
| 5. | Students typically work on course projects alone with little supervision from me. | **Response:** ☐ |
| 6. | Sharing my knowledge and expertise with students is very important to me. | **Response:** ☐ |
| 7. | I give students negative feedback when their performance is unsatisfactory. | **Response:** ☐ |
| 8. | Activities in this class encourage students to develop their own ideas about content issues. | **Response:** ☐ |
| 9. | I spend time consulting with students on how to improve their work on individual and/or group projects. | **Response:** ☐ |
| 10. | Activities in this class encourage students to develop their own ideas about content issues. | **Response:** ☐ |
| 11. | What I have to say about a topic is important for students to acquire a broader perspective on the issues in that area. | **Response:** ☐ |
| 12. | Students would describe my standards and expectations as somewhat strict and rigid. | **Response:** ☐ |
| 13. | I typically show students how and what to do in order to master course content. | **Response:** ☐ |
| 14. | Small group discussions are employed to help students develop their ability to think critically. | **Response:** ☐ |
| 15. | Students design one of more self-directed learning experiences. | **Response:** ☐ |
| 16. | I want students to leave this course well prepared for further work in this area. | **Response:** ☐ |
| 17. | It is my responsibility to define what students must learn and how they should learn it. | **Response:** ☐ |
| 18. | Examples from my personal experiences often are used to illustate points about the material. | **Response:** ☐ |
| 19. | I guide students' work on course projects by asking questions, exploring options, and suggesting alternative ways to do things. | **Response:** ☐ |
| 20. | Developing the ability of students to think and work independently is an important goal. | **Response:** ☐ |

| | | |
|---|---|---|
| 21. | Lecturing is a significant part of how I teach each of the class sessions. | **Response:** ☐ |
| 22. | I provide very clear guidelines for how I want tasks completed in this course. | **Response:** ☐ |
| 23. | I often show students how they can use various principles and concepts. | **Response:** ☐ |
| 24. | Course activities encourage students to take initiative and responsibility for their learning. | **Response:** ☐ |
| 25. | Students take responsibility for teaching part of the class sessions. | **Response:** ☐ |
| 26. | My expertise is typically used to resolve disagreements about content issues. | **Response:** ☐ |
| 27. | This course has very specific goals and objectives that I want to accomplish. | **Response:** ☐ |
| 28. | Students receive frequent verbal and/or written comments on their performance. | **Response:** ☐ |
| 29. | I solicit student advice about how and what to teach in this course. | **Response:** ☐ |
| 30. | Students set their own pace for completing independent and/or group projects. | **Response:** ☐ |
| 31. | Students might describe me as a "storehouse of knowledge" who dispenses the fact, principles, and concepts they need. | **Response:** ☐ |
| 32. | My expectations for what I want students to do in this class are clearly defined in the syllabus. | **Response:** ☐ |
| 33. | Eventually, many students begin to think like me about course content. | **Response:** ☐ |
| 34. | Students can make choices among activities in order to complete course requirements. | **Response:** ☐ |
| 35. | My approach to teaching is similar to a manager of a work group who delegates tasks and responsibilities to subordinates. | **Response:** ☐ |
| 36. | There is more material in this course than I have time available to cover it. | **Response:** ☐ |
| 37. | My standards and expectations help students develop the discipline the need to learn. | **Response:** ☐ |
| 38. | Students might describe me as a "coach" who works closely with someone to correct problems in how they think and behave. | **Response:** ☐ |
| 39. | I give students a lot of personal support and encouragement to do well in this course. | **Response:** ☐ |
| 40. | I assume the role of a resource person who is available to students whenever they need help. | **Response:** ☐ |

## **Appendix VII** Initial Teacher Classroom Observation Rubric

This rubric was sent to Delphi panel for validation. Hence, a part was readied for the panel member to give their suggestion in refining this rubric at the initial stage of the preparation process.

**Part A: Personal Information**

Name: ______________________________ Age: ______________________

Year of service: ________________________ Gender: _________________

**Part B : Teacher Observation Rubric (TOR)**

Instruction: In the rubric below, please indicate which item that you think is appropriate and related to self-directed learning in pre-university Biology self-directed learning readiness. You may also input your suggestions at the column given.

Class : ____________________ Time: _____________

| CATEGORY | 4 Very Good/ all the time | 3 Good/often | 2 Poor/seldom | 1 Very poor/never |
|---|---|---|---|---|
| Biology cognitive readiness | The observed teacher mastered the biology concepts very well and cognitively readied for biology SD lesson. | The observed teacher mastered some of the biology concepts and cognitively less readied for biology SD lesson | The observed teacher mastered only a few of biology concepts and cognitively not readied for biology SD lesson | The observed teacher did not master the biology concepts and cognitively not readied for biology SD lesson. |
| Biology learning skills readiness | The observed teacher mastered the learning skills for biology SD lesson. | The observed teacher mastered some of the learning skills for biology SD lesson. | The observed teacher master only a few learning skills for biology SD lesson. | The observed teacher did not master the learning skills for biology SD lesson. |
| Emotional Readiness in Biology | The observed teacher emotionally very readied for biology SD lesson. | The observed teacher emotionally readied for biology SD lesson. | The observed teacher emotionally less readied for biology SD lesson. | The observed teacher emotionally not readied for biology SD lesson. |
| Use of instrument | The observed teacher can give clear and accurate instruction of the use of the instruments. | The observed teacher can give accurate instruction of the use of the instruments. | The observed teacher can give instruction of the use of the instruments | The observed teacher cannot give instruction of the use of the instruments. |
| Laboratory techniques | The observed teacher can give clear and accurate instruction of the techniques of biology experiments. | The observed teacher can give accurate instruction of the techniques of biology experiments. | The observed teacher give instruction of the techniques of biology experiments. | The observed teacher did not give instruction of the techniques of biology experiments. |
| Data collection / reading instrument | The observed teacher can facilitate the collect and record of data /results effectively and accurately | The observed teacher can facilitate the collect and record of data / results accurately | The observed teacher can facilitate the collect and record of data/results. | The observed teacher cannot facilitate the collect and record of data/results. |
| Experimental design skills | The observed teacher can facilitate the design of biology experiment effectively and accurately. | The observed teacher can facilitate the design of biology experiment effectively. | The observed teacher can facilitate the design of biology experiment. | The observed teacher cannot facilitate the design of biology experiment. |
| Data analysis and interpretation skills | The observed teacher can facilitate analyse and interpretation of the data to make conclusion effectively and accurately. | The observed teacher can facilitate analyse and interpretation of the data to make conclusion effectively. | The observed teacher can facilitate analyse and interpretation of the data to make conclusion. | The observed teacher cannot facilitate analyse and interpretation of the data to make conclusion. |
| Facilitation skills readiness | The observed teacher mastered the facilitating skills for biology SD lessons. | The observed teacher mastered some of the facilitating skills for biology SD lessons. | The observed teacher mastered only a few facilitating skills for biology SD lessons. | The observed teacher did not master the facilitating skills for biology SD lessons. |
| What are the possible prohibiting factors observed? | | | | |
| What are the possible promoting factors observed? | | | | |

**Panel suggestions:**
Direction: It is possible that some elements might not be included in Part B. If you have some suggestion in your mind that may be helpful for the improvement of instrument kindly mention in the space provided below;

__________________________________________________________________________

__________________________________________________________________________

Upon completion of this survey, please kindly return the form by emailing to kwansiewwai@yahoo.com, or fax to 6 03 9057 7287

I hereby suggest that, this rubric is suitable (content / language) for the use of identifying the hindering factors in STPM Biology SD lesson.

________________________________

( )

**Appendix VIII** Initial Student Classroom Observation Rubric

This rubric was sent to Delphi panel for validation. Hence, a part was readied for the panel member to give their suggestion in refining this rubric at the initial stage of the preparation process.

**Part A: Personal Information**

Name: ___________________________________ Age: ______________________

Year of service: ___________________________ Gender: _________________

**Part B : Student Observation Rubric (SOR)**

Instruction: In the rubric below, please indicate which item that you think is appropriate and related to self-directed learning in pre-university Biology self-directed learning readiness. You may also input your suggestions at the column given.

Class : __________________________ Time: ________________

| CATEGORY | 4 Very Good/ all the time | 3 Good/often | 2 Poor/seldom | 1 Very poor/never |
|---|---|---|---|---|
| Biology cognitive readiness | The observed student mastered the biology concepts very well and cognitively readied for biology SDL. | The observed student mastered some of the biology concepts and cognitively less readied for biology SDL | The observed student mastered only a few of biology concepts and cognitively not readied for biology SDL | The observed student did not master the biology concepts and cognitively not readied for biology. |
| Biology learning skills readiness | The observed student mastered the learning skills for biology SDL. | The observed student mastered some of the learning skills for biology SDL. | The observed student master only a few learning skills for biology SDL. | The observed student did not master the learning skills for biology SDL. |
| Emotional Readiness in Biology | The observed student emotionally very readied for biology SDL. | The observed student emotionally readied for biology SDL. | The observed student emotionally less readied for biology SDL. | The observed student emotionally not readied for biology SDL. |
| Use of instrument | The observed student can use the instruments accurately | The observed student can use the instruments with limited guidance. | The observed student can use the instruments with extensive guidance and demonstration. | The observed student cannot use the instruments after extensive guidance and demonstration. |
| Laboratory techniques | The observed student mastered all the techniques of biology experiments taught. | The observed student mastered some of the techniques of biology experiments taught. | The observed student mastered only a few techniques of biology experiments taught. | The observed student did not master the techniques of biology experiments taught. |
| Data collection / reading instrument | The observed student can collect and record accurate data /results | The observed student can collect and record accurate data / results with limited guidance. | The observed students can collect and record accurate data/results with extensive guidance and demonstration. | The observed students cannot collect and record accurate data/results after extensive guidance and demonstration. |
| Experimental design skills | The observed student can design biology experiment with clear procedures and techniques identified. | The observed student can design biology experiment with clear procedures and techniques identified with guidance. | The observed student can design biology experiment with clear procedures and techniques identified with extensive guidance and demonstration. | The observed student cannot biology experiment with clear procedures and techniques identified after extensive guidance and demonstration. |
| Data analysis and interpretation skills | The observed student can analyse and interpret the data to make conclusion. | The observed student can analyse and interpret the data to make conclusion with limited guidance. | The observed student can analyse and interpret the data to make conclusion with extensive guidance and demonstration. | The observed student cannot analyse and interpret the data to make conclusion after extensive guidance and demonstration. |
| What are the possible prohibiting factors observed? | | | | |
| What are the possible promoting factors observed? | | | | |

Direction: It is possible that some elements might not be included in Part B. If you have some suggestion in your mind that may be helpful for the improvement of instrument kindly mention in the space provided below;

_______________________________________________________________________

_______________________________________________________________________

_______________________________________________________________________

_______________________________________________________________________

Upon completion of this survey, please kindly return the form by emailing to kwansiewwai@yahoo.com, or fax to 6 03 9057 7287

I hereby suggest that, this rubric is suitable (content / language) for the use of identifying the hindering factors in STPM Biology SDL.

________________________________________________________________________

**Appendix IX** Classroom Observation Protocol

Code:_____________

Name: ___________________________________________ Age: _______

Gender: ________ Time: ___________

School : ____________________ Readiness score:________

**Objective:**

To identify the characteristics of the student/teacher in learning/teaching. (Record the observations of how the student/teacher behaviour during lessons (focus the interactions).

| **Time** | **Observation** | **Remarks** |
|---|---|---|
| 5min | | |
| 10min | | |
| 15min | | |
| 20min | | |
| 25min | | |
| 30min | | |
| 35min | | |
| 40min | | |
| 45min | | |
| 50min | | |
| 55min | | |
| 60min | | |

Field notes / extra comments

**Appendix X** Interview Protocols

**Personal Information**
Name: ____________________________________ Age: ______________________
Year of service: ____________________________ Gender: _________________

**Objective of interview:**
To find out the factors influencing the SDL readiness

**Duration**: 20 – 30 Minutes

**Sample**: STPM Biology teachers and students who are willing to be interviewed

**Instructions**:
Interviewees shall be reminded of the objective of the interview
Consent must be obtained from the interviewee prior to the interview
The interviewee can discontinue the interview at any point of the interview
The interviewee can refuse to answer any questions which they think they do not want to answer
All personal details of the interviewee shall be kept confidential
The content of the interview is only meant for the use of this research

**Interview questions for student**
Students' interview focuses on getting the factors influencing the SDLR for students. The questions will focus on getting the students ideas of what factors they think will influence them in the process of SDL.

How well do you think of your mastery of biology laboratory skills and techniques?
What do you normally do when you face problem in your biology study?
What do your teachers do when you face problem in your biology study?
What do you think about SDL?
How do you think you can study biology with SDL?
How do you normally study biology? Which way do you think most effective in helping you to study biology?

**Interview questions for teacher**
Teachers' interview focuses on getting the factors influencing the teachers' readiness in SDL lessons for STPM Biology. The questions will focus on getting the teachers ideas of what factors they think will influence their SDLeR for Biology.

How well do you think of your mastery of interacting skills in conducting biology lesson?
What will you do when you face problem in conducting biology lesson?
What do your school management board do when you face problem in conducting biology lessons?
What do you think about SDL in biology?
How do you think you can teacher with SDL in Biology?
How do you normally teacher biology? Which way do you think most effectively helping student to study biology?

**Appendix XI** Consent Form

I, ________________________ (IC No: ______________________) hereby agreed to participate in the research conducted by Kwan Siew Wai (IC No: 750725145630) in pursuing her PhD.

I give the consent to Kwan Siew Wai in;

_____ observing my lessons

_____conducting interview with me.

I also knew that all the data collected during interviews and classroom observations are used for the research purposes. There will be no obligation from me to allow Kwan Siew Wai in using the data collected, either in the form of photo, video record, interview transcript, observation field note or other forms of data, in all her reports, articles, book chapters, books and other form of presentation it maybe.

Thank you.

__________________________

Name :

IC No :

Date :

**Appendix XII** Sample of Observation Expanded Field Notes

**CODE : TFN 4**
Observer: Kwan Siew Wai Date : 13/6/13
Time : 11.35 – 12.45 School : MBSSKL
Name : Pn. Aida Gender: Female
Class : Lower 6 (9 students) Year of Service : young

Objective:
1. Identifying the hindering factors of SDLR.
2. Observing ways of interaction between teachers and students.

**Lecture (Lipid)**

The location of the lesson was at the same laboratory as Z *(The previous observed teacher)* did her lessons. The laboratory was tidy and well organized or lecture. With two LCD projectors located at both sides of the center white-board.

I went into the laboratory to meet the teacher, Pn. Aida, 10 mins before the lesson asking for permission to observe her class. She gave me the consent to sit at the back of her class.

When bell rang (recess over), students gradually entering the class. It took about 5min for the students to enter the lab.

Teacher spent time managing the class. *(Looks like she is the class teacher of this group of students.)* The classroom chaos needed to be deal with included, 1. Records of students' details (number of 'A's in SPM), 2. allocation of sport houses, 3. collecting of fees.

After about 10mins Pn Aida started the lesson with giving out some handouts. From her lesson, Pn Aida seem to be an approachable teacher. Students asked much questions during the lesson. Pn Aida was young *(in about yearly 30s)*. Although did not master English very well, she conducted the lesson in both BM and English. Whenever long explanation is needed, she used BM to overcome her weakness in English. She also seems to be moderately mastering the content of lesson. Some of the questions projected by the students were not handled well, and enough information was not provided for students to find the answer themselves.

Students referring to their textbooks and reference books very often. Rarely jotting down notes. Students responded to teacher's questions promptly. However, teacher failed in giving positive response to the students' answers most of the time. Teacher provided changes for the students to ask questions but students do not really know what to ask *(sign of not understanding the content at all)*.
After 20 mins of the lesson, 2 girls started their own conversation at one corner of the class.

During the lesson, teacher frequently referring the lesson to the need of the syllabus.
T: This is important, take note. It is in the examination syllabus.
Teacher gave sample examination questions on the board, asking students to attempt the questions. While students were trying to answer the question, teacher showed an example answer and asked students to jot down the answer.

T: Please jot down the answers (while pointing to the board where she wrote the answers)
Students then stopped the attempts of answering but busy copying the teacher's provided answers.

Whenever students raised question, teacher will approached to the student. The rest of the class actually did not know what happened between the teacher and the student. The question remained secretive to the rest of the class.
T: Take your time. Do your work.
Teacher gave time for students to try questions, and to write down their answers on the handouts. Meanwhile teacher walking around to give personal guidance to the students. However, the students seemed to be not able to provide the answers.  Therefore, after walking around, the teacher went back to the stage and gave the model answer on the board.
T: Look here, this is how you should write in your answer. Those who don't know, please copy now.

Then teacher immediately continue the lesson with a new topic. Teacher instructed a girl to draw the diagram of cholesterol on the board. The girl seemed to be confused and do not know what to do, so she refers to the textbook. While she was drawing the diagram, the teacher set aside and just watching her. Meanwhile a girl moved from the center of the class to join the two girls at the corner to start their conversation. Teacher obviously did not notice this.

The girl failed to draw the diagram and another boy was instructed to help by the teacher. Teacher remained sitting there. When the boy finished the drawing, teacher immediately started to teacher with the diagram. *(No encouragement given, not even a word of 'thanks', very minimum constructive interactions were seen)*

During the lecture, occasionally teacher will say 'yes' as agree to the answers given. Most of the time teacher showed puzzle faces toward answers given by students. This caused students to be confused too.

The two girls continued their conversation. Teacher walked over to the girls and looked at their handouts. Some guidance were given to the girls, but the girls seemed to be more confused, and started to discuss about the answers which disagreed by the teacher. Students left in puzzle.

Teacher then entered into another new topic. *(Total of 3 topics in a 70mins lesson, triglyceride, steroid, and protein).* A lot of questions were asked during the lessons, but not all with proper answers. Students always left in puzzle.

Teacher called out another student to draw the amino acid. But never thank her when finished. Student started to be tire. Bell rang in 5 mins after the teacher started the new topic. *(Poor time management)*. However, teacher continued to teach in faster speed. Hence, caused delayed to the next class.

**Appendix XIII** Sample of Interview Transcription

Interview ( School: Lesson)

**Name: Majinah (50+)** 2013 STPM Biology Teacher

Year of service: 20+ Time: 1245am – 110pm

**R: researcher** **M: Majinah**

R: Thank you for your time for having this interview session.

M: You are welcome.

R: The purpose of the interview is to ask about what is the factor influencing the SDL readiness among teachers and students.

M: factors?

R: yes

R: For your information, this conversation will last about 20 – 30 min. And it is only for my research purpose. All your personally details will be kept confidential.

M: Mmmm…. What are the factors influencing SDL readiness?

R: Yes the aim of this interview is to know about what are the factors influencing the students and teachers in SDL readiness.

M: I think the first one is the basic knowledge. The students when they come from form 5 level, their knowledge in biology is not in depth. They just learned to pass the exams. I have asked them, you know, what did they got for their SPM. Some of them got very good results, A+, … when they come here, they are lost. because When they see the form 6 syllabus is so wide and so much in depth, right? For example they cannot explain, they are not able to explain properly. They just know one word only. They do not know how to elaborate. That is their problem. Because in form 6 level, when they need to answer, structure and essay, they have to elaborate their points. That's what I found the hindering factor. Their knowledge is not really that deep.

R: That's mean the mastery of the concept?

M: yah. The mastery of the concepts. They are not clear. Like today, I asked them about plasma. They do not know what is plasma. They named red blood cell, they name… that's mean they are… maybe they are so blur. They think that..that.. is the correct one, alright? And, secondly, from what I've seen them the hindering factor is of course is the syllabus. The syllabus is very wide.

R: for STPM?

M: For STPM. Let say like one.. for the first semester, the second semester, third semester. For example one topic, they cannot…I don't have the pleasure of explaining clearly, you know, explaining in detail, or maybe I would like to have some examples, from living example, for example if they learn about let's say osmoregulation, you know? To explain in detail what's happening in every steps. I don't have that pleasure. I just focus on the main thing only. Ah..this is what happen, this is what happen, this is what happen…this is what happen…this is what the question will look like. That is the second problem that I'm facing. I have to help these students. I just don't have enough time to go into detail. And then I don't have enough time for revision.

For form six (STPM), it is a different kind from SPM. For form six, they have to be able to describe. The description, that mean clearly steps by steps, let's say the process, clearly step by step. But because, as I said, we go focus on the point, so they don't elaborate enough. So they don't get enough marks for a particular question. Because of elaboration. For example if I ask to write an essay, that I gave let's say 10 points…10 marks. They are able to give me only 5 points. So they cann't target for the maximum number of marks.

So what I'm trying to do now, as I teach I try to teach them the answering technique as well. Another problem is the answering technique. Answering technique maybe acquire as we go along throughout the years. But I found out the modular system, I don't have time, because finished the syllabus, exam. That mean, I don't have time for them to take questions and then we go over the question again and again, you know? For example the terminal, the…. old STPM, by the time I finish the syllabus I have about 6 weeks I can mingle on the revision. So I'll give past year questions. The same question again and again, so we go into depth how to tackle the question. So at the end of the year the student are readied this on the technique. So that's why… quite a number of students get A. For example, the previous one, we have 4 students with A for biology. But the modular system for term one none of my student get an A. The best they get B+. So I cann't blame because these are good students.  And then from my way of thinking, if these students were the same as the previous years he could get an A. That was my thinking, you know? He is my A student. But because of that problem, they cannot master the technique of answering.

R: when you talk about not enough of time, you are referring to what…what actually trigger the not enough of time?

M: Syllabus! The syllabus is so wide I have to teach…. And then you know? By the time, still cannot. Sometime we have to do extra time, and then we have only one week to drill over the question… One week is not enough. After one week…Exams. So how could I help them?

R: That's mean frequent exams?

M: Yes. And exam also only one day one term. Even that one… usually my students, when I give the exam they will show progress. See? First term, second term, third term they will show progress. But this one, how could I evaluate them? One exam suddenly they face the real exam. You see? So I have no time to actually help them. You know? To..to.. to add to their knowledge. That one I just don't have.

R: So what do you think a SD student should have?

M: First, they must be mature student. Form six, is… you always say they are mature students, they know what they want to do. But sometime, it is the opposite. Ada saja, one or two who still think like a kid, you have to push, you have to push, and you have to push.

SD student, mature student, they know what to do. They know what they want from the teacher.. I could not teach all. They have to do research, they have to click on the internet to choose all this material, and they should think which one is the best for them based on the syllabus. You see? And they should also use the 'tube'. The 'tube' is the good one, I always the 'tube'. Sometime I click on the "tube" to show them. Because they can see the 3D, they can see the process clearly..

R: the tube you mean "youtube"?

M: Ya.. youtube… That one is very good! But very few actually. They just…I don't know how they use the internet.so.. Usually, my student, my ex-students when they come back they will tell me after STPM, then they use the internet. That's a shame la to me.

R: That means the student internet accessibility…

M: not only to the internet, they can use books, other books. You know? But book ah, one thing the hindrance is the language. I have experience, my .. I scolded one of the boys, I remembered. Why cann't even you go and read a simple thing? Then one boy stood up, after I scolded the class, one boy stood up. This is a story which good for a teacher. To know, to understand the student. "Teacher", he said, "Our English is not as profession as you. We read one text, you know, one page, it took me half an hour to read", he said. "and then it took me another half an hour to understand". It doesn't click you know. I thought that Form six student, you know, we are using the medium English, I thought they all understood. But they don't.

R: they are suppose to be the group of students who had Science in English since form one, isn't it?

M: Ah.. For MBS.. and these are students coming from other schools. Then, I realised my mistakes. You know? It is unfair for me to ask them to read something which to them is very very hard. So now I advise them if you got any problem the first thing is to come and see me. That mean I could explain faster. And then after that, you could understood little bit what I have been telling, and then you increase you knowledge through the internet. I encourage them to use the internet, because I use the internet as well. Such a vase info there. So they should be able to study on their own. As you say SDL. They should study on their own.

Next thing I found that many of my students they are not prepared for the lesson. Meaning, if they know after this amino acid, next is the syllabus is the protein. They don't prepare.

R: The initiative?
M: Yes, initiative memang tak ada. They don't prepare the lesson. That's why when I asked they don't know what to answer. Alright? So they don't prepare at least, you know, they prepared some questions. Let's say amino acids, so what are the questions that I don't understand. No.. none of them, you know? Really ask me an intelligent question. Tak ada

Previously I had.. many.. They will challenge me! Like your years la…Challenge me… ha..all this questions. You know that..I have to pause and find the source. Dulu mana ada internet kan? To get the answer. But these days huh, the students all take facebook only, all …. tak ada.. tak ada pergi dalam dalam tak ada. all very atas atas only. That's why they don't have enough, when to write essay they have nothing to explain. That's the problem.

R: What do you think about how to actually improve the Self-directedness?

M: Okey.. that's a good question. As a teacher I cannot say change the syllabus because is too wide. Alright? Self-directed learning, for me is team work. That mean you assign a student one topic. So that let them go and find out certain things to present. But there is a catch there… you cannot do every topic. Because some topic need to understand the concept first, right? If you go and teach about osmoregulation, aiyo.. how can the students understand the concept? You can only pick from the syllabus. That is what we did in MBS. Pick from the syllabus where is the direct thing, alright? This the students can do on their own, this, this this, can do on their own…So we assign homework, so this one, this is team work, you have to present on certain days. Just like that. So they go and do research, they have to prepare their powerpoint and then they present in the class. They have to come out and teach the class.

R: When you say about students doing research what kind of research you give them?

M: For example the…. the one like…. is the direct topic from the syllabus. We took from the… for example the analytical methods in science research. Chromatography for example, that is direct. For example the electron microscope, the light microscope. Those only we can pick, you see? but very few. And one more, we cannot do.. let say..ooh.. nevermind, let them do all. To me is unfair, the students they have other things in their life. They have Coco.. you know? Put up until the afternoon. If you ask the form six, what time they reach home? Many of them would say after 5. Your life also will be after 5, because a lot of things happening in school and they have to take part also.
So is it fair for biology teacher to ask them to do this, chemistry teacher ask to do that? To me is unfair. So pressure them. Even now I give them a few topic is pressure them. They will come and ask me "teacher, teacher what is this?" So is unfair. So only certain topics that I pick from the syllabus.

R: How about the fieldwork that is in the syllabus, that the students have to collect samples?

M; Oh, that one is a sad story, I tell you! Not like your year. You write a really good project. Like the one I that teach them. But now they changed. Is very simple. Just pass the module paper to them, that's all. With the results. Not like that we did… collecting… they collect only ten. So the fieldwork like the quadrat, remember? We did quadrat? No more. They did it, but they answer in the module system. Not like the one that we did like as if in university level with the literature review and so on.. no more. Very simple for this group.. modular groups. Very simple already

R: Do you think the modular system will help the students to acquire the skills for SDL?

M: Sorry, the answer is no.. I informed the Mr. Principal already, the problem. With my experience… this year is my last year actually, I'll bersara this year. I said, This is the problem what I have seen occurring in my class. The students are not ready, they are very weak, and then the time, you know? to do extra thing. Because for biology, in order to understand you have to read extra. You know? Cannot just on the surface only. You have to go into depth to understand what is actually going on. They don't, they just don't have the time. The TIME is the limiting factors, yes..

(Bell rang and teacher need to enter class)

R: Well, I think that's all for this time. Thank you for your time.

M: Okey.

**Appendix XIV** Open Ended Question's Answers with Frequency

| Answers | Frequency | |
|---|---|---|
| | Student | Teacher |
| parents encouragement | 3 | 2 |
| fiends help | 3 | - |
| peer pressure | 5 | - |
| friends and family | 2 | 5 |
| Friend | 9 | 2 |
| Family | 3 | - |
| Social | 1 | 5 |
| Environment | 36 | 14 |
| examinations results | 7 | 3 |
| pressure of further study | 1 | 2 |
| examination | 4 | 6 |
| communication with parent | 1 | 2 |
| Health | 4 | 1 |
| eating while studying | 1 | - |
| information available | 3 | 4 |
| reference books | 3 | 5 |
| wrong info in reference book | 2 | - |
| weak edu sys | 2 | 3 |
| pack examination schedule | 1 | 7 |
| too many procedure | 1 | 5 |
| free and easy to learn | 1 | - |
| Time | 23 | 12 |
| sleeping time | 2 | - |

**Appendix XV** Factors Influencing the SDLR and SDLeR with Frequency

| **Factors** | **Frequency** | | |
|---|---|---|---|
| | **SDLR** | **SDLeR** | **Total** |
| **Time** | 49 | 11 | 60 |
| **Environment** | 53 | 3 | 56 |
| **Emotional Readiness** | 41 | 5 | 46 |
| **Biology Cognitive Readiness** | 25 | 13 | 38 |
| **Self-Efficacy** | 34 | 1 | 35 |
| **Interest** | 32 | - | 32 |
| **Examination Oriented** | 21 | 10 | 31 |
| **Biology Learning Skills Readiness** | 23 | 3 | 26 |
| **Syllabus** | 17 | 6 | 23 |
| **Interpretation of SDL** | 17 | 6 | 23 |
| **Learning Sources** | 14 | 5 | 19 |
| **Friends** | 17 | - | 17 |
| **Data Analysis and Interpreting Skills** | 13 | 2 | 15 |
| **External Influences** | 11 | - | 11 |
| **Interacting skills** | - | 11 | 11 |
| **Family** | 10 | - | 10 |
| **Electronic Technology** | 10 | - | 10 |
| **Experimental Design Skills** | 5 | 2 | 7 |
| **Laboratory Skills** | 4 | 1 | 5 |
| **Management support** | - | 2 | 2 |

**Appendix XVI** Constructive Interactions

| **Types of Constructive Interactions** | **Examples of Excerpts (audit trail)** | **Types of Engagements** |
|---|---|---|
| **Question and answer** | The students seemed alert of what their friends were asking, and paying full attention to their friends' answers… very active interactions between teacher and students were observed in the lesson (Perak, TFN24 R29 – 33) | Cognitive<br>Emotional |
| | Students asking questions from time to time during lesson. (Kuala Lumpur, TFN2 R61 – 62) | Cognitive<br>Physical |
| | Throughout the lesson, students raise many questions… (Kuala Lumpur, TFN3 R65 – 68) | Cognitive<br>Physical |
| | After reading from the textbook, the teacher started discussion with some questions. Students responded to the questions actively. (Selangor, TFN16 R35 – 37) | Cognitive<br>Physical |
| **Encouragement** | When students managed to answer the questions, teacher praise the student immediately. In fact, whole class appeared happier while the teacher started praising the students… (Kuala Lumpur, TFN7 R22-25) | Emotional,<br>Cognitive |
| | Students were encouraged and confident to elaborate from their answers to make it more precise. (Kuala Lumpur, TFN2 R42 – 43) | Emotional |
| | Each and every question from the students was attended positively by the teacher. Students seemed very encouraged to elaborate their views. (Kuala Lumpur, TFN2 R64 – 66) | Emotional<br>Cognition |
| | Throughout the practical session, the students were engaged to their work and they kept encouraging each other to do the work properly. (Kuala Lumpur, TFN11 R47 – 49) | Emotional<br>Physical<br>Cognition |
| | Teacher kept encouraging the students… (Perak, TFN24 R35) | Emotional |
| **Discussion** | Teacher mostly conducted discussion with the students during lesson. (Selangor, TFN18 R 46 – 47) | Physical<br>Cognition |
| | There will be discussion among the group members whenever they faced difficulties in their work (Kuala Lumpur, TFN12 R50 – 52) | Physical |
| **Mutual trust** | Students were allowed to leave and enter the classroom freely in conducting their practical session… students behaving well and conducting their work with good discipline. (Kuala Lumpur TFN11 R 28 – 33) | Physical<br>Emotional |
| | 5 min before the bell rings, students returning from the field group by group (Kuala Lumpur, TFN12 R61 – 62) | Emotional<br>Physical |
| **Focus group teaching** | When students were conducting their work, teacher visited group by group to give instruction or guidance when it was needed. (Kuala Lumpur, TFN11 R23 – 26) | Physical |
| | Students were preparing the presentation in their groups respectively. Teacher gave some comments along the way. Teacher helped in enhancing the presentations by projecting some questions to the group. (Kelantan, TFN21 R23 – 25) | Cognitive<br>Emotional<br>Physical |
| **Guidance** | Teacher gave guidance along the way when the student attempted to answer the question… the students were busy writing down teacher's | Physical<br>Cognitive |

| Types of Constructive Interactions | Examples of Excerpts (audit trail) | Types of Engagements |
|---|---|---|
| | guided answers onto their notebooks or textbooks. (Selangor, TFN14 R44 – 46) | |
| | When students were conducting their work, teacher walking around to give guidance when necessary (Kuala Lumpur, TFN6 R46 – 47) | Physical<br>Cognitive |
| | Teacher gave help and guidance to the students when needed (Selangor, TFN17 R50 – 51) | Physical |
| | Teacher gave guidance along the way, while the students attempted to answer the questions. (Selangor, TFN 14 R 36 – 47) | Physical |
| **Calling names** | Teacher always called out the names of the students to answer her questions. Therefore students were actively engaged and following her lesson. (Melaka, TFN23 R60 – 62) | Cognitive<br>Emotional |
| | In 30th minute, teacher gave an essay question and called out the students to provide the answer. (Selangor, TFN14 R27 – 43 – 45) | Cognitive |

**Appendix XVII Letter of Approval From EPRD**

**Appendix XVIII Sample Letter of Approval From Local Education Department**

**Appendix XIX Letter to School**

Kwan Siew Wai
25, Lorong Pikrama 1,
Taman Sri Petaling
57000 Kuala Lumpur.

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Tuan/Puan Pengetua, Tarikh:

**<u>Permohonan Untuk Menjalan Kajian Di Kawasan Sekolah</u>**

Dengan segala hormatnya saya ingin meminta kebenaran Tuan/Puan Pengetua untuk menjalankan kajian di kawasan sekolah. Saya berjanji bahawa kajian saya hanya dijalankan dalam keadaan sebenar proses P&P tanpa sebarang gangguan atau intervensi. Dicadangkan tempoh kajian dalam ______________________________

Butiran kajian saya adalah seperti berikut:

| | |
|---|---|
| Objektif | :1. Memahami kesediaan pelajar and guru Biologi STPM dalam 'self-directed learning'<br>2. Mengenalpasti faktor-faktor halangan untuk SDL di kalangan guru dan pelajar. |
| Kumpulan sasaran | : Semua guru dan pelajar biologi STPM |
| Cara Kajian | : 1. Soal Selidik (boleh dilaku di luar waktu persekolahan / masa rehat)<br>2. Temu bual (boleh dilaku di luar waktu persekolahan / masa rehat)<br>3. Pemerhatian dalam kelas (tiada intervensi) |

Bersama surat permohonan ini, saya lampirkan salinan surat-surat kebenaran menjalan kajian dari EPRD dan JPN, dan juga lampiran langkah-langkah kajian ini untuk rujukan Tuan/Puan Pengetua dan guru yang terlibat.

Semoga permohonan saya ini dapat diluluskan oleh Tuan/Puan Pengetua.

Segala kerjasama dan timbang rasa Tuan/Puan didahului dengan ribuan terima kasih.

Sekian.

Yang benar,

_______________________

Kwan Siew Wai
012 368 3919
kwansiewwai@yahoo.com