CONTENT ANALYSIS OF ENERGY AND SUSTAINABILITY OF LIFE IN MALAYSIAN FORM TWO SCIENCE TEXTBOOK

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FACULTY OF EDUCATION
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ABSTRACT

Textbooks are predominantly use as an instructional tool in classrooms. This research is driven due to significant role possess which then affects classroom teaching and learning delivery. Hence, textbooks analysis is imperative as it helps to rectify and strengthen the textbooks for teachers to deliver effective learning. Therefore, the purpose of this research is to analyse this valuable learning tool of Form Two Science textbook as it may acts as one of the reasons that affects the accomplishment of learning objectives. This qualitative research consists of two data collection techniques which were content analysis and interview. The textbook was analysed using conceptual framework from Florida University Department of Education (FLDOE) while the interview data were interpreted deductively. The content was analysed based on three elements which were (i) content, (ii) presentation and (iii) assessments. Only four chapters from the theme 'Energy and Sustainability of Life' were analysed due to its physics related concepts which consider difficult for students. In addition, four teachers' perceptions on the content, presentation and assessments of the Science textbook were obtained as they have hands-on experience to produce data triangulation with meaningful results. The content analysis found all the requirements set by national syllabus were aligned with textbook. Nevertheless, the analysis from the four chapters of the textbook found only one example of designing experiment which may affect the effectiveness to cultivate problem solving skills among students. Other criteria that emerged from this research were caring, patriotic and STEM careers. However, results found that limited examples may results in lower efficiency of objectives to be achieved in real life. Meanwhile, the textbook does not consist of any error in scientific theory,

however few in websites and grammatical errors were found. In terms of presentation, it consists of attractive and clear organisation, but lacks of labelling in figure and colour cues. It was also discovered that the chapter summaries were good, however, without much beneficial information. Results also shown some of the visuals possess glaring texts with complex background. The cartoon comic presented consists majority of single panel image compared to sequential story which may able to bring pleasure in reading for Generation Z. Whereas in context of assessments, it was discovered that the activities, formative and summative practices questions were majority under LOTS category compared to HOTS category. From the interview data, it was asserted by teachers the need to increase the number of HOTS questions in the textbook since examination questions will be difficult. Findings also shown that teachers encounter time constraint in the classroom which causes the textbook unable to be fully utilized which is something need to be taken into consideration in order to fully utilised a good textbook. This research able to further intervene as it holds valuable notions to tackle effectively the highlighted keys and limitations by producing competent textbooks in the future for the benefits of students.

Keywords: science textbook, textbook analysis, content analysis, presentation, assessments

ANALISIS KANDUNGAN TENAGA DAN KELESTARIAN HIDUP DALAM BUKU TEKS SAINS MALAYSIA TINGKATAN DUA

ABSTRAK

Buku teks digunakan secara meluas sebagai alat bantu mengajar di bilik darjah. Penyelidikan ini didorong oleh peranan penting buku teks yang mempengaruhi pengajaran dan pembelajaran di kelas Sains. Oleh itu, analisis buku teks adalah sangat penting dalam membantu menambahbaik dan memperkukuh buku teks agar guru dapat menyampaikan pembelajaran secara efektif. Oleh itu, tujuan kajian ini adalah untuk menganalisis buku teks Sains Tingkatan Dua kerana ia berperanan sebagai salah satu sebab yang mempengaruhi pencapaian objektif pembelajaran. Penyelidikan kualitatif ini menggunakan dua teknik pengumpulan data iaitu analisis kandungan dan temu bual. Buku teks dianalisis menggunakan kerangka konsep oleh Jabatan Pendidikan Universiti Florida (FLDOE) sementara data temu bual ditafsirkan secara induktif. Buku teks ini dianalisis berdasarkan tiga elemen iaitu (i) kandungan, (ii) persembahan dan (iii) pentaksiran. Hanya empat bab dari tema 'Tenaga dan Kelestarian Kehidupan' dianalisis kerana konsepnya yang berkaitan dengan fizik yang dianggap sukar bagi pelajar. Di samping itu, persepsi empat orang guru mengenai kandungan, persembahan dan pentaksiran buku teks Sains tersebut diperoleh kerana mereka mempunyai pengalaman langsung untuk menghasilkan triangulasi data dengan penaksiran yang bermakna. Analisis kandungan mendapati bahawa semua keperluan yang ditetapkan oleh sukatan pelajaran nasional diselaraskan dengan buku teks. Namun demikian, analisis daripada empat bab buku teks tersebut hanya menemui satu contoh rekaan eksperimen yang mungkin

mempengaruhi keberkesanan memupuk kemahiran menyelesaikan masalah dalam kalangan pelajar. Kategori lain yang muncul daripada penyelidikan ini ialah sikap penyayang, patriotik dan kerjaya STEM. Analisis mendapati contoh yang terhad dalam buku teks boleh menyebabkan pencapaian objektif pembelajaran akan terganggu. Sementara itu, buku teks tidak mengandungi kesalahan dalam teori Sains, namun terdapat sedikit ketidaktepatan dalam laman web dan tatabahasa. Dari segi persembahan, ianya menarik dan mempunyai organisasi yang jelas, namun, terdapat kekurangan pelabelan dalam gambar dan penanda warna. Juga didapati ringkasan bab adalah baik, namun kurang maklumat bermanfaat. Hasil kajian juga menunjukkan beberapa visual mempunyai teks yang tidak jelas dengan latar belakang yang kompleks. Komik kartun yang dipersembahkan juga hanya terdiri daripada gambar panel tunggal berbanding dengan cerita komik berurutan yang mungkin dapat memberikan keseronokan membaca untuk Generasi Z. Manakala dalam konteks pentaksiran, didapati bahawa aktiviti, soalan praktik formatif dan sumatif adalah majoriti dalam kategori LOTS berbanding dengan kategori HOTS. Dari data temu bual, ditegaskan oleh guru bahawa perlunya meningkatkan jumlah soalan HOTS kerana soalan peperiksaan adalah sukar. Dapatan juga menunjukkan bahawa guru menghadapi kekangan masa di dalam kelas yang menyebabkan buku teks tidak dapat digunakan sebaiknya. Penyelidikan ini dapat dimanfaat dengan lebih lagi untuk menangani secara berkesan kekurangan buku teks dan dapat menghasilkan buku teks yang lebih kompeten pada masa akan datang untuk faedah para pelajar.

Kata-kata kunci: buku teks sains, analisis buku teks, analisis kandungan, persembahan, pentaksiran

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LIST OF ABREVIATIONS AND ACRONYMS

FLDOE:	Florida University Department of Education
HOTS:	Higher Order Thinking Skills
ICT:	Information and Communication Technology
KSSM:	Standard Based Curriculum for Secondary Schools
LOTS:	Lower Order Thinking Skills
PISA:	Program of International Student Assessment
PT3:	Form 3 Assessment
RBT:	Revised Bloom's Taxonomy
TIMSS:	Trends in International Mathematics and Science Study

CHAPTER 1

INTRODUCTION

1.1 Introduction

This introduction chapter will explain on the focus of research which is on Malaysia Form Two Science textbook corresponding with national Science education. It is to reflect on the understanding of Form Two Science textbook. This chapter discusses on its' background, statements of problems, research objectives and questions, significance of research, definitions and limitations of research.

1.2 Background

"It is a miracle that curiosity survives formal education."

-Albert Einstein

Generally, we are all born curious, but it is often not nurtured, discouraged and dampens as we grow up. Children tend to be highly curious which is important for adults to keep it ignites as our own curiosity drive ways to solve problems and create new ideas. Therefore, science education acts as a concrete platform to ensure a country's economy growth as it solve problems that lies in our interfaces of life. In Malaysia, the utmost aim of science education is to provide manpower in the science and technological field (Chiu, 2016; Sua, 2012). Moreover, in August 2018, The New Straits Times newspaper postulates that National Council for Scientific

Research and Development reported Malaysia requires 500,000 scientist and engineers in 2020 to face difficulties of Industrial Revolution 4.0 (Vijaindren, 2018).

With ample supply of skilful professionals able to ensure industrial and economic growth together with environmentally sustainable way (Cash et al., 2003; Hruby, 2018; Lutz & Samir, 2011). Hence, solid grounding in science ensures good career employability and would make students more valuable in a job market (Fensham, 2008; Hanapi & Nordin, 2014). In Malaysia, science education system is highly related with Science textbooks as it acts as a basis teaching source for the teachers and major source of information towards the students (Hedge, 2011; Rillero, 2010). In addition, textbooks still serve as a crucial material guidance for the teachers when there is a new curriculum implemented (Rahman & Haslynda, 2014). Hence, there is a necessity to analyse the Science textbook to identify its appropriateness for the use of the targeted students.

There are three elements which present in almost every learning material which are content, presentation and assessments which were analysed. In terms of content, a good textbook should not consist of any factual error which is considered as a crucial standard to be obligate (Khine, 2013). Besides, the content must be able to develop profound conceptual understanding in comparison with factual memorizations. This considered as important as it fulfils the 21st century to generate problem-solving skills students according to Malaysian Science curriculum (Khine, 2013; MOE 2016). Moreover, the level of treatment of the textbook is important in terms of its complexity as it should be appropriate to the students' level in order to maintain their interest as too simple will bored them while too complex will demotivate them (FLDOE, 2015).

Meanwhile, presentation element is considered significant as well since most of the Science concepts are abstracts where graphics or drawings able to help students to understand the text thoroughly. In addition, a good presentation such as having a clear organisation of content in the textbook and attractive colours used able to maintain students interest to use the textbook. Readability of textbooks with shorter sentences are also important to ease and captivate readers' attention (Zhao & Mahrt, 2018). Such good presentation which consists of coloured typography cues, labels, table of comparisons and summaries able to ease the teachers and students when reading and skimming.

Next, assessments are considered vital in a textbook as it is used to evaluate students understanding and improve students' achievement. This able to effectively promote learning as students able to identify on the matters that they need revision on and act as a platform for the students to apply their understanding. On the other hand, incorporation of Information and Communication Technology (ICT) in the textbooks assessments or practices able to attract students' interest. Therefore, a good textbook should consist of assessments with various activities to motivate the students and consists of more open-ended questions to generate higher order thinking skills students to improve their learning (Khine, 2013).

These good qualities in terms of content, presentation and assessments were critically analysed and discussed in this research as it plays a significant role in contributing towards students' learning as textbooks act as a basis fundamental tool in education. This able to produce competitive textbooks in the future as the strengths and limitations of the textbook were meticulously discussed. Consequently, this will lead to constructive adaptations taken by future Ministry and publishers which will benefit the teachers and students in the long term.

1.3 Problem Statement

Textbooks still dictate as the ultimate source of knowledge and learning material for most students and teachers as they rely to obtain comprehensive information in science curriculum (Izquierdo et al., 2008; Roberts, 2013; Woodward, 2012; Vahdany, 2015). It acts as a strongly reliable material as it is approved by the education's ministry according its' standard curriculum. Nevertheless, the competences of textbooks are concerned which may comprise of adequate instruction material, however is not successful in terms of providing the students with problem-solving skills in real-life applications (Balliet et al., 2015; Cantrell & Robinson, 2002; Kutch, 2011; Riskowski et al., 2009). As a result, this research able to bridge the gap by analysing on the textbook assessments of Higher Order Thinking Skills (HOTS) questions to strengthen their problem solving skills in real-life applications.

Other problems that present in Science textbooks according to Khine (2013) are consist of many new challenging terms. Science terms need proper explanation to result in understanding. This however only can be achieved when the students master in reading before they can read to learn. In general, glossary section in the textbooks helps to ease this difficulty. Hence, this gap of having difficult scientific terms needs to be identified where this research is carried out to analyse the textbook profoundly such as the Glossary section. Moreover, according to Khine (2013), it was found that the Science textbooks on chapter *Earth* consist of 453 errors or overgeneralization which may cause misconceptions among the students. Therefore, this stresses the importance to carry out analysis of the Science Form 2 textbook to evaluate its' valuable components.

In addition, there are other weaknesses found in the noble textbooks in other countries. For instance, a Biology textbook used in 2004-2005 which approved by Republic of Turkey Ministry of National Education was found inappropriate in terms of visual presentation according to a research by Özay and Hasenekoğlu (2007). Besides, research has been conducted in Turkey as well on 10^{th} grades Biology textbook had also found several weaknesses such as lacking of scientific inquiry processes, inappropriate students' level, poor questioning skills, misconceptions, unattractive activities, inappropriate visual materials, unclear topics' objectives and unorganised contents (Çobanoğlu & Ġahin, 2009; Gök, 2012).

Whereas, in Malaysia, there were few limitations shown in previous textbooks even though it is known as ultimate reliable source. There were very few researches conducted on Science textbooks which were more than two decades ago, for example the last researches were completed by Cheok (1994) and Ho (1997). It might due to meticulous and detailed work in critically analysing the textbooks which may discourage researchers from choosing this research (LaBelle, 2010).

For instance, one of the old research conducted on Malaysia Science textbook was by Cheok (1994). It was highlighted the necessary to review the past Form One Science textbook as it was found that the quality of the textbook in terms of presentation, moral values, assessments and others were on average and good category from the interview conducted with school teachers. It was studied according to six different zones as different Science textbooks were used based on its' zones. The content, language and scientific terms aspect was generally rated as good according to the teachers. Whereas for the presentation, illustration and moral values aspects, it was rated as good as a whole, but two zones rated it as merely average. Meanwhile, the exercises on the end of the chapters and the layout aspects were

evaluated as average for five of the zones except for one zone which rated it as good. Subsequently, the researcher stated that upgrading of the textbook was required to achieve excellent result.

The next few researches conducted in Malaysia Science textbook was by Ho (1997). It was explained that higher level inquiry activities were lacking in Form Two Science textbooks. It was also found that the textbook should incorporate more guided-inquiry (teacher-formulated questions with students' own conclusions) and some open-inquiry activities (students formulate own inquiry questions) (Sadeh & Zion, 2012). Teachers were also encouraged to modify the activities to give more opportunities for the students to improve their higher level thinking skills according to the research. Hence, it was suggested the textbook to revise in order to achieve the objectives of the curriculum.

There were also numerous errors occurred in other Malaysia textbooks apart from Science which were approved by the Ministry of Education. For example in 2015, Malacca was placed up north in a country map in Year Six History textbook. While in 2016, a Form 6 STPM textbook had claimed that Tamil language is borrowed from languages such as English, Greek and Portuguese. This has caused anger in Indian community as it is pertaining sensitive issue according to the Deputy Education Minister Datuk P. Kamalanathan (Ooi, 2017). Whereas, in the Bahasa Malaysia, English, Science and Mathematics textbooks unable to cultivate sense of concern towards the environment to the students as the content focused only on the language aspects (Savita et al., 2017). This will effect on textbooks trustworthiness and consequently develop insecurities from the teachers and students as they heavily rely on textbooks which may hinder learning.

Moreover, as the adjusted Standard Based Curriculum for Secondary Schools (KSSM) has been enforced starting year 2017, there is a plead stated to be unhappy on the textbooks in a newspaper excerpt from The Star in May, 2017. This is due to several mistakes found in English translations in both Science and Mathematics textbooks. It was believed that this will cause a student's language proficiency as student will pick up these wrong phrases, terms and grammar as they assume it is correct (Ooi, 2017). Despite of all the meticulous vetting done by the ministry and preparation from professional educators, there are still issues that need to be looked into in order to enhance the teaching and learning of science. These issues need to be emphasized because in Malaysia, textbook is the most pertinent and reliable source of information used in national's curriculum. Therefore, this research is important as it helps to bridge this gap by identifying and producing awareness of any issues found in the textbook.

Meanwhile, we are living in electronic era where a major part of our life encompasses of technologies and interesting visuals compared to ordinary textbooks. However, textbooks are still the most reliable and prevalent source of education curriculum. For instance, even technology savvy countries such as Finland and Singapore encourage the use of textbooks (Oates, 2014; Yeasmin & Uusiautti, 2018). Additionally, England scores poorer than Finland and Singapore in Trends in International Mathematics and Science Study (TIMSS) data survey in 2011 which might due to their practices on 'worksheet culture' (Martin et al., 2012).

In England, only 4% use Science textbook which is extremely low in comparison to well-performed countries with high usage of textbook of 94% in Finland and 68% in Singapore (Oates, 2014). This is also in comparison with 'worksheet culture' in England which seems like a series of fleeting knowledges than

the structured measure (Price, 2015). This shows the importance to have good textbook medium for the teachers to assist the students during classroom learning as it is highly related to students' achievement (Pratama & Retnawati, 2018). The noble old textbooks should not be shunned as it can guides to a more central to the education system and consequently provide the totality of the education to achieve intended learning goals of science education. Nevertheless, proper adjustment shall be made to make the book exciting which can be compete as technology does.

However, regardless of the significant use of textbooks in Malaysia, the international benchmarking tests showed that Malaysia scored poorly compared to Finland and Singapore. Textbooks are usually considered as the chief causation for examination performance where one of the reasons that unable to produce proficient students might due to the incompetent content of the textbook that affects students' learning (Loewen, 2018; Singer & Tuomi, 2003; Tyson, 1997; Weiss et al., 2003).

According to the Program of International Student Assessment (PISA) test, which acts as a benchmarking test to rank worldwide countries has shown that Malaysia scores badly in 2009. According to Malaysian Education Blueprint 2013-2025, PISA test has shown Malaysia was positioned at 52nd place out of 66 countries with a mean score of 422 in Science. Then in PISA 2012, for scientific literacy score has decline to the score of 420 which is below average where the global average score was 501 (Chen, 2013).

There were some studies mentioned there is a strong relationship between textbook used and students' achievement which may contribute as one of the reason of poor performance in our country (Pratama & Retnawati, 2018). It may be related to our content of textbook as Malaysia widely uses textbooks in our education system (Loewen, 2018; Mustapha, 2008). Hence, it is significant that a comprehensive

research should be carried out on textbook in order to identify the gap of the constructive and destructive key points or any errors for future advancement of the Form 2 Science textbook and subsequently our science curriculum in Malaysia.

In Malaysia, majority of the research carried out on science textbooks has surveyed on content aspect, visuals, assessments, reading ability, learning materials and activities in the past decades (Chan, 1998; Cheok, 1994; Ho, 1997). However, there is no recent updated research conducted on the Science textbooks in Malaysia for the past two decades. Hence, this research is conducted to analyse the Form 2 Science textbook in terms of its' content, presentation and assessments which consists of teachers' opinions as well as they're the most frequent users of textbooks besides the students.

In addition, it is important to obtain teachers opinion and recognize their needs such as creating teacher-friendly method to ensure an effective learning as textbooks acts as a major supporting teaching material in classroom (Collins, 2012; Valverde, 2002). Moreover, textbooks help to support teachers during teaching progress and aid the inexperienced teachers who are reasonably low confidence to teach in communicative way (Mares, 2003; Tomlinson, 2012). Teachers are important as students need guidance and support from them to help in facilitates learning on how to read the informational text effectively while comprehension support is needed to become proficient readers (Block et al., 2002; Pressley, 2000). Hence, teachers' opinions able to propose valuable teaching strategies, modelling and insights on the strengths and weaknesses of the science textbooks to accommodate the students in the future. These valuable teachers' opinions able to benefit future production of textbook to ease the teachers on classroom teaching. Whereas, it able to motivate students' learning process to persistently interested in using the textbook.

Meanwhile, quality was meticulously emphasized in the preparation of the textbooks however does not provides a guarantee of quality. A systematic research should be conducted which involves the teachers to evaluate the science textbooks to ensure it would be suitable and practical for the students in the classroom situation. Quality textbooks are able to achieve the requirements of a quality teaching to ensure comprehensive support to the students' learning. Hence, analysis of this Science textbook with regard to teachers' perception able to bridge the gap by identify and rectify any problems that exist.

As Science textbooks covers from the content, presentation and assessments to act as a whole, it is important to analyse all these key elements. For example, if the contents are sufficient and according to its' level, attractively presented, stimulating activities and related to daily life, this will significantly increase students' interest and learning will occur promptly. Therefore, textbooks act as valuable learning tool to achieve goals of quality science education curriculum (Okeefe, 2013). We need to consider the validations of the positive vital role of textbooks in education to complement and mutually benefits the teachers and students. Therefore, the purpose of this research is to analyse the science textbooks to evaluate it as an educational medium.

However, only 1 theme were analysed that known as 'Energy and Sustainability of Life'. It consists of four chapters which are *Electricity and Magnetism* (Chapter 7), *Force and Motion* (Chapter 8), *Heat* (Chapter 9) and *Sound Waves* (Chapter 10). It comprises of physics related concepts pertaining electricity, force, heat and others which are consider notoriously difficult and greatly causes misconceptions among students (Chi, 2005; Lising & Elby, 2005; Perkins et al., 2006; Slotta & Chi, 2006). These challenging topics may due to disconnected physics

facts or students' biases towards material substances which consider as something distinct (Slotta & Chi, 2006). Some of the students also perceived physics concepts to be too challenging, difficult, boring and irrelevant (Angell et al., 2004; Oon & Subramaniam; 2011; Spall et al., 2004). Therefore, this research that focuses on these challenging topics able to discover ways to improve the gap of Science textbooks. Figure 1.1 summarized the problems that contribute towards analysing of the textbook.

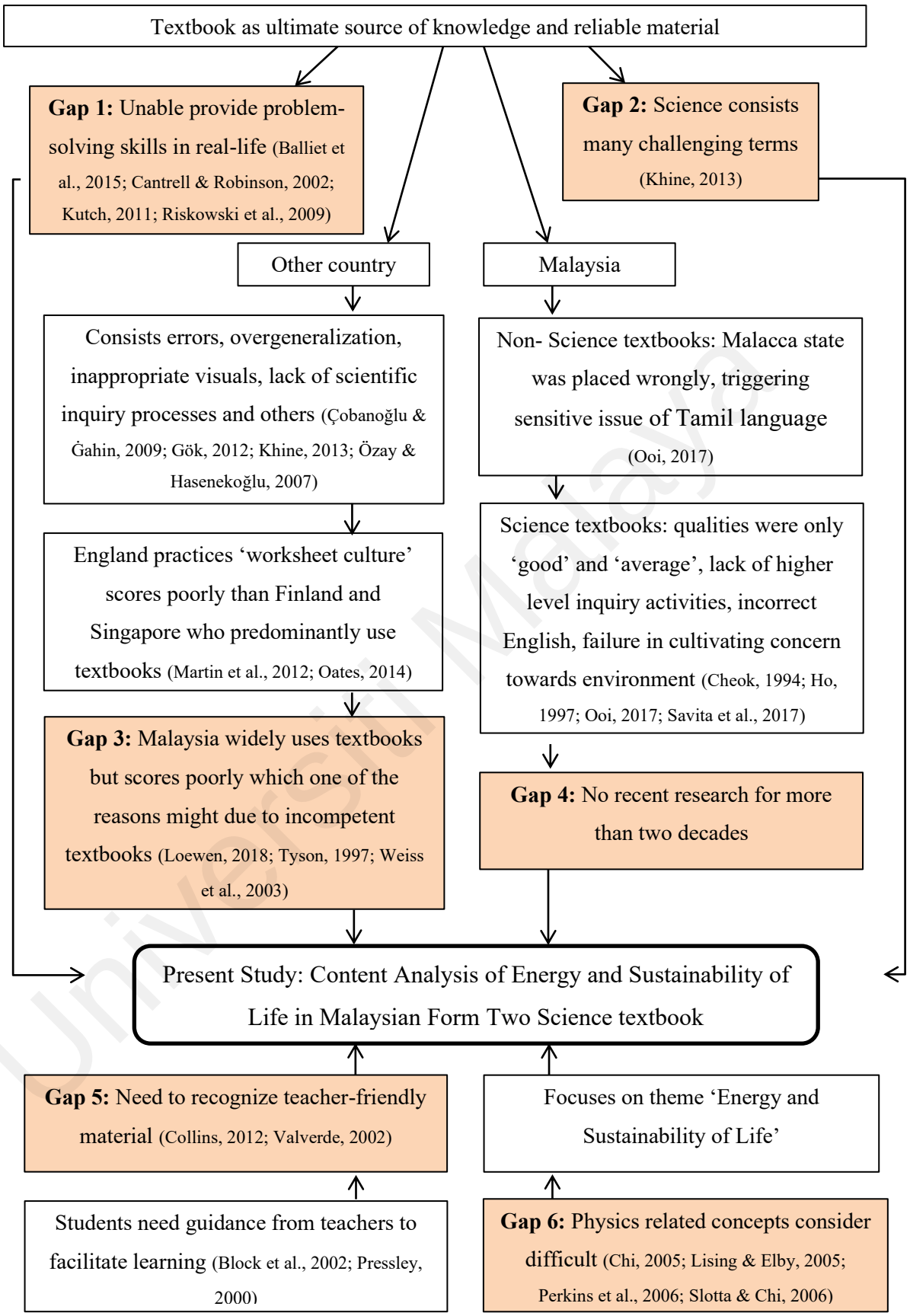


Figure 1.1 Summary of the Problem

1.4 Research Objectives

Despite the constant chasing of technology integration in education system, textbook is still the core and entrusted material which teachers and students will seek to. Therefore, a new initiative was implemented which is Standard Based Curriculum for Secondary Schools (KSSM) where Science Form 2 textbook is newly introduced in the year of 2018. This textbook syllabus focuses on to produce future citizens with critical thinking and innovative problem-solving skills in this century. Therefore, this research generally aims in analysing the Form Two Science textbook for better quality production of textbooks in the future.

Based on the aim, this research projected to achieve the following objectives:

Objective 1:

To analyse the Form 2 Science textbook of the local secondary schools in Malaysia on theme 'Energy and Sustainability of Life':

a. in terms of content
b. in terms of presentation
c. in terms of assessments

Objective 2:

To explore the teachers' perception of the content, presentation and assessments of the Form 2 Science textbook.

1.5 Research Questions

This research is a dissertation analysis of Malaysia Form 2 Science textbook on the theme Energy and Sustainability of Life. It is primarily interested about the construction of the textbook with regard to content, presentation, assessments and the opinions of the teachers responds towards this textbook. To ensure this research achieve its aimed objectives, the following questions will guide the researcher to answer deliberately on the research:

Question 1:

How is the content of the Form 2 Science textbook of local secondary schools in Malaysia on theme 'Energy and Sustainability of Life'? To answer the research question, it is divided into three sub-research questions which are used to act as guidance:

a. How is the content of the Science textbook?
b. How is the presentation of the Science textbook?
c. How is the assessments of the Science textbook?

Question 2:

How do the teachers perceived the content, presentation and assessments of the Form 2 Science textbook?

1.6 Significance of Research

Historically, textbooks has been the most readily accessible and utilized source for teachers in science education and still consider the most relevant source in determining the content, methods, educational values and cultural information in classrooms (Abdullah, 2009; Rillero, 2010). For this cause, research studies have been carried out in science textbook analysis for the past decades. Therefore, it is important that this research is carried out to evaluate on the textbook.

The textbook used in this research is Form Two Science textbook, which are used for the whole national curriculum starting in January 2018 after the launch of Standard Based Curriculum for Secondary Schools (KSSM) in 2017. Regardless it is quite a new book, one should always look forward on improving the selected material by analysing its' pros and cons for future textbook editions. The results from this research will definitely useful to the Ministry of Education as the findings will indicates problems faced by teachers and students which the Ministry can then take corrective measures. It also benefits the Textbook Division or the Curriculum Development Centre as appropriate considerations can be taken to improvise future textbooks.

On the other hand, with the high demand of textbooks which in line with the technology today of printing industries, textbooks become ubiquitous in each school as it acts as major foundation of educational component and source of information in teaching. However, with this huge number of publishers in market may cause difficulty in choosing the right textbook and consequently, the selection of textbook may create a significant effect on education and learning process as textbooks play a major tool in learning (Ke, 2012; McGrath, 2002; Okeefe, 2013).

Therefore, this research is important as it reveals the strengths and weaknesses of the textbooks along with teachers' perception where it can lead to beneficial adaptations for the commercial publishers to be aware of the inadequacies. According to Chelimsky (MacDonald, 2006), he proposes three conceptual frameworks to outline the objectives of textbooks evaluations. The objectives are to contribute towards a revamp publication of textbooks, to evaluate the liability that reflects its competence as support to the teachers and to assists skills development of the teachers (Litz, 2001; Roseman et al., 2001; Olivares-Cuhat, 2002; Sherin, 2002).

On the other hand, textbooks that contain merely text are way too boring which may hinder students' learning efficiency and often mistaken as source of only memorization. It is undeniable as well that technology is much more captivating than textbooks, which is why the need of incorporating of technology into most of the science textbooks nowadays to make it interesting and nurturing scientific skills. Hence, textbooks not only contain merely text but guidelines to access to a certain website or application which may consist of learning games or videos that able to motivate students.

Textbooks are still the most preferable material to use for learning as it is easier to use compare to technology that may have technical inconveniencies. Therefore, with the aid of textbooks as available learning material able to benefit the teachers to concentrate on their real duty of teaching than dispersing their energy and time to prepare teaching materials (Lawrence, 2011; Tomlinson, 2012). Most of the teachers rely heavily on textbooks for their teaching due to the convenience of the resource, however does not accustomed to only using textbook as an experienced teacher (Hedge, 2011; Ramírez, 2004; Rillero, 2010; Roseman et al., 2001). Moreover, a high-quality textbook is considered as fundamental tool for the teachers

which plays a domineering role in teaching process to facilitate learning in the implementation of new curriculum (Clement, 2008; Koppal & Caldwell, 2004; Rahman & Haslynda, 2014).

According to Brookhart (2011), the authority for knowledge was not so much the teachers but was the textbooks. This is supported by Phillips (2006) as stated that no teachers able to teach excellently in all science areas which cause the teachers to rely heavily on textbook in a certain topic as well. There are also limited experienced teachers who usually will rely heavily on the textbooks for classroom instruction (Lemmer et al., 2008). Generally, teachers act as mediator of the source of knowledge from the textbooks to channel to the students. Thus, textbook should be high quality and comprehensive which encompass various assessments, materials and activities to stimulate the students and eventually studied in this research.

Hence, this research able to benefit the students as it able to provide information on their preference for the ministry and publishers to take note for future reference. It is vital that research to be carried out to analyse on the textbooks towards accomplishing the curriculum objectives. As teachers' opinions will also be included in this research, Ministry of Education and publishers able to emphasize on how to maximize complete advantage of the useful features or counteract any probable weaknesses of the textbook which will then benefit the Ministry, publishers, teachers and students in a long term.

1.7 Definition of Terms

The main terms used in this research have been operationally defined as below:

1. Form Two Science textbooks

The Form Two Science textbooks refer to Science textbooks which have been approved by the Textbook Division by the Ministry of Education following to the Standard Based Curriculum for Secondary Schools (KSSM). The textbooks are used in the whole local secondary schools of Malaysia. However in this research, only one theme were analysed from the textbook which was 'Energy and Sustainability of Life'.

2. Content

Reviewing content considered as challenging as it is broad and diverse (Florida University Department of Education [FLDOE], 2015). Content is generally refers as entirety of the message that it wants to be delivered and expressed (Neuendorf, 2016). A good textbook content may be judged by the comprehensiveness of the content without the aid of other resources and its' level of content accuracy in it (Khine, 2013). The way of the message to be presented may be misinterpreted or insufficient according to individuals as it is a subject matter. For this research, the main idea of content in a textbook is according to FLDOE's (2015) definition as many specialists had studied comprehensively for the past decades since 1999. Some of the main features of content in this study which adapted from

FLDOE (2015) were alignment with curriculum requirements, level of treatment or the complexity of content according to its level and accuracy of content.

3. Presentation

Presentation is defined by the approach of how the content is being portrayed in the textbook to ease the content understanding and motivate learning process (FLDOE, 2015). In this research, the presentation of the textbook is judged by the textbook organisation, visual graphical aids, readability, clarity of the visuals, adequate visuals and visual representations other than texts which adapted from FLDOE (2015) features.

4. Assessments

In this research, assessments refers to effective evaluations used in the textbook to promote and facilitate learning process for the students (FLDOE, 2015). It is also to ensure the desirable textbook curriculum objectives and outcomes to be achieved. The features analysed were according to FLDOE (2015) which were the activities parallel to Revised Bloom's Taxonomy (RBT), formative practices, summative practices, mastery practices and self-reflection checklists.

5. Standard Based Curriculum for Secondary Schools (KSSM)

KSSM is the acronym of *Kurikulum Standard Sekolah Menengah* which refers to Standard Based Curriculum for Secondary Schools. It was implemented in the year of 2017 until present which in line with the Malaysian Education Blueprint 2013-2025. It is aimed to focus more on problem-based and project-based work to equip students with 21st century skills. In this research, the Form Two Science

Standard Based Curriculum for Secondary Schools (KSSM) textbook was referred to as Form Two Science textbook.

6. Learning Standard

The Learning Standard refers to comprehensive specifications of the syllabus required by the Ministry of Education in a specific manner. Each of the specifications is measurable where it must be oblige and achieve. It provides thorough information regarding the chapters to be developed. The profundity and scope of the chapters were evidently defined in this Learning Standard.

1.8 Limitations of the Research

The nature of this research is exploratory which only get in depth on the features of Science textbook without taking account of classroom observation. However, interviews with teachers were carried out to obtain insights from their classroom experience. This research was limited to only one of the textbook from Standard Based Curriculum for Secondary Schools (KSSM) curriculum which was Form Two Science textbook. It was also only one out of four themes were analysed which was 'Energy and Sustainability of Life' that comprise of four chapters known as *Electricity and Magnetism* (Chapter 7)*, Force and Motion* (Chapter 8)*, Heat* (Chapter 9) and *Sound Waves* (Chapter 10). This theme is considered as exceptionally difficult as it relates to physics where most students prejudice towards material substances (Chi, 2005; Lising & Elby, 2005; Perkins et al., 2006; Slotta & Chi, 2006). In addition, time constraint is also one of the factors to unable to analyse all the chapters. Therefore, the results cannot be generalise to all of the textbook chapters as each chapter consist of different content.

The elements studied were restricted to those important aspects which identified by FLDOE (2015). This is due to its' broad yet distinguishable elements for a systematic analysis. Besides, it has been written and field-tested since 1999 by a group of curriculum specialist, educators and other evaluation specialists. Other aspects of textbooks such as gender equity, ethnicism, teachers' guide, self-learning suitability and others have not been included. It is also not consists of all the aspects listed as FLDOE such as expertise of content development, index section, bibliography section and others. Nevertheless, according to Scriven (2003), analysis of textbooks commonly influenced by the context or researchers' preferences which results on no common agreement on analysis criteria for textbooks nor other teaching mediums (Ansary & Babaii, 2002).

This research was also restricted to English version of the Form Two Science textbooks to identify any literature or grammatical inaccuracy as researcher is more proficient in English and due to time constraint. Bahasa Malaysia version of the textbook will not be analysed which may consist of its own dispute.

It was also limited to only teachers' perception on the textbooks where this research would have benefitted from students' perception as well. However, teachers' are considered as experienced and reliable source of information as they have used the textbooks in their classroom lessons and hence the information provided able to equip in this research.

1.9 Summary

As mentioned, Science is one of the major assets of economy growth in a country if it is thought well by the nation. Indeed, science education is the principal to produce students with scientific skills. Textbooks are strongly related in achieving such result as it pervasively use in Malaysia and consists of the content to be delivered to students (Mustapha, 2008). As textbooks were carefully chosen and approved to be used in a country, there were still several international studies spotted numerous weaknesses and misconceptions on its' textbooks. Moreover, in Malaysia, there was no recent research conducted from the past 20 years in analysing the Science textbooks which unable to provide more information to the education stakeholders. Therefore, it is important to carry out this research to analyse any useful or important information for future use of the country.

It was only analysed on one of the themes, which is 'Energy and Sustainability of Life' as it is usually considered as difficult physics related subjects. It was analysed according framework by FLDOE (2015) which consists of elements that can be found in all learning materials which are content, presentation and assessments. Besides, teachers' perception on the content, presentation and assessments are vital to obtain valuable insights of their classroom experiences. The next chapter will discussed more on the literature review of textbooks preparation, past textbook studies and the frameworks used in this researc

CHAPTER 2

LITERATURE REVIEW

2.1 Introduction

The objective of this chapter is to deliver background information of central topics related to the main variables in this research. It is also written with the aim to understand important key ideas which were used in this course of research. This chapter discusses on curriculum reforms in Malaysian Science education and in secondary schools, preparation of Science textbook, role of science textbooks, studies related to analysis of science textbooks and perception of teachers on textbooks.

2.2 Curriculum Reforms in Malaysian Science Education

Malaysia education system had been through numerous changes along the time to fit in the age and era. Careful planning of curriculum has been chosen to fulfil cognitive development of students. According to Samad and Idris (2017), curriculum is defined by an educational programme which comprise of curriculum and co-curricular activities to accomplish skills, spiritual aspects, knowledge and other elements. Curriculum also refers to organisation managed by schools or institutions which to ensure accomplishment of objectives of the curriculum through the teaching of the teachers (Chung et al., 2013).

Science was incorporated as a compulsory subject in Malaysia in 1965 after gained its independence from British. Even so, Malaysia still continues to retrieve science curriculum which originated from England (Sumintono, 2015). It was also at

this time Ministry of Education promoted to review the secondary school science curriculum due to the approaches used at that time was inadequate in terms of understanding of the scientific skills. A team of curriculum experts from Malaysia and Britain were responsible to amend science curriculum for the secondary schools. With this advent, three kinds of science curriculum were implemented which were Scottish Integrated Science, Nuffield O-Level pure Science Syllabus and Nuffield Secondary School Science (Lee, 1992; Sumintono, 2015; Tan, 1991).

In 1969, the Integrated Science for Malaysian schools was adapted from the Scottish Integrated Science was introduced for the lower secondary level. The main intention of this Malaysian Integrated Science Curriculum was to nurture the spirit of inquiry and the uses of science processes skills. Meanwhile, for the upper secondary level, it consists of three new sciences: Biology, Chemistry and Physics which introduced in 1972 to Form Four science students and to Form Five students in the next following year. This was modified from the Nuffield 'O' level Pure Science syllabus.

Whereas in 1974, Nuffield Secondary School Science was adapted to become Modern General Science for the Arts stream. The curricula were implemented gradually and by 1975, all the secondary schools were conducting the new science curricula. Generally, these curricula focused on inquiry skills as well which involved active learning approaches such as performing experimentations, making observations or hypothesis and going on field trips (Tan, 1991; Lee, 1992). With this distinction, students are expected to develop their logical thinking and problem-solving skills.

2.3 Curriculum Reforms in Secondary Schools

In 1988, New Curriculum for Secondary Schools (KBSM, *Kurikulum Baru Sekolah Menengah*) was introduced to all Form One and Remove level students starting with four languages subjects which were Bahasa Malaysia, English, Chinese Language and Tamil Language. In 1989, it was then introduced for all the other subjects which include Science at Form One level. As a continuation to it, a new secondary curriculum, Integrated Curriculum for Secondary Schools (KBSM, *Kurikulum Bersepadu Sekolah Menengah*) was developed and implemented gradually in all secondary schools. By 1993, science KBSM was fully in effect and was taught to Form Five students who did not pursue Pure Sciences. The goal is to equip students by means of knowledge and problem-solving skills, guided by moral values with a culture of science and technology which in the meantime values the nature while preserving and conserving the environment (MOE, 2002). Hence, the science curriculum was revamped to achieve the aims of KBSM.

Then in 2017, a revised set of curriculum named Standard Based Curriculum for Secondary Schools (KSSM, *Kurikulum Standard Sekolah Menengah*) was implemented which is a continuous plan from the Primary School Standard Curriculum (KSSR, *Kurikulum Standard Sekolah Rendah*) which started on 2011. Primary School Standard Curriculum (KSSR) is a bold and progressive implementation by the Ministry which is to prepare the future generation of competitive future ahead while described as a holistic transformation in curriculum and schools (Paramasivam & Ratnavadivel, 2018).

In this new Standard Based Curriculum, reasoning skills was further added in Standard Based Curriculum for Secondary Schools (KSSM) from the basis of 3R during KBSM to 4R (Reading, wRiting, aRithmetic and Reasoning) which is in line with the Malaysian Education Blueprint 2013-2025. This new revised curriculum comprise of parity amount of knowledge, liberal skills that encompasses divergent thinking, leadership, problem-solving skills and innovative. It still stressing on student-centred teaching however focusses on problem-based and project-based work. The science Standard Based Curriculum for Secondary Schools (KSSM) curriculum aims to generate interest and creativity amongst pupil, master knowledge in science and scientific thinking skills to facilitate them to solve problems.

There are seven objectives stated in the Secondary Science Standard Based Curriculum for Secondary Schools (KSSM) syllabus for the pupils to achieve which are:

(1) Use the inquiry approach to fulfil their curiosity and their interest in science

(2) Acquire knowledge and understanding to explain phenomena scientifically

(3) Communicate information relating to science and technology intelligently and effectively

(4) Design and carry out scientific investigation, evaluate evidence and make conclusions

(5) Apply scientific knowledge, procedural knowledge and epistemic knowledge in posing questions, interpreting data, problem-solving and decision making in context of real-life

(6) Create awareness that discoveries through scientific research is a result of the ability of the human mind to understand natural phenomena towards a better life

(7) Create awareness that development of science and technology has an implication on the mores, social, economic and environment issues in the local and global context

The framework chosen for Standard Based Curriculum for Secondary Schools (KSSM) curriculum is basically based on six domain strands which are Communication, Spiritual, Attitude and Value, Humanity, Personal Development and Aesthetic and Science and Technology. This integration is targeted to develop human capital that appreciate noble values, bring knowledgeable, and think creatively and innovatively (Figure 2.1).

Figure 2.1 The framework of Secondary School Standard-Based Curriculum (MOE, 2016)

The ministry has sequenced the transformation to three waves along the 13 years from 2013 to 2025. The first wave is Wave 1 (2013-2015) that accountable to revamp the established curriculum to concoct for structural change. Subsequently is the ongoing Wave 2 (2016-2020) for introducing structural change where Primary School Standard Curriculum (KSSR) and Standard Based Curriculum for Secondary Schools (KSSM) were rolled out at this level. It was aimed to elevate the content and standards of learning to the international par. Following by Wave 3 (2021-2025) which targets to strengthen the structural change. In approaches to implement all these three waves of reform, the Ministry collaborate with professional associations like the Southeast Asian Ministers of Education Organisation Regional Centre for Special Education Needs (SEAMEO-SEN) (MOE, 2013).

2.4 Preparation of Science Textbooks

Alongside with the unveiling of the new Standard Based Curriculum for Secondary Schools (KSSM) curriculum, new editions of textbooks were written to equip to all the new syllabi which occurs as early as Greek classical era (Graham, 1941, as cited in Khine, 2013). Hence, textbooks indeed are the most vital medium in teaching and learning process which it functions to achieve the objectives and aim of the Standard Based Curriculum for Secondary Schools (KSSM) curriculum. Preparation of Science textbooks are composed with the target to conveying science concepts, facts, principles besides than cultivating creative, critical and analytical thinking skills to the students. Meanwhile for the teachers, Science textbooks serve as a guide in teaching by including ideas on how the students can obtain knowledge,

design experiments, scientific skills and good virtues (Phillips, 2006). Therefore, it is important to identify the process of developing the Science textbook.

The production of Science textbooks was coordinated by Textbook Division from the Ministry of Education which formed in 1967. As KBSM was implemented in 1989, it was first started off with the Form One Science textbook but the preparation of the book took two years which it was prepared in 1987. Same incident for Form Two Science textbooks which were prepared in 1988 before the commencing of the syllabus in 1990. It was applied to all the subsequent levels which were prepared in the following years one after another.

Numerous procedures were required to produce Science textbooks. Firstly, commercial publishers were invited to send in their proposals under the 'open system'. The publishers and their respective authors were asked to join a briefing organised by the Curriculum Development Centre and the Textbook Division about the ways to produce the proposals. The authors that responsible in writing Science Standard Based Curriculum for Secondary Schools (KSSM) textbooks were generally school teachers or lecturers from higher learning institutions.

Then, the Textbook Division and a panel of evaluators will evaluate the proposals submitted by the publishers. Only seven publishers were selected to write the Science Standard Based Curriculum for Secondary Schools (KSSM) Form Two textbooks. Next, the publishers' authors had to improve the chapters in the proposal and carry on to write the rest of the text based on the Learning Standard specified by the Textbook Division. It is known as thorough syllabus requirements for a particular level to contain detailed information pertaining to the topics. The scope and depth of the topics will be clearly defined in this Learning Standard. Then, a schedule was given for the publishers and authors to adhere on for the preparation process.

Detailed information of a certain topics covered in the syllabus will be given by the Document Standard for them to comply on. Generally, in the Science curriculum, topics are presented in thematically manner while the contents in each topic are arranged according to the hierarchy of concepts from concrete to abstract. In the Document Standard, a short description was included in each of the topic. Whereas, the content in the textbooks are strictly following to the qualifications outlined. Moreover, the chapters and the texts contained in the chapters in the Science textbooks were organised in the same order as in the Document Standard according to its particular layouts.

The thickness of the textbooks was also stated by the Textbook Division. It is also necessary to include most of the science concepts, principles or activities in each of the textbooks stated. The finalized proofs were then sent to the Textbook Division for examining (Mahmood, 2009). The textbooks which were approved by the Textbook Division will be distributed to each school under the Textbook Loan Scheme (MOE, 2008). Therefore, this process of selecting a textbook is definite and crucial as it determines the content of education as an important instructional material.

2.5 The Role of Science Textbooks

Science textbooks are considered as the most predominant component of science instruction as science textbooks are the main source of information even in inquiry-oriented curriculum. This implies to about 90% of the secondary science teachers who rely heavily on textbooks as their main source as they used up to 90% of the classroom time (Ajayi, 2005; Blumberg, 2007; Fadhli, 2000; Fuchs & Bock,

2018; King, 2010; Mikk, 2000; Radcliffe et al., 2004; Risner et al., 2000; Stein et al., 2001; Watts-Taffe, 2006; Wiley & Barr, 2007). Even in Malaysia, textbooks are widely use in our education system (Loewen, 2018; Mustapha, 2008). This shows the massive dependence of teachers on the Science textbooks proceeding on what and how in classroom teaching. Consequently, this primary knowledge that transferred to students will act as continuous lifetime learning.

Textbooks consist of predefine scope and order of science content, scientific concepts, scientific skills and methods to convey these ideas to students for many science educationalists (Roberts, 2013). Therefore, students are expected to master the topics from the textbooks since they're used as main organiser as well as reliable material for examinations. Textbooks also designed to equip students to take a dynamic role as a society of the world through the problem-solving and decision-making skills as they able to construct their own thinking with such knowledge acquire from righteous education (Mikk, 2000; Sunal & Haas, 2002). Hence, good textbooks able to transform students and teachers as well as it act as a powerful catalyst to achieve national goals of science education (Davis & Krajcik, 2005; Schmidt et al., 2007).

Nevertheless, it is undeniable we are living in computerised era. This includes fascinating graphical equipped videos whereas textbooks only able to provide large quantities of mundane words. Besides, there were numerous applications have been established to replace the old-fashioned textbooks such as electronic textbooks, Google Suite, e-learning and other online materials which are far more interesting and appealing (Moore & Kearsley, 2011). Moreover, these technologies may able to save cost instead of purchasing paper-based textbooks (Bliss et al., 2013; Wiley et al., 2012). In Malaysia, electronic textbook were available in 2019 for the secondary

students in the form of PDF (Portable Document Format) first before modifying into more interactive (Chin, 2018). Nevertheless, the content will still remain the same as textbooks.

Textbooks can be easily access and much more convenient with just a book but Information and Communication Technology (ICT) curriculum may face limitations as it would need several sources such as electricity, computers, tablets, power outlets, software and probably internet connection. Besides, research shows that these media technology transformation still unable to triumph over the ancient textbooks design. For instance, printed materials were proven to be more effective and easier for reading than digital reading (Daniel & Woody, 2013; Lenhard, et al, 2017; Mangen et al., 2013; Singer & Alexander, 2017). It was also found in a research where students prefer to use printed textbooks compared to electronic textbooks for learning (Woody et al., 2010). Moreover, text materials which consist of comprehensive explanations able to prove benefit in learning regardless of their reading ability which validate the role of text in textbooks itself (Ainsworth & Burcham, 2007; Best et al., 2005; Linderholm et al., 2000). Thus, textbooks still remain to be use apart from the electronic textbook in Malaysia.

Nevertheless, according to Kane (2016), there is a strong relationship between passive learning and achievement. Our mind tend to wander off when a teacher is solely doing nothing but reading from a textbook which is not interesting and engaging in two way learning. Therefore, even a textbook without interesting assessments, appealing visuals and technologies unable to thrive in todays' world. Hence, textbooks should be revamp to a new era of education to make it less dreary to be competent as technology does which is why technology is embedded in most of the textbooks in todays' culture. For instance, teaching strategies which include

mixture of classroom and online learning environment is advocated to produce better sense of community and better learning in contrast with fully traditional learning method nor through the internet method (Bonk & Graham, 2012; Kazu & Demirkol, 2014; Rovai & Jordan, 2004; Yapici & Akbayin, 2012). Hence, there is no a single tool that can be fit for all needs. Therefore, production and growth of textbooks is a perennial practice which needs to be sustained by continuous and rigorous research and development (Mahmood, 2009).

2.6 Studies Related to Analysis of Science Textbooks

As science textbooks plays a major tool in science education syllabus, numerous analysis of textbooks of its features have been carried out as a concern of its quality and its effectiveness to be used in the classroom (Okeeffe, 2013). Besides, most of the learning textbooks were average products from the results of studies and researchers have questioned the capability of textbooks to achieve the requirements of quality teaching which is why studies should be carry out to further improving the textbooks (Cheok, 1994; Demoss & Nicholson, 2005; Ho, 1997; Ooi, 2017; Price, 2012).

2.6.1 Past studies on Science textbooks

In this chapter, researches had been categorized according to the textbook elements chosen which were content, presentation and assessments. This is due to the comprehensive yet distinguishable elements used to categorise the textbook. For the content element encompasses in textbooks, several studies had been conducted such

as from Anderson and Botticelli (1990), Lloyd (1990, as cited in Wang, 1998), Eltinge and Robert (1993), Jeffery and Roach (1994, as cited in Wang, 1998). Anderson and Botticelli (1990) conducted a research on quantitative methods on content organising in textual composition within four high schools Biology textbooks. Even though there is significant difference in the specifics of the models, it is commonly accepted that understanding of written text is a dynamic process rather than quantitatively measured into units form. It requires current knowledge structures to be used in analysing the written communication into expressive units that were symbolically altered and integrated into existing memory. The development is undeniably complicated, involving considerable relations between internal information processing and the organisation of the written material which is why is not chosen in content analysis in this research.

In another research conducted by Lloyd (1990, as cited in Wang, 1998), it investigates the content of three biology textbooks which was on reading comprehension of *photosynthesis* through the aspect of its elaboration. Generally, these textbooks were chosen based on their differences in target audiences such as students' capabilities. The results discussed were in terms of amount of elaboration, relevance of philosophies used to elaborate main concepts, relationship of the elaboration to anticipated readers and the common relationship between how texts convey information and students' learning. Generally, it focused profoundly on quantity of elaboration on a certain topic which is not intended to analyse in depth for this research. However, it is slightly related as this research discusses on elaboration as well such as on readability of the textbook and its' targeted assessments.

Meanwhile a research conducted by Eltinge and Robert (1993) had discussed on science as inquiry process based on linguistic content analysis. This linguistic content analysis method is through categorizing key words from the textual data using logistic regression techniques. The material used was high school biology textbook and the results revealed science inquiry was depicted higher in introductory chapters and at the start of paragraphs. Overall, it determines how science is portrayed. Nevertheless, this method used to determine the result was mainly about describing science as inquiry.

Another research was conducted by Jeffery and Roach (1994, as cited in Wang 1998) whom analysed the content text that consists of protoconcepts of evolution topic. The materials used in this research were elementary and middle school science textbooks. It was found that 17 concepts which were described as important concepts for evolution were retrieved from wrongly interpreted texts. Hence, from this research, it had generated grounded theory of concept of evolutionary protoconcepts through the analysis of texts. Thus, it is important to analyse the content to discover any misleading concepts.

Meanwhile, for element of presentation in textbook, several researches had been conducted as well such as from Ametller and Pintó (2002) and Dimopoulus (2003). Ametller and Pintó (2002) explored on the favourable images which certainly benefit the delivering of the science concepts to the students. However, students may also encounter troubles in understanding pictures of what message or key concepts that wants to be conveyed. The result from the research suggested that students need help from teachers to interpret the images precisely. Therefore, it is important to get the teachers' perception to receive feedback that is beneficial for future use which is practiced in this research.

Besides, research of Dimopoulos *et al.* (2003) also indicated that images are considerably more meaningful than texts in a textbook. Therefore, modern textbooks consist of more pictures than past textbooks. This may also due to availability of current advance technologies that accelerate this idea besides than making the textbook more interesting and beneficial. As images play an important role in a textbook, it is one of the elements included in this research.

Whereas, for assessment element in science textbook, a research was conducted in Turkey on analysing its' Chemistry textbooks and teacher-generated questions on a chapter about gas laws (Nakiboğlu & Yildirir, 2011). There were a total of 720 questions from topic on gas laws and teacher-generated examination questions. It was categorized into three groups which were recall, algorithmic and conceptual. Most of the questions were conceptual type questions. This research derived that students unable to develop conceptual understanding and produce optimum reasoning skills. Hence, it is substantially vital to examine the questions comprise in the textbook to evaluate its' efficiency in facilitating students' learning.

On the other hand, Doran and Sheard (1974, as cited in Park & Lavonen, 2013) conducted a research in State University of New York which encompasses of two elements which were content and presentation where content is considered as the major importance when a teacher browsing through textbooks. It is similar with this research as it also stressed on accuracy of information, textbooks organisation, illustrations' quality, material appearance, daily life examples, compassion towards environment, students' participation, text readability, durability and variety of attractive learning ways. It involves other components which were not included in this research such as mathematical oriented where it considered as a good preparation for the students as some Science topics requires mathematics concepts. However, it

was stated that this theory is sometimes unreliable as each student's mathematical skills varies significantly. Another element which was not included in this research was on teachers' aid where it stressed on the textbook as an aid for a teacher to understand better. It was not included in this research as the main targeted consumer of textbooks is for the students where some of the students practice self-regulated study without depending too much on teachers in this era (Sungur & Tekkaya, 2006).

Whereas, Anderson and Armbruster (1984) had conducted a research on two related elements too which were content and assessments. They focused on the content area such as its structure, coherence and audience appropriateness as main criteria for evaluating textbook. The content must be error free, accurate and precise so it does not deliver wrong information. It also touched on assessments as it warns to avoid using instructions that are too ambitious that consists of aim, description and instruction which will make the instructions long and cumbersome. It also emphasize well developed textbooks should contain activities where the students must synthesize what they have learned, fun games tasks such as puzzles and extra practice on difficult chapters. Hence, a good textbook is also based on the content and assessments criteria.

Next, more researches had conducted on all three of the elements (content, presentation and assessments) which is why this research comprise of all the elements for a comprehensive research (Chiappetta & Fillman, 2007; Cook, 2008; Gök, 2012; Khine, 2013; McLeod, 1979; Okeeffe, 2013; Wang, 1993). A research conducted by McLeod (1979) is more stressed on experiments which determines the importance of selecting textbook for optimizing worthy science learning. He strongly adheres to a principle where experiments are compulsory when science is learnt as a process. This includes whether does the students often required to make vigilant

observations, inferences, predictions, presenting data in systematic way to enhance communication ability. The other key principles were content appropriateness, definition of concepts, meaningful activities, reading level, eye-appeal and safety. Generally, this includes all the elements but it emphasized more to the experiment-based analysis.

Based on a research by Wang (1998), a total of 31 papers were studied regarding ways of textbook analysis. However, all the studies analysis at least involve one of these distinguish elements which are content, presentation and assessments. These reanalysis has proposed a wide numbers of approaches for content analysis and yet, there was no agreement in the criteria used to determine the suitability of such research methodology. It also found that most of the researchers had fragmented uses in analysing the content of the textbook which is more likely to be adapted by researchers. This acts as one of the factor of this research to be adapted from conceptual framework as well due to absence of established framework.

According to a research by Chiappetta and Fillman (2007), three out of the five Biology textbooks investigated had reasonable balance of nature of science. Learning in science no longer only encompasses the body knowledge but as a way of investigation inquiry of science. Hence, content as an element is important as it determine the textbook value. Besides, the presentation element was taken into account as well as where it emphasize the way to learn through tables and charts. Assessments were also considered such as the activities provided for the students. It was stated that a complete analysis of textbooks includes definitions, comprehensive paragraphs, pictures, charts, questions and hands-on activities.

In another research by Cook (2008), stated that illustrations which include pictures, diagrams, graphs, sketches and tables are necessary in visual learning in science. According to the research, it is proven the effect of visual images on the students and their learning. It was conducted based on a topic in Biology, which is meiosis on 86 secondary biology students. However, illustrations alone are not adequate enough for the students as there are misconceptions among the students have been documented. Therefore, teachers should not assume students to understand the visuals in the textbooks entirely by themselves but must help to teach them how to critically study the illustrations to avoid misunderstanding. It was also emphasize to pay extra care on the colours used in the graphics since many students deduce different colours to its different structures. As a result, it was found that illustrations are very important to aid in better understanding in comprehension as it explains "why" the steps were taking place yet other tools should also be used for thorough understanding. Hence, in this research, there are other criteria besides than presentation element, which were content and assessments.

On the other hand, a book of critical analysis of science textbooks was published in Netherland which discussed the importance of visualisations, text analysis and targeted assessments criteria which used to find out a quality teaching material (Khine, 2013). There are two elements which considered important which were textual and visual material. In science learning, illustrations aspect is considered even more vital because science consists of abstract theories that can't be depicted physically in the reality. It is believed that this integration of these two modes of texts and visual able to produce a good science textbook can be. Therefore, these two elements of content and presentation were included in the research as it was found to be beneficial to relate both of the elements which may deduce other relationships. All

of these past researches had been summarized in Table 2.1 according to the textbook elements chosen according to authors' level of interest which were on content, presentation and assessments.

Table 2.1

Summarisation of the Elements Used in Textbook Analysis

Year	Author	Research Title	Element/s
1990	Anderson & Botticelli	Quantitative analysis of content organization in some biology texts varying in textual composition.	• Content
1990	Lloyd	The elaboration of concepts in three biology textbooks: Facilitating student learning.	• Content
1993	Eltinge & Robert	Linguistic content analysis: A method to measure science as inquiry in textbooks.	• Content
1994	Jeffery & Roach	A study of the presence of evolutionary protoconcepts in pre-high school textbooks.	• Content
2002	Ametller & Pintó	Students' reading of innovative images of energy at secondary school level.	• Presentation
2003	Dimopoulos *et al.*	Towards an analysis of visual images in school science textbooks and press articles about science and technology.	• Presentation
2011	Nakiboğlu & Yildirir	Analysis of Turkish high school chemistry textbooks and teacher-generated questions about gas laws.	• Assessments
1974	Doran & Sheard	Analyzing science textbooks.	• Content • Presentation

1984	Anderson & Armbruster	Learning to read in American Schools.	• Content • Assessments
1979	McLeod	Selecting a textbook for good science teaching.	• Content • Presentation • Assessments
1998	Wang	Science textbook studies reanalysis.	• Content • Presentation • Assessments
2007	Chiappetta & Fillman	Analysis of five high school biology textbooks used in the United States for inclusion of the nature of science.	• Content • Presentation • Assessments
2008	Cook	Students' comprehension of science concepts depicted in textbook illustrations.	• Content • Presentation • Assessments
2013	Khine	Analysis of science textbooks for instructional effectiveness.	• Content • Presentation • Assessments

In conclusion, there are a lot of criteria to evaluate a textbook depending on the focus of respective researchers as different researchers may emphasize on different aspects of the textbooks. There were a lot of methods and checklists been produce as well from the researchers. Nevertheless, despite the many studies of textbook analysis, there was no standard framework produced for researcher to evaluate a textbook. It was usually based on few fragments of elements to conduct the research. Generally, the elements involved are content, presentation and assessments which are more commonly been supported by various researchers.

2.6.2 Frameworks for textbook analysis

Few frameworks were developed from previous researches on textbook analysis. For instance, a research that related to content which was by Okeeffe (2013) where it discussed the motivational factor content in a textbook that obtained from Wittlin (1978). Wittlin (1978) introduced three factors for textbook analysis which were Initial Arousal, Attending Message Reception and Maintenance of Attention (Table 2.2). For the Initial Arousal component, it must initially be interesting to be able to attract the attention from students. It was analysed in this research but it was known as Level of Treatment according to FLDOE (2015) where the beginning of the textbook chapters should begin with real-life examples or thinking questions which suites the students' level. After attaining their interest, the information that wished to channel to the students must be clear which known as Attending Message Reception. It is known as presentation element in this research as it comprise of charts or graphs where the information can be understand in a clearer way. Lastly, in the section of Maintenance of Attention, it is almost the same as FLDOE (2015) adaptation which known as assessments where both emphasize to include activities, questions and various senses to be used through the learning to maintain students' attention. The motivational element to engage students' attention is almost the same as the research used but it was extensively discussed which were not opted in this research.

Table 2.2

Factors to Consider for Textbook Analysis by Wittlin (1978)

Initial Arousal	Attending Message Reception	Maintenance of Attention
Danger: Underestimation	**Danger:** Overestimation	**Danger:** Monotony
To Avoid the Danger: Relevance, interest, dissonance, sensory, appeal, appeal to effect	**To Avoid the Danger:** White space, signal noise, planned redundancy, integration of multiple channels, hierarchal organisation under key areas	**To Avoid the Danger:** Change modality, insert questions, vary senses used, drama of issues

Another framework used was by MEAS (Media Assessment) (Astleitner, n.d.) group which had designed a hierarchical structure in a tree form (Figure 2.2). This is to evaluate certain quality of educational media of both printed and electronic media found. It consists of elements which involve in this research in the aspects of content, presentation and assessments as well. For instance, content and facts accuracy, layout presentation, colours used, table of contents, instructional mediums, exercises and group works.

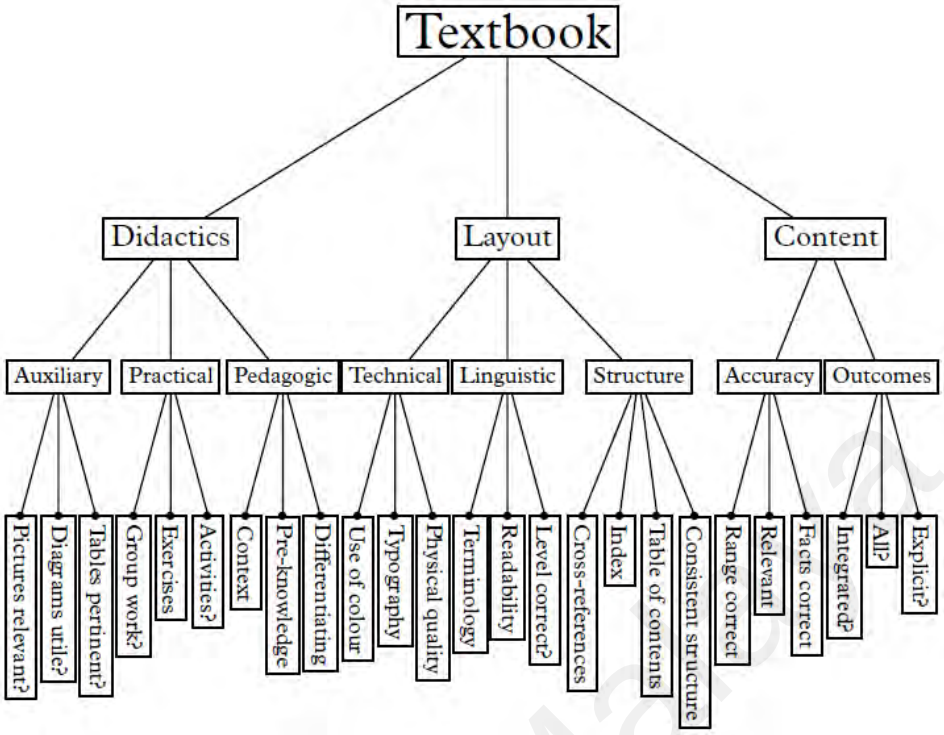


Figure 2.2 The hierarchical structure criteria used by the MEAS group to evaluate textbooks by Astleitner (n.d.)

Nevertheless, this hierarchical structure was then transformed and presented in vertical levels (Figure 2.3). This is to fit in more criteria on the levels and easier to comprehend the evaluation instrument.

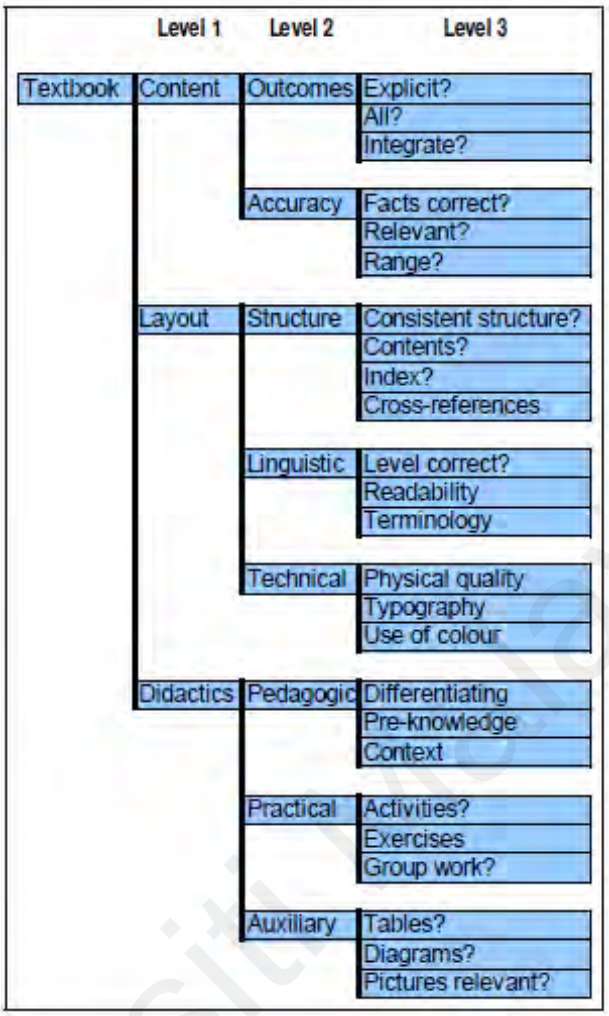


Figure 2.3 The hierarchical structure criteria used by the MEAS group to evaluate textbooks with vertical representation of levels by Astleitner (n.d.)

However, for MEAS group to obtain their valid data, their method involves comprehensive research on the textbook features such as obtaining data on learner achievement according to the education goals. It also comprise of calculation of certain percentage allocated for each criteria. This affect many researchers disapprove using such method as it lacks of accessibility research-based measures to analyse learning materials (Goldsmith et al., 2000; Stein et al., 2001). Therefore, another framework was used for this research but the main idea of using content, presentation and assessments as criteria remains.

Another framework was developed by Florida University Department of Education (FLDOE) (2015) where Gök (2012) use it to compared two textbooks based on the elements of were content, presentation and assessments. From the research conducted, it was found that one of the textbook depicts extensive content nevertheless with more facts that were not fit to the level of the students. Nonetheless, it also lacked of some of the important major themes in the topics. On the other hand, the other textbook contained more technology, experiments, students-oriented activities and real-life associated examples. Various systematic information able to obtain from using FLDOE framework. The research also accompanied by perceptions of the interviewed teachers. Hence, it is important to get teachers' opinions as they're one of the major users of textbook which may encounter any distinct experiences that able to benefit to the research.

2.7 Elements of FLDOE

The Florida University Department of Education (FLDOE) framework which adapted in this research is categorized into three organised elements known as content, presentation and assessments. It was written, studied and field-tested since 1999 which a period of nine years before it was revamped in year 2008 and later on in 2015 by a group of curriculum specialist, instructional designers, educators, evaluation specialists and other administrators. It was also interconnected to other variety of frameworks or studies used in pedagogical analysis of science textbooks. This due to the broad yet distinguishable elements among each other which makes the research able to divided in a systematically, organised and evidently.

Additionally, these elements present in every learning material to act as a whole. Hence, numerous subcategories able to form under these three categories (Table 2.3).

Table 2.3

Subcategories of Priorities Criteria Used in this Research

Content	i)	Alignment with curriculum requirements
	ii)	Level of treatment
	iii)	Accuracy of content
Presentation	i)	Organisation
	ii)	Readability
Assessments	i)	Activities parallel to Revised Bloom's Taxonomy
	ii)	Formative practice
	iii)	Summative practice
	iv)	Mastery practice
	v)	Self-reflection checklist

To carry out a deeper assessment of subcategories, articles about each subcategory were used parallel to the FLDOE criteria. A summary of content analysis design has been derived from this (Figure 2.5).

2.7.1 Content

The content of the Form 2 Science textbook were analysed using selected criteria from FLDOE framework which were alignment with curriculum requirements, level of treatment and accuracy of content. The content is mainly required to be parallel with national obligation in order to achieve its objectives.

i) Alignment with curriculum requirements

The content should fulfil the required curriculum standards such as the subjects, grade level, objectives and skills. Moreover, to judge to what extent the content align with curriculum requirements is the ability and effectivity it can stretch students' mind to generate critical thinking, problem-solving, innovation and creativity. Most importantly the content of the instrument should also be adequate enough to stand on its own without the help of using other sources.

ii) Level of treatment

According to the framework, the content should be not too simple as it will bored the students, however, it should be not too complex as it will discourage them. Therefore, adequate and appropriate treatment content that match the level of the students are important to ensure to achieve learning objectives. It should also be mentally challenging in terms of thoughts and technical instead of putting vast encyclopedia content. This addition of dense factual information rejects a higher level thinking, critical analysis and explanations. Therefore, many books comprise disconnected details that fail to educate or stimulate the students (Ravitch, 2004; Sewall, 2004).

iii) Accuracy of content

A good quality of content should be error-free and absence of biases in context. It has to be precise in terms of historical context and up-to-date facts and theories besides than the graphic or other elements of instruction. Moreover, the content should be signifying the domain knowledge with objective.

2.7.2 Presentation

The presentation of the textbook is also equally important as it helps to motivate students in learning and ease the learning process of the content and assessments of the textbook. It is analysed based on two ideas which were textbook organisation and readability.

i) Organisation

The structure and format of the material should be clear, easily distinguished and in an expected order so that teachers and students able to recognize the structures and ideas of the content. With such clear organisation, it will ease the teachers and students when skimming, browsing or reading.

ii) Readability

Readability level of the Science textbook was determined to identify the easiness of reading and whether the age level was taken into account during the textbook preparation. In this research, the readability level of the Science textbook was analyse using Word's Flesch Reading Ease formula by Rudolf Flesch (1948 as cited in Lenzner, 2013; McNamara et al., 2012). The latent idea of readability formula is that text is easier to read when sentences are shorter and lesser number of polysyllabic words since the formulae is based on the sentence length and amount of syllables (Daniels, 1996; Génova et al., 2013; Gök, 2012). The output will give a score from 1 to 100 which the higher the value, the easier the text to read. Meanwhile, Flesch-Kincaid Grade Level (McNamara et al., 2012) is to determine which level grade the passage is meant to.

The Word's Flesch Reading Ease formula were used on four randomly chosen paragraphs which each were selected from the four chapters. Each paragraph consists 100 words minimum from the Science textbook. Texts were typed to a Microsoft Word document and analysed automatically using the readability statistics which are Flesch Reading Ease and Flesch-Kincaid Grade Levels in the Microsoft Word application (Dunne et al., 2013; Gök, 2012; Stockmeyer, 2009). Regardless of the wide use of this readability formula, the results of the scores are still tackled with severe disapproval among researchers themselves as the formula predominantly rely on two variables which are word length and sentence length which may not be entirely reasonable analysts of language difficulty (Gök, 2012; Lenzner, 2013). Hence, readability of instructional materials also depends on the language style such as coherent text language that explains information and containing transition words. For example, "yet", "also", "next", "however" and other phrases that produces logical connections. Meanwhile, in terms of visual readability, the visuals should be sufficient, vivid visuals and other form of visuals other than text such as graphs, charts and others.

2.7.3 Assessments

In addition to a good content and attractive presentation of textbook, assessments are imperative as it provides ways to assess students learning progress and impart clearer understanding. This is to ensure students able to achieve the targeted goals or outcomes. It should consist of several good assessment strategies as a test to determine how well the students have achieved the targeted learning outcomes and ease their learning on which area they should improve. Therefore, the

objectives and activities in the textbooks were analysed as it corresponds with assessment strategies to ensure the objectives to be achieved.

i) Activities parallel to Revised Bloom's Taxonomy (RBT)

The activities were analysed according to context of Revised Bloom's Taxonomy (RBT) of educational objectives (Bloom, 1956, as cited in Krathwohl, 2002; Vosloo, 2007). Bloom's taxonomy consists of three categories which are cognitive, affective and psychomotor. Bloom only conducted study on cognitive component where the objectives comprise of recalling to synthesizing new ideas. It is differentiated into six phases: *Remembering, Understanding, Applying, Analyzing, Evaluating* and *Creating* (Figure 2.4) (Krouska et al., 2018). There are also few types of assessment strategies such as formative, summative and mastery practices (Huhta, 2008).

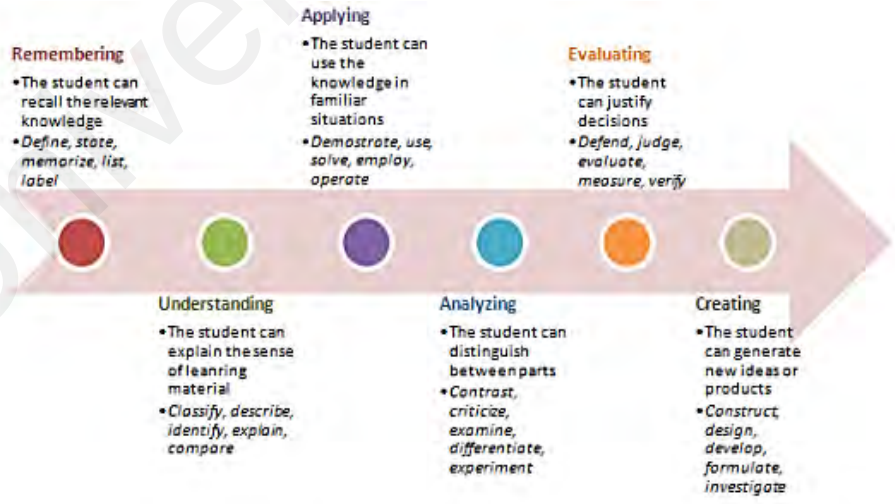


Figure 2.4 Revised Bloom's Taxonomy (Krouska et al., 2018)

ii) Formative practice

Formative practice occur throughout learning but provides more improvement-oriented towards the students as teachers able to monitor their progress and identify their weaknesses. From this formative assessments leads to summative practice which able to enhance their performance. Some examples of formative practices include problem-solving situations, require students to relate new readings to previously learned information, presentations, brainstorming or producing charts and others that may help students to achieve the targeted objectives.

iii) Summative practice

Summative practice located at the end of learning which functions to evaluate and test the students' understanding at that specific time. In comparison with formative practice, summative practice requires students to solve it more independently. The questions were mainly arranged according to Revised Bloom's Taxonomy (RBT) levels to prepare the students for more challenging questions.

iv) Mastery practice

From this formative and summative practices leads to mastery practices which able to enrich their performance and master the learning objectives (MOE, 2016; Wininger & Norman, 2005). Generally, the questions in this section were mostly under Higher Order Thinking Skills (HOTS) which consists of analyzing, evaluating and creating questions to create competitive students (Pappas et al., 2013; Yahya et al., 2012).

v) Self-reflection checklist

Self-reflection checklist is located at the end of learning content as it is considered as self-monitoring checklist for own learning development. This type of reflection able to act as a revision guidance for the students to identify and make corrections of their own learning progress.

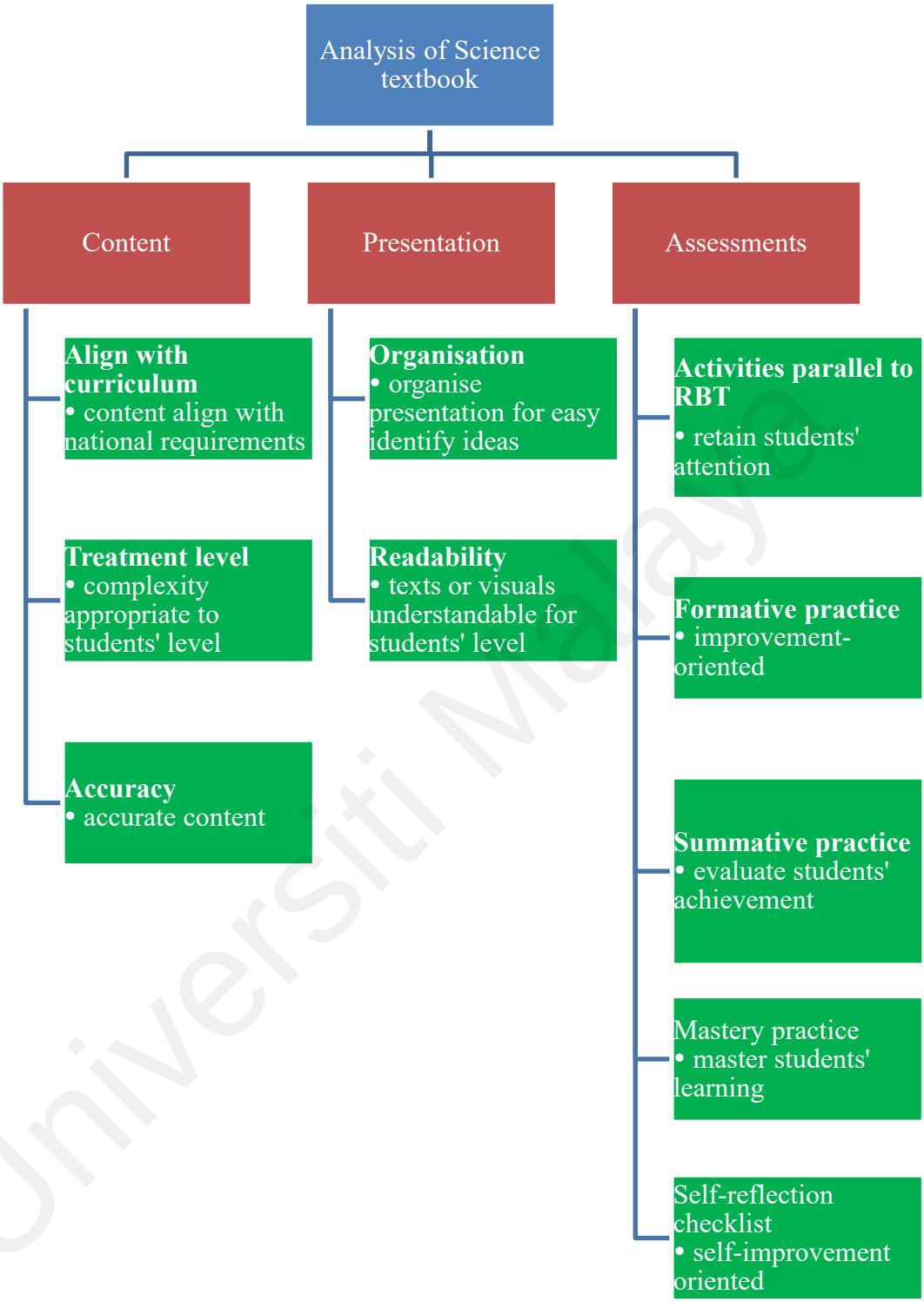


Figure 2.5 Summarization of adapted FLDOE's elements

2.8 Teachers' Perception on Textbooks

In Malaysia, Science textbooks are consider as adequate package which determines the science curriculum in schools and act as greatest stimulator where most of the teachers relied heavily on them (Embong et al., 2012). Therefore, it is important to carry out interview with the teachers as they're most probably the first person that able to detect any mistake from the textbooks and consider the best person to assess a textbook. Moreover, by interviewing the teachers, it certainly able to identify its' pros and cons of the textbook as the teachers experience the hands-on of conducting the class lessons with the students. This certainly helps to improve future production of textbooks when ample profound characteristics have been recognised and weaknesses able to be rectified.

In 1979, Finley (as cited in Meyer, et al., 1988) had designed an evaluation checklist for the teachers as assessors for science curriculum. The checklist includes assessors examining content, learning difficulty, presentation and teach ability. The results of the checklist were according to a five point scale rating ranging between "strongly disagree" and "strongly agree". This was similar as the research involved on content, presentation and assessments criteria as well. However, this research was interested on using qualitative measures to obtain word-beneficial opinions compared to scales rating.

On the other hand, Digisi and Willett (1995) conducted a research on practise of reading and textbooks from the perception of high school biology teachers. It was based on self-report mail questionnaire which is quantitative data and personal interview which is qualitative data. There were 184 respondent teachers who answered the questionnaire. A subsample of 16 teachers which extensively represent

the questionnaire sample were chosen to be interviewed with their textbooks for better recall. It was found that the use of textbooks was altered by the teachers based on their academic level classes. For example, the teachers equipped the students with more reading activities for the lower academic level classes and expect them to gain biology content in the class. Meanwhile, for the advanced academic classes, the students were expected to learn from independent reading and classroom lessons. The biology teachers fully comprehend that reading and inquiry activities are equally vital in learning biology yet they were ambiguous on ways to integrate reading strategies into their curriculums. Some of the interview questions towards the teachers were "how teachers instruct reading in the textbook" and "what activities used with the reading given". Hence, it is related to this research as it involved the textbook content corresponds with assessments and the readability where the teachers may contribute their opinions on it.

Meanwhile, a research of content analysis of Biology textbooks accompanied by five interviewed teachers had been conducted (Gök, 2012). The research adopted FLDOE framework to analyse textbook according to content, presentation and learning strategies. Some of the examples of the interviewed questions were "how accurately the content presented" and "what do you think about the visuals". The interview questions were open-ended type which were recorded and noted down in front of them. Hence, it is important to get teachers' opinions as they're one of the major users of textbook which may encounter any distinct experiences that able to benefit to this qualitative research.

2.9 Conceptual Framework

Throughout the history of education, researches have been carried out on textbook analysis in order to investigate the quality of instructional materials in education system. A frequent method for textbook studies is through content analysis. Hence, conceptual framework was constructed based on the objective of this research which aligns with the requirement of national curriculum standards. Conceptual frameworks represent "prescriptive, analytical and methodological purposes" which can avoid rapid and subjective analysis besides than providing direction for the researcher (Miles, 2014; Wang, 1998). The conceptual framework was adapted from FLDOE which act as a guidance for this qualitative research. It consists of three priorities elements known as content, presentation and assessments (Figure 2.6).

All of these elements can be found in every instructional material where the tools related for teaching purposes. The instructional materials can be differentiated by print or computer based materials (Martin, 2011). In this research, the printed material of the Science textbook is selected for analysis. Other print based materials include magazines, newspaper, brochures, posters and journals. Whereas, computer based materials include internet websites or rotating disks such as Compact Disk (CD) or Digital Versatile Disk (DVD) (Kipphan, 2001).

Even though there were many methods to determine the quality of the textbook, FLDOE framework was considered the most suitable to define as it presents the results in a more scientifically comprehensive manner yet distinguishable among each other which on content, presentation and assessments. Moreover, content analysis is described by a method which enables replication and producing standard inferences from the information (Drisko & Maschi, 2015;

Krippendorff, 2013). Following this clear set of conceptual framework able to determine the trustworthiness of the inferences and replicability. This consistency acts as a safeguard that allows the instructional materials to be judge fairly rather than on basis of individual and idiosyncratic perceptions (Neuendorf, 2016). Therefore, this able to guide the research in a standardise manner. This framework also gives prospect to assess many aspects of an instructional material under the categories of content, presentation and assessments.

The qualitative data that obtained from the textbook analysis were triangulated with teachers' interviews who used the textbooks on-field to create significant results and profound understanding. Such information collected on the analysis able to raise awareness to the publishers and consequently benefits the Ministry, teachers and students. Useful features able to be identify and emphasize while any probable weaknesses able to be counteract from this analysis. Hence, this research will significantly affect on the education and learning of the students in a long term.

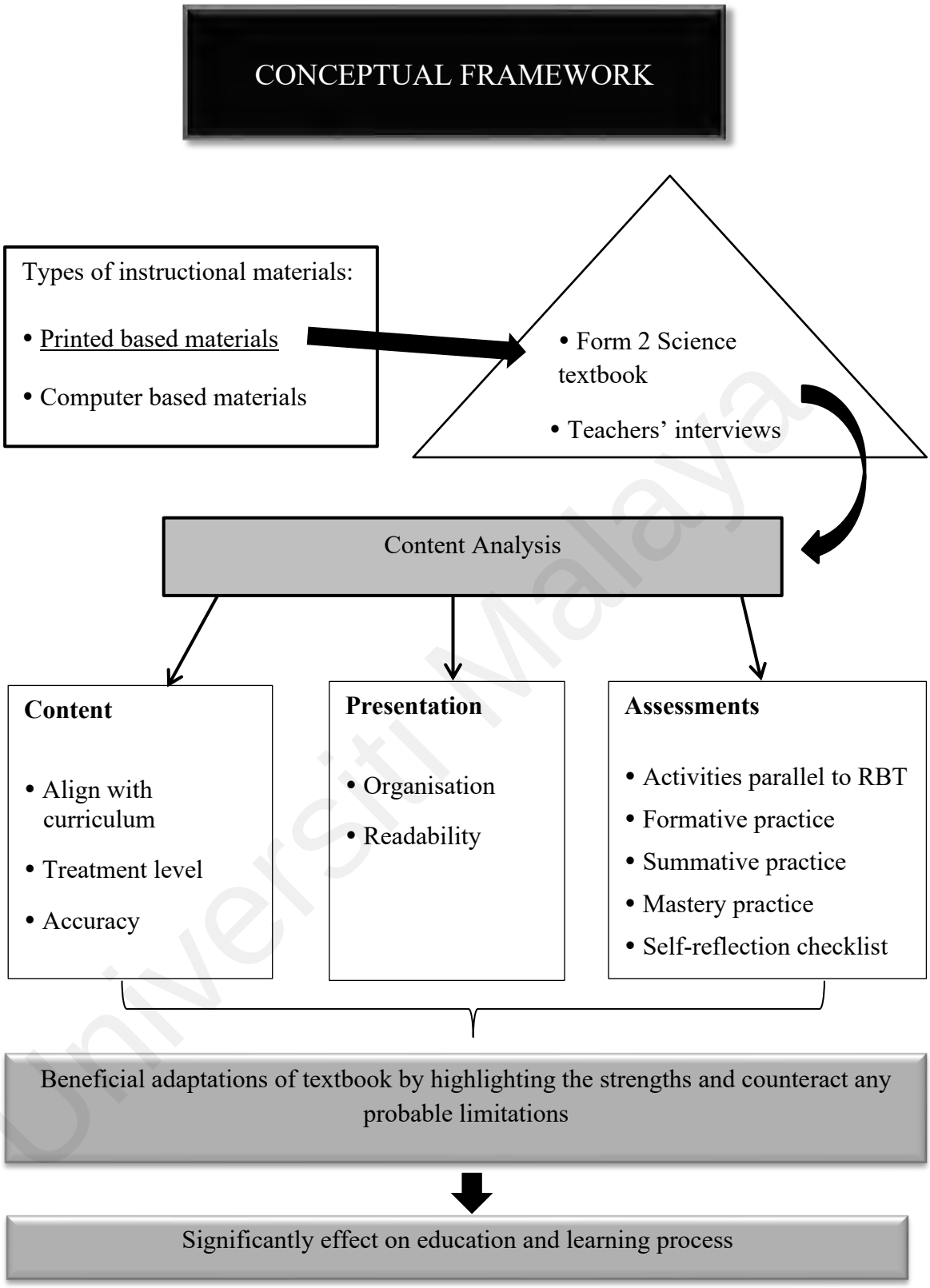


Figure 2.6 Framework of research

2.10 Theoretical Framework

Teachers spend almost majority of their time of teaching by using textbook (Fadhli, 2000; Fuchs & Bock, 2018; King, 2010; Mikk, 2000; Radcliffe et al., 2004). It is indeed textbooks are considered as the backbone of curriculum as it acts as comprehensive learning material which approved by the education's ministry. As many conceptual frameworks were designed for content analysis, a theoretical framework is important as well as they give life to a research and able to make this research firmly fixed in an established theory created from credible studies rather on individual instincts (Akintoye, 2015; Imenda, 2014). In this manner, all the aspects of these research ideas were connected to the theoretical framework (Adom et al., 2018; Grant & Osanloo, 2014).

The theoretical foundation of this research derives from a model by Jenkins (1979, as cited in McDaniel & Butler, 2011), a tetrahedral model adapted for classroom learning (Figure 2.7). It is a four planes model interacting the textbook learning material as the controlled variable with all the other factors that may critically influenced by other factors in a classroom environment as textbooks are not used in vacuum (Grimaldi et al., 2019; Marsh & Butler, 2012; Swanepoel, 2010). This adapted framework operates by the four vertex which represents the four underlying factors or variables that affect learning. The factors were grouped according to their given type which are nature of the textbook, learning instruction, students' characteristics and task demand. Each of the edge of the modal shown a two-way interaction which will influence learning portrayed in the two-way arrow in the diagram. Whereas, each plane shows a three-way interaction together with the dotted line which means the entire figure of the model is a multi-dimensional process

which shows four-way vigorous interaction of all the variables as a whole. Hence, the quality of the Science textbook will be influenced by the dynamic interaction with the other three variables. By understanding what and how this variables affect the quality of textbook able to further intervene the framework of textbook analysis.

In this research, the controlled variable which is the Form 2 Science textbook are vital teaching material and pertinent source of knowledge towards the teachers and students. Therefore, the content of the textbook in terms of its readability, accuracy, attractiveness and assessments of the textbook able to greatly affect the students' learning process. This learning material able to stimulate or hinder students' learning which will then influence their interest and examinations performance based on this framework established. This is due to dynamic interconnection produced in a classroom learning environment.

Apart from the learning material, learning instruction account as one of the vertices in the tetrahedral model which plays a significant impact on learning process as well. This is due to the teachers who acts as the facilitators on what kind of learning instructions to be channeled towards the students from the textbook in terms of the content or activities. If they review the text to be crucial, they may use and modify the section for classroom learning however, if they judge it to be not necessary, they could have neglected it from the textbook to be taught in order to facilitate active learning in the classroom (Schell & Butler, 2018). Hence, with learning instruction as one of the variables in classroom environment may influence the outcome of the quality of the textbook. Students are more likely to turn their attention to their teachers' interaction with the textbook during the classroom learning than only the textbook itself. This is according to Ansary & Babaii (2002, as cited in Mohammadi & Abdi, 2014) that no matter how flawless the textbook will be,

it is not a miracle tool but more towards teachers' commands on the textbook. Therefore, a good quality textbook is also influenced by the accompaniment of good teachers' instructions and adaptations which the data has been obtained from the teachers' interviews.

The next variable is the students' individual characteristics which manipulated by the students' interest, prior knowledge and cognitive abilities of the students which may contributes towards textbook quality. For example, students who have great interest in Science subject may able to pay attention and understand easily compare to students who are not interested in the subject (Cheung, 2018). Students with prior knowledge before the textbook introduction may also easily comprehend the text due to lesser cognitive load compare to students who do not have any knowledge beforehand (Seery & Donnelly, 2012). Lastly, students' cognitive abilities also able to affect their learning as not all students in the same cognitive level (Dunlonsky et al., 2013). For example, not all students able to synthesize new ideas which varies according to the students abilities despite having a good textbook. Nevertheless, a good textbook able to influence students' interest and cognitive abilities as well as it is a two-way interaction.

The last variable is task demand refer to the critical measure of how learning is evaluated which is the external examinations. In Malaysia, there are only two major local government examinations in secondary school which are Form 3 Assessment (PT3) and Malaysian Certificate of Education (SPM) which is in Form 3 and Form 5 respectively (Chongo et al., 2020). Therefore, the content of Form 2 Science textbook are mostly influenced by Form 3 Assessment (PT3) to provide numerous preparation for the students before the examination. On the other hand, the task demand of the examinations may also influence the learning instruction of the

teachers as they may modify their teaching without following the textbook in order to fulfil how the learning is evaluated which is the attempt to gain high scores for their students in examinations (Swanepoel, 2010; Yan, 2018). This incident may cause students unable to understand comprehensively or apply other important scientific skills as the teachers only spend most of her time to ensure high scores in paper-based examinations. By critically analysed and recognizing all the variables are affecting one another lead researcher to understand better that purely content analysis of textbook are not sufficient to prove the quality of the textbook content but other variables that correlated as well in the classroom learning environment as it is important to know where the intervention is taking place.

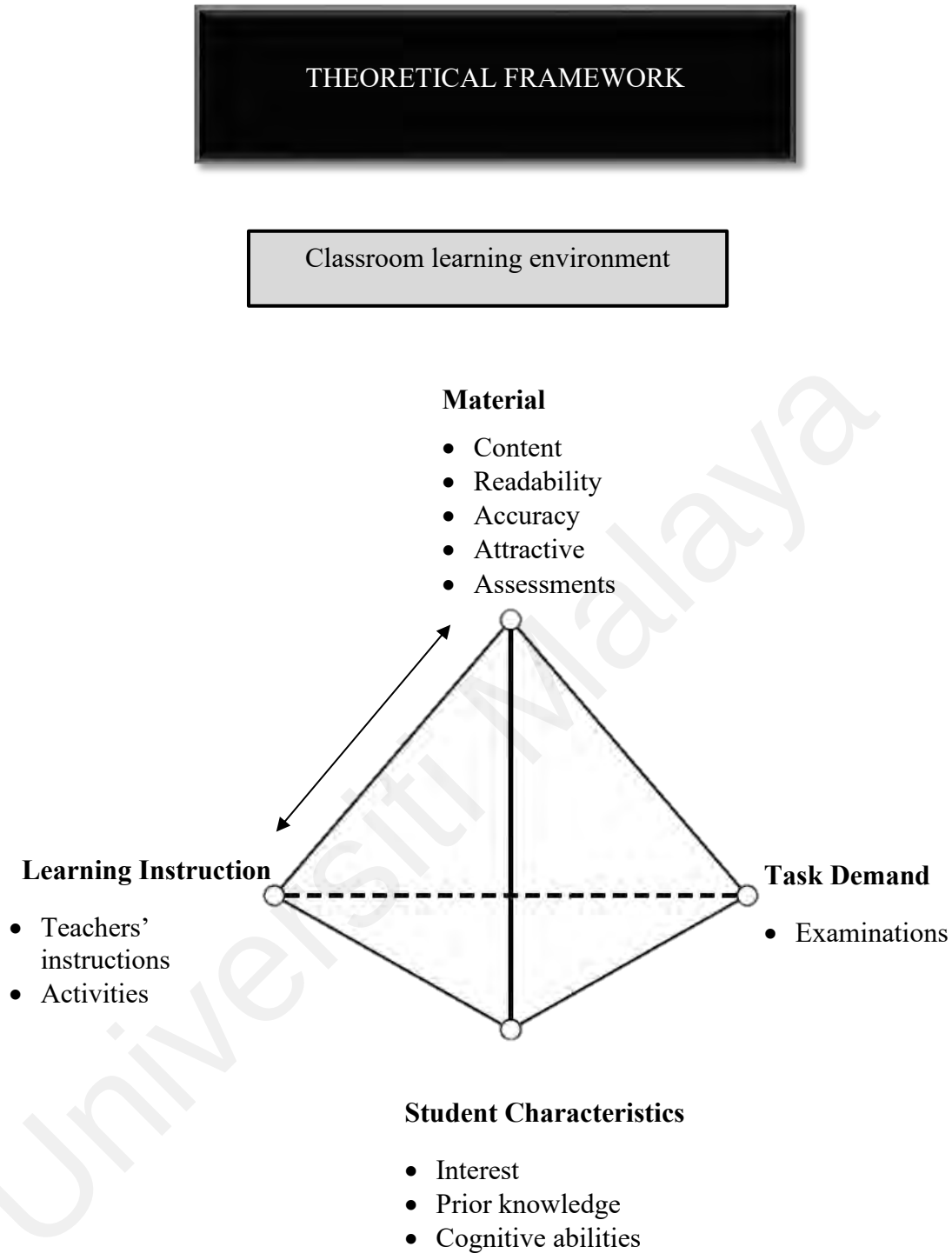


Figure 2.7 A tetrahedral model for theoretical framework (adapted from Jenkins, 1979)

2.11 Summary

As discussed, the process of textbooks preparation undergoes several reformation of curriculum in our country for continuous improvisation and to ensure the best curriculum achieved. In secondary schools, New Curriculum for Secondary Schools (KBSM) was introduced in 1988 which then revamped into Integrated Curriculum for Secondary Schools. Later, in 2017, Standard Based Curriculum for Secondary Schools (KSSM) was established until present. This shows the significant role of textbooks in our country for continuous revamping.

Inevitably, Science textbooks holds a great responsibility in science education as it carries the content that wished to be delivered to the students. It also significantly affects the students' perception and interest on science which is why it is important to carry out this research. The review of the literature showed the broad range of methods conducted in analysing a content of a textbook. However, in this research, all the range of specifications can be categorised into three elements which were its' content, presentation and assessments which were used to analyse the Science Form Two textbooks. These three organised elements were adapted from conceptual framework of Florida University Department of Education (FLDOE).

Nevertheless, this analysing of Science textbook would not be sufficient as it is only armchair evaluation without real-life experiences and field-tested. Therefore, it is important to collect opinions and perceptions from the teachers who used the Form Two Science textbooks in their classroom. Hence, this research will be able to ascertain the level of degree to how well the Form Two Science textbooks are and other beneficial information obtained. Consequently, this information will be useful

for future reference to the education stakeholders, writers, publishers, teachers and students.

CHAPTER 3

METHODOLOGY

3.1 Introduction

The aim of this study was to analyse on the Form Two Science textbook in terms of content, presentation and assessments which triangulated with data from teachers' interviews. This chapter constructed an outline of methods to analyse the data in order to answer the research questions. This qualitative research used two main approaches which were content analysis and interview technique.

Section 3.2 explains on the research method used while Section 3.3 discusses on the selection of interview participants. Then, Section 3.4 discusses on the data collection techniques, whereas, Section 3.5 explains on the research procedures used. Next, Section 3.6 discusses on data analysis for both document analysis and interview analysis. The trustworthiness of the research will be discussed in this chapter as well.

3.2 Research Method

This research is conducted based on qualitative research paradigm. Basic qualitative research design was chosen as the research design in order to obtain in-depth information to understand the scenarios better and consequently enhance the development of future textbook editions (Sandin, 2003). The researcher is interested to analyse the Form 2 Science textbook with the teachers' perception in non-numeric

data and deductively manner. Both the document and interview analysis were conducted according to qualitative methods. Hence, any interesting criteria that may emerge during the research were considered to be added to the research. In addition, interviews were only conducted after document analysis had been completed in order to produce meaningful data triangulation discussions towards the research participants.

3.3 Selection of Participant

The samples of this research were targeted to Form Two Science teachers with at least one year of experience in using the Science textbook in their classroom as a criterion. This is due to newly introduced Form Two Science textbooks in year 2018. This selection of participant is through purposeful sampling which is widely used in qualitative research in order to select individuals that have experience or information in this situation to provide beneficial data. They were also selected according to convenience sampling which is one of the type for purposeful sampling which based on convenience of time, location, money and availability of respondents (Cresswell & Plano, 2011; Creswell, 2014; Palinkas et al., 2015).

Besides than their experiences possessed, the participants should also able to communicate their opinions expressively and in articulate manner in order to obtain a rich data (Bernard, 2002; Palinkas et al., 2013). Four teachers from three schools in Selangor were selected in this research to obtain the necessary data. The site selection of schools in Selangor was according to 'typical case sampling' as the schools use the same Science textbook throughout Malaysia which consider as usual

phenomenon of interest and also according to convenience sampling to obtain the participants (Merriam & Tisdell, 2015; Patton, 2002).

Prior to data collection, a demographic questionnaire (Appendix G) and consent form (Appendix H) were given to the selected participants. The participants were briefed on the research purposes, research procedures, average time of interview and implication of this research. They were informed of their right to withdraw any time from this interview. Table 3.1 shows the summary of demographic information of the participants. Pseudonyms were given to protect their real identities for this research writing.

Table 3.1

Demographic of Research Participants

Name	Years of teaching experience	Years of teaching using the textbook	Teaching qualification	Location of the school
Nadia	16	2	Malaysian teacher training	Urban
Aiza	1	1	B. Ed Physics Education	Urban
Najwa	5	2	B. Ed Physics Education	Urban
Ng	11	2	B. Ed Science Education	Urban

Meanwhile, the number of research sample is not the key concern for qualitative research where the number of participants may be different for each research as the main focus is on the phenomenon holds (Creswell, 2008). For instance, Digisi and Willett (1995) conducted their interview on 16 teachers on their perceptions of reading and textbooks while Gök (2012) interviewed five teachers on comparison of textbooks. Nevertheless, Bowden (2005) suggests not too many participants in qualitative research as it may cause difficulty in managing the data but just enough participants to provide adequate information. This is known as saturation point where the interview data information given will be no other new data can be obtain from the samples (Creswell, 2008; Guest et al., 2006; Mason, 2010). Hence, four teachers were selected for interview with saturation point obtained.

3.4 Data Collection Technique

This research involves two data collection techniques which were from the document analysis of the Form 2 Science textbook and interviewing the teachers who use the textbook in their classrooms. The interview will be carried out after document analysis data were obtained for data triangulation to produce meaningful data.

3.4.1 Document

In this part of research, it involves the data collection technique for document analysis according to qualitative approach. The data is obtained from only one textbook which was the Form 2 Science textbook. The main detriment however is that outcomes were strictly limited to data only. Therefore, to overcome this

disadvantage, data triangulation of interview was conducted to the teachers who use the textbook after the document analysis in order to triangulate the data from analysis of textbook.

Form 2 Science textbook is the Science textbook used by all of Form 2 students in Malaysia as national syllabus (Figure 3.1). The reason why Science Form Two is chosen is due to Form Two students have experienced at least one year of Science education in the secondary school during the data collection of this study. This is certainly a good exposure and preparation as they know what skills to be improved and other beneficial information that can be obtained from their previous experience. The Form Two Science textbooks were the second batch of Science textbook prepared for the Standard Based Curriculum for Secondary Schools (KSSM). Therefore, it is most probably written in better procedure and meticulously to reveal the clear objectives of the curriculum.

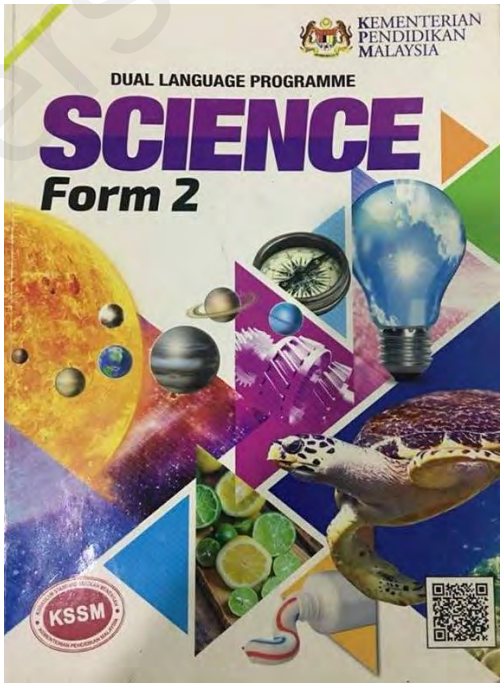


Figure 3.1 Cover of Science Form 2 official textbook in Malaysia

These Form Two Science textbook has choices of two languages which are Bahasa Malaysia and English in this dual language program. The textbook is published by Karangkraf Network Sdn Bhd, a private company which has been approved by the Ministry of Education Malaysia to publish official national Science Form 2 textbook in local secondary schools. It was first published in 2017 and used as first batch in year 2018 in this new Standard Based Curriculum for Secondary Schools (KSSM) syllabus.

The textbook has four themes, 13 chapters and total of 288 pages in the syllabus. It is co-authored by a team of four people: Jariah binti Khalib, Maznah binti Omar, Badariah binti Hamzah and Shamsulikram bin Abdul Hamid. Meanwhile, a team of four people as translators: Ram Kumari K. Raman, Yew Chiam-Hauo, Sharon Cheli Moorthy and Shirley Monica. Whereas, for editors were Nadiatulaini binti Azenan and Kumutha Murugiah. The designer was Mohd Fauzi bin Mohamad Hassim and the illustrator was Wan Hamizan bin Wan Hussin. In this research, only one theme was analysed which was 'Energy and Sustainability of Life' due to the difficulty of physics related theme which may consider as too challenging, boring and irrelevant for the students (Subramaniam; 2011). It consists of four chapters which were *Electric and Magnetism* (Chapter 7), *Force and Motion* (Chapter 8), *Heat* (Chapter 9) and *Sound Waves* (Chapter 10).

3.4.2 Interview

After obtaining data from the document analysis, the interview of the teachers opinions based on the criteria (content, presentation and assessments) of the textbook were then be collected. The interview protocols were created after obtaining document analysis results in order to produce data triangulation. For example, from the document analysed, significant interview questions which adapted from FLDOE method were created and modified to be used in the teachers' interviews. Semi-structured (contains both open-ended and close-ended questions) interview technique were used for the teachers to express their opinions and provide more insight information (Hanson et al., 2011; Raziskovanja & Naravovarstva, 2011).

3.4.2.1 Preliminary research

Preliminary research was conducted to field-test the future research for ideal achievement and identify any problems that may exist in the actual research interview. This result on researcher able to improve and correct the method as required based on the information collected from the preliminary research (Kistin & Silverstein, 2015; Leon et al., 2011; Teijlingen et al., 2001). In this research, the method used was interview questions which were adapted from FLDOE method as its conceptual framework.

The interview was carried out to a Form 2 Science teacher from a local secondary school. The teacher has teaching experience for about 12 years while only one year of experience using the new Standard Based Curriculum for Secondary Schools (KSSM) Science Form 2 textbook where she uses the textbook for almost

every day in the classroom. The teacher was requested to respond to the face to face interview according to the questions proposed (Appendix B). The interview took around 40 minutes.

The teacher was also asked to highlight any terms, words or sentences which he/she did not understand in order to carry out proper modification. The interview protocol was enhanced, based on the interview session with the teacher (Appendix C). For instance, the number of questions has been increased to break down into two questions. This is due to a question consists of both strength and limitation which were then broken into two different questions (Question 13, 24, 29) for clearer understanding.

Meanwhile, some questions sentences were extended with clearer description as Question 5, Question 11 and Question 12 have been added with "towards the students". Whereas, Question 6 has been added "in the classroom" for clearer explanation. On the other hand, Question 11 was simplified for better understanding. It was previously from "What do you think about the success of portrayal towards humanity to instill compassion and care?" which then simplified to "What do you think about the success of instilling compassion and care?". Hence, preliminary research is important to be carried out in order to revamp the interview questions for clearer understanding for the actual research.

3.5 Research Procedure

This research consists of two procedures which were for document analysis and interview. Generally, the procedures for document analysis will be conducted prior to procedures of interview.

3.5.1 Procedures of document analysis

The document analysis was conducted by the researcher using the Form 2 Science textbook. It was analysed according to the listed elements which adapted from FLDOE (2015). A framework was then constructed from the adaptation to act as a better tool for analysis. The adapted framework was then reconstructed and validated by two experts in Science education who have 10 years of experience of teaching at school universities (Appendix A). The experts examined meticulously into every points indicated in the framework. For instance, the experts opposed the opinion of using justified paragraphs for readability in all text figures which is much reasonable as it is easier to read.

Next, any significant data obtained from the textbook were recorded and pictures were taken accordingly to be analysed and discussed. For example, the glaring texts presented in the textbook was captured and discussed in the findings with other studies (Figure 3.2). Later, it was asked as one of the interview questions towards the teachers whether do they find it difficult to read and do they really used this section during their classroom teaching.

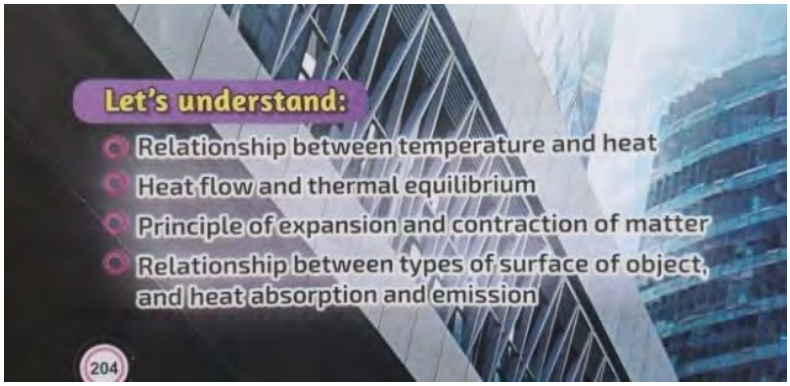


Figure 3.2 Example of glaring texts captured for document analysis

Meanwhile, there is another section that requires another reviewer to validate which is on the assessment strategies of the textbook as the questions were categorized into Bloom's taxonomy levels. Hence, a meeting was conducted between the researcher and a reviewer (a postgraduate student of educational science) to ensure inter-rater reliability to be achieved with a minimum similarity score of above 95% as an acceptable level of agreement for accuracy (Maruna, 2010). Further discussion was carried out to resolve any disputes that occurred.

3.5.2 Procedures of interview

The interview with the teachers was only conducted after the document analysis in order to generate meaningful questions to be asked. For example, question of 'Do you aware of the questions at the beginning of every chapter for example in page 140? Do teachers use the questions towards the students?' was generated based on the document analysis of the textbook.

Prior to the interview, the teachers were told the purpose of this research conducted. They were guaranteed that they will remain anonymous to protect their identities where pseudonyms were given namely Nadia, Aiza, Najwa and Ng as their real names will not be revealed. Moreover, answers won't be judged as the central importance of this research is to look at the insights that they could provide to this research. The teachers were also told that the data of the interviews would be assuredly confidential and only be used for this research. The interviews data were collected using notes and voice recording in front of them where the results and interpretations of the interviews were checked with the respondents.

Interviews were conducted one-by-one and last about 45-50 minutes. Opinions and comments of the teachers were taken in order to support the research by increasing the trustworthiness of the data (Guion, 2002). Therefore, the teachers able to provide feedback of any additional ideas regarding the improvement of the Science textbook. Gillham (2000) stated that the advantages of using semi-structured interviews for supporting content analysis were it was relatively easy by identifying functional statements, modifying interview according to the respondents' replies, recording them, and then requesting the respondent to verify their precision.

3.6 Data Analysis

As the data information was collected, data analysis steps will then be performed. It involves data analysis for two sections which were data analysing through document analysis of the Form 2 Science textbook and interview data analysis from the teachers who use the textbook in their classrooms.

3.6.1 Document Analysis

In this research, qualitative document analysis has been chosen to analyse the content of the data. According to Drisko and Maschi (2015), document analysis can be differentiated into three methods of analysing which are basic content analysis, interpretive content analysis and qualitative content analysis. However, there is no clear dividing line for each of the methods. Basic content analysis belongs to the quantitative method while interpretive and qualitative content analysis focuses on qualitative method. Basic content analysis (Weber, 1990, as cited in Drisko & Maschi, 2015) is based on word count and statistical analysis which is commonly used in social work literature as the data is fixed and stable.

Meanwhile, for interpretive content analysis is the act of interpreting and producing inferences during the analytical process (Krippendorff, 2013, as cited in Drisko & Maschi, 2015). Some of the authors argue interpretive content analysis may or may not have empirical statistics data (Ahuvia, 2001; Krippendorff, 2013, as cited in Drisko & Maschi, 2015). On the other hand, qualitative document analysis refers to a set of methods to produce implicit themes which is used in this research. It is mainly stressing on descriptive information than critical analysis of information. It is known as thematic analysis by using coding method to obtain the results (Braun & Clark, 2006; Schreier, 2012, as cited in Drisko & Maschi, 2015).

By scrutinizing many studies on science textbook analysis throughout the past years such as Analyzing Science Textbooks by Doran and Sheard (1974 as cited in Park & Lavonen, 2013) and Analysis of Science Textbooks for Instructional Effectiveness by Khine (2013), the Form 2 Science textbook were analysed according to three different elements which were content, presentation and assessments. These analyses of the document were guided by framework of Florida

University Department of Education (FLDOE) in 2015 (FLDOE, 2015) (Table 3.2). However, based on the document analysis, additional sub-elements had been included, such as related STEM careers and scientific values. This is to emphasize Science related careers exist in this country in order to captivate students' interest as Malaysia requires more manpower in science and technological field to face Industrial Revolution 4.0 (Chiu, 2016; Sua, 2012; Vijaindren, 2018). Whereas, the scientific values discovered were caring and patriotic which were to have more humanities and compassion towards mankind, environment and society as it is equally vital to science core values.

Table 3.2

Elements of FLDOE compared to Elements of Framework Used in this Research

Elements of FLDOE	Elements of the framework used in this research
Content	
i) Alignment with curriculum requirements ii) Level of treatment iii) Expertise for content development iv) Accuracy of content v) Currentness of content vi) Authenticity of content vii) Multicultural representation viii) Humanity and compassion	i) Alignment with curriculum requirements ii) Level of treatment iii) Accuracy of content
Presentation	
i) Comprehensiveness of student and teacher resources ii) Alignment of instructional	i) Organisation ii) Readability

components

iii) Organisation

iv) Readability

v) Pacing of content

vi) Ease of use of materials

Learning strategies	**Assessments**
i) Motivational strategies	i) Activities parallel to Revised Bloom's Taxonomy (RBT)
ii) Teaching a few "Big Ideas"	ii) Formative practice
iii) Explicit instruction	iii) Summative practice
iv) Guidance and support	iv) Mastery practice
v) Active participation	v) Self-reflection checklist
vi) Targeted instructional strategies	
vii) Targeted assessment strategies	

This framework is chosen as it encompasses a complete comprehensive of a textbook can possess through the elements of content, presentation and assessments in a systematic manner. Subsequently, the text was interpreted based on framework adapted by researcher. The main benefit of using this approach is easy to revise data due to its inconspicuous nature. Hence, it is easier to amend any mistakes made in the analysis process. The textbook data were analysed according to the adapted framework (Appendix A) which had been validated by two reviewers. Then, the document was analysed according to the framework where significant results obtained were then recorded and pictures will be taken.

For instance, based on the framework constructed in terms of content, the textbook information provided should be sufficient enough without the aid from other sources to ease readers to understand. However, from this document analysis found that few context shown lacking of explanation such as in Figure 3.3 as it does not explain thoroughly how the charges travel in the electroscope device which may

cause confusion among the readers. Therefore, from the document analysis results able to identify the type of questions to be asked during the interview later on. The content was analysed from the beginning of the textbook chapter and ends before the practices at the end of the chapter as it will be discussed under section assessment later.

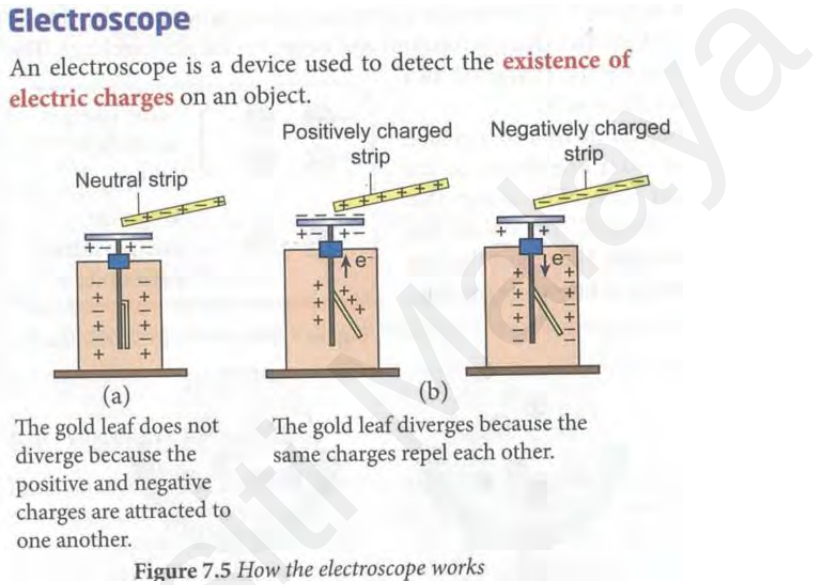


Figure 3.3 Example on document analysis in content element

Meanwhile, in terms of document analysis for presentation element, it was generally according to the external appearance of the textbook. It was found that the summary of Chapter 8 (Force and Motion) was dull as it consists of a lot wordings, lack of colourful borders and important information to attract and ease readers (Figure 3.4). This may hinder the effectiveness of the Summary objectives. Hence, this able to construct the interview questions accordingly to justify the research document analysis.

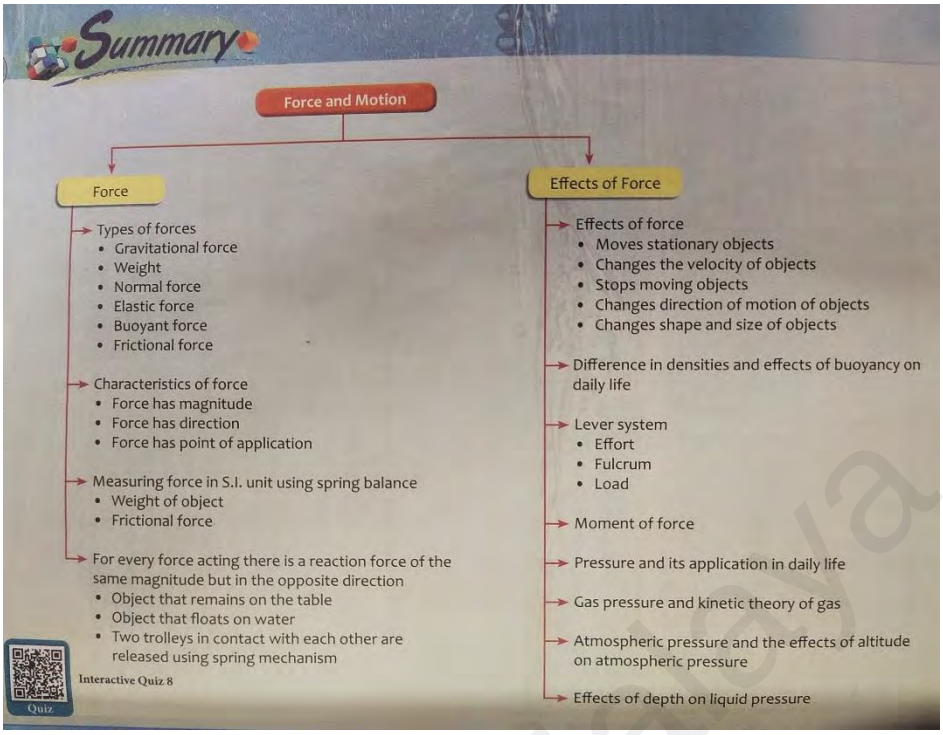


Figure 3.4 Example on document analysis in presentation element

Lastly, in terms of assessments, the questions located in the assessments section were mostly analysed and categorized according to Revised Bloom's Taxonomy level (RBT) in order to distinguish what type of questions mostly found in the textbook such as Lower Order Thinking Skills (LOTS) or Higher Order Thinking Skills (HOTS). For example, in Figure 3.5 shown Question 2 and Question 3 were in Applying and Understanding level respectively. The results were then verified and discussed with another reviewer to ensure inter-rater reliability with at least 95% accuracy score as an acceptable agreement (Maruna, 2010). Following the document analysis, graphs were then generated for better comparison and it was found that most of the questions in the textbook were in category of LOTS. Therefore, from the results generated able to produce data triangulation with the teachers' perceptions regarding the textbook assessments.

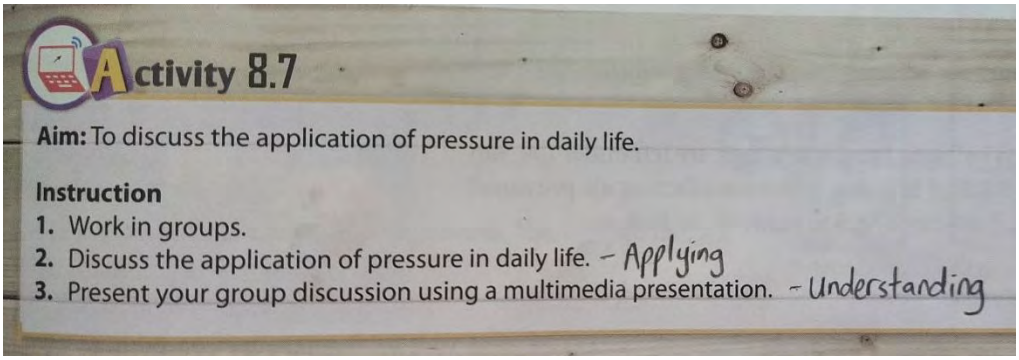


Figure 3.5 Example on document analysis in assessment element

3.6.2 Thematic Analysis of Interview Data

Thematic analysis of interview data was carried out which the audio recordings were recorded by researcher's mobile phone. It was labeled according to the participant teachers and will be kept in computer for further analysis and records. The audio recordings were transcribed verbatim in Microsoft Word. The data were then arranged and read thoroughly. As some of the participants spoke using Malay language, Brislin back-translation method was carried out by another bilingual expert translator in order to maintain the quality and accuracy of the translation into the targeted English transcript (Brislin, 1970 as cited in Tsai et al., 2020). Any disputes were further resolved by agreement through discussion.

Next, manual coding method was used in this research. The codes were then numbered and the frequencies of the same codes were categorized together to represent its general theme (Rossman & Rallis, 2012). For instance, a transcript of a teacher which stated *"this textbook very good because more colours that can attract the students. And I like the tree map and so on." (IT1, ln. 196-198)* can be coded as "attractive presentation" which will then be placed as the category of organisation under the theme of presentation. The categories and themes were adapted from

FLDOE (2015). Subsequently, the statistical result of the codes obtained were interpreted and produced into meaningful interpretation.

To obtain the answers to the research questions, the interview transcripts and field notes were examined carefully to achieve the research objectives. Different colours were manually highlighted on the related data to ease reading and categorisation. The researcher then compared the sets of coding and necessary changes were made to produce well fitted codes which were then concluded as in Table 3.3.

Table 3.3

Coding Map on the Teachers' Perception of the Textbook

Categories	**Coding**
Theme: Content	
i) Alignment with curriculum requirements	align with learning standard, good daily life examples, good STEM career examples, lack of field trips, Science relatable to environment than patriotism, students' laidback attitude towards environmental and patriotic topics
ii) Level of treatment	sufficient explanation, inadequate explanation and examples, requires other source of aid for understanding, unfitting students' level, insufficient time to use all the textbook features
iii) Accuracy of content	consist inaccuracies, QR codes unable to be used
Theme: Presentation	
i) Organisation	attractive, clear figures, well organized, well bordered, inadequate highlighting, inadequate labelling, incompetent glossary, incompetent summary
ii) Readability	well tables, well mind maps, well chapter summaries, inadequate QR links for videos, difficult visual readability, difficult readability
Theme: Assessments	

i) Activities parallel to Revised Bloom's Taxonomy	interesting activities, too many students in a classroom
ii) Formative practice	comprehensive questions, too many straight-forward questions, require to copy questions
iii) Summative practice	interesting questions, consists HOTS questions, lack of HOTS questions, HOTS questions should allocate marks
iv) Mastery practice	good questions, HOTS questions should allocate marks
v) Self-reflection checklist	comprehensive self-reflection checklist

Writing of the findings will then be carried out which will be presented in Chapter 4. The formed themes were interpreted and evaluated through readings to find theories from past related literatures that related to the themes. In general, qualitative research involves analysing the data deductively from the bottom up which creating particulars to general themes and produce interpretations. This means the meaning is created from the data collected during the field (Creswell, 2014). Figure 3.6 shows the summary process of interview analysis and coding of raw data.

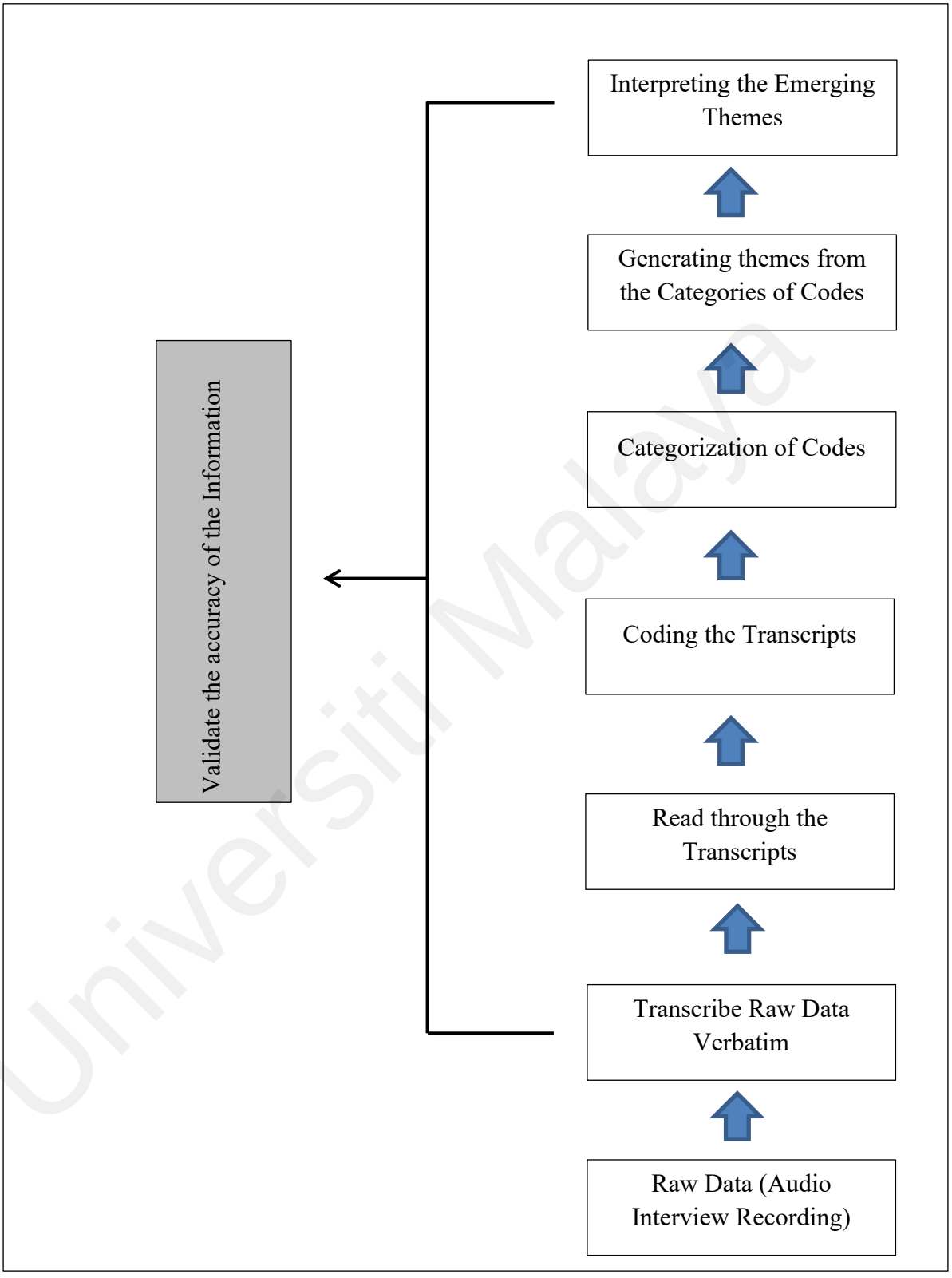


Figure 3.6 Process of data analysis and coding of raw data (Adapted from the work of Creswell, 2014)

3.7 Trustworthiness of the Research

Trustworthiness of a research refers to the accurateness of the findings with specific measures. It is considered as one of the strong point of qualitative research as it concludes whether the findings are precise from the perspectives of the researcher, the participant or the readers. Other terms that similar to trustworthiness which were discusses broadly are validity, credibility and authenticity (Creswell & Miller, 2000; Lincoln et al., 2011). The trustworthiness strategies used in this research were based on the strategies proposed by Creswell (2014) to increase the accuracy of findings and trustworthiness. As there were two types of analysis which were document analysis and analysis of interview, the trustworthiness measures taken were slightly vary.

For both of the document analysis and interview trustworthiness strategies were using data triangulation and peer debriefing (Creswell, 2014). Data triangulation is the major strategy used by the researcher to enhance trustworthiness of the data where the data acquired from textbook analysis was triangulated together with the interview perceptions of teachers. This unification of two sources is considered as adding trustworthiness to the research. The semi-structured interviews contribute broader viewpoints which significantly benefit to data triangulation as well (Denzin, 2006; Guion, 2002).

Meanwhile, peer debriefing refers to the researcher's peer who is a lady whom completed her doctoral studies which is experienced in this research to continuously ask challenging questions about interpretations and procedures. This method of peer debriefing is better to use throughout the entire research as critical paradigm able to establish between the cooperation. The peer debriefer can offer her

opinions, ideas or feedback through written or verbal form. For instance, the element of motivational strategies of textbook was removed as it is considered inexact and subjective topic to be analysed from a textbook. Hence, this type of peer debriefing support able to add credibility to this research (Creswell & Miller, 2000).

Whereas, for interview trustworthiness strategies were using member checking and rich, thick description (Creswell, 2014). Member checking is to ensure the accuracy of qualitative findings by checking the final themes or codes obtained back to the participated teachers. The transcribed data and the results of the codes or themes used were emailed to the respective participants to seek for validations, comments and feedbacks. This ensures the trustworthiness of the researcher's data interpretations of the findings.

Another strategy is by using rich, thick description during the interview. The interview details such as its settings and transcripts were richly transcribed verbatim from the audio recordings to provide detailed information. The audio recordings could be replayed many times to allow the researcher to obtain meaningful responses in parallel to the notes that were taken down by hand as well during the interviews. This helps to support findings and increase the trustworthiness (Noble & Smith, 2015).

3.8 Summary

To conclude, there were two approaches to obtain the information on the Science Form 2 textbook which were through document analysis and interview analysis from the perceptions of the teachers. Interview will then be carried out after the document analysis. This is known as data triangulation to enhance the

trustworthiness of the data and broaden the research to produce meaningful results. The content analysis of the Form 2 Science textbook were analyse according to adapted Jenkins tetrahedral model framework which coincide with conceptual framework by Florida University Department of Education (FLDOE). The interview data will then be related with the content analysis to obtain any considerable explanation or justification. The main objective of this qualitative research is to obtain meaningful information in the form of characters concerning to the Science textbook. Table 3.3 shows the summary of process of analysis for this research according to the data collection technique. Whereas, Table 3.4 shows the summary of the methodology for data collection techniques and data analysis of the research.

Table 3.4

Summary of Analysis Process

Description	Content analysis	Interview
Steps	a) Using conceptual framework adapted from FLDOE (2015) in terms of: i) Content ii) Presentation iii) Assessments b) Using constructed framework	a) Preliminary research b) Selection of participants c) Conduct interview with the teachers d) Data analysis: i) Transcribe ii) Generate coding iii) Generate themes iv) Interpret themes
Trustworthiness	a) Data triangulation b) Peer debriefing	a) Data triangulation b) Peer debriefing c) Member checking d) Rich, thick, description

Table 3.5

Summary of Methodology

Research Objectives	Research Questions	Data Collection Technique	Data Analysis Method
1. To analyse the Form 2 Science textbook of the local secondary schools in Malaysia on theme 'Energy and Sustainability of Life': a) In terms of content b) In terms of presentation c) In terms of assessments	1. How is the curriculum of the Form 2 Science textbook of local secondary schools in Malaysia on theme 'Energy and Sustainability of Life'? a) In terms of content b) In terms of presentation c) In terms of assessments	i) Analysis of content	a) Using framework adapted from FLDOE (2015). b) Using constructed framework (adapted from FLDOE (2015))
2. To explore the teachers' perception of the content, presentation and assessments of the Form 2 Science textbook.	2. How do the teachers perceived about the content, presentation and assessments of the Form 2 Science textbook?	i) Interviews with the Science teachers	a) Raw data transcribed verbatim. b) Early codes generated according to analysis from constructed framework. c) Categorizations of codes into themes formed. d) Data from the analysed textbook and teachers' perception triangulated from other sources as well to interpret the themes.

CHAPTER 4

FINDINGS AND DISCUSSION

4.1 Introduction

This chapter presented the data analysis through content analysis of the Science textbook which to answer the first research question of this research. The data was triangulated with the teachers' interviews to produce significant and meaningful discussion directed by the second research question. The research questions are as follow:

1. How is the syllabus of the Form 2 Science textbook of local secondary schools in Malaysia on theme 'Energy and Sustainability of Life'?
2. How do teachers perceived about the content, presentation and assessments of the Form 2 Science textbook.

These two objectives were engaged to produce data triangulation to explore the phenomenon in-depth throughout this research. The theme 'Energy and Sustainability of Life' in Form 2 Science textbook was analyse in terms of content, presentation and assessments which were adapted from FLDOE (2015). Only significant elements were chosen and adapted due to its conspicuous elements. The content of the Science textbook was analysed following to the alignment with curriculum requirements, level of treatment and accuracy of content (Section 4.1). Whereas, the presentation of the Science textbook was examine based on its organisation and readability (Section 4.2). Lastly, for the assessments, they were

analysed according to activities parallel to Revised Bloom's taxonomy (RBT), formative practice, summative practice, mastery practice and self-reflection checklist (Section 4.4).

4.2 Content

The content of the Form 2 Science textbook is analysed according to alignment with curriculum requirements, level of treatment and accuracy of content which are parallel with the criteria of Science Standard Curriculum (KSSM). It is to develop composed individuals in a holistic approach in terms of knowledge, emotional, spiritual and physically balanced. It is also to shape individuals with scientific skills, innovative, creative and visionary besides cultivating the use of technologies (MOE, 2016).

4.2.1 Alignment with curriculum requirements

Textbooks that had been approved by Ministry of Education must be align and fulfil Standard Based Curriculum for Secondary Schools (KSSM) requirements to produce students who show high intellectual skills and scientific skills to achieve national's objectives (MOE, 2016). Therefore, Table 4.1 was constructed which derived from the Standard Based Curriculum for Secondary Schools (KSSM) requirements in Malaysia. It depicts the checklist of fulfilling the Learning Standard, consists of carry out or designing experiments, daily life applications and applications of 21st century skills which were communication, critical thinking, collaboration and informative. Following the textbook analysis, few other criteria

were developed which were values and STEM careers. The values emerged from this research were caring and patriotic. It is recorded according to the chapters in the theme 'Energy and Sustainability of Life' in Form Two Science textbook.

Table 4.1

Checklist of National Standard Based Curriculum for Secondary Schools (KSSM)

Science Requirements According to Chapters

Features		Theme 3 – Energy and Sustainability of Life			
		Ch 7: Electricity and Magnetism	**Ch 8: Force and Motion**	**Ch 9: Heat**	**Ch 10: Sound Waves**
Fulfil learning standard criteria		✓	✓	✓	✓
Experiments	Carry out	2	2	2	-
	Design	-	-	1	-
Daily life application		4	17	6	8
21st century skills	Communication				
	i) Using technology	1	1	-	2
	ii) Using other than technology	1	1	2	-
	Critical thinking	2	-	1	-
	Collaboration	2	2	2	3
	Informative	8	1	-	2
Values	Caring	-	-	1	-
	Patriotic	-	1	-	-
STEM career		-	1	-	-

4.2.1.1 Learning Standard criteria

According to MOE (2016), a national approved textbook must fulfil all the requirements of Learning Standard criteria which are measurable that had been conceptualized according to the learning areas stated in Standard Based Curriculum for Secondary Schools (KSSM) (Appendix D). Nevertheless, the list of Learning Standards is not stated in the textbook but only available in MOE portal (2016). Based on analysis, all of the four chapters in the theme 'Energy and Sustainability of Life' in Form Two Science textbook fulfil the learning standard criteria as required in Standard Based Curriculum for Secondary Schools (KSSM) (Table 4.1). The learning standard comprise of thinking and scientific skills to be included in the textbook. These skills act as list of objectives which were transcribed in measurable manners to ensure it will be achieved in a textbook (Figure 4.1 and Figure 4.2).

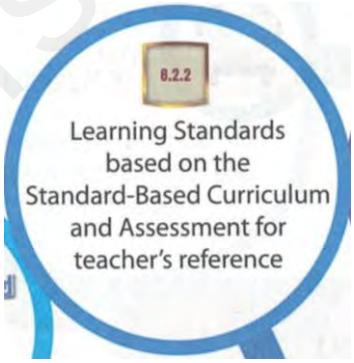


Figure 4.1 Learning Standards explanation in the textbook

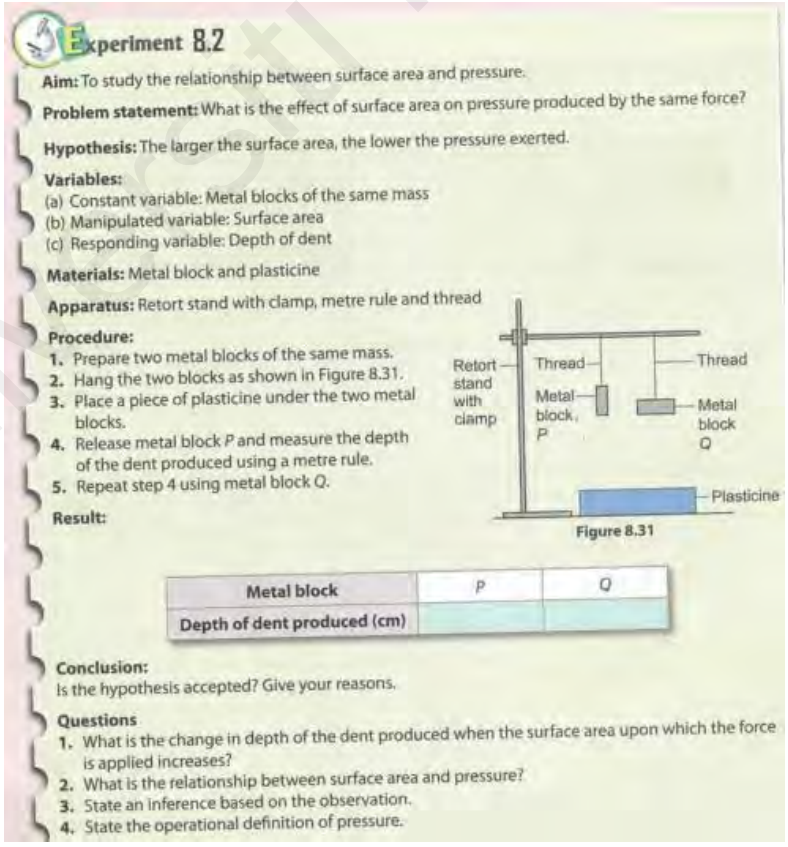
Figure 4.2 The portrayal of the Learning Standard on bottom of the related page

Generally, the content in the textbook are adequate for understanding as the teachers agreed. Nadia explained, *"I will show the videos, slideshow but the content is sufficient enough for them just to make them to have better understanding…" (IT1, ln. 33-34)*. Nevertheless, the teachers also commented that they need other source of aid for better understanding and more examples as asserted by Aiza *"we cannot depend fully on textbook. This textbook just roughly explains. We need another module to help us teach in the class. So, we have another Science module. Cannot depend fully on this textbook." (IT2, ln. 33-35)*. Hence, it can be deduce that although the content follows the Learning Standard proposed by Standard Based Curriculum for Secondary Schools (KSSM), teachers still need supporting materials to assist them during teaching and learning process.

4.2.1.2 Experiment

Based on the analysis, the researcher has categorised experiments in the textbook into two categories which are carrying out experiment and designing experiments. For carry out experiments, students need to follow exactly the procedure as stated like inside a 'cookbook' (Figure 4.3). Based on the analysis (refer Table 4.1), three out of four chapters include two experiments for each chapters.

However, for Chapter 10 (Sound Waves) has none which may cause students to be less driven in this chapter as experiments are considered enjoyable and promote learning for students since they able to actively participate (Sha et al., 2015; Sládek et al., 2011). Najwa also asserted that "they love it if it's experiments" *(IT3, ln. 264)*. Students' interest are highly related to their learning performance which consequently influence their achievement in examinations. This is according to the research tetrahedral theoretical framework where the textbook is influenced by students' characteristic as well. Therefore, maintaining students' interest on Science are imperative which is through active participation in experiments as Cheung (2018) also found that many of the students love Science compare to other subjects due to the fun experiments.



Experiment 8.2

Aim: To study the relationship between surface area and pressure.

Problem statement: What is the effect of surface area on pressure produced by the same force?

Hypothesis: The larger the surface area, the lower the pressure exerted.

Variables:
(a) Constant variable: Metal blocks of the same mass
(b) Manipulated variable: Surface area
(c) Responding variable: Depth of dent

Materials: Metal block and plasticine

Apparatus: Retort stand with clamp, metre rule and thread

Procedure:
1. Prepare two metal blocks of the same mass.
2. Hang the two blocks as shown in Figure 8.31.
3. Place a piece of plasticine under the two metal blocks.
4. Release metal block *P* and measure the depth of the dent produced using a metre rule.
5. Repeat step 4 using metal block *Q*.

Retort stand with clamp
Thread
Thread
Metal block, *P*
Metal block *Q*
Plasticine

Figure 8.31

Result:

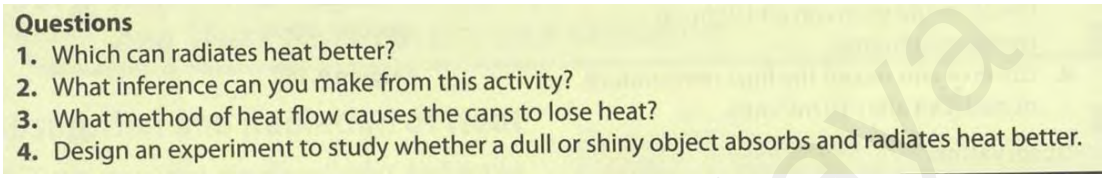
Metal block	*P*	*Q*
Depth of dent produced (cm)		

Conclusion:
Is the hypothesis accepted? Give your reasons.

Questions
1. What is the change in depth of the dent produced when the surface area upon which the force is applied increases?
2. What is the relationship between surface area and pressure?
3. State an inference based on the observation.
4. State the operational definition of pressure.

Figure 4.3 Example of carry out experiment

On the other hand, for designing experiments, it only consists of one activity which was on Chapter 9 (Heat) in Question 4 (Figure 4.4). Designing experiment activity is considered as a more challenging work than carry out experiment as it requires more scientific inquiry and critical thinking skills, where students need to construct an experiment by using their own ideas.



Questions

1. Which can radiates heat better?
2. What inference can you make from this activity?
3. What method of heat flow causes the cans to lose heat?
4. Design an experiment to study whether a dull or shiny object absorbs and radiates heat better.

Figure 4.4 Designing experiment required in Experiment 9.2 (pg 218)

This type of question usually stimulating and motivating for the students as they able to prove and work together to solve something intriguing by testing the hypothesis by themselves (Westbroek et al., 2017). It is also beneficial as students able to understand and relate the concepts better by observing it. By projecting in such an interesting way able to create a sense of autonomy as they are relying on their own critical thinking skills and consequently able to enhance their problem solving skills too (Kim & Tan, 2011; Mutakinati, 2018). However, based on a research by Dong (2017), it is stated that there is a necessity to produce a better experimental textbook in their country as teachers who have not enough scientific inquiry skills would just followed the textbook.

Designing experiments may consider as difficult tasks however able to stimulate students in terms of creativity besides than understanding. For example according to Suardana et al. (2018), such experiment able to prove the achievement of required objective. By providing such opportunity to design their own experiments also able to enhance their problem-solving skill which is as an important scientific

skill besides than engaging students' participation (MOE, 2016). Nevertheless, students may require support and scaffolding in designing experiment as it may consider too challenging for some students (Arnold et al., 2014; Durmaz, 2016).

4.2.1.3 Daily life application

Another important criterion in the curriculum is the knowledge of application on our daily life in order to solve problems and making decisions that related to life. By making a connection with daily life examples able to arouse students' curiousity to conduct relatable research besides than enhancing students' understanding and learning (Ormanci & Cepni, 2019). All of the four chapters consist of daily life examples and applications in the content such as in Figure 4.5.

Figure 4.5 Daily life examples in textbook

A total of 35 daily life examples were found in these four chapters analysed where a teacher commented *"this textbook for me is very good, it's complete." (IT1, ln.* 16). Chapter 8 (Force and Motion) has the highest number of examples in daily life applications which consists of 17 examples in comparison with Chapter 7 (Electricity and Magnetism) which has the lowest number of examples in daily life with only four examples. It is advisable that Chapter 7 (Electricity and Magnetism) to add more daily life examples which would not seem vast inconsistent between the chapters which may influence students expectation on the next chapter (MacKenzie, 2015). The increase number of daily life examples also able to increase the connection between the context while stimulate their thinking skills when trying to link the concepts with daily life examples (Anwar, 2007; Ormanci & Cepni, 2019).

There is also a section known as 'My Science World' in the textbook specifically for situation where students encounter with science related problem on daily life (Figure 4.6).

Figure 4.6 Explanation on 'My Science World' in textbook

There were many daily life examples in the textbook content, however, the one which labeled as 'My Science World' shown only one example from the four chapters analysed. It was shown in Chapter 8 (Force and Motion) (Figure 4.7). The lack of problem solving examples may inhibit students from improving their critical thinking and creativity skills which suggested to be increase (Ormanci & Cepni, 2019).

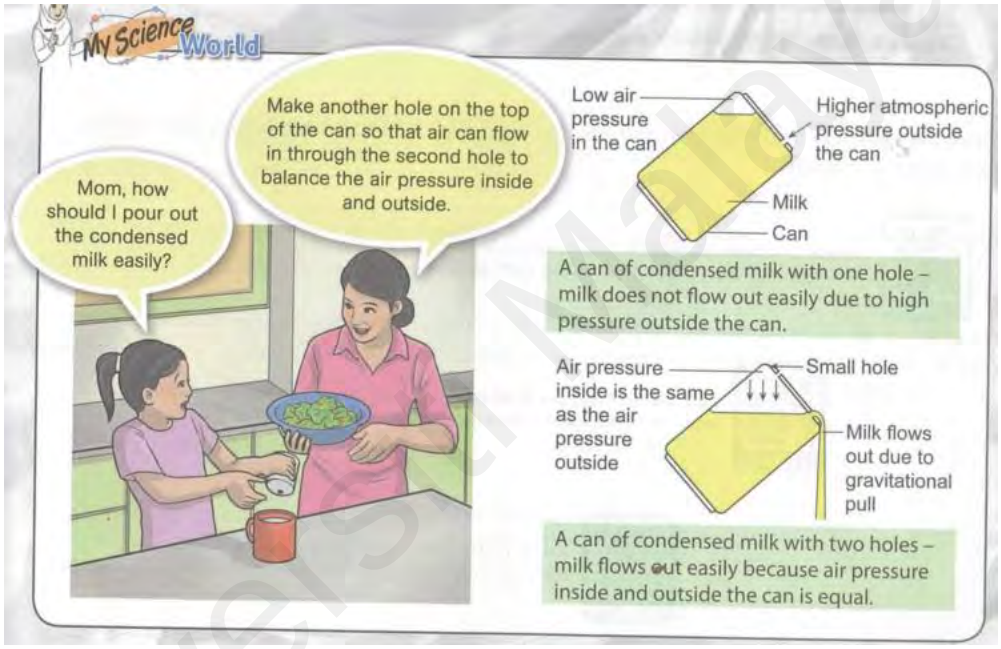


Figure 4.7 Example of 'My Science World' section in textbook

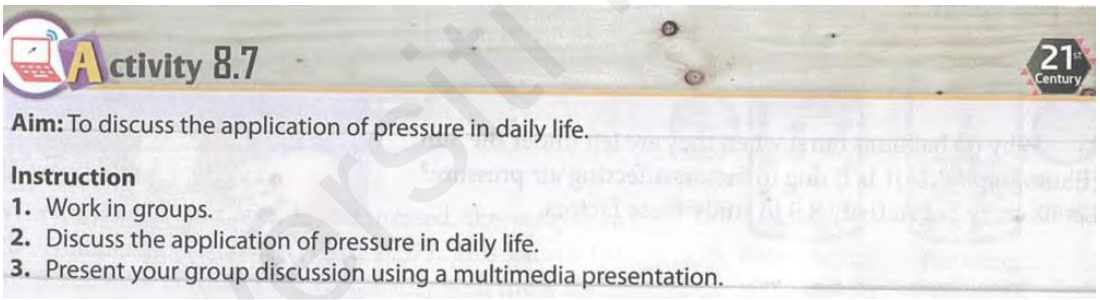
4.2.1.4 21st Century skills

In addition to the curriculum objectives, it is intended to produce 21st century skills pupils that consist of adequate thinking, literate and life skills to be applied in life in their future professions. The 21st century skills selected in this research were communication, critical thinking, collaboration and informative (MOE, 2016). These

skills were certainly important to accommodate 21st century needs towards the nation as it able to generate new ideas and resolve problems.

Communication

Communication refers to students' platform that able to communicate or voice out their thoughts and ideas positively while working with a group of pupil using various methods either in verbal, written or technology ways. All the four chapters consists of two activities each which requires verbal presentation skills. Figure 4.8 depicts an example of verbal activity which requires application of ICT in Question 3.


Activity 8.7

21st Century

Aim: To discuss the application of pressure in daily life.

Instruction

1. Work in groups.
2. Discuss the application of pressure in daily life.
3. Present your group discussion using a multimedia presentation.

Figure 4.8 Example of communication activity with application of ICT

Whereas, in terms of using technology as a way to present the ideas was found in all of the chapters except in Chapter 9 (Heat) which has no verbal activities using ICT (Information and Communication Technology). According to Malaysia Education Blueprint (2012), technology is regard as an essential aspect to enhance students' learning as it makes learning fun, engaging, effective and beneficial for their ICT skills. Therefore, apart from academic context, effective persuasive

communication is also an important skill in 21st century as it helps to convey the intended message proficiently (Dede, 2010; Turiman et al., 2012).

Critical thinking

Critical thinking pupil is generally refer to a pupil who able to think creatively, critically and innovatively to solve a multifaceted problems with confidence in real world applications (Dwyer et al., 2014; Turiman et al., 2012). It is one of the objectives as stated in Standard Based Curriculum for Secondary Schools (KSSM) strategy. In the textbook, a section known as 'Brain Teaser' was allocated which consists of questions that challenge pupil to think critically (Figure 4.9 and Figure 4.10).

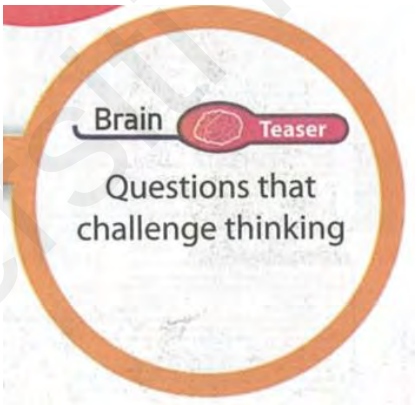


Figure 4.9 Explanation on 'Brain Teaser' in textbook

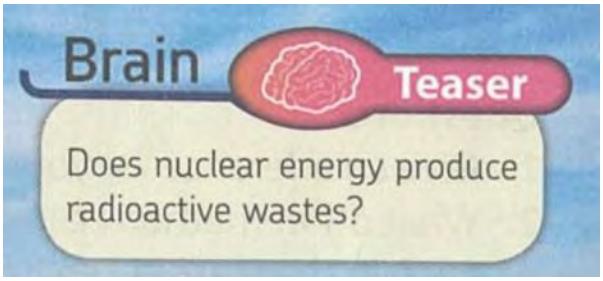


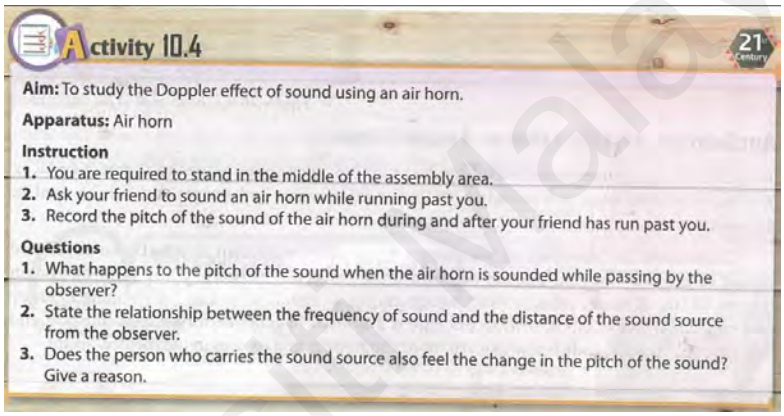
Figure 4.10 Example of 'Brain Teaser' section in textbook

Nevertheless, only two chapters out of the four consist of 'Brain Teaser' sections which were on Chapter 7 (Electricity and Magnetism) and Chapter 9 (Heat). A total of three examples from these two chapters in this Theme 3 (Energy and Sustainability of Life). Therefore, it is recommended that each of the chapter to include critical thinking question to courageously challenge the students' to think as it was stated as a very important skill but was also found inadequate in few researches (Arum & Roksa, 2011; Momsem et al., 2010). These type of thinking questions able to encourage students to be proactive and constantly seek scientific answers beyond the textbook information to any type of challenging questions (Nguyen et al., 2019). Nevertheless, to synthesis such questions were considered difficult and time consuming (Stanger-Hall, 2012).

Collaboration

Collaboration or teamwork activities was found in all of the four chapters where the pupil is given chance to work harmoniously with other teammates. Such collaborative activities able to enhance their interpersonal skills to create sense of respecting and appreciating towards each other either as a leader or team member. These interpersonal skills are gained through the collaboration among team members as they able to read and cope with their own emotions from the social discussion which will then be applied practically in their future workplaces (Dede, 2012; Turiman et al., 2012).

Most of the activities comprise of collaboration opportunity through presentation activities in grouping manner in the textbook. Collaboration activities is almost the same as communication activities as discussed earlier as it involves discussion among team members. However, only Chapter 10 (Sound Waves) consists one extra activity which involves collaboration skills without much communication skills where it requires another partner to run past while sound an air horn to carry out the experiment (Figure 4.11).


Activity 10.4

21 Century

Aim: To study the Doppler effect of sound using an air horn.

Apparatus: Air horn

Instruction

1. You are required to stand in the middle of the assembly area.
2. Ask your friend to sound an air horn while running past you.
3. Record the pitch of the sound of the air horn during and after your friend has run past you.

Questions

1. What happens to the pitch of the sound when the air horn is sounded while passing by the observer?
2. State the relationship between the frequency of sound and the distance of the sound source from the observer.
3. Does the person who carries the sound source also feel the change in the pitch of the sound? Give a reason.

Figure 4.11 Example of collaboration activity in textbook

Informative

Informative known as content that is rich in information and knowledge in terms of local or global relating life issues which may motivate and enhance the students' interest (Laughridge, 2011). It is well balance with various types of disciplines, ethical issues or laws related to the information. Therefore, this able to produce students who are not only well in academic but also rich with instructive knowledge from all around the world. Figure 4.12 shows an example of informative knowledge pertaining on cargo ships used across the globe in Chapter 8 (Force).

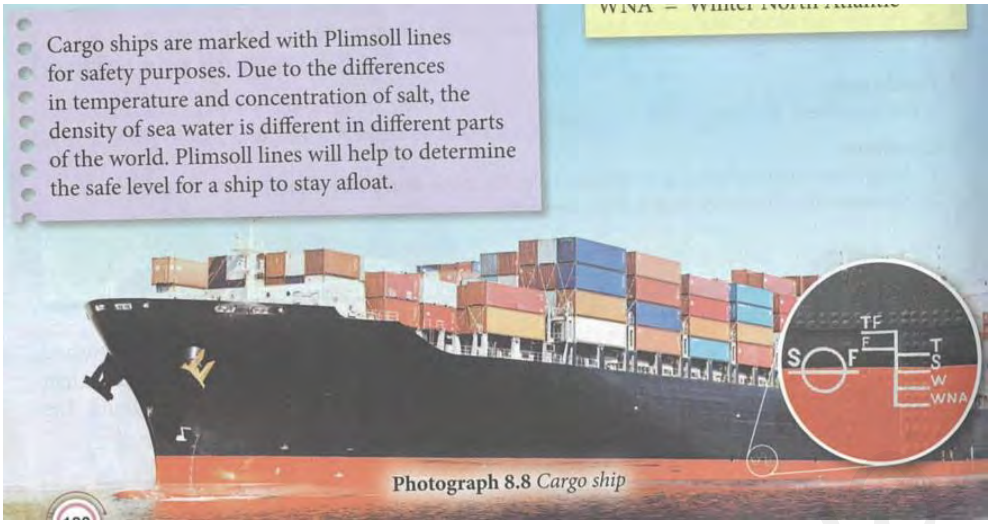


Figure 4.12 Informative knowledge on Cargo ships in Chapter 8 (Force)

In the textbook, there is a section that related to informative knowledge which known as 'Science Info'. It refers to additional information that added to the topics (Figure 4.13 and Figure 4.14).

Figure 4.13 Explanation on 'Science Info' in textbook

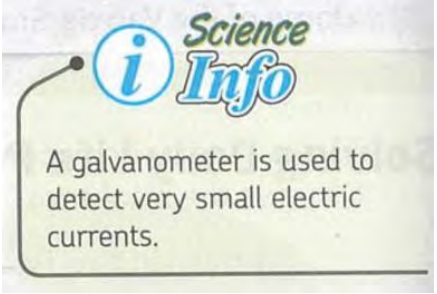


Figure 4.14 Example of 'Science Info' in textbook

A total of 11 ‘Science Info’ examples were found in three chapters where Chapter 7 (Electricity and Magnetism) recorded the highest with eight examples, followed by Chapter 10 (Sound Waves) with two examples and lastly Chapter 8 (Force and Motion) with only one example. The inconsistency of the number of examples where Chapter 9 (Heat) recorded none should include more informative issues to utilise such section to increase students’ interest and able to relate with real life applications (Laughridge, 2011). This is to create an influential textbook to shape the students’ attitude to what they should know rather than textbook that only functions to transfer information (Chao et al., 2017; Komalasari & Saripudin; 2018).

4.2.1.5 Values

A good Science textbook should not only teach and consists of science core knowledge and skills but also able to nurture good values on the pupils. Through my research on analysis of textbook, the researcher established two values that are important in Science curriculum which are caring and patriotic. This is due to the whole definition of success in an individual should also encompasses practicing good values besides than only triumph in Science knowledge to produce a morally responsible generation.

Caring

Aside from science core values, a textbook includes humanities values such as caring which is stated in Standard Based Curriculum for Secondary Schools (KSSM) are important to show empathy, concern and respect towards others. These caring portrayals able to impart on the students' morality through such curriculum textbook (Bim & Egorova, 2016). It is also to ensure sustainability of environment and responsibility to serve the society.

Nevertheless, in this Theme 3 (Energy and Sustainability of Life) of the textbook, it only consists of one example found in Chapter 9 (Heat) that shows caring value to conserve the environment which uses the application of green technology (Figure 4.15). This is to create awareness as most science invention such as industrial factories emits harmful gases and waste to landfill nor ocean which will then effect on the biological ecosystem. This explains the importance for students to know and understand the impact of irresponsible science development and attitude. Moreover, most of the science technological materials are provided from the nature such as woods, copper, rocks and others which is why it is important to value and conserve the environment.

However, with limited textbook examples and educational trips of portrayal towards environmental care may cause difficulty to raise awareness of importance of environment and consequently unable to achieve nation's objective (Paredes-Chi, 2018). Nevertheless, according to a teacher explanation, she confronted *"actually the information given quite good, is just that we want the student to apply in their daily situation. Like I think if we can bring them to these areas, the real marine parks, the*

forest reserve then they can value the information but they haven't do that." (IT1, ln. 107-109).

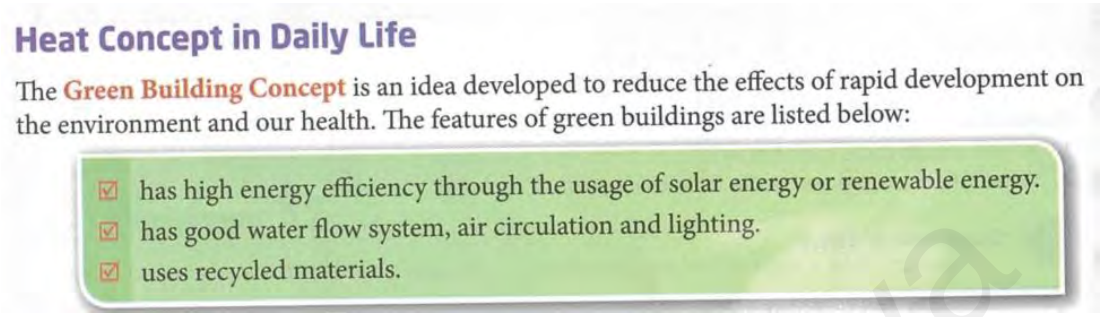


Figure 4.15 Example of caring value in application of Green technology

According to a research, it was stated that some Science textbooks unable to demonstrate a sense of caring towards the environment as the students were taught to focus more on other aspects (Savita et al., 2017). Ng even confronted that it was *"moderate. Students usually don't care about environment, so they're just laidback." (IT4, ln. 106-107)*. Following the tetrahedral theoretical framework, students' interest will also influence on the learning material as they are not motivated on the activity if they do not find the importance of it which in this situation is our environment. This is because students generally have a strong enthusiasm to engage in activity which they understand the importance of it (Cohen & Sherman, 2014; Schell & Butler, 2018). However, it was stated that the extend of discussion on environment in a textbook is depending on the degree of a country connected to the global environmental issue rather on a specific set of interest (Bromley et al., 2010). Therefore, to minimize the gap of global environmental issues, it is suggested the textbooks production should achieve mutual agreement of textbook writers and environmental officers as they may have more knowledge and examples to curb environmental related issues. The production of such caring Science textbooks with

ability to capture students' interest able to acts as a platform to nurture responsible students to conserve the environment wisely rather than unethical environmental pollution and over-exploitation of resources.

Patriotic

Patriotism which defines by the love and support towards own country is important as stated in Standard Based Curriculum for Secondary Schools. According to Bim and Egorova (2016), education able to instil intrinsic values such as patriotism and humanity among students. Through cultivating patriotism in textbook able to elevate their love spirit for Malaysia and inspire them to be proud of Malaysia. It is labeled as 'My Malaysia!' which depicts patriotism of latest success of Science in Malaysia (Figure 4.16).

Figure 4.16 Explanation on 'My Malaysia!'in textbook

However, it only consists of one example in this Theme 3 (Energy and Sustainability of Life) which is on Chapter 8 (Force and Motion) (Figure 4.17). Increasing the example of patriots succeed may increase the awareness and knowledge of the country's achievement. The teachers agreed that the textbook unable to fully instil patriotism as Nadia confronted *"I don't think so.. I don't think*

so.. Because this one for me more to environment, value our natural resources." (IT1, ln. 114-115). Besides, it might not be effective as it needs to cultivate at a very young age where children should narrate and involve themselves to think why and how the patriots struggled to instil higher patriotism value (Nussbaum, 2012).

Figure 4.17 Example of 'My Malaysia!' in textbook

4.2.1.6 STEM careers

Meanwhile, to benefit pupils and country in the long run, Science, Technology, Engineering and Mathematics (STEM) practice is emphasized in national Science Curriculum. Hence, STEM related careers information is beneficial to both the students and national development as able to attract students' interest and raise their awareness on the STEM careers as they can set as their future careers. Nevertheless, it was stated that the careers should be written in a various representation manner as it may lead to gender inequality that may influence their interest on Science (Good et al., 2010; Pienta & Smith, 2012).

In the textbook, it is shown as 'Career in STEM'. By providing such examples on the textbook able to help students to recognise that there is numerous successful science careers. Nevertheless, only one example depicted in Theme 3 (Energy and Sustainability of Life) which is on Chapter 8 (Force and Motion) as presented in Figure 4.18. Nonetheless, it is still an interesting career as Nadia mentioned that *"actually most of the students, my students they're very interested in this kind of careers, engineering field right." (IT1, ln. 23-24)*. However, she confronted that she *"do not explain in detail but I touch a bit about it." (IT1, ln. 28)*. Students who are interested able to pay attention more easily while the teachers act as the mediator on what kind of information to be taught in the classroom (Cheung, 2018; Schell & Butler, 2018). Therefore, students' interest and teachers' instruction greatly impact on the textbook practice based on the tetrahedral theoretical framework as textbooks are not used in a vacuum condition but dynamically influenced in a classroom setting.

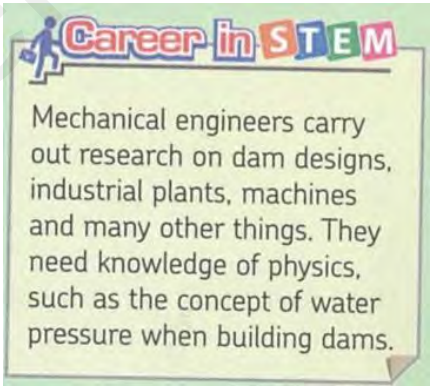


Figure 4.18 Example of career in STEM section

4.2.2 Level of treatment

Level of treatment in this study refers to the density and complexity of content to ensure it is simple and complex based on students' abilities and level to motivate students for continuous learning. It is analysed based on four sub-criteria which are (1) starting with real-life example and thinking questions, (2) sufficient details to understand without the aid of other sources, (3) verbal discussions activities and (4) teaching timeframe.

All these sub-criteria help to treat the difficulty of the content throughout the learning journey of the students. By starting with real-life examples able to stimulate their interest whereas thinking questions able to act as an opportunity and as a challenge to think critically and creatively. Meanwhile, comprehensive explanation are important to treat content difficulty as insufficiency content may cause confusion and unmotivated as it may seem too difficult to understand. On the other hand, verbal discussion activities are equally vital as able to interact with students whenever they encounter any difficulty or misunderstanding as teachers will be there to guide them. Adequate teaching timeframe are also important in order to have sufficient time to ensure students' understanding and to conduct all the activities provided in the textbook to strengthen learning.

4.2.2.1 Starting with real-life example and thinking question

Incorporating real-life example and thinking question on the beginning of a chapter may able to make students understand better and boost their interest as they able to relate with their daily life experiences and think critically. Generally, all chapters start with thinking questions indicated on one whole page (Figure 4.19). Table 4.2 shows the list of thinking questions according to its chapter.

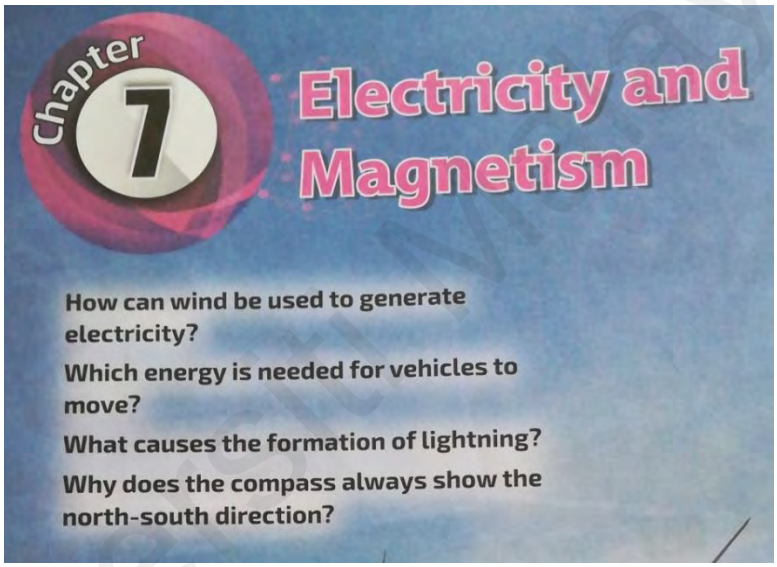


Figure 4.19 Example of thinking questions on chapter introduction

Table 4.2

List of Thinking Questions on Chapter Introduction

Chapter 7: Electricity and Magnetism	Chapter 8: Force and Motion	Chapter 9: Heat	Chapter 10: Sound Waves
• How can wind be used to generate electricity? • Which energy is needed for vehicles to move? • What causes the formation of lighting? • Why does the compass always show the north-south direction?	• All daily activities involve force. We need force to produce motion. What is the meaning of force? • What is the effect of force on daily activities?	• Why are tall buildings fixed with shiny glass panels? • Why does a thick glass break when it is filled with hot water? • How do thermometers works? • Why is a bonfire lit on a cold night? • How does heat affect gas?	• Can sound waves propagate to the bottom of the sea? • How do our ears respond to sound? • What is echo? • What is the limitation of a human's hearing?

Based on Table 4.2, all of the questions from each of the chapters were related to real-life examples and thinking questions were used. This may enhance students' motivation and understanding throughout the learning process. However, Chapter 8 shows the least number of questions which has two questions compare to other chapters. In addition, both of the questions used were also on Lower Order Thinking Skills (LOTS) which was on remembering level which uses only recalling information. These questions may dampen students' interest as it may not effectively stimulate critical thinking skills and oppose with science education objectives which is applying understanding skills than memorising facts (Eshun & Mensah, 2013; Tofade et al., 2013; Hazelton et al., 2012; Hindarto & Iswari, 2017).

However, the interview with teachers found out that they do not use these questions during chapter introduction. Ng confronted that she *"don't use these questions but I only use if it appears in the reference book (Science Process Skill) as they consist the same kind of questions which are relatable." (IT4, ln. 56-57)*. Meanwhile, Nadia explained that *"yes, but we do not refer this straightaway, but as we go along the content, these questions will come up." (IT1, ln. 54-55)*. This may due to time constraint as she stressed that *"the time is very limited. Because as a teacher and students, we not only focus on the lesson, we have extra activity as well. Like last year we have a problem right, the haze, many pandemic situations so school may have to close. Then missed out the lesson already. We have to catch up. Starting from Chapter 10 to Chapter 13, I teach my students very fast. So I don't have time to do those activities. If only they can maybe reduce the syllabus a bit or give me more time for our lesson then only we can do." (IT1, ln. 64-69)*. Hence, learning instructions from the teachers in a classroom setting will significantly influence on

the accessibility of the textbook content following the tetrahedral theoretical framework.

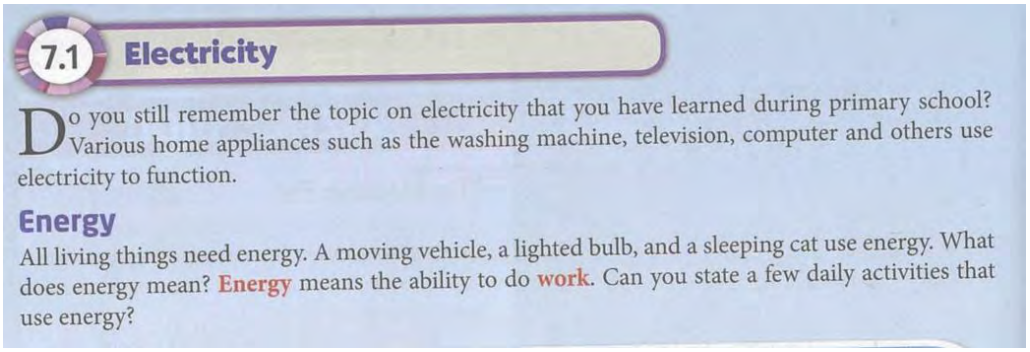
Meanwhile, for further analysis of the beginning of the chapters' paragraph was shown on Table 4.3. It depicts the checklist of starting the chapters with real-life example or thinking question in the beginning of the paragraph.

Table 4.3

Checklist of Starting with Real-life Example and Thinking Question Based on Chapters

Chapter	Start with real-life example	Start with thinking question
7: Electricity and Magnetism	✓	✓
8: Force and Motion	✓	✓
9: Heat	✓	×
10: Sound Waves	✓	✓

Based on Table 4.3, it portrays the significant use of starting the textbook chapters with real-life connections examples and thinking questions for all of the chapters (Figure 4.20).



7.1 Electricity

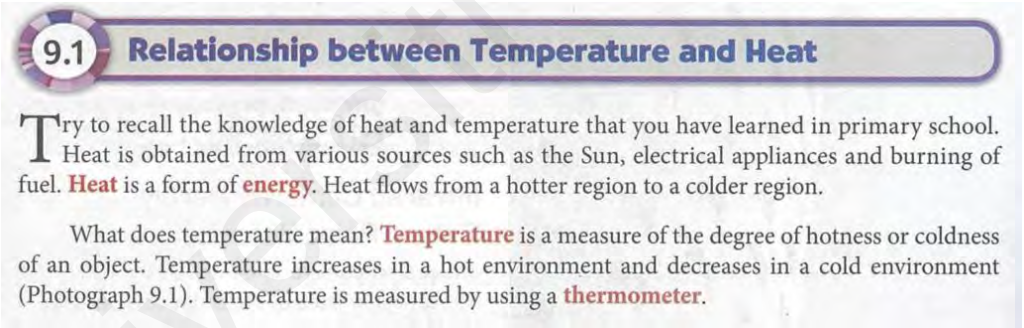
Do you still remember the topic on electricity that you have learned during primary school? Various home appliances such as the washing machine, television, computer and others use electricity to function.

Energy

All living things need energy. A moving vehicle, a lighted bulb, and a sleeping cat use energy. What does energy mean? **Energy** means the ability to do **work**. Can you state a few daily activities that use energy?

Figure 4.20 Example on real-life examples and thinking questions on beginning of chapter

Nevertheless, Chapter 9 (Heat) lack on starting with thinking question on the beginning of the chapter may unable to provoke students to think critically and maintain their interest (Figure 4.21) (Eshun & Mensah, 2013; Tofade et al., 2013).



9.1 Relationship between Temperature and Heat

Try to recall the knowledge of heat and temperature that you have learned in primary school. Heat is obtained from various sources such as the Sun, electrical appliances and burning of fuel. **Heat** is a form of **energy**. Heat flows from a hotter region to a colder region.

What does temperature mean? **Temperature** is a measure of the degree of hotness or coldness of an object. Temperature increases in a hot environment and decreases in a cold environment (Photograph 9.1). Temperature is measured by using a **thermometer**.

Figure 4.21 Example on lacking of thinking question on beginning of chapter

4.2.2.2 Sufficient details without aid from other sources

The complexity present in the textbook should encompass of sufficient details from the textbook itself for students to understand easily without the aid from other sources. Few shortages were found in Chapter 7 (Electricity and Magnetism). For instance, Figure 4.22 only briefly shows how the electroscope works. It doesn't

explain how the charges travel in the device which cause students unable to fully understand. The following excerpt explained Najwa's distressed in the class:

> *It's confusing, can't understand. The students can't understand when I explained using this textbook. So I use Science Process Skill book especially on this chapter. Very often they asked me "Teacher, why the gold leaf does not diverge? How does its mechanism works?" and all that. So they really don't understand (IT3, ln. 89-90).*

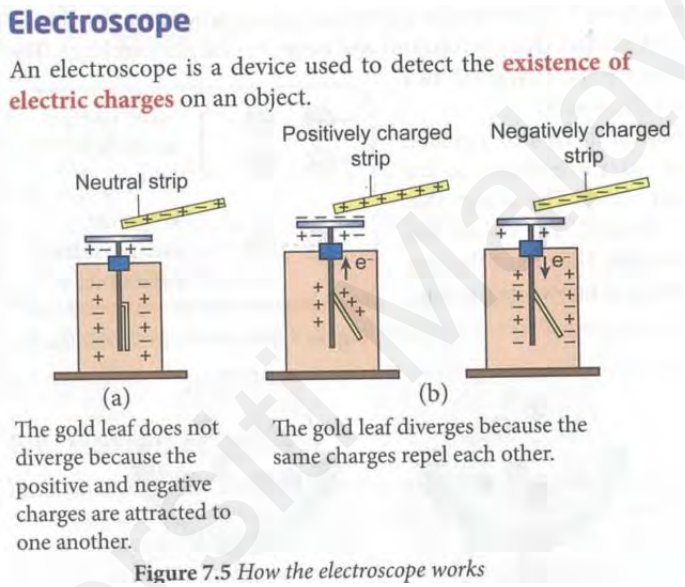


Figure 4.22 Example on lacking of explanation regarding sources of energy

Meanwhile, Figure 4.23 shows lacking of explanation on how microfibre cloth works. It was said that the cloth able to cause the TV screen not become dusty quickly but with less information on how it works may deter students from fully understand. Aiza also agreed that *"it doesn't mentioned here because the explanation for this chapter I use another Module (Science Process Skill)." (IT2, ln. 81-82)*. It was actually due to microfiber membrane has positively charged ion which able to attract the negative charges of the dust easily (Chen et al., 2017). Therefore, a well-developed textbook able to influence a teacher's belief to continuously using it rather

than demotivating in order to achieve the targeted curriculum objectives (Davis, 2009). Nevertheless, a teacher commented that *"this is a good example because it gives a real situation that they can observe in their daily life… We also have our real microfiber cloth that students can try in the lab." (IT1, ln. 79-80)*.

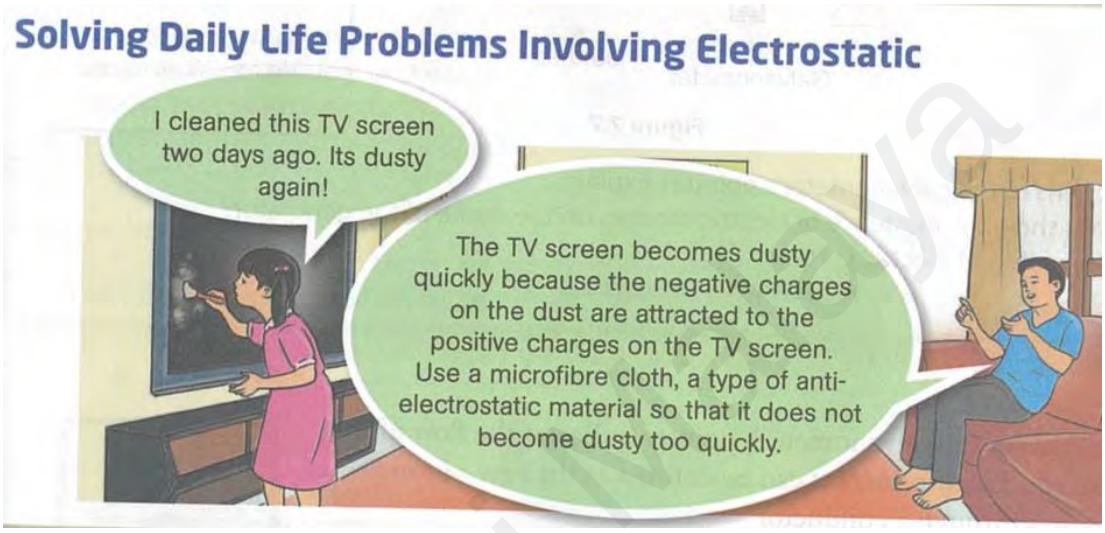


Figure 4.23 Example on lacking of explanation on how microfibre cloth works

Hence, from this content analysis of textbook able to identify the reasons that influence teachers' instruction to not use the textbook. As examined using the tetrahedral theoretical framework, the teachers' learning instruction to use other source of learning material instead of the Science textbook may influence the result of this research. For instance, we cannot conclude students' poor interest or examination performance are low merely due to the Science textbook when it is affected by other learning materials instructed by the teachers. Therefore, this content analysis and interview with the teachers able to understand the classroom situations better.

On the other hand, Figure 4.24 also depicts lacking of explanation on how the devices work. It only provides examples of devices which are good real-life examples however lack of explanation on how these devices works. This may cause students unable to fully comprehend in terms of application. It was said that a lower performance will be obtain if the information assigned abruptly without any explanation as complete understanding unable to be achieved (Dunne, 2010; Kager, 2015). Besides, a strong understanding of the applications able to expand students' thinking skills to excel in future industries (Knapp et al., 2017). Nevertheless, not all examples need to have full explanation as it is only interested to let students recognise the real-life examples after the fundamental concept introduced (Maharani et al., 2018).

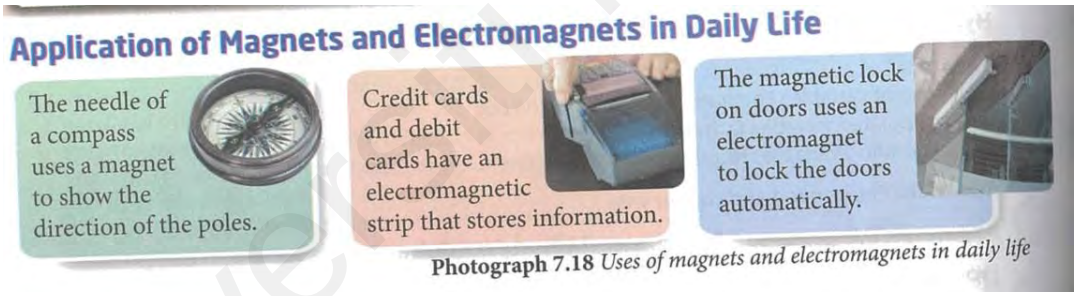


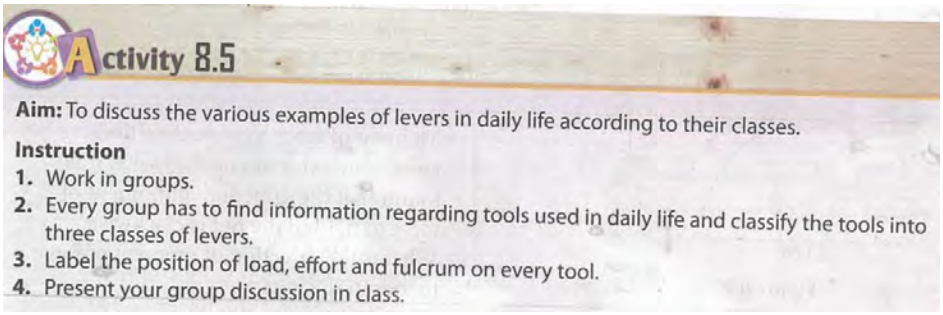
Figure 4.24 Example on lacking of explanation on how the devices work

It was also stated from the teacher's interview that the examples in the book is insufficient which caused the teachers need other reference book. Ng asserted *"the Module (Science Process Skill) that I refer to will usually provide more examples. This textbook has limited examples. Need to have reference book and can't fully refer to merely this textbook." (IT4, ln. 128-131)*.

Nevertheless, the teachers agreed the textbook content are actually considered sufficient but require other sources as well for better understanding as she explained *"I will show the videos, slideshow, but the content is sufficient enough for them just to make them to have better understanding so that's why I find extra video from the Youtube example of the activities that I want." (IT1, ln. 33-35)*. Ng stated that she needs other source than textbook for better understanding as she said *"the book (Science Process Skills) helps us and students to understand more." (IT4, ln. 40-41)*.

4.2.2.3 Verbal discussion activities

As this section focuses on the treatment level on complexity of the textbook, verbal discussions are considered important to be analyse. Discussions and interactions help students to understand better through practical class discussions and promotes them to communicate their ideas (Pombo & Talaia, 2012). This is almost the same as mentioned above on the section of alignment with national curriculum where its' objective is to produce 21st century skills pupils with communication skills (Section 4.1.1.4). Nadia agreed that discussions are important as she explained *"for weak students of course teachers need to guide them. So far I teach DLP (Dual Language Programme) class, not all students are smart, some of them are quite weak, so I have to guide them." (IT1, ln. 253-255)*. Figure 4.25 shows an example of discussion activity involving group (Question 2) and presentation section (Question 4) during classroom learning. Such verbal activity able to encourage communication among their peers and teachers for better understanding and improvement.



Activity 8.5

Aim: To discuss the various examples of levers in daily life according to their classes.

Instruction

1. Work in groups.
2. Every group has to find information regarding tools used in daily life and classify the tools into three classes of levers.
3. Label the position of load, effort and fulcrum on every tool.
4. Present your group discussion in class.

Figure 4.25 Example on verbal discussion activity

Table 4.4

Number of Discussion Activities Based on Chapters

Chapter	Number of discussion activities
7: Electricity and Magnetism	2
8: Force and Motion	2
9: Heat	2
10: Sound Waves	2

According to the Table 4.4, a total of two discussion activities involving collaboration and presentation skills were found on each of the chapters. Such interactive activities may enhance the students understanding as they construct their own ideas. On-field verbal discussion during classroom learning may also beneficial as the teachers able to provide guidance, corrections and comments immediately. It is more engaging as it involves students' participation than only reliant on teachers which then able to produce communicative competence students (Dourado & Leite, 2013; Pombo & Talaia, 2012). However, it was stated that discussion activities consume a lot of time and may be hard to control in a classroom (Dourado & Leite, 2013).

4.2.2.4 Teaching timeframe

Time is also one of the important factors in level of treatment to ensure the coverage of complex content. Therefore, interview with the teachers were conducted to obtain their opinions on the timeframe based on their real-life experiences in the classrooms. Generally, it was agreed that there were insufficient time for the teachers to conduct their lesson on the stipulated time which cause the teachers did not utilise all the features in the textbook. Aiza stated that she did not use the QR code activities in the textbook as she *"didn't use because I use my Powerpoint presentation and the Module (Science Process Skills)." (IT2, ln. 95)*. This may cause students unmotivated to attempt this feature as she stated *"they don't use this QR code." (IT2, ln. 101)*. Therefore, teachers' instruction in the classroom able to effect on the effectiveness of the textbook according to the tetrahedral theoretical framework adapted in this research as students do not explore the QR activities. Likewise, according to Mohammadi & Abdi (2014), the teachers and students only focussed on the textbook content and neglected other source of materials from the textbook such as CDs. This shows the importance of teachers' instruction in the classroom which may effect on students learning using the textbook.

Another teacher also claimed that she did not manage to utilise all the activities from the textbook due to time constraint. She confessed,

> *Starting from Chapter 10 to Chapter 13, I teach my students very fast. So I don't have time to do these activities. If only they can maybe reduce the syllabus a bit or give me more time for our lesson then only we can do. (IT1, ln. 67-69)*

Meanwhile, Najwa confronted that she was rushing to finish the broad syllabus as she stated,

> *Dense and many chapters to teach. Imagine January until September, October we have PT3 you know all that, so Chapter 1 until Chapter 13 and we have many holidays. Usually insufficient time and we need to rush. But we have another option. If using this textbook, it is time consuming to teach one by one because it's too much. So we use PowerPoint presentation which is simpler. If teaching using one by one from the textbook will certainly unable to finish. (IT3, ln. 63-68)*

Moreover, the difficulty of the syllabus is also considered high as Nadia explained *"some students maybe they can't digest well because like I said before the level quite high, some of them maybe they need to do extra revision to catch up with the lesson." (IT1, ln. 16-18)*. In addition, she commented *"my students not many of them can score A for my subject, only few of them. Like the middle class that I teach, the third class only 1 student score A." (IT1, ln. 74-75)*. She also further asserted that some of the students did not complete their homework which may be unmotivated due to difficulty of syllabus as she narrated *"so far I teach DLP class, not all students are smart, some of them are quite weak, so I have to guide them. But some of them I asked them to do, they haven't do." (IT1, ln. 254-255)*. Therefore, by allocating more time for the classroom lessons or decrease the difficulty of syllabus may able to help the teachers to strengthen their students' understanding, skills and knowledge. Nevertheless, according to Schell and Butler (2018) students who willing to accept that learning is challenging able to improve and achieve better with the

right effort and practices which will then influence the tetrahedral relationship of students' cognitive abilities with the analysed textbook.

4.2.3 Accuracy

The accuracy of the textbook content is known to be utmost important as it affects the learning process attained towards students. Such accuracy is signified in terms of literature, visuals, labels, videos, website link and others. It is expected that an approved national textbook is free from any form of inaccuracies as it acts as a reliable learning material in this country for the teachers and students. However, there were few inaccuracies spotted in this textbook in terms of technical and literature manner.

4.2.3.1 Technical inaccuracies

There were technical inaccuracies spotted in QR readers application in the textbook. A total of 16 QR readers were found from Chapter 7 to Chapter 10 which consists of either video, interactive quiz or additional information for students to explore through the scanning of QR codes. However, two inaccuracies were found where the first inaccuracy was found in Chapter 9 (Heat) (Figure 4.26).

Figure 4.26 Inaccuracy of QR code in Chapter 9 (Heat)

It was stated as “No post found” through scanning of the QR code or the website link stated (Figure 4.27).

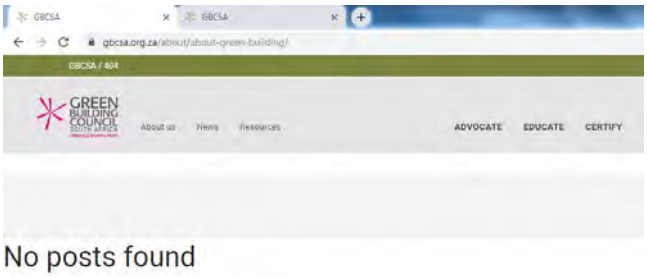


Figure 4.27 Result shown an error in Chapter 9 (Heat)

The next QR code inaccuracy was found in Chapter 10 (Sound Waves) (Figure 4.28).

Figure 4.28 Error of QR code in Chapter 10 (Sound Waves)

It was indicated as “This page could not be found” through scanning of the QR code or the website link given (Figure 4.29).

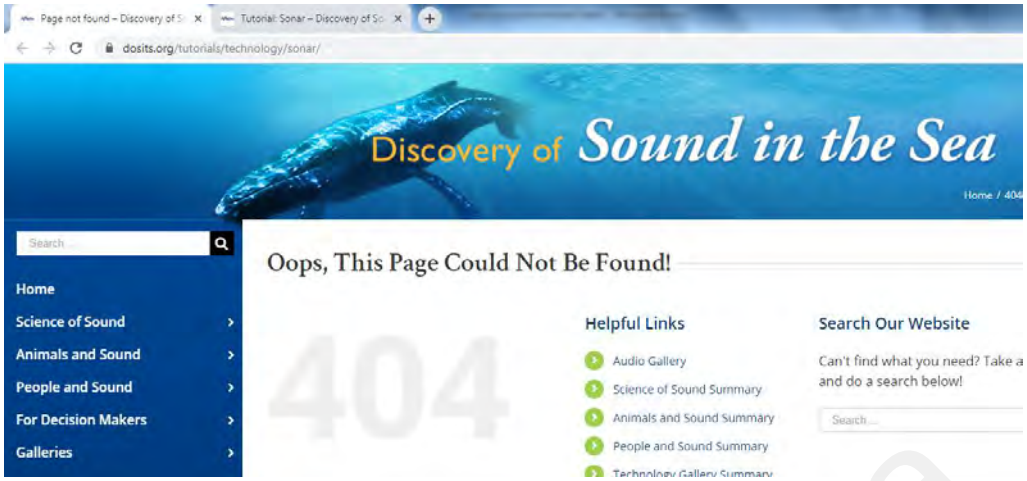


Figure 4.29 Result shown an error in Chapter 10 (Sound Waves)

These errors may cause distressed on teachers as one of them confronted *"I've tried but I don't know where I went wrong, I couldn't get the image, I followed the steps, but maybe my steps is wrong, but if you able to teach me, I'm willing to learn. I tried to scan the image but I couldn't get it." (IT1, ln. 89-91)*. Consequently, students who were asked to enter the link were also affected as the teacher explained *"I gave the link to the students but the students told me after that "teacher, we cannot enter the link." (IT1, ln. 96-97)*.

4.2.3.2 Literature inaccuracies

On the other hand, literature inaccuracies were found in terms of writing and grammar. It spotted in self-reflection section in Chapter 10 (Sound Waves) where extra care for proofreading is advisable. In Figure 4.30, there is an inaccuracy in terms of writing used in the self-reflection checklist as the sentence was just 'Doppler effect'. It lacks of a verb as the sentence before it was 'After learning this chapter,

you are able to'. Therefore, it is recommended the sentence to be reconstructed to 'Explain the Doppler effect'.

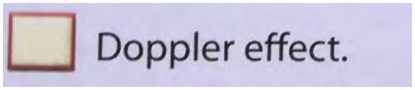


Figure 4.30 Writing inaccuracy in Chapter 10 (Sound Waves) (Page 235)

A grammatical inaccuracy was also found in the same checklist (Figure 4.31). As a lot of phenomena and applications were studied in reflections of sound waves, it is suggested the word 'application' to be modified to 'applications'.

Figure 4.31 Grammatical inaccuracy in Chapter 10 (Sound Waves) (Page 235)

Generally, there is no inaccuracy in terms of scientific disciplines, however few errors were found in technical and literature manner. The corrupted QR codes may affect the teachers to conduct the intended website lesson while the grammatical inaccuracies may distort students' language coherency which is why it is important to have more type of proofreaders to ensure utmost accuracy (Harwood, 2019).

4.3 Presentation

Presentation is important as it acts as an aid for the content and assessments in order to accelerate learning. The presentation of the Form 2 Science textbook is analysed based on the organisation and readability of the textbook. Through supply of aesthetic values to make attractive textbook with good organisation and readability

able to encourage and entice students besides than aiding in terms of clearer conveyance and memorizing important concepts.

4.3.1 Organisation

A good organisation of a textbook is vital as it motivates reader to engage and enjoy reading due to its clear organisation (Dettori, 2010; Stroet et al., 2015). A good organisation of a textbook also enables readers to easily identify the ideas of the content according to the visible format as one of the teacher narrated the textbook presentation *"compared to previous syllabus, this textbook very good because more colours that can attract the students. The diagram very clear and colourful. And I like the treemap and so on" (IT1, ln. 196-198)*. There are a section known as "Introduction" that explains about the general and special features of the textbook in the first few pages of the textbook (Figure 4.32).

Figure 4.32 Introduction page of the Form 2 Science textbook

It also consists of step-by-step guidelines for students on how to use the digital component of the textbook, which is the QR reader application which can be found in the textbook (Figure 4.33). These clear guidelines provide clarity for both students and teachers which then able to motivate the learners (Stroet et al., 2015). The types of activities of the QR code provided are videos, interactive quizzes or additional information. It also has AR (Augmented Reality) technology where it can create 3D image from mobile phone.

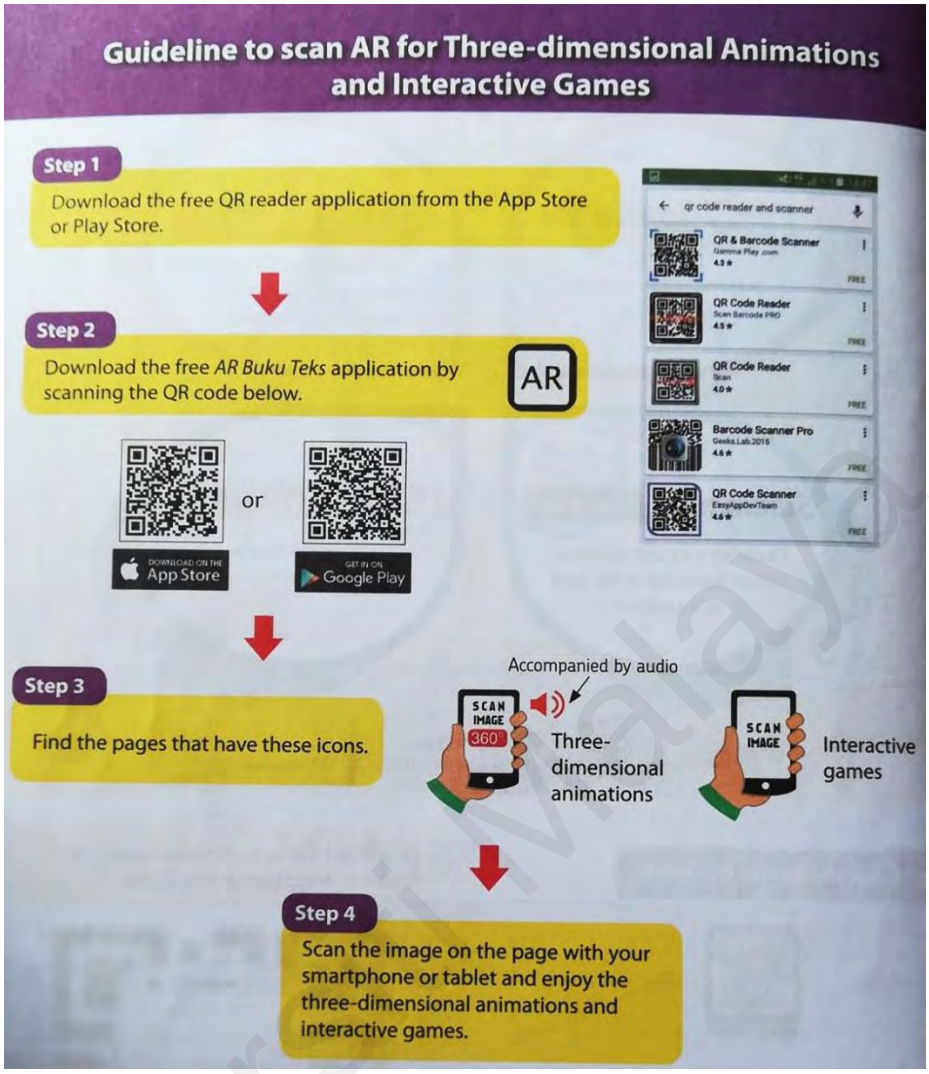


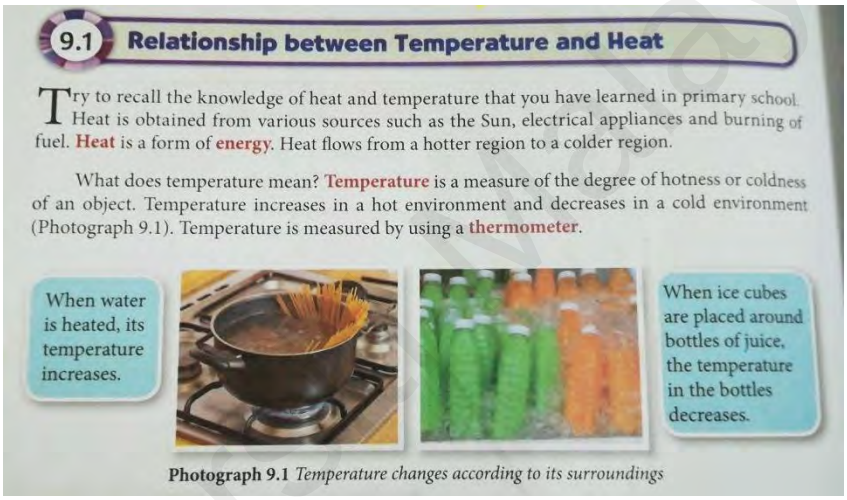
Figure 4.33 Guideline on how to use QR reader application

In this research, an organised textbook is analysed based on typography cues, borders, labeled figures, visuals near to related text, and also organised lists such as table of comparisons, table of content, objectives, glossary and summaries.

4.3.1.1 Typography cues

Typography cues refer to visible font such as bold, italics, font size and highlighting to clearly identify concepts and orders. As refer to Figure 4.34, red highlights of keywords were indicated to facilitate skimming for students. It also acts

as one of the leaning strategies as it able to strengthen and signal the intended purpose for the students to remember rather than making it to look attractive (Encheff, 2013; Rouet et al., 2011; Kolers, 2012). However, the context should not consists of redundant colour cues such as on random "main ideas" to avoid misleading the students where it should only highlight the important ideas and concepts (Geda, 2016). Bolding was used to distinguish the photograph's label as well as italic for the caption used. Larger font size was also used for the section's title.



9.1 Relationship between Temperature and Heat

Try to recall the knowledge of heat and temperature that you have learned in primary school. Heat is obtained from various sources such as the Sun, electrical appliances and burning of fuel. **Heat** is a form of **energy**. Heat flows from a hotter region to a colder region.

What does temperature mean? **Temperature** is a measure of the degree of hotness or coldness of an object. Temperature increases in a hot environment and decreases in a cold environment (Photograph 9.1). Temperature is measured by using a **thermometer**.

When water is heated, its temperature increases.

When ice cubes are placed around bottles of juice, the temperature in the bottles decreases.

Photograph 9.1 *Temperature changes according to its surroundings*

Figure 4.34 Typography cues

However, Figure 4.35 depicts lack of colour cues inserted on the tree map of the comparison of levers in Chapter 8 (Force). The texts explaining the location of the effort, fulcrum and load are suggested to insert additional highlights on which part is in between in order to compare with the other levers. This is to ease remembering and better comparison to achieve the specific purpose of learning the concepts (Encheff, 2013; Rouet et al., 2011; Kolers, 2012) as Ng agreed where she and other teachers highlighted herself the key points, as reflected from the following excerpt:

Yes. For example, the other teachers also will highlight themselves the "load, fulcrum, effort" in class. First class lever is fulcrum at middle, second class lever will be load. But this textbook doesn't highlight. (IT4, ln. 148-150)

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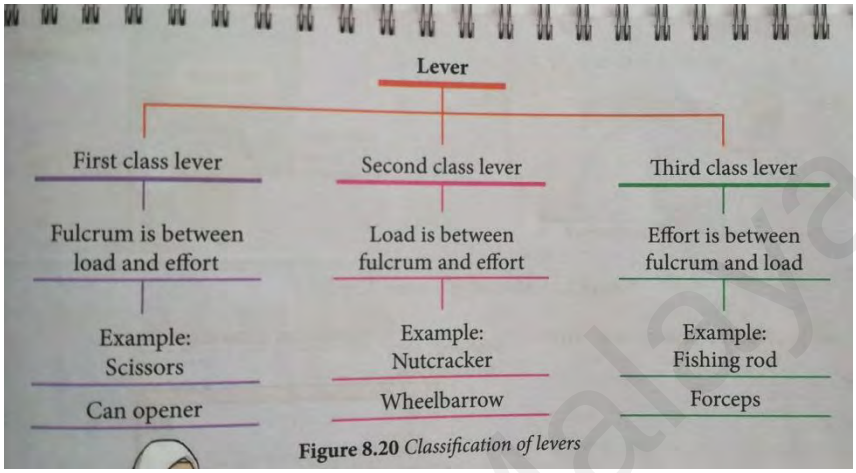


Figure 4.35 Lack of colour cues in Chapter 8 (Force)

4.3.1.2 Borders

Meanwhile, the division of content by incorporating borders contributes towards better organisation of the ideas sections. Such borders include boxes, circles or signs that distinguish it from the other texts. For instance, the features mentioned in the textbook such as Science Info, Brain Teaser, My Science World, experiments, safety precautions and activities were well separated in its' own borders (Figure 4.36). The borders were consistently used for the same type of feature as it creates better understanding (Encheff, 2013). The teachers agreed the presentation of the textbook were well organized and colourful. Najwa explained *"I love it. It's colourful where the presentation is not boring compared to old times which are not attractive as this. This is attractive. Even the order of the textbook is well-ordered, for example it has*

lots of borders." (IT3, ln. 141-143). Nadia also explained *"the diagram very clear and colourful." (IT1, ln. 197)*.

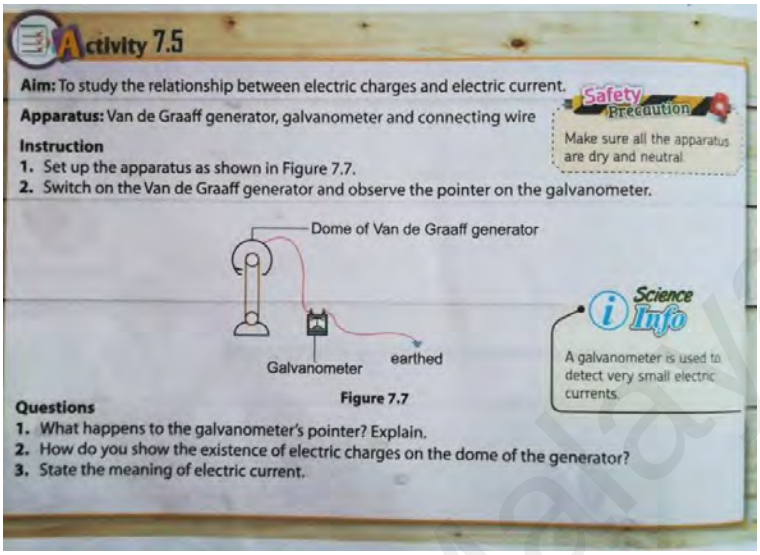


Figure 4.36 Example of borders used

4.3.1.3 Labeled figures

Labels are also important in figures as clearly labeled diagrams able to convey message more effectively in order to assist low-ability students (FLDOE, 2015). For instance, Figure 4.37 shows numerous labels on the diagram to ensure students able to understand profoundly.

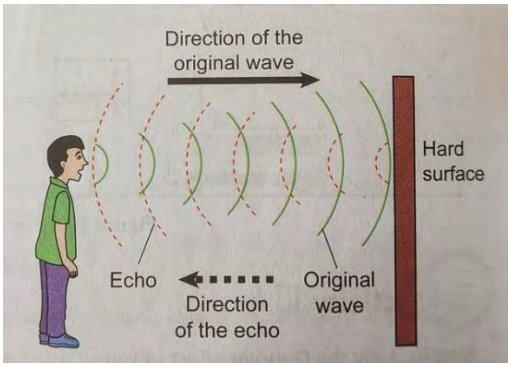


Figure 4.37 Clearly labeled diagram

Nevertheless, it is recommended in Chapter 7 (Electricity and Magnetism) that the protons and electrons are labeled on the diagram to ease skimming and locating information during learning process (Figure 4.38). An important and clearly labeled figures without redundant labelings able to guide students to understand independently when using the textbook (Geda, 2016). According to Jian (2016), labeled diagrams with major steps able to profoundly enhance students understanding and memorization than text passages. The teachers also agreed where she asserted *"yes, they need to label the charges… For me, we as teachers, we already understand but from students' perspective, so maybe it could be labeled." (IT1, ln. 147-148)*. However, according to the tetrahedral theoretical framework every students possessed different learning abilities which may influence the efficiency of the learning material as a teacher believed her higher achiever students don't require the labels as they already knew. Nevertheless, she emphasized maybe for the lower achiever students may not know, as reflected from the following excerpt:

> *Because I'm teaching higher achiever students which don't require the labels as they already knew. However, maybe for the lower achievement students may not even know positive symbol, maybe. But it's not required in my class. (IT2, ln. 155-157)*

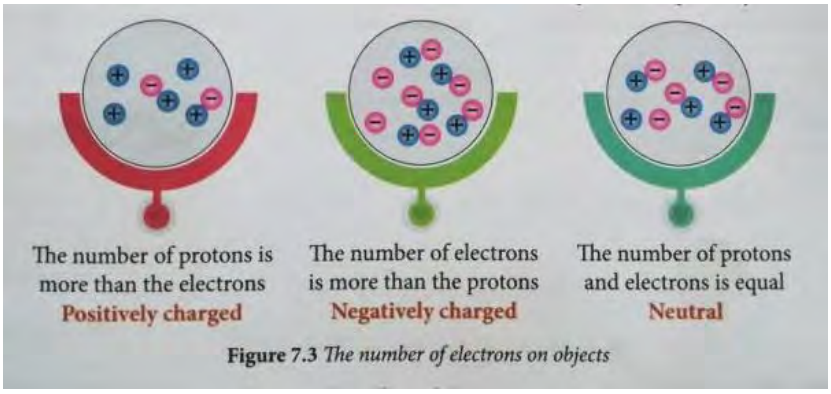


Figure 4.38 Lacking of labels

4.3.1.4 Visuals near to related content

Visuals in a textbook should also be presented near to the related texts compare to student that needs to hassle locating for the visual (Figure 4.39). This able to maintain students' interest and ease them to locate during learning process.

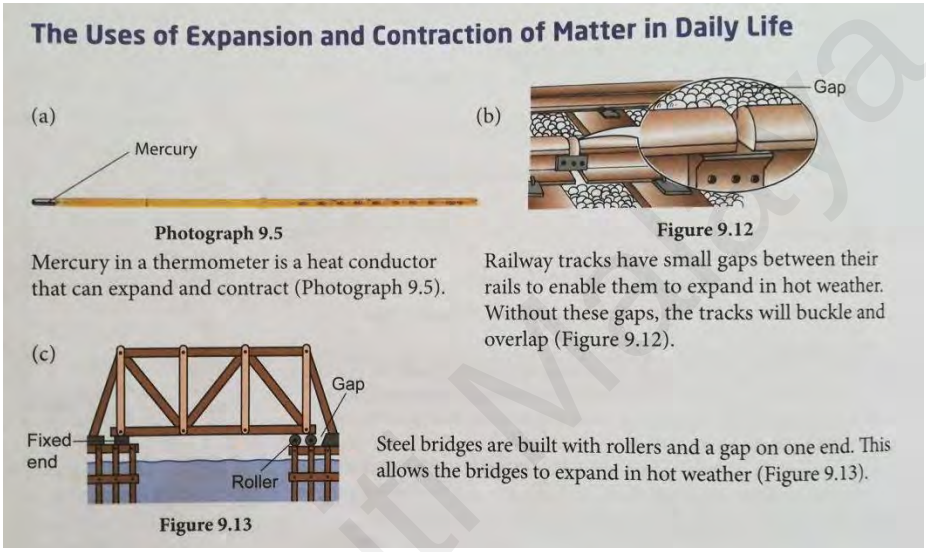


Figure 4.39 Example of visuals near to related content

4.3.1.5 Table of comparisons

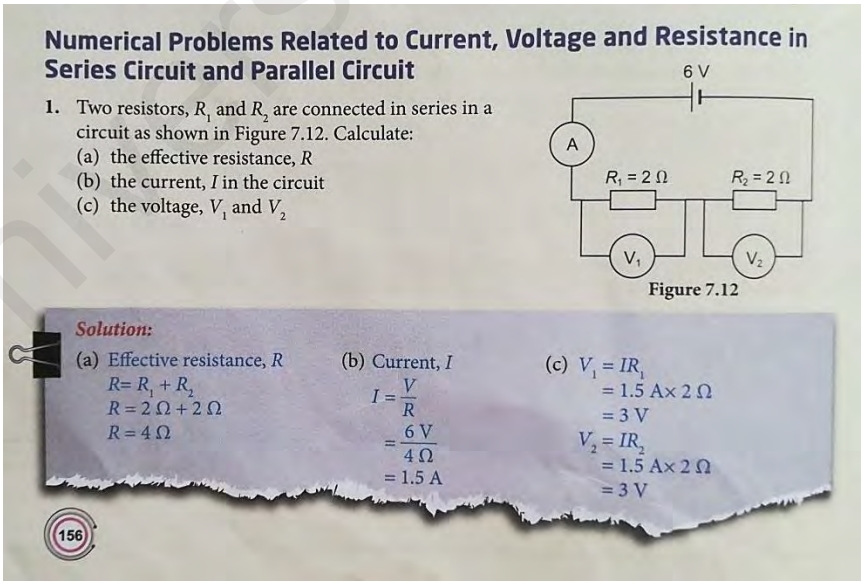
Table of comparisons of concepts are consider as a constructive tool to help in understanding as critical thinking able to be generated from analyzing the differences rather on memorising. This able to help students improve their memory. Nadia also mentioned that the table of comparison of Figure 4.40 has a *"very good explanation." (IT1, ln. 152)*.

Table 9.1 *The differences between heat and temperature*

Heat	Temperature
A form of energy	The degree of hotness or coldness of an object
Measured in joule (J)	Measured in degrees Celsius (°C) or kelvin (K)
The amount of heat depends on the type of material, quantity of material and temperature	Temperature depends on the degree of movement of the particles in a matter.

Figure 4.40 Example of table of comparison between heat and temperature

Moreover, by using table of comparison able to simplify and interpret the complex information effectively (Braasch et al., 2013). Figure 4.41 and Figure 4.42 show calculation for series and parallel circuit respectively in Chapter 7 (Electricity and Magnetism). As each type of circuits has different types of formula and calculation, it is recommended if it can be placed in the form of comparison table to ease understanding and memorising for the students.



Numerical Problems Related to Current, Voltage and Resistance in Series Circuit and Parallel Circuit

1. Two resistors, R_1 and R_2 are connected in series in a circuit as shown in Figure 7.12. Calculate:
   (a) the effective resistance, R
   (b) the current, I in the circuit
   (c) the voltage, V_1 and V_2

Figure 7.12

Solution:

(a) Effective resistance, R
$R = R_1 + R_2$
$R = 2\ \Omega + 2\ \Omega$
$R = 4\ \Omega$

(b) Current, I
$I = \frac{V}{R}$
$= \frac{6\ V}{4\ \Omega}$
$= 1.5\ A$

(c) $V_1 = IR_1$
$= 1.5\ A \times 2\ \Omega$
$= 3\ V$
$V_2 = IR_2$
$= 1.5\ A \times 2\ \Omega$
$= 3\ V$

156

Figure 4.41 Calculations for series circuit

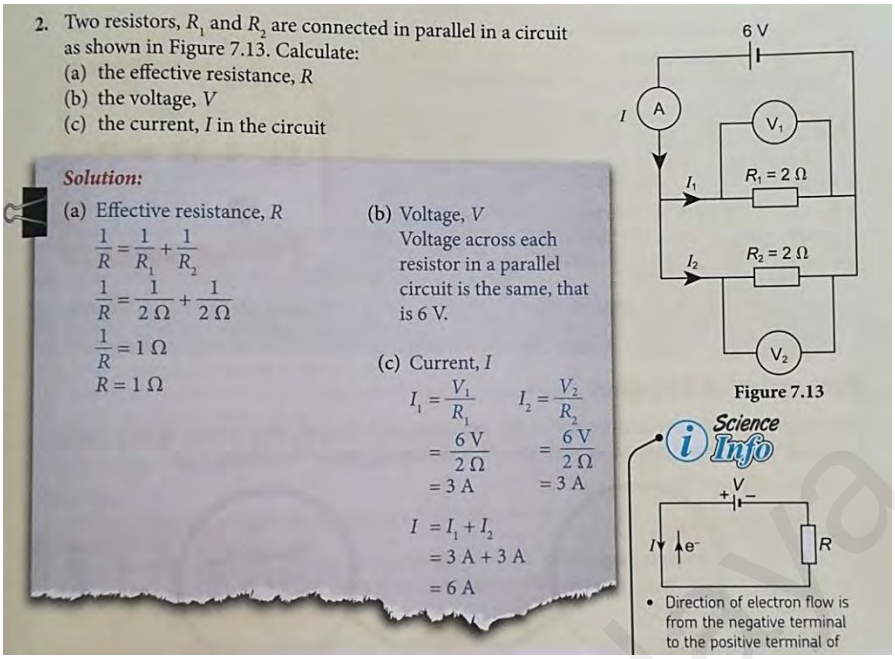


Figure 4.42 Calculations for parallel circuit

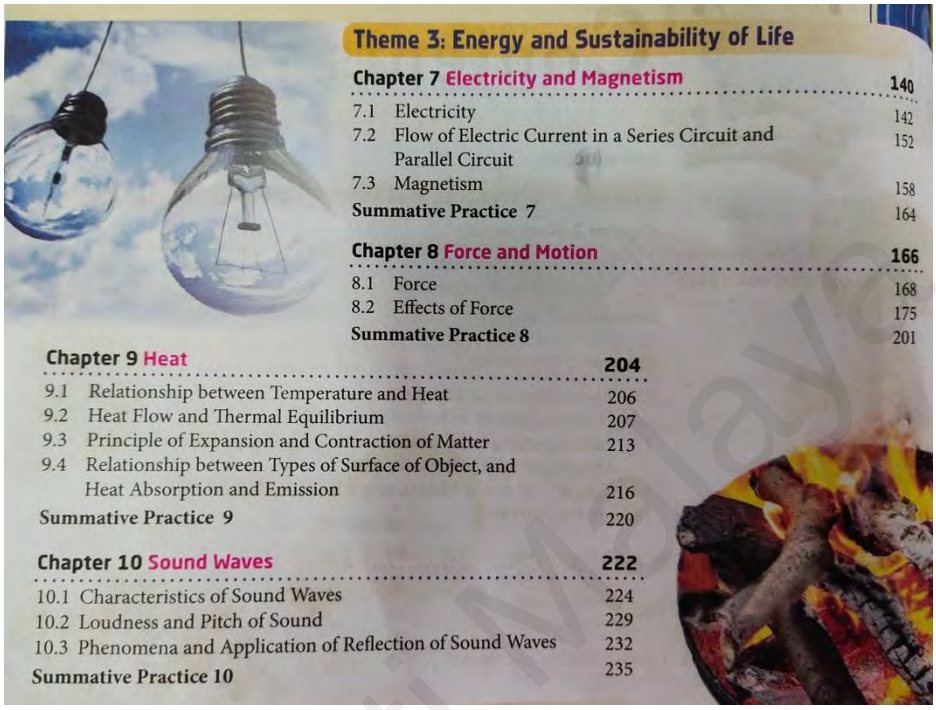
However, Najwa stated that students actually will know how to distinguish based on the alphabet numbered but in table form will be more organise, as reflected from the excerpt:

> *Students actually know these alphabets numbered (a), (b), (c) but can place it in table form to be more organise. Maybe they use these borders instead because they afraid students will get bored. So they do it nicely. (IT3, ln. 173-175)*

4.3.1.6 Table of content

The table of content of the Form 2 Science textbook is shown in a great organisation. It consists of pictures that related to its' following themes. Besides, the themes were also highlighted with coloured borders for easier view. The titles of the chapters were also highlighted in magenta coloured texts, bolded, dotted lined and

consist of bolded page numbers. The sub-chapters consist of its' page numbers as well (Figure 4.43).



Theme 3: Energy and Sustainability of Life

Figure 4.43 Table of content of the textbook

4.3.1.7 Objectives

A clear set of objectives acts as a content outline which will introduce the chief ideas on what a student will learn. It is also from these objectives will serve as a checklist for self-reflection on what they should learn (Table 4.5). The objectives section is known as 'Let's understand' in this textbook (Figure 4.44).

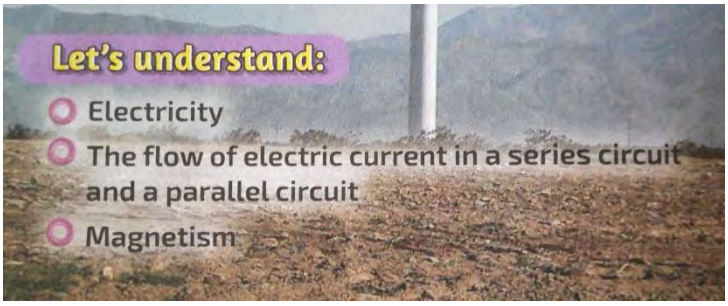


Figure 4.44 Example of objective section

Table 4.5

List of Objectives According to Chapters

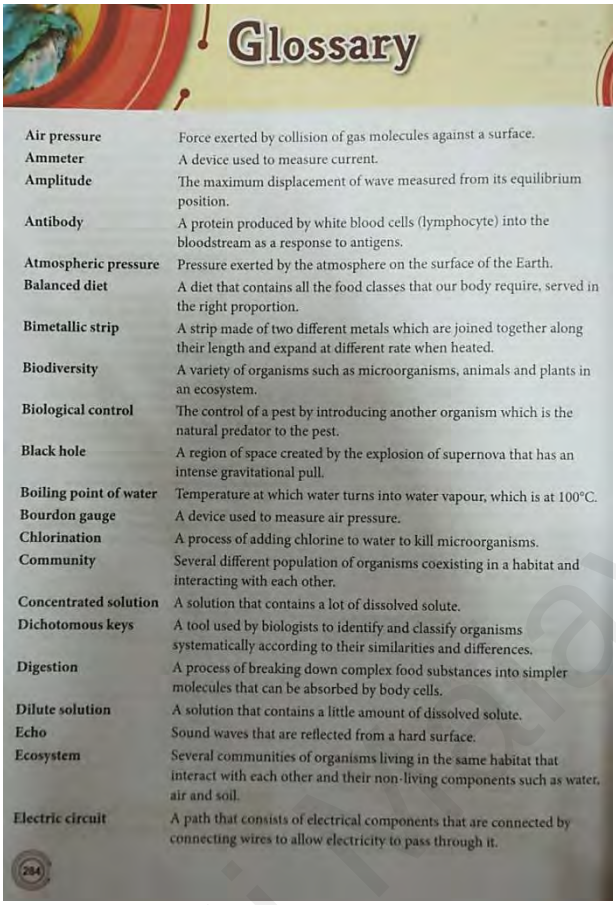
Chapter 7: Electricity and Magnetism	Chapter 8: Force and Motion	Chapter 9: Heat	Chapter 10: Sound Waves
• Electricity • The flow of electric current in a series circuit and parallel circuit • Magnetism	• Force • Effects of force	• Relationship between temperature and heat • Heat flow and thermal equilibrium • Principle of expansion and contraction of matter • Relationship between types of surface of object, and heat absorption and emission	• Characteristics of sound waves • Loudness and pitch of sound • Phenomena and applications of reflection of sound waves

The objectives were stated on the first page of the introduction of the chapter. Objectives should be clear and match to the course of curriculum intended. In Chapter 8 (Force and Motion), it consists of lowest number of objectives with only

two objectives listed while the other chapters consists of at least three to four. Moreover, the number of pages in Chapter 8 (Force and Motion) shown the highest with 37 pages followed by Chapter 7 (Electricity and Magnetism) (27 pages), Chapter 9 (Heat) (17 pages) and Chapter 10 (Sound Waves) (15 pages). It is recommended for Chapter 8 (Force and Motion) to list more number of objectives in order for the students to get a clearer view on what to be expected as it has high number of pages (37 pages). This way, the students can expect more things to learn and focus better based on the objectives listed as it able narrow down to what students should achieved at the end of the chapter (Flick, 2015; Sánchez Beltrán, 2018).

4.3.1.8 Glossary

Glossary is a type of aid as a quick guidance to obtain a major scientific vocabulary definition. This section is located near to the end page of the textbook. This able to ease searching process than using other resources in the event of internet disruption. Figure 4.45 shows the glossary of the textbook. The terms were arranged clearly in alphabetically order from A to Z. Such manner able to ease students to browse for intended terms.



Glossary

Air pressure	Force exerted by collision of gas molecules against a surface.
Ammeter	A device used to measure current.
Amplitude	The maximum displacement of wave measured from its equilibrium position.
Antibody	A protein produced by white blood cells (lymphocyte) into the bloodstream as a response to antigens.
Atmospheric pressure	Pressure exerted by the atmosphere on the surface of the Earth.
Balanced diet	A diet that contains all the food classes that our body require, served in the right proportion.
Bimetallic strip	A strip made of two different metals which are joined together along their length and expand at different rate when heated.
Biodiversity	A variety of organisms such as microorganisms, animals and plants in an ecosystem.
Biological control	The control of a pest by introducing another organism which is the natural predator to the pest.
Black hole	A region of space created by the explosion of supernova that has an intense gravitational pull.
Boiling point of water	Temperature at which water turns into water vapour, which is at 100°C.
Bourdon gauge	A device used to measure air pressure.
Chlorination	A process of adding chlorine to water to kill microorganisms.
Community	Several different population of organisms coexisting in a habitat and interacting with each other.
Concentrated solution	A solution that contains a lot of dissolved solute.
Dichotomous keys	A tool used by biologists to identify and classify organisms systematically according to their similarities and differences.
Digestion	A process of breaking down complex food substances into simpler molecules that can be absorbed by body cells.
Dilute solution	A solution that contains a little amount of dissolved solute.
Echo	Sound waves that are reflected from a hard surface.
Ecosystem	Several communities of organisms living in the same habitat that interact with each other and their non-living components such as water, air and soil.
Electric circuit	A path that consists of electrical components that are connected by connecting wires to allow electricity to pass through it.

Figure 4.45 Glossary section of the textbook

However, the teachers confronted that they only used this section occasionally. Najwa explain that she don't use the glossary because the definition usually is already inside the text or it will be located inside the other reference book (Science Process Skill) which she used in the school (IT3, ln. 179-180). Therefore, the teachers' instruction acts as one of the factors which influence the learning material based on the tetrahedral theoretical framework when a teacher judge what is important to be taught in the classroom (Schell & Butler, 2018). According to Peters (2017), a student commented that the glossary which comprise of the chosen terms should be hinted in the text to notify there is definition provided since not all words included in the glossary. Even a teacher stated that she needs to remind her students to use it, as reflected from the excerpt:

Nadia: Once a while we will refer to the glossary.

Interviewer: The students will use it?

Nadia: We need to remind them. (IT1, ln. 167-171)

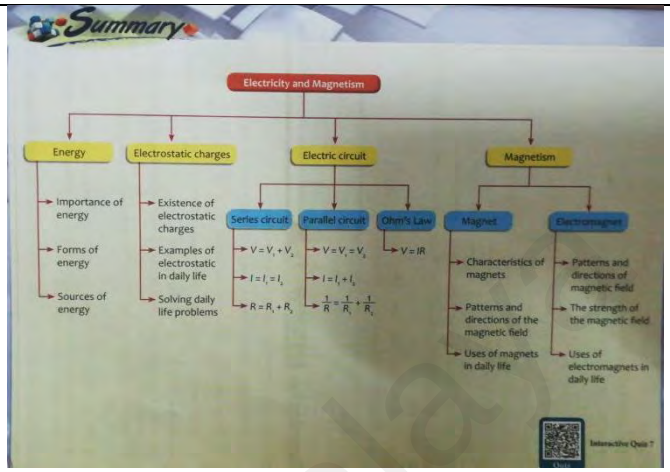
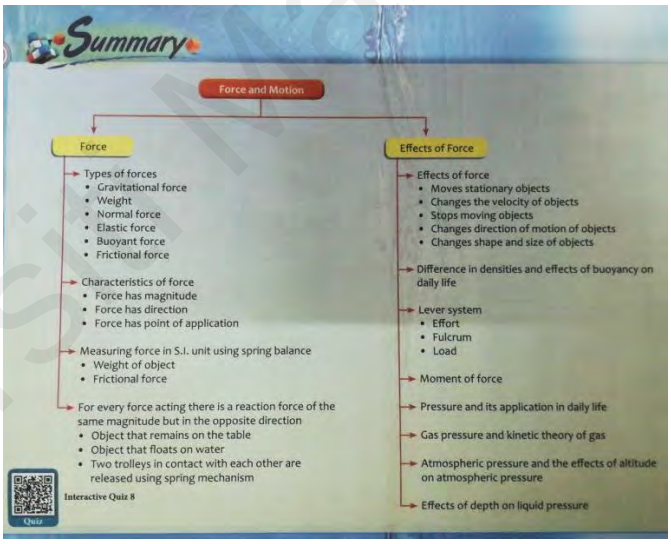
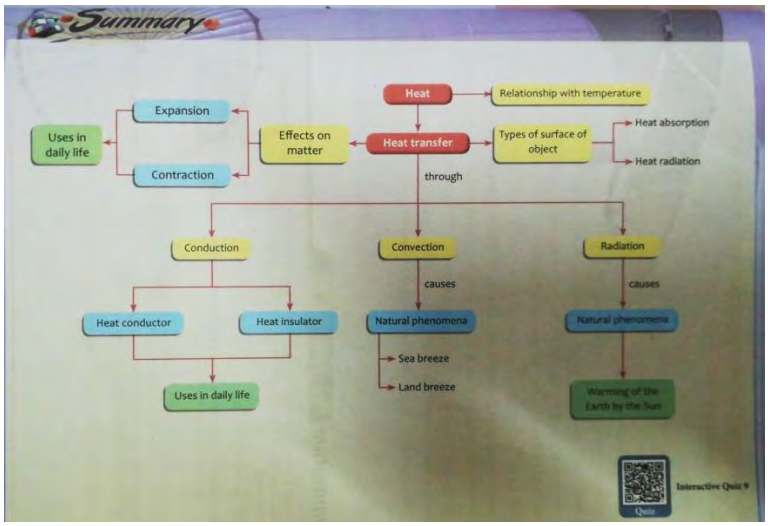
4.3.1.9 Summaries

Summaries are considered useful as it is easier to read the important key ideas of a chapter in just a page in the form of mind map. Table 4.6 shows the summaries of all the chapters. According to Zubaidah et al., (2017), summaries help students to understand wisely the flow of the main ideas of a topic in a creative manner as Aiza emphasize that she asked her students to copy down and add own ideas which reflected from the following excerpt:

I love the summary. Usually I will ask my students to copy down and make their own mind map but add some ideas. Regardless, I like it. (IT2, ln. 188-189)

Table 4.6

Summary Section According to Chapters

Chapter	Summary section
7: Electricity and Magnetism	
8: Force and Motion	
9: Heat	

10: Sound Waves

According to the summaries of all the four chapters, only Chapter 8 (Force and Motion) had few coloured borders used compared to other chapters. This may cause students unmotivated to read as the teachers also agreed to restructure in the form of mindmap as she asserted *"they need to change. Like they need to make tree map, more presentable. This one seems like too many words." (IT1, ln. 180-181)*. It only consists of many general sub-topics which does not contain any significant ideas. Ng actually suggested it should add figures as well where she explained *"I think if on this Chapter Force and Motion is a bit hard to understand because they did not order it correctly. Maybe, it should design like mind map form which is better. They should also add graphics and figures. It's incoherent because the sentences are too long." (IT4, ln. 193-196)*. This may be improve if future draft was provided for field-testing on students to obtain their opinions whether it is easy to read and its' effectiveness (Sinaga et al., 2017).

Whereas, the other three chapters' summaries consists main components however without much in-depth explanation which was agreed by Nadia as she commented *"the summaries very simple and accurate but I think it's good if can add some information." (IT1, ln. 175-176)*. Without much information may inhibit the

effectiveness of a meaningful summary section of a textbook for skimming purposes as it lacks of useful concepts and ideas (Merchie & Van, 2016; Wette, 2017).

4.3.2 Readability

The readability of a textbook refers to features that enable reader to read easily and understand without much difficulty. Readability is affected by few aspects where in this research, it is analysed based on readability value and level, clear visuals, adequate visuals and visuals representations other than texts.

4.3.2.1 Readability value and level

Readability value and level greatly influence on the students understanding and learning. Readability value which is obtained through readability formula is a common and famous method in order to identify the difficulty of reading the texts. One of the methods is the Flesch Reading Ease score which is calculated from the Microsoft Word application. The score obtained will be between zero to 100 where it is interpreted as higher the score, the easier it is to read. The score obtained for this textbook is 58 which classified as fairly difficult in the Flesch reading ease score table (Appendix E) where this category is estimated to suite level 10^{th} (Form 4) students. According to the interpretation table, level 8 (Form 2) should categorised under the category of standard with score from 60 to 70. Therefore, it is recommended to reduce the number of syllable and shorten the length of the sentence in order for the passage can be read with ease by the students (Ayodele, 2013).

Meanwhile, Flesch-Kincaid Grade Level also able to calculate automatically from Microsoft Word application to define which level grade the passage belongs to. Readability with a higher students' level may hinder their learning (Kortz et al., 2017; Peters, 2017). According to the results, it is equated to level 8.7 which already exceed level 8 (Form 2) and near to level 9 (Form 3). In general, the readability level of Science textbooks will be higher due to its descriptive vocabulary (Gallagher et al., 2012). However, it is recommended to lower the reader's reading level since Science textbooks consists many unfamiliar or scientific vocabulary which may cause difficulties to read compare to narrative texts (Badreddine, 2019; Swanepoel, 2010). It is also recommended that future draft to be provided for field-testing on students to identify the readability to have better quality textbooks as texts which consist of too many ideas will cause confusion on students and consequently failed to transfer intended knowledge (Sinaga et al., 2017).

According to the teachers, it was agreed that the readability was fairly difficult for the students as Nadia explained *"maybe some of it as I told you the level of syllabus quite high. We as adults still able to understand. But as students, they take time to understand. For weak students they will face a problem to understand the sentence." (IT1, ln. 190-192)*. Meanwhile Ng highlighted that she prefer to use another reference book (Science Process Skills) as the textbook wordings are too much, as reflected from the following excerpt:

> *Want to rate it low but quite pitiful. I use this textbook but I prefer to use Module (Science Process Skills) more. For example, the textbook want to explain something but the wordings are too much and not in orderly mannered which cause difficulty to understand. (IT4, ln. 215-216)*

However, readability value shouldn't represent the whole result as language is affected by many aspects by the reader which can't be measure statistically (Hartley, 2016; Zamanian & Heydari, 2012). For instance, grammar mistakes and other typography features may also affect the readability. Whereas, using transition words such as 'yet, however, hence', using active voice than passive voice, absence of unnecessary words able to increase readability of the content. In the paragraphs analysed, it consists of numerous transition words such as 'therefore, conversely, this causes, but' which may help students to comprehend better (Appendix F). Without such transition words may have damaging effects for readers' understanding as they need to deduce the missing words (Gençer & Çetinkaya, 2015; Reed & Kershaw-Herrera, 2016). Moreover, besides than the readability score obtained using Microsoft Word application, it also shows the percentage of passive voice where the value obtained is 33%. This proves higher amount of active voice used (67%) which benefits the students as they able to comprehend better (Hill-Briggs et al., 2012; Shukla et al., 2013).

4.3.2.2 Clear visuals

Aside from the texts, clear visuals of it from the textbook also an important factor to ensure readability to achieve. From the analysis of the chapters, all the visuals depict good and clear resolution with no blurry which considered important to ease students learning (Encheff, 2013). Nonetheless, the texts on the objectives section (Let's Understand) and other texts possess glaring texts regardless the sharp contrast of black and white (Figure 4.46).

Figure 4.46 Glaring text with complex background

The teachers agreed that it was difficult to read as Aiza justified due to the colours which may affect the students understanding (IT2, ln. 200). This is due to the high contrast produces glows and hence causes glaring towards the readers. It is suggested to avoid high contrast by using a dark grey text instead of a pure black text. Likewise, an off-white background can be use instead of pure white. Besides, the presence of complex background containing picture may cause the text difficult to read (Tsali & Alexiou, 2016). Nadia also agreed as she asserted *"I need to comment this one because the background colour. Something needs to be change here. Even this (page 209), the words bit blur." (IT1, ln. 185-186)*. It is suggested to use coloured boxes which able to ease reading as it distinguish from the complex background as shown in Form 3 Standard Based Curriculum for Secondary Schools (KSSM) Science textbook (Figure 4.47).

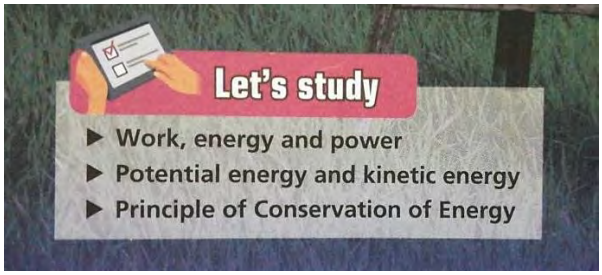


Figure 4.47 Example of coloured boxes used for better reading

4.3.2.3 Adequate visuals

In this Form 2 Science textbook, it comprises of many visuals and pictures which accounted for better understanding and memory towards the students. The visuals were almost located on each and every page of the textbook. Moreover, according to FLDOE (2015), students regardless lower or higher ability students typically need more visuals. Attractive visuals also act as a learning strategy as it motivates students to spend more time to read on a textbook as they're prone to other digitals such as mobile phones which may seems inappropriate as it will disrupt the lesson (Park & Lavonen, 2013; Zohrabi et al., 2012). Hence, visuals are important and essential in order to produce an attractive and successful textbook (Guo et al., 2018; Janko & Peskova, 2013).

4.3.2.4 Visuals representation other than texts

Visuals representation which consists of information apart from text also able to enhance readability effectively than long text passages which takes more effort and time as it constraining the readers memory (Dwyer et al., 2010; Jonker et al., 2012). Visuals representation that present in the textbook were circle diagram (Figure

4.48), schematic diagram (Figure 4.49), picture (Figure 4.50), sketch (Figure 4.51), tree map (Figure 4.52), comparison table (Figure 4.53), online video from attached QR code (Figure 4.54), AR technology (Figure 4.55) and cartoon comic (Figure 4.56).

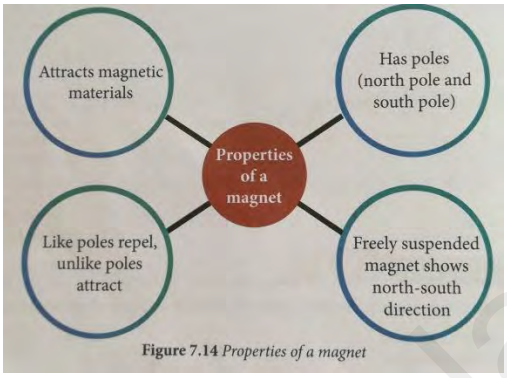


Figure 4.48 Circle diagram used in the textbook

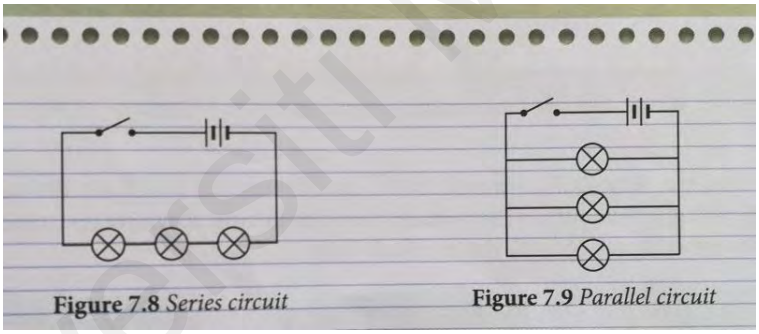


Figure 4.49 Schematic diagram used in the textbook

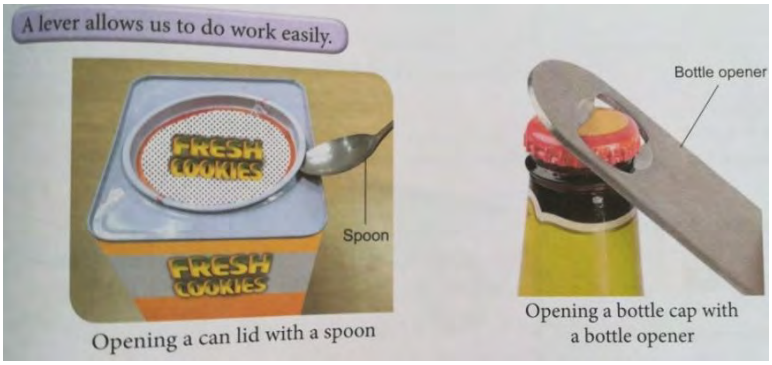


Figure 4.50 Pictures used in the textbook

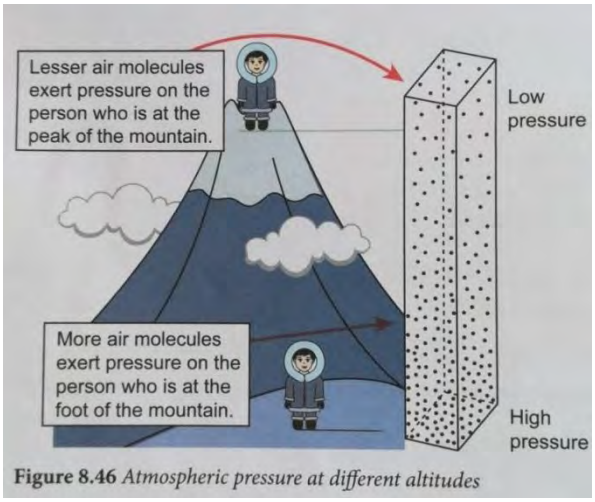


Figure 8.46 *Atmospheric pressure at different altitudes*

Figure 4.51 Sketch used in the textbook

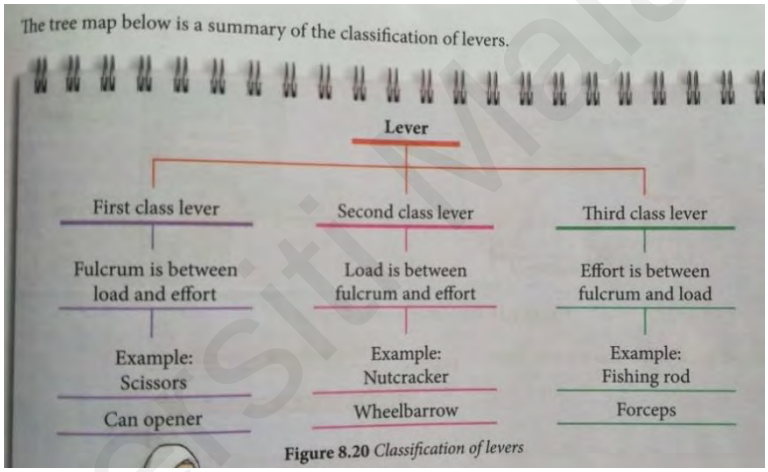


Figure 8.20 *Classification of levers*

Figure 4.52 Tree map used in the textbook

Table 9.1 *The differences between heat and temperature*

Heat	Temperature
A form of energy	The degree of hotness or coldness of an object
Measured in joule (J)	Measured in degrees Celsius (°C) or kelvin (K)
The amount of heat depends on the type of material, quantity of material and temperature	Temperature depends on the degree of movement of the particles in a matter.

Figure 4.53 Table used in the textbook

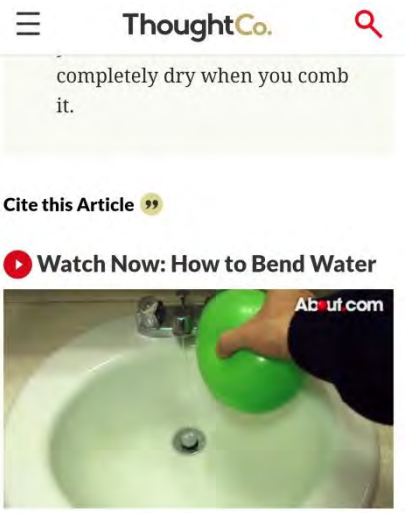


Figure 4.54 Online videos from QR codes

The number of videos from QR codes attached in the textbook were only four where one from each chapter. This may be considered less as teachers usually find more videos to enhance students understanding as Nadia stated *"if they have the video, easier, I can scan and show the video. Sometimes, I find the videos from Google and show to them." (IT1, ln. 261-262).*

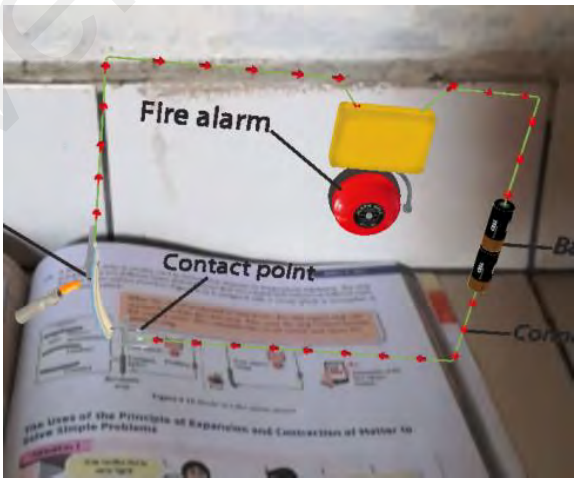


Figure 4.55 AR technology in the textbook

Based on Figure 4.55, there is an application provided that able to scan specific images into fascinating 3D images. Guidelines were provided as discussed in Section 4.3.1. Such images were listed on the app and a logo is provided at the side of the textbook image as an indication. According to a Malaysia research by Gopalan et al., (2015), it was shown that 70 students responded that such significant technologies are fun and engaging as generation Z students are more incline towards technologies gadgets which highlights the need to gain their interest as Najwa stated her students are *"very playful" (IT3, ln. 263)*. Nadia agreed with the good presentation of the images as she mentioned *"very good because there are tables and mindmaps to present the information. They also provide 3D image." (IT1, ln. 136-137)*. Nevertheless, from the four chapters analysed, only one 3D image provided which was on Chapter 9 (Heat).

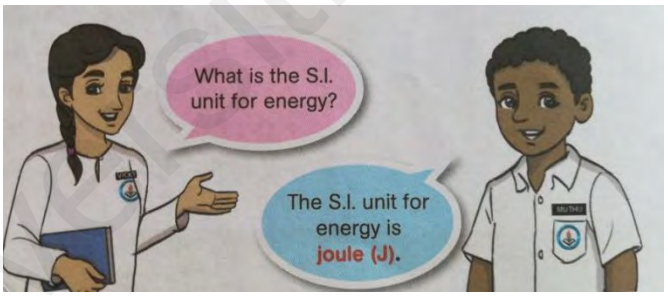


Figure 4.56 Cartoon used in the textbook

Based on Figure 4.56, there is only visual representation of cartoon which majority has a single panel image to relay the idea than using sequential comic stories which considered as limited comic presentations (Cohn, 2013; Zanettin, 2010). Comic literatures able to motivate and ease students to read better as it has shorter sentences and captivating. Moreover, according to research by Ravitch (2004), books which contain lively, exciting narrative or comic literatures are

considered pleasurable to read compared to reading textbooks which will considered as a chore or task. Comic literatures do not cause much effect on conceptual guidance but to ease readers to locate the information easily than reading text passages that requires more effort to read which is advised to put in more lively comic literatures for generation Z to motivate the students to read (Dwyer et al., 2010; Jonker et al., 2012; Zhao & Mahrt, 2018). This is supported by Ng as she stated "*Students are not going to read all the words but only want to read important sentences." (IT4, ln. 215-216)*. This is to ensure textbook can be fun and easy to be read rather than long passages that may bored the students (Asadi et al., 2015).

4.4 Assessments

Aside from a good content of textbook and its' attractive presentation, assessments were equally important as it able to tackle on effective ways to test and evaluate the students' learning progress through the assessments. The assessments used in this Form 2 Science textbook were analysed according to activities parallel to Revised Bloom's taxonomy (RBT), formative practice, summative practice, mastery practice and self-reflection checklist. The sections known as Activity, Formative Practice, Summative Practice, HOTS Mastery and Self-Reflection in the textbook to ensure students achieved the learning objectives and outcomes.

These assessments were categorised according to Bloom's taxonomy levels where the results were checked by another reviewer (a postgraduate student of educational science) to ensure inter-rater reliability. After comparing the results, similarity above 95% was consider as an acceptable level of agreement for all the activities, formative, summative and mastery practices in the textbook to ensure

accuracy (Maruna, 2010). Any disputes were resolved by further discussion. There was also self-reflection in a checklist at the end of each chapter to evaluate their own performance and improve on the matters that they need revision on. Hence, all of these assessment strategies used in the textbook will be analysed accordingly.

4.4.1 Activities parallel to Revised Bloom's Taxonomy (RBT)

In this Form 2 Science textbook, it consists of few activities along the learning content in order to keep students afresh and to avoid decline in attention among students (Vlieghe & Zamojski, 2020). As Najwa also agreed as she stated *"my students are very happy when I asked them to do the activities…" (IT3, ln. 209)*. The activities included in this textbook is analysed according to Revised Bloom's Taxonomy (RBT) levels. This is to ensure the effectiveness of the activities assessment corresponds with national objectives which were to produce 21st century skills students in order to solve problems in the real world pertaining to science and to produce critical thinking students. This RBT differentiated into six levels: *Remembering, Understanding, Applying, Analyzing, Evaluating* and *Creating* (Krouska et al., 2018). These levels are arranged from lower level of concrete to higher level in form of abstract (Pappas et al., 2013). It is then categorised into two categories which are Lower Order Thinking Skills (LOTS) and Higher Order Thinking Skills (HOTS). The first three levels of the Bloom's taxonomy belong to LOTS which are remembering, understanding and applying. Whereas, analyzing, evaluating and creating are under HOTS (Pappas et al., 2013; Yahya et al., 2012).

Generally, the difficulty of the questions from the activity section was gradually amplifies according to the RBT levels which also the same as the research conducted as the difficulty of the exam questions increases (Freeman et al., 2011). Likewise, the same goes to the content, formative, summative and mastery practice in the textbook where the level of difficulty increases along the context.

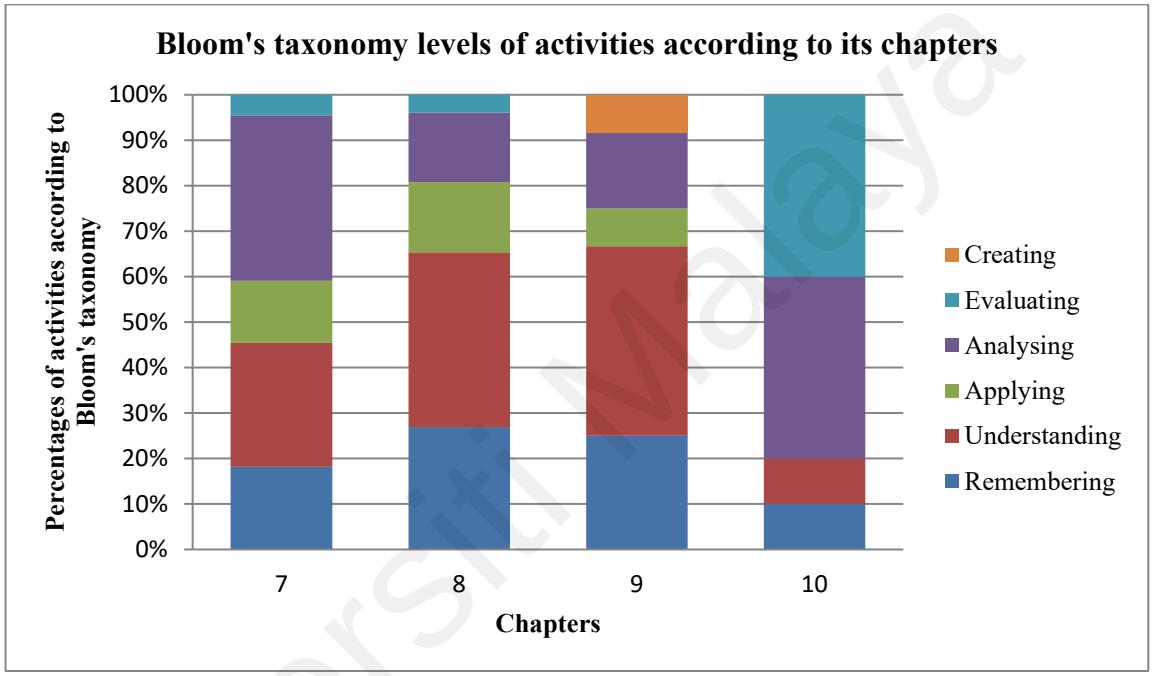


Figure 4.57 Bloom's taxonomy levels of activities according to its chapters

Figure 4.57 is constructed based on the results from inter-rater reliability with a reviewer as stated earlier. It was constructed with a similarity above 95% as an acceptable level of agreement to ensure accuracy (Maruna, 2010). According to the Figure 4.57, the activities present in the textbook were mostly under LOTS with 58.5% while HOTS questions consist of 41.5%. It was stated that HOTS questions are vital to create curious students with good problem-solving skills however LOTS questions are also important to encourage lower achievers (Hugerat & Kortam, 2014; Khine, 2013). HOTS questions able to motivate students to learn as it challenge

students to think out of the box rather than one-dimensional questions which only have one correct answer, however, to produce such multifaceted questions may be difficult and time consuming (Arum & Roksa, 2011; Stanger-Hall, 2012).

Most of the LOTS questions were on understanding level. The activities were mainly focuses on ability to grasp and channelling the knowledge. This may due to fulfil the objectives of Standard Based Curriculum for Secondary Schools (KSSM) curriculum according to the Learning Standard criteria where it focuses on students to be verbally proficient (Appendix D). Moreover, the activities able to strengthen their understanding as they may face difficulties during the classroom learning (Biggs, 2011, Keene et al., 2010).

Nevertheless, managing huge number of students during the activity may affect the efficiency of the activities as Aiza highlighted *"my school has 3000 plus students. One class we have 40 something and for me, honestly the activities are very good but I think are suitable for around 20 to 30 students. Then the activities will be very effective. Actually 40 plus students very noisy you know right." (IT2, ln. 210-213)*. This needs to be considered by the ministry to improve on our education system for better effectiveness to utilise the good activities and questions of the textbook.

4.4.2 Formative practice

Another assessment strategy use in this textbook is through formative practise. Formative practice located throughout the learning content thus, able to deliver more improvement-oriented to the students as teachers are there to assists and motivates the students to reinforce learning (Burkill & Eaton, 2010). Correspondingly, this

scaffolding provided from the teachers able to help the students to understand even when complex terms were introduced. Scaffolding was then reduced in summative and mastery practice which located at the end of the chapter.

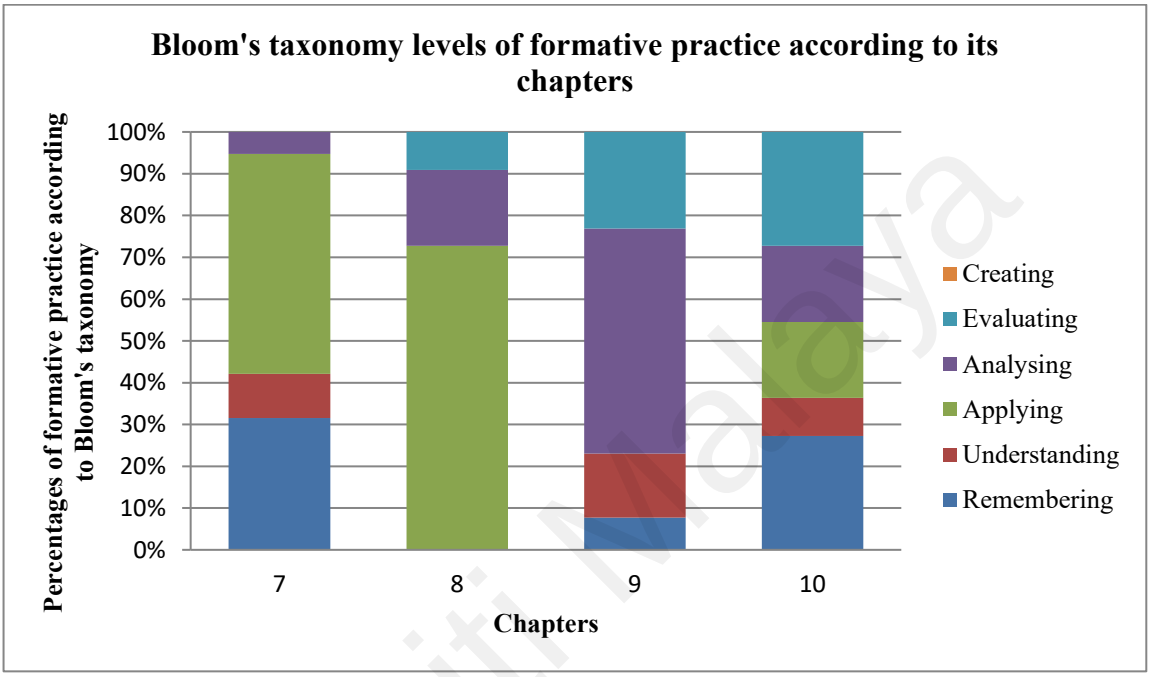


Figure 4.58 Bloom's taxonomy levels of formative practice according to its chapters

Figure 4.58 which formed from the inter-rater reliability results shows the formative practices were mostly under LOTS with 61.5% while HOTS recorded 38.5%. The LOTS questions were predominantly on applying level. One of the reasons is due to numerous calculation questions as this theme involves a lot in physics-related matter. Nevertheless, there is no creating level question which may due to formative section usually aims to provide improvement with teachers' guidance rather than assessment to the students (Burkill & Eaton, 2010). Besides, creating questions are time consuming for the students to think as it is the most difficult level which is why it was opted out from formative practice but mostly in assessment type practices such as summative and mastery practice (Burkill & Eaton,

2010; Samo, 2017). Nadia agreed and even explained *"actually I like their formative practices because when you answer their questions, it's like you already have the notes. For me quite good, if they able to answer means they understand that topic and indirectly they write the notes." (IT1, ln. 208-210)*. On the other hand, Aiza commented that the questions were moderate and very straight-forward (IT2, ln. 280). In addition, she stated that she mostly used another book (Science Process Skills) for practice as it is time consuming. Hence, the teachers' instructions are important as it determines the type of learning material to be used in a classroom environment according to the tetrahedral theoretical framework as reflected from the excerpt:

> *As we are doing these formative practices, we can't instruct the students to scribble the answers on the textbook. So they need to copy the questions first. Imagine we have 50 students requires to copy in a class and chit-chatting among friends, how do we able to finish teaching? This is just a little. So imagine if we instruct them to copy, I think even one hour may not complete which is why there are some topics that we instruct them to copy while some we discuss the answers. However, it depends on the topic as if it's a hard like this (Chapter 8: Force and Motion), we may not discuss. We will use Module (Science Process Skills) as the topic is hard because it's hard to just verbally discuss. Honestly, we use Module a lot. (IT2, ln. 284-292)*

4.4.3 Summative practice

Aside from formative practice, there is also summative practice consists in the textbook. The difference among both of these practices is summative practice located at the end of the chapter as a type of assessment (Burkill & Eaton, 2010).

Simultaneously, this practise able to summarise and allow students to recognise which area they should improve on. Answers were provided near the end of the textbook to revise.

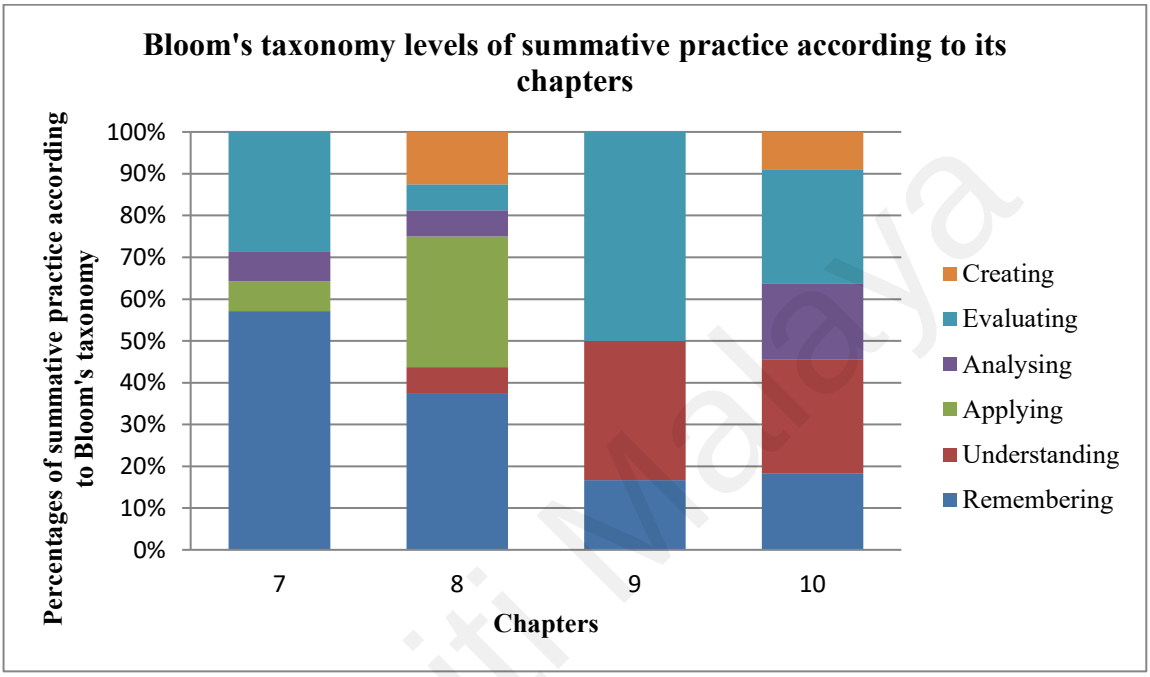


Figure 4.59 Bloom's taxonomy levels of summative practice according to its chapters

Based on Figure 4.59 that formed from the inter-rater reliability results portrays the summative practices were mostly under LOTS with 58.5% while HOTS questions consist of 41.5%. It is predominantly on remembering level to recall the facts. This may due to summative characteristic which interested to evaluate how well the students able to remember the information through low level questions such as true-false and fill in the blank questions (Tarman & Kuran, 2015). Despite the low level question, it is also presented in crossword puzzle manner in the textbook (Figure 4.60) which able to act as a fun game, hence, creating an enjoyable learning as Najwa commented *"they're interesting compared to other thinking questions which cause students condense in the class." (IT3, ln. 304-305).*

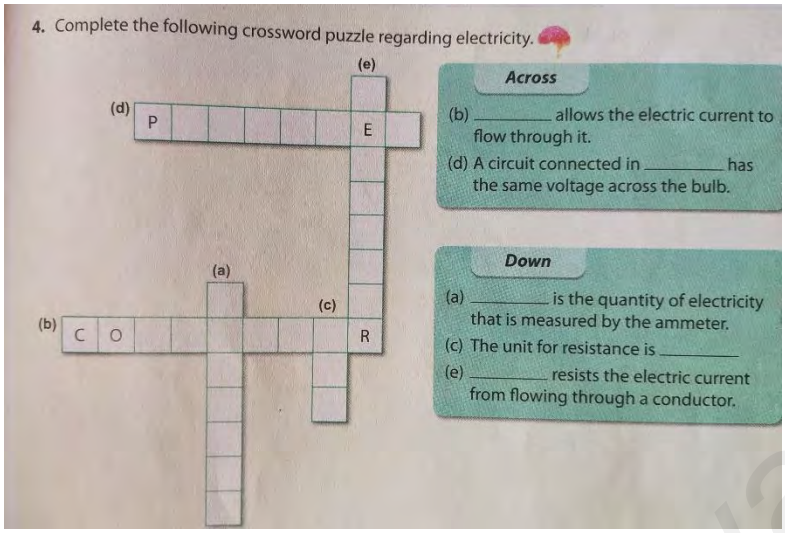


Figure 4.60 Crossword puzzle

Besides, LOTS questions are easier to evaluate the answers and better scorer reliability using such close-ended questions than open-ended questions (Rihulay, 2016; Silviana, 2018). However, in science education it was not encouraged to only memorize the facts without understanding (Hazelton et al., 2012; Hindarto & Iswari, 2017). Nevertheless, a high percentage of evaluating questions were also present which falls on HOTS category which is what science education targeted on (Aktamis & Yenice, 2010; Zachariades et al., 2013).

Najwa also complimented this Summative practice section consists of HOTS questions and interesting puzzle activity (IT3, ln. 296-297). However, Ng asserted HOTS questions should be more than LOTS questions as she asserted *"maybe they can increase HOTS questions. Meanwhile, the easy type questions should be lesser and HOTS questions should be more." (IT4, ln. 337-338)*. HOTS questions of open-ended questions also tend to motivate the students as they able to feel autonomous on the task given and pleasure of learning (Cerasoli et al., 2014; Miele et al., 2020). In addition, Nadia commented *"almost similar with PT3 questions but I think they should provide the marks at the end of the question so that the students can estimate*

the points they should write." (IT1, ln. 231-233). This is proven with tetrahedral theoretical framework as learning material questions are affected by the structure of PT3 examinations (Schell & Butler). This is due to the examinations able to reflect what students should know and answer which they practiced from the textbook, however points should be allocated at the end of the questions to ease the students.

4.4.4 Mastery practice

Mastery practice is located at the most end of the chapter. It functions to strengthen and allow the students to master their learning from the formative and summative practice earlier on where both are to evaluate the students during learning process and at the end of the chapter respectively (Kularbphettong et al., 2015). These mastery questions able to enhance their performance and simultaneously master the 21st century skills which the national requires (MOE, 2016; Wininger & Norman, 2005).

Table 4.7

Bloom's Taxonomy Levels of Mastery Practice According to Its' Chapter

Chapters	Number of question	Bloom's taxonomy levels
7	1	Analysing
8	1	Evaluating
	1	Creating
9	2	Creating
10	2	Creating

Table 4.7 which constructed on the inter-rater reliability results of above 95% agreement shows all of the mastery practice questions belong to HOTS category. It is mostly on creating level as this type of question able to give opportunity for students to be creative forming new invention and also able to create a sense of competency during the learning process (Fadeeva et al., 2010; Samo, 2017). However, Najwa commented on a Mastery creating question that *"actually the activity is very good but time constraint." (IT3, ln. 226)*. Moreover, despite these HOTS questions, a teacher commented *"to be honest, not many students able to answer this question independently. We need to guide them. Because it involves real situation right. And they should add marks at the end of the questions like I said." (IT1, ln. 237-239)*.

Regardless the difficulty of the Mastery questions, the number of questions were considered less as it only has one or two in each chapter. It is suggested to increase since examination questions were mostly HOTS questions which agreed by the teachers, as reflected from the excerpt:

> *I think they can add more questions rather than only one question here because PT3 consists of only HOTS questions, so I think one question is not enough. However, the other latter chapters consist more but if possible, add more questions will be better. (IT2, ln. 309-312)*

In addition, Ng also stated that HOTS calculation examples should be included in the content too as reflected from the excerpt:

> *Moderate, but I don't use. I use the other book (Science Process Skill). The calculation example is easy. If students only refer to this kind of examples are way too easy because exam questions will be hard. So, if want to improve the textbook perhaps should add HOTS examples. The examples shouldn't be easy like these. (IT4, ln. 166-169)*

Nadia also further added "*if possible they can relate the questions that relate to PT3, like Higher Order Thinking questions here but when I refer to the PT3 questions, the way the questions in the exam is different right. If possible they can include that type of questions in the textbook, I think that's an improvement." (IT1, ln. 125-128)*. This is followed by the tetrahedral theoretical framework as learning material and examinations are interconnected. When the exams requirements are too different from the textbooks' cognitive learning process will cause effect on the poor achievement (Schell & Butler, 2018). Nevertheless, according to William (2010), assessments would not be easy and predictable in order to make students' learning effective and proactive. Henceforth, textbook assessments are considered the central of education process to ensure and create highly competitive students.

4.4.5 Self-reflection checklist

Self-reflection checklist is used to ensure the students able to improve on specific area at the end of the chapter. It was in a checklist form to allow students to check easily on their performance and thus improve on the matters they need to revise on (Lesley, 2015). Najwa also keen to use this checklist as reflected from the excerpt:

> *We usually use this because it helps us to determine the ability of the students to understand. For example, before I start the lesson, I will ask them to refer to Self-reflection. So, if the students able to grasp, they tick. I will also use it to check whether I have explained this to my class. From this, I able to ensure I'm done for this chapter. Actually, I like this. (IT3, ln. 317-321)*

Hence, the checklist should be informative and adequate according to Standard Based Curriculum for Secondary Schools (KSSM) Learning Standard criteria. From the analysis, it was found that all the self-reflection checklists were adapted from the Learning Standard criteria. Nevertheless, there were two grammatical errors which were discussed earlier in Section 4.2.3 (Accuracy). Figure 4.61 shows the self-reflection checklist of the textbook.

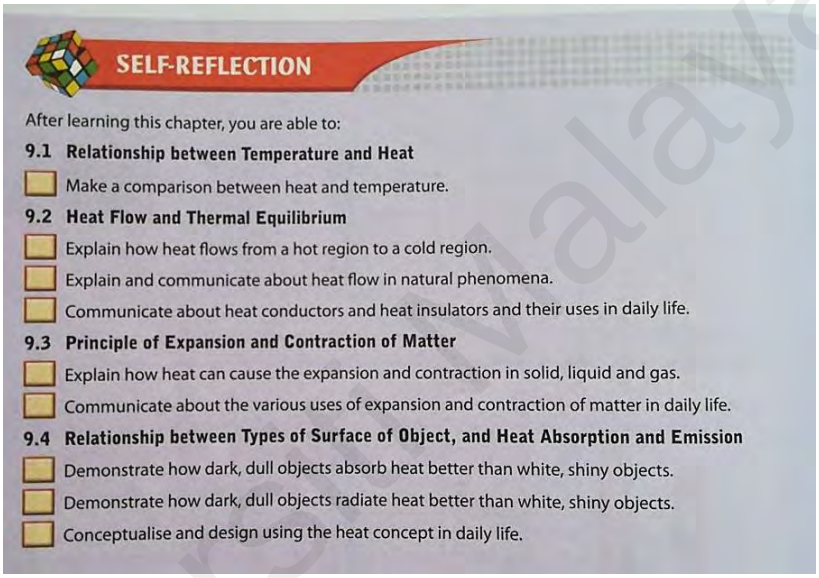
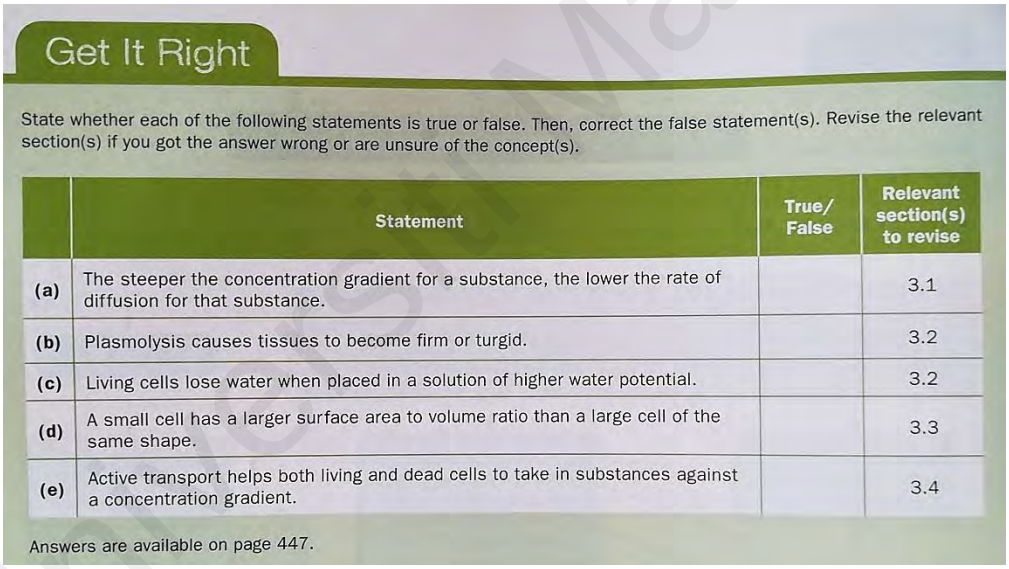


Figure 4.61 Example of self-reflection checklist

Nevertheless, not all teachers used this section as one of the teacher explained *"I don't discuss. As I told you, time constraint so I have to rush." (IT1, ln. 248)*. Henceforth, learning material are greatly related and influenced by learning instruction as students usually pay attention towards the teachers' command compare to the textbook according to Ansary & Babaii (2002, as cited in Mohammadi & Abdi, 2014). Therefore, teachers' judgement whether the section to be crucial or not may influence the outcome of the quality of the textbook according to the tetrahedral theoretical framework used in this research.

Meanwhile, based on a Singapore's Biology textbook (Lam & Eric, 2013), the self-reflection section was slightly varied as it includes true or false questions in order to evaluate their understanding with answers located at the end of the textbook (Figure 4.62). This way may be more time saving and effective as it is direct and easier for the students to truly identify which sub-topic they should focuses more if they obtain a wrong answer. Nevertheless, the list of questions may not cover all the sub-topic compared to the Science textbook which was more comprehensive. Therefore, there are many techniques for accessing self-reflection section depending on authors' level of interest.



Get It Right

State whether each of the following statements is true or false. Then, correct the false statement(s). Revise the relevant section(s) if you got the answer wrong or are unsure of the concept(s).

	Statement	True/ False	Relevant section(s) to revise
(a)	The steeper the concentration gradient for a substance, the lower the rate of diffusion for that substance.		3.1
(b)	Plasmolysis causes tissues to become firm or turgid.		3.2
(c)	Living cells lose water when placed in a solution of higher water potential.		3.2
(d)	A small cell has a larger surface area to volume ratio than a large cell of the same shape.		3.3
(e)	Active transport helps both living and dead cells to take in substances against a concentration gradient.		3.4

Answers are available on page 447.

Figure 4.62 Self-reflection of Singapore's Biology textbook (Lam & Eric, 2013)

4.5 Summary

This chapter presented the findings of the research and the subsequent discussions to answer the research questions. The research question aims to identify the syllabus of the Form 2 Science textbook of local secondary schools in Malaysia on theme 'Energy and Sustainability of Life' in terms of content, presentation and

assessments from the reviewed framework (Appendix A). The perceptions from the teachers were then implored alongside with the document analysis for data triangulation on the content, presentation and assessments of the Form 2 Science textbook in order to obtain meaningful results.

The content of the Form 2 Science textbook is imperative to identify since textbooks play as one of the major factors that contribute towards students' score in examinations as about 90% of the secondary Science teachers rely heavily on textbooks in our education system (Fuchs & Bock, 2018; Loewen, 2018). It also acts as a major tool to obtain credible source of information which then cause massive dependence of teaching using the textbooks in our nation. Generally, the analysis in terms of content found out that it fulfils all the Learning Standards requirements set by the Ministry of Education. However, there were some content showed insufficient explanation of how such devices works which may hinder students from complete understanding as the teachers also agreed the Form 2 Science textbook was only sufficient for understanding. It lacks of detailed explanations and examples which cause the teachers to seek information from other source of aid.

Moreover, the content of the textbook also showed few inaccuracies on the QR codes and grammatical errors in the textbook which may hinder the learning process in the classroom as few teachers encountered problems during QR codes scanning as the websites were not accessible. Meanwhile, along my research, STEM careers and other two values which were caring and patriotic were established. Nevertheless, there were limited examples which then agreed by the teachers' opinion as it may not be effective to achieve the objective in real life practice. On the other hand, the treatment level of the textbook found that insufficient classroom time lessons were one of the biggest concern among the teachers as the interview found

out that many sections of the textbook were not able to be utilised due to time constraint such as the designing experiments, self-reflection checklist, glossaries, activities and assessments practice.

Meanwhile, the presentation of the textbook was colourful, attractive and presented in clear manner which were agreed by all the teachers. However, there were few inadequacies in terms of keywords highlighting as the textbook showed no highlights in the differences of the information presented to ease understanding and skimming which was agreed with other teachers. The summary of Chapter 8 (Force and Motion) on the other hand showed too much of words which were then stressed by the teachers that it may cause students unmotivated to read. Moreover, the readability score also classifies as fairly difficult from the analysis which were also highlighted by the teachers that it is difficult for the students to comprehend due to the extensive sentences. The teachers also agreed the glaring texts showed in the textbook cause distress for readers to read which may then affects their motivation to read.

Whereas in context of learning strategy, the teachers were happy with the competent activities in the textbook as students enjoyed the activities. However, the teachers asserted that time constraint and huge number of students in a classroom cause some of the activities unable to be fully carried out and may affects its effectiveness. The questions from the textbook also parallels with conceptual framework used as the questions gradually increased based on the RBT levels. Apart from that, there was more number of LOTS category questions compared to HOTS category which also stressed by the teachers to include more HOTS questions as the examinations questions will be difficult. Teachers further stressed to include marks at the end of the HOTS questions to ease students. However, it was also stated that

many students unable to answer HOTS questions independently due to the difficulties which further research may be needed to find appropriate solutions. Many assessment practices in the textbook were unable to be fully conducted by the teachers due to time constraint. Hence, time pertaining issues need to be highly consider in order to fully utilised the textbook and consequently achieve nation's education objectives.

In the following chapter, summary of the findings, implications of the research and the conclusion of the research will be discussed.

CHAPTER 5

SUMMARY, IMPLICATIONS AND CONCLUSION

5.1 Introduction

In this chapter, the summary research findings and implications of this research were presented. The future research towards existing literatures and recommendations on future studies were also discussed. Lastly, in this chapter will close with a conclusion of the research.

5.2 Summary of Research Findings

This research able to highlight the significant elements of the textbook and its limitation in terms of content, presentation and assessments. In terms of content, it is important to have activities pertaining communication, collaboration and verbal discussion activities amongst student to equip them with essential 21st century skills. Findings also showed the lack of designing experiments which able to enhance problem solving skills (MOE, 2016). Besides there were also several drawbacks of the textbook where it should include more examples on daily life applications, critical thinking questions and informative local or global context to create assertive students' attitude who able to solve multifaceted problems in real world (Dwyer et al., Turiman et al., 2012).

Along my research, I also established STEM careers and other two values which were caring and patriotic as a good textbook does not only consist of science core knowledge but with humanitarian values as well. Nevertheless, there was limited examples of STEM careers and portrayal of caring and patriotism values depicted in the textbook. Meanwhile, introduction chapter of a textbook should consist of thinking questions and should not under category of LOTS which may dampen students' interest in the beginning of the chapter in order to stimulate critical thinking skills and motivate readers (Eshun & Mensah, 2013; Tofade et al., 2013).

Insufficient content was also found in the textbook as it consists of examples without explanation of how such devices works as the information was assigned abruptly without complete understanding from the students (Dunne, 2010; Kager, 2015). It is also important to have more type of proof-readers prior to publication as there were few inaccuracies on the QR codes and grammatical inaccuracies in the textbook. Hence, proof-readers on technical and literature issues are needed to ensure no disruption during classroom lesson and distortion in students' language coherency during learning process (Harwood, 2019).

Meanwhile, in terms of presentation, the textbook was presented in colourful, attractive and clear manner where it consists of attractive borders, clear guidelines and clear organisation. In context of organisation, it has various typography cues however as discussed earlier, it was agreed with other teachers that Figure 4.35 depicts lack of colour cues of keywords highlighting to highlight the concept differences. Additionally, numerous labels were included in the textbook except Figure 4.38 which shows lack of labelling on the figure may effect on skimming process and students' understanding. The data also shown that all visuals were near to related context and table of comparison in the textbook also presented in great

organisation. The research also found that the textbook consists good table of comparisons, however, it is recommended the two different calculations of Figure 4.41 and Figure 4.42 to be presented in table of comparison manner to ease understanding and memorisation.

A clear set of objectives were also shown in the textbook except on Chapter 8 (Force and Motion) as the objectives were consider little regardless consists the highest number of pages compared to other chapters which may effect on students' expectation on the objectives presented (Flick, 2015; Sánchez Beltrán, 2018). It was also discovered that the glossary section was only used occasionally by the teachers despite arranged in alphabetically manner. It is recommended the chosen term in the glossary to be hinted in the context to notify the readers (Peters, 2017). Findings also found that the summaries in the textbook were good however without much beneficial information and concepts (Merchie & Van, 2016; Wette, 2017). The summary of Chapter 8 (Force and Motion) also shown too much of words compared to mind map design which may cause students unmotivated to read.

Meanwhile, the data shown that readability score was 58 which classified as fairly difficult and the grade level found was 8.7 which already exceed level 8 (Form 2) and nearer to level 9 (Form 3). It was further asserted by the teachers the readability were difficult for the students. Nevertheless, the textbook also shown the presence of transition words and higher number of active voice which may able to ease readability. The textbook presentation of visuals were clear, however as discussed earlier, the visual in Figure 4.46 possess glaring texts with complex background is suggested to use coloured boxes to distinguish from the background. Findings also shown that there were many other types of visual representations in the textbook such as circle diagram, schematic diagram, picture, sketch, tree map,

comparison table, online video from attached QR code, AR technology and cartoon comic. However, as discussed, the cartoon comic majority depicts single panel image compared to sequential comic story which may able to bring pleasure in reading for Generation Z (Asadi et al., 2015; Jonker et al., 2012; Zhao & Mahrt, 2018).

Whereas in context of assessments, it was discovered that the activities, formative and summative practices questions were majority under LOTS category compared to HOTS category where it was 58.5%, 61.5% and 58.5% respectively for LOTS category. From the interview data, it was asserted by teachers the need to increase the number of HOTS questions which is also illustrated in Mastery Practice in the textbook since examination questions will be difficult with HOTS questions. Teacher further advised to include marks at the end of the HOTS questions to ease the students.

Nevertheless, it was said that many students unable to answer the questions independently where further research need to be done to find appropriate solutions and actions. Findings also show that teachers encounter time constraint in the classroom which causes the textbook unable to be fully utilized regardless being beneficial. This resulted in some teachers confessed to not use the QR codes, self-reflection checklist, glossary section, activities and assessments practices which are something need to be taken into consideration in order to fully utilised a good textbook tool to achieve the intended learning outcomes.

5.3 Implications of the Research

The findings from this research able to cause few implications for Malaysian Education Curriculum. This research shows the highlighted keys and limitations of the textbook which will benefits future curriculum developer, publishers and writers to tackle effectively on the components to amplify the impacts on students. The findings of this research also shown that LOTS questions were higher than HOTS questions which may not able to achieve the realistic objective to produce 21st problem solving skills and critical thinking students. This can only be achieve if curriculum developer, publishers, textbook writers and teachers acknowledge and understand the importance of science skills which also constitutes open-ended questions rather than memorizing questions that soon will be forgotten.

As shown in this textbook, it does not comprise of only texts but with other variety technology adoptions which consider highly beneficial in todays' era to be aware by publishers. Apart from these implementations, digital version of textbooks (PDF version) is also provided with traditional printed textbook. Nevertheless, as discussed earlier, students may not prefer reading from digital devices compared to textbooks, however, teachers may need other source of entities besides than only textbooks to ease classroom teaching such as PowerPoint slides presentation and other online materials. To conclude, textbooks should consist wide variety of presentations, activities and assessment strategies in order to continuously captivate their interest in learning rather than only long text passages of textbooks.

In addition, this research helps to understand how teachers actually used and think about the textbooks that contribute towards students' learning. It was emphasized from the teachers that teaching periods were insufficient. As a

consequence of time were disregarded, the textbook components unable to be utilized completely and designed in an adequate manner. Therefore, teachers' perceptions are important to help distinguish the problem and need of textbooks development.

5.4 Future Research and Recommendations

This research conducted with a number of limitations where recommendations were provided. First, only Form 2 Science textbook were used which future research may consider to look into other textbooks, grades or other reference materials related other than textbooks. In addition, only one theme was analysed from this textbook where future research can look comprehensively to all the other themes.

This research collected insights from four teachers where the data may be expanded if there is more number of participants. Another aspect to be improved is to include more number of schools from different economic states such as rural areas in Malaysia for future research if budget permits to obtain any meaningful information regarding technological or laboratories use. The researcher also discovered that more perceptions from different parties such as from students, curriculum developer, publishers and writers are valuable as it helps to further intervene to establish a competent textbook.

5.5 Conclusion

Given the importance and major use of textbooks, it is substantial to analyse textbook to obtain valuable insights in terms of content, presentation and assessments. As far as many considerations are towards technology practices, the traditional textbooks are still remain as vital pedagogic material to act as supporting teaching material and learning to take place for the students. Therefore, from this research, it is important to carry out analysis in order for the textbook to be influential towards students' attitude and be taught dynamically to enhance the quality of textbooks to achieve nation's objectives.

As the quality of a textbook may also cause impacts on teaching and learning process of students, this in-depth research of textbook analysis is worthy of considerations. Subsequently, the results of this research may create a significant difference on future production of new textbooks by implementing the highlighted points and resolving the limitations discussed. From the findings of this research, it can be concluded that there are many strengths of the textbook, however, the textbook also consists of numerous limitations to achieve our nation objectives and targets. From the teachers' interview, it was found that students are not very keen towards using textbooks which is why it is important to focus in incorporate more technological features to capture the interest of generation Z students.

The results of this research also able to be use as rubric for future integration of textbooks. Therefore, the results of the textbook analysis is considered valuable as the information obtained able to be assimilated for better quality production of textbooks when ample profound characteristics have been recognised and weaknesses able to be rectified. Consequently, this benefits nations' education as

well as teachers obtain a comprehensive teaching material to improve students learning. It is hoped that this research able to serve as an awareness tool for curriculum developer, publishers and stakeholders to effectively produce the best curriculum materials in selecting and decision making to contribute to successful textbooks implementation. Hence, continuous and rigorous research of textbooks is a perennial practise to ensure growth of textbooks and continuous improvisation which consequently benefits nations' education.

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APPENDICES

APPENDIX A

Framework for Science textbook analysis (Adapted from: FLDOE, 2015)

Elements	Description	Remarks
(1) Content a) Align with curriculum • the content of the textbook need to be align with national curriculum requirements	• The content need to fulfil national curriculum learning standard • Consists of experiments • Consists of daily life applications • Applications of 21st century skills: *i) Communication: platform for students to express ideas in verbal or written manner using technology.* *ii) Critical thinking: questions that require to think critically* *iii) Collaboration: collaborative activities where students learn to work with each other harmoniously and cooperatively.*	

	iv) Informative: additional information and knowledge either in local or global issues with vast understanding that related to it.
b) Treatment level • define as the complexity must be appropriate to the students' level	• Should start with real-life example or thinking question on each chapter • Consists sufficient details to understand the content within the textbook without the aid of other sources • Consists verbal discussions activities to ensure understanding
c) Accuracy • the content must be accurate	• Absenteeism from errors either in scientific context, visuals, videos, websites or technological problems
(2) Presentation a) Organisation • the presentation must be clearly organised to easily identify ideas	• Typography cues such as fonts sizes, font types or highlights for better indications • Using borders for better identifying • Figures must be labeled • Visuals located near to related text

	• Consists of table of comparisons • Consists of table of content • Consists of objectives • Consists of glossary • Consists of clear summaries for logical orders
b) Readability • the texts or visuals should be understandable based on the students' level	• Determine readability value • Determine the suitability of the passage towards the intended students' level • Clear visuals without glare • Easy viewing as sentence ends on same page as it begins • Adequate visuals for easy understanding • Consists of other text information such as graphs, charts or maps
(3) Assessments • textbooks must include assessments to test students' achievement	• Consists of revised Bloom's taxonomy cognitive levels activities or assessments:

i. *Remembering: able to memorize and recall the knowledge*
ii. *Understanding: able to explain and compare*
iii. *Applying: using knowledge and skills in other situations*
iv. *Analyzing: split information into smaller parts and make relationship between the parts*
v. *Evaluating: using knowledge to make conclusion and produce justifications*
vi. *Creating: generating concepts, products or techniques innovatively*

- Consists of self-reflection checklist

APPENDIX B

Interview questions for preliminary research

Content	1. How well does the content align with National requirements? 2. How well is the information presented in the textbook relevant to student's life? 3. What do you think about the STEM career opportunities that are presented in the textbook? Do the teachers explain that to the students? For example, in page 199? 4. How well is the difficulty of the content? Does it need another source of aid to understand? 5. Do you aware of the questions at the beginning of every chapter for example in page 140? Do teachers use the questions? 6. What do you think of the timeframe of this teaching material? 7. How well is the accuracy of the content presented? 8. How well is the explanation of how the microfiber cloth works in pg 147? 9. How well are the accessibility of the QR codes and websites? Do you use the QR codes or ask the students to use it? 10. Some of the QR codes that I analysed are broken webpage (page 218). Did any students commented? 11. What do you think about the success of portrayal towards humanity to instill compassion and care? 12. What do you think about the success of instilling patriotism? 13. What do you think about the strength and limitation of the textbook in terms of content?
Presentation	14. In terms of textbook presentation, how well is the organisation presented? 15. How well is the highlighting colour of text used? Do you think there is a need to highlight the words in page 183 on which part is in between? 16. How well is the labelling presented? Do you think there is a need to label the charges in page 145? 17. How well is the table of comparisons for example in page 206? 18. What do you think about the *series* and *parallel circuit* calculations presented in page 156 and 157? 19. What do you think about the glossary section? Do you use the section? 20. How well are the chapters' summaries presented? 21. What do you say about the summary of Chapter 8 in page 200? 22. What do you say about the visual readability of words example in page 204?

	23. How well is the readability of words? Is it easy to understand? 24. What do you think about the strength and limitation of the textbook in terms of presentation?
Assessments	25. How well are the formative practices in the textbook? 26. How well are the summative practices in the textbook? 27. How well are the mastery questions in the textbook? 28. What do you think about the rubrics of self-reflection at the end of the chapters? 29. What do you think about the strength and limitation of the textbook in terms of assessments?

APPENDIX C

Restructured interview questions for teachers

Content	1. How well does the content align with National requirements? 2. How well is the information presented in the textbook relevant to student's life? 3. What do you think about the STEM career opportunities that are presented in the textbook? Do the teachers explain that to the students? For example, in page 199? 4. How well is the difficulty of the content? Does it need another source of aid to understand? 5. Do you aware of the questions at the beginning of every chapter for example in page 140? Do teachers use the questions to the students? 6. What do you think of the timeframe of this teaching material in the classroom? 7. How well is the accuracy of the content presented? 8. How well is the explanation of how the microfiber cloth works in pg 147? 9. How well are the accessibility of the QR codes and websites? Do you use the QR codes or ask the students to use it? 10. Some of the QR codes that I analysed are broken webpage (page 218). Did any students commented? 11. What do you think about the success of instilling compassion and care towards the students? 12. What do you think about the success of instilling patriotism towards the students? 13. What do you think about the strength of the textbook in terms of content? 14. What do you think about the limitation of the textbook in terms of content?
Presentation	15. In terms of textbook presentation, how well is the organisation presented? 16. How well is the highlighting colour of text used? Do you think there is a need to highlight the words in page 183 on which part is in between? 17. How well is the labelling presented? Do you think there is a need to label the charges in page 145? 18. How well is the table of comparisons for example in page 206? 19. What do you think about the *series* and *parallel circuit* calculations presented in page 156 and 157? 20. What do you think about the glossary section? Do you use the section? 21. How well are the chapters' summaries presented? 22. What do you say about the summary of Chapter 8 in page 200? 23. What do you say about the visual readability of words

	example in page 204? 24. How well is the readability of words? Is it easy to understand? 25. What do you think about the strength of the textbook in terms of presentation? 26. What do you think about the limitation of the textbook in terms of presentation?
Assessments	27. How well are the formative practices in the textbook? 28. How well are the summative practices in the textbook? 29. How well are the mastery questions in the textbook? 30. What do you think about the rubrics of self-reflection at the end of the chapters? 31. What do you think about the strength of the textbook in terms of assessments? 32. What do you think about the limitation of the textbook in terms of assessments?

APPENDIX D

Learning Standards criteria stated in Standard Based Curriculum for Secondary Schools (KSSM)

Chapter	Learning Standard
Chapter 7 : Electricity and Magnetism	7.1.1 Describe and communicate about energy.
	7.1.2 Explain and communicate about the existence of electrostatic charges.
	7.1.3 Explain with examples on electrostatic in daily life.
	7.1.4 Draw a conclusion that the flow of charges produces electric current.
	7.1.5 Characterise current, voltage and resistance and their units.
	7.1.6 Draw a conclusion on the relationship between current, voltage and resistance.
	7.2.1 Elaborate and communicate about the flow of electric current in series circuit and parallel circuit.
	7.3.1 Draw a conclusion about the characteristics of a magnet.
	7.3.2 Describe and communicate about electromagnet.
	7.3.3 Carry out an experiment and communicate about the uses of magnet and electromagnet in daily life.
Chapter 8 : Force and Motion	8.1.1 Elaborate and communicate about force.
	8.1.2 Explain that force has magnitude, direction and point of application.
	8.1.3 Measure force in S.I. unit.
	8.1.4 Explain with examples that every action force has an equal (same magnitude) reaction force but in the opposite direction.
	8.2.1 Elaborate and communicate about the effects of force.
	8.2.2 Explain and communicate the relationship between the

	differences in densities and the effects of buoyancy in daily life.
	8.2.3 Classify and solve problems on levers based on the position of fulcrum, load and effort.
	8.2.4 Explain and communicate about the moment of force.
	8.2.5 Carry out an experiment and communicate about pressure and its application in daily life.
	8.2.6 Elaborate and communicate about gas pressure based on the kinetic theory of gas.
	8.2.7 Explain and communicate about the existence of atmospheric pressure and the effects of altitude on the magnitude of pressure.
	8.2.8 Explain the effects of depth on liquid pressure.
Chapter 9 : Heat	9.1.1 Make a comparison between heat and temperature.
	9.2.1 Explain how heat flows from a hot region to a cold region.
	9.2.2 Explain and communicate about heat flow in natural phenomena.
	9.2.3 Communicate about heat conductors and heat insulators and their uses in daily life.
	9.3.1 Explain how heat can cause the expansion and contraction in solid, liquid and gas.
	9.3.2 Communicate about the various uses of expansion and contraction of matter in daily life.
	9.4.1 Demonstrate how dark, dull objects absorb heat better than white, shiny objects.
	9.4.2 Demonstrate how dark, dull objects radiate heat better than white, shiny objects.
	9.4.3 Conceptualise and design using the heat concept in daily life.
Chapter 10 : Sound Waves	10.1.1 Communicate about the basic characteristics of sound waves.
	10.2.1 Explain frequency and its unit, and amplitude of vibration.
	10.2.2 Relate frequency to pitch.

10.2.3 Relate amplitude to loudness.

10.2.4 Explain with examples loudness and pitch using musical instruments.

10.3.1 Explain with example phenomena related to reflection of sound waves such as echo and Doppler effect

10.3.2 Explain with example the applications of reflection of sound waves

10.3.3 Elaborate and communicate about limitations of hearing for humans and animals

10.3.4 Explain with examples ways to overcome human limitations of hearing

APPENDIX E

Flesch reading ease score table

Reading Ease Score	Description	Estimated Reading Grade
0 – 29	Very difficult	College graduate
30 – 39	Difficult	College grade
40 – 59	Fairly difficult	10^{th} - 12^{th} grade
60 – 69	Standard	8^{th} - 9^{th} grade
70 – 79	Fairly easy	7^{th} grade
80 - 89	Easy	6^{th} grade
90 - 100	Very easy	5^{th} grade

(Zamanian & Heydari, 2012)

APPENDIX F

Paragraphs from the Form 2 Science textbook for readability

The pattern of the magnetic field depends on the shape of the conductor used. For example, the magnetic field lines produced by a straight wire and a coiled wire are concentric circles. Magnetic field lines are closer where the magnetic field is stronger. The strength of the magnetic field reduces as it moves away from the centre of the conductor. The pattern of the magnetic field produced is not affected by the direction of the current that flows through the conductor. The direction of the magnetic field is determined by the direction of the electric current. The right-hand grip rule determines the direction of the magnetic field of the current flow in a straight wire (pg. 160).

When a drink is sucked out of its packet, the packet will compress (Photograph 8.15). What causes the packet to compress? When the drink is sucked out, the drink inside the packet becomes a partial vacuum and the air pressure inside decreases. Therefore, the higher air pressure outside will press onto the packet and compress it. The air pressure outside is called the atmospheric pressure. Atmospheric pressure is the pressure exerted by the atmosphere on the surface of the Earth and all objects on the Earth. Do you know that atmospheric pressure depends on the altitude? Atmospheric pressure decreases as altitude increases (pg. 192 and pg. 196).

The particles in a solid vibrate at a fixed position. When the solid is heated, the particles vibrate faster and move further apart from one another. This causes the volume of the solid to increase because the solid expands. Conversely, when the solid is cooled, the particles vibrate slower and move closer to one another. This causes the volume of the solid to decrease because the solid contracts. The particles in liquid and gas move freely.

When the liquid and the gas are heated, the particles move faster and randomly. The distance between the particles also increases. This causes the volume of the liquid and the gas to increase because the liquid and the gas expand (pg. 214).

The reflection of different sound waves can be produced when sound waves hit different surfaces. The recorded reflections will provide a variety of information and images that can be used in different sectors. Ultrasound is a type of soundwave with a frequency of more than 20 000 Hz. An ultrasound cannot be heard by humans but can be heard by animals such as bats that use it for navigation (Figure 10.10). A sound reflection technology known as sonar is used in the shipping industry to detect underwater objects. This technology is also used in other sectors such as medical and fisheries (pg. 232).

APPENDIX G

Questionnaire for teachers

Dear Teachers,

My name is Lim Yi Xing and currently pursuing my Master studies in University of Malaya (UM) under the supervision of Dr Hidayah binti Mohd Fadzil. My research is on "Content Analysis of Energy and Sustainability of Life in Malaysian Form 2 Science Textbook". This questionnaire is primarily for me to have some background information on your teaching qualifications, teaching experiences, and number of years you have teach using the current KSSM Form 2 Science textbook.

I would highly appreciate if you could fill in this demographic information and allow me to interview you and your experience in using the KSSM Form 2 Science textbook.

All the names and contact information will be kept confidential.
Thank you very much.
Lim Yi Xing

NAME	
SCHOOL ADDRESS	
NUMBER OF YEARS AS TEACHER	
TEACHING QUALIFICATION	
NUMBER OF YEARS TEACHING USING THE KSSM FORM 2 SCIENCE TEXTBOOK	

APPENDIX H

Consent Form

Name of the Researcher: Lim Yi Xing

Research Title: Content Analysis of Energy and Sustainability of Life in Malaysian Form Two Science Textbook

Research Participant Name: _____

This interview will take about 30 to 40 minutes, but you have the right to stop or withdraw from it at any time.

Thank you for agreeing to be interviewed as part of the research project. As ethical procedures, it is necessary to obtain your consent to being interviewed and how the information in the interview will be used. This is to ensure you understand the aim of your involvement and that you agree the conditions of participating. Would you therefore read and sign this form to certify you approve and notified the following:

- you are voluntarily taking part in this project and aware that can stop the interview at any time
- you will be remained anonymous to protect your identity
- no individual names or schools will be revealed during this interview
- interview will be audio recorded and handwriting notes will be taken down
- transcript will be produced and will only be accessible by researcher and academic colleagues who collaborated during the research
- the transcripts and final themes will be emailed to you to seek your validations or feedbacks
- the actual recording will be kept limited to my own accessibility
- any changes of the conditions above will only occur with your further explicit approval

_____	_____
Participant's Signature	**Researcher's Signature**
_____	_____
Participant's Name	**Researcher's Name**
_____	_____
Date	**Date**

APPENDIX I

Approval from Ministry of Education

KEMENTERIAN PENDIDIKAN MALAYSIA
BAHAGIAN PERANCANGAN DAN PENYELIDIKAN DASAR PENDIDIKAN
ARAS 1-4, BLOK E8
KOMPLEKS KERAJAAN PARCEL E
PUSAT PENTADBIRAN KERAJAAN PERSEKUTUAN
62604 PUTRAJAYA

TEL : 0388846591
FAKS : 0388846579

Ruj. Kami : KPM.600-3/2/3-eras(5683)
Tarikh : 5 November 2019

LIM YI XING
NO. KP : 930403145206

NO 3O, JALAN AMPANG TENAR 28/27
SHAH ALAM 40400 SHAH ALAM
SELANGOR

Tuan,

KELULUSAN UNTUK MENJALANKAN KAJIAN DI SEKOLAH, INSTITUT PENDIDIKAN GURU, JABATAN PENDIDIKAN NEGERI DAN BAHAGIAN DI BAWAH KEMENTERIAN PENDIDIKAN MALAYSIA

Perkara di atas adalah dirujuk.

2. Sukacita dimaklumkan bahawa permohonan tuan untuk menjalankan kajian seperti di bawah telah diluluskan.

" CONTENT ANALYSIS OF MALAYSIAN FORM TWO SCIENCE TEXTBOOK "

3. Kelulusan adalah berdasarkan kepada kertas cadangan penyelidikan dan instrumen kajian yang dikemukakan oleh tuan kepada bahagian ini. Walau bagaimanapun kelulusan ini bergantung kepada kebenaran Jabatan Pendidikan Negeri dan Pengetua / Guru Besar yang berkenaan.

4. Surat kelulusan ini sah digunakan bermula dari **8 November 2019** hingga **4 Mei 2020** .

5. Tuan dikehendaki menyerahkan senaskhah laporan akhir kajian dalam bentuk *hardcopy* bersama salinan *softcopy* berformat pdf dalam CD kepada Bahagian ini.Tuan juga diingatkan supaya mendapat kebenaran terlebih dahulu daripada Bahagian ini sekiranya sebahagian atau sepenuhnya dapatan kajian tersebut hendak diterbitkan di mana-mana forum, seminar atau diumumkan kepada media massa.

Sekian untuk makluman dan tindakan tuan selanjutnya. Terima kasih.

"BERKHIDMAT UNTUK NEGARA"

Saya yang menjalankan amanah,

Ketua Sektor
Sektor Penyelidikan dan Penilaian
b.p. Pengarah
Bahagian Perancangan dan Penyelidikan Dasar Pendidikan
Kementerian Pendidikan Malaysia

salinan kepada:-

JABATAN PENDIDIKAN SELANGOR

* SURAT INI DIJANA OLEH KOMPUTER DAN TIADA TANDATANGAN DIPERLUKAN *

APPENDIX J

Nadia's Interview Transcript Sample

IT1 (Nadia Interview Transcript 1)
Time of visit : 10.15AM
Duration : 30 minutes
Date : 22/2/2020
Place : SMK XX

Interviewer: How well does the content align with National requirements?

Nadia: I think, in my opinion for me it's a bit higher for their level. I do understand that they want to increase their quality of our education that's why they increase the level of the syllabus.

Interviewer: How well is the information presented in the textbook relevant to student's life?

Nadia: Oh I think this textbook for me is very good, it's complete. The problem is some students maybe they can't digest well because like I said before the level quite high, some of them maybe they need to do extra revision to catch up with the lesson.

Interviewer: What do you think about the STEM career opportunities that are presented in the textbook? Do the teachers explain that to the students? For example, in page 199?

Nadia: Actually most of the students, my students they are very interested in this kind of careers, engineering field right. Many students interested in this kind of careers.

Interviewer: So the teachers explain about this?

Nadia: Erm, I do not explain in detail but I touch a bit about it.

Interviewer: How well is the difficulty of the content? Does it need another source of aid to understand?

Nadia: Of course, definitely. I will show the videos, slideshow but the content is sufficient enough for them just to make them to have better understanding so that's why I find extra video from the Youtube example of the activities that I want.

Interviewer: Do you need another book?

Nadia: For me as a reference of course I need other reference book so that I can compare the content. And for some revision book the content of the book maybe we can get extra information.

Interviewer: Do you remember the name of the reference book?

Nadia: Usually I will refer Sasbadi and uhmm what else.. I have more..

Interviewer: Is it Science Process Skill?

Nadia: Ahh yes I use Science Process Skill for the activities.

Interviewer: Do you aware of the questions at the beginning of every chapter for example in page 140? Do teachers use the questions to the students?

Nadia: Yes but we do not refer this straightaway, but as we go along the content, these questions will come up.

Interviewer: What do you think of the timeframe of this teaching material in the classroom?

Nadia: You mean in that period or?

Interviewer: The whole year.

Nadia: The time is very limited. Because as a teacher and students, we not only focus on the lesson, we have extra activity as well. Like last year we have a problem right, the haze, many pandemic situations so school may have to close. Then missed out the lesson already. We have to catch up. Starting from Chapter 10 to Chapter 13, I teach my students very fast. So I don't have time to do those activities. If only they can maybe reduce the syllabus a bit or give me more time for our lesson then only we can do.

Interviewer: How well is the accuracy of the content presented?

Nadia: For me is quite good. Quite good but for my level as I told you it's quite high for them. For your information, my students not many of them can score A for my subject, only few of them. Like the middle class that I teach, the third class only 1 student score A.

Interviewer: How well is the explanation of how the microfiber cloth works in page 147?

Nadia: This is a good example because it gives a real situation that they can observe in their daily life.

Interviewer: But their explanation of how it works is it ok?

Nadia: Ya ok. We also have our real microfiber cloth that students can try in the lab.

Interviewer: How well are the accessibility of the QR code and websites? Do you use the QR code or ask the students to use it?

Nadia: I've tried but I don't know where I went wrong, I couldn't get the image, I followed the steps, but maybe my steps is wrong, but if you able to teach me, I'm willing to learn. I tried to scan the image but I couldn't get it.

Interviewer: Some of the QR that I analysed are broken webpage. Did any students commented?

Nadia: I gave the link to the students but the students told me after that "teacher, we cannot enter the link" or "teacher, the link gave other information" but I forgot which link they told me.

Interviewer: What do you think about the success of instilling compassion and care towards the students?

Nadia: Can you elaborate more?

Interviewer: Like towards the environment.

Nadia: Actually the information given quite good, is just that we want the student to apply in their daily situation. Like I think if we can bring them to these areas, the real marine parks, the forest reserve then they can value the information but they haven't do that.

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Interviewer: What do you think about the success of instilling patriotism towards the students?

Nadia: That one.. I don't think so.. I don't think so.. because this one for me, more to environment, value our natural resources.

Interviewer: What do you think about the strength of the textbook in terms of content?

Nadia: For me this textbook very good compare to the previous textbook because this textbook provide more information. And actually if the student read the textbook, for me, they can get the information.

Interviewer: What do you think about the limitation of the textbook in terms of content?

Nadia: Limitation.. uhm I think in terms of PT3, if possible they can relate the questions that relate to PT3, like Higher Order Thinking questions here but when I refer to the PT3 questions, the way the questions in the exam is different right. If possible they can include that type of questions in the textbook, I think that's an improvement.

Interviewer: How about the content wise, is it sufficient?

Nadia: For me, it is sufficient. Just that the way they present the questions.

Interviewer: In terms of textbook presentation, how well is the organisation presented?

Nadia: Very good because there are tables and mindmaps to present the information. They also provide 3d image.

Interviewer: How well is the highlighting colour of text used? Do you think there is a need to highlight the words in page 183 on which part is in between?

Nadia: Yes, it could be better if they could highlight, more presentable.

Interviewer: How well is the labelling presented? Do you think there is a need to label the charges in page 145?

Nadia: Yes, they need to label the charges. For me, we as teachers, we already understand but from students' perspective, so maybe it could be labeled.

Interviewer: How well is the table of comparisons for example in page 206?

Nadia: Very good explanation.

Interviewer: What do you think about the series and parallel circuit calculations presented in page 156 and 157?

Nadia: Sufficient enough for the students to understand. Most of my students if they really follow the lesson, they can do the calculations.

Interviewer: Do you think there is a need to put it in table form?

Nadia: In terms of presentation, I think in table form is better because we put in table form they can compare.

Interviewer: What do you think about the glossary section? Do you use the section?

Nadia: Once a while we will refer to the glossary.

Interviewer: The students will use it?

Nadia: We need to remind them.

Interviewer: How well are the chapters' summaries presented?

Nadia: The summaries very simple and accurate but I think it's good if can add some information.

Interviewer: What do you say about the summary of Chapter 8 in page 200?

Nadia: I think they need to change this summary.. they need to change. Like they need to make tree map, more presentable. This one seems like too many words.

Interviewer: What do you say about the visual readability of words example in page 204?

Nadia: I need to comment this one because the background colour. Something need to be change here. Even this (page 209), the words bit blur.

Interviewer: How well is the readability of words? Is it easy to read?

Nadia: Maybe some of it as I told you the level of syllabus quite high. We as adults still able to understand. But as students, they take time to understand. For weak students they will face a problem to understand the sentence.

Interviewer: What do you think about the strength of the textbook in terms of presentation?

Nadia: Compared to previous syllabus, this textbook very good because more colours that can attract the students. The diagram very clear and colourful. And I like the tree map and so on.

Interviewer: What do you think about the limitation of the textbook in terms of presentation?

Nadia: So far for me good, it's good. A few minor weaknesses like just now the glaring part. Still can accept.

Interviewer: How well are the formative practices in the textbook?

Nadia: Actually I like their formative practices because when you answer their questions, it's like you already have the notes. For me quite good, if they able to answer means they understand that topic and indirectly they write the notes.

Interviewer: So they have to copy back the questions?

Nadia: If I ask them to do, definitely I will ask them to copy because at the end, they have to return the book right.

Interviewer: Is the time enough?

Nadia: Uhm depends on the situation. For Chapter 10 until 13 maybe not enough time. If at the beginning, Chapter 1 until 9, if they really put their effort, then they can complete.

Interviewer: But I heard the Sasbadi book has almost the same questions is it?

Nadia: Almost the same, but slightly different. But actually it's a bit redundant. But actually the workbook helps us a lot. Like for the chapters we need to rush, we can ask the students to answer the questions in the workbook. Indirectly, they already answered the questions.

Interviewer: How well are the summative practices in the textbook?

Nadia: Ok, very good because they give HOTS questions. Almost similar with PT3 questions but I think they should provide the marks at the end of the question so that the students can estimate the points they should write.

Interviewer: How well are the mastery questions in the textbook?

Nadia: To be honest, not many students able to answer this question independently. We need to guide them. Because it involves real situation right. And they should add marks at the end of the questions like I said.

Interviewer: What do you think about the rubrics of self-reflection at the end of the chapters?

Nadia: Honestly, I don't touch this part.

Interviewer: So you don't discuss this with your students as well?

Nadia: I don't discuss. As I told you, time constraint so I have to rush.

Interviewer: What do you think about the strength of the textbook in terms of assessments?

Nadia: Students ok, they like it. But for weak students of course teachers need to guide them. So far I teach DLP class, not all students are smart, some of them are quite weak, so I have to guide them. But some of them I asked them to do, they haven't do.

Interviewer: What do you think about the limitation of the textbook in terms of assessments?

Nadia: If possible can they attach the videos, like we can scan the QR code? For example, for each topic? If they have the video, easier, I can scan and show the video. Sometimes, I find the videos from Google and show to them.

Interviewer: My interview has end. Do you have any questions or anything you want to add?

Nadia: I'm looking forward if Ministry can take action especially the number of students.

Interviewer: Ok, thank you so much.