DEVELOPMENT AND USABILITY OF THE FOUNTAIN OF PHASE (FOP) MODEL FOR THE CONCEPT OF MATTER IN TEACHING AND LEARNING CHEMISTRY

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SULTAN IDRIS EDUCATION UNIVERSITY

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Thank You.

ABSTRACT

This study aims to develop a concrete model, the Fountain of Phase model, for the concept of matters and determine the usability of the FOP model. The design of this study is a development study based on the ADDIE model. A need analysis was administered to fourteen (14) chemistry teachers across PPD Muallim, Perak, to assess the need for using the concrete model as a teaching aid in science and chemistry education. Two validated instruments used in this study are the model's validity questionnaire (MVQ) and the model's usability questionnaire (MUQ). The MUQ was adapted from the questionnaire Usefulness, Satisfaction, and Ease of Use (USE) by Lund in 2001. The model was evaluated by five (5) experts from Universiti Pendidikan Sultan Idris (UPSI), including subject matter experts, lecturers in the field of chemical education, and lecturers with at least three (3) years of experience in teaching aid development. The FOP model had obtained a 0.99 Content Validity Index (CVI) value, which was considered good. The results showed a high percentage of agreement, exceeding 85%. Besides, the first user's feedback was administered to seven (7) chemistry teachers in Hulu Selangor and Hulu Perak. A high mean was found for usefulness (M=6.19; SD=0.84), ease of use (M=5.77; SD=1.32), ease of learning (M=5.82; SD=1.36) and satisfaction (M=5.94; SD=1.13). As a conclusion, this study has developed a valid and usable FOP model. The implications of this study imply that the FOP model could be used as an alternative teaching aid to teach the concept of matter.

PEMBANGUNAN DAN KEBOLEHGUNAAN MODEL *FOUNTAIN OF PHASE* (FOP) BAGI KONSEP JIRIM DALAM PENGAJARAN DAN PEMBELAJARAN KIMIA

ABSTRAK

Kajian ini bertujuan untuk membangunkan sebuah model konkrit, dinamakan sebagai *Fountain of Phase* (FOP) bagi konsep jirim dan menentukan kebolehgunaan model tersebut. Rekabentuk kajian ini adalah kajian pembangunan berdasarkan model ADDIE. Analisis keperluan telah dilaksanakan terhadap empat belas (14) guru kimia di PPD Muallim, Perak, bagi mengenalpasti keperluan menggunakan model konkrit dalam pendidikan sains dan kimia. Dua instrumen yang sah telah digunakan dalam kajian ini iaitu soal selidik kesahan model (MVQ) dan soal selidik kebolehgunaan model (MUQ). MUQ telah diadaptasikan daripada soal selidik *Usefulness, Satisfaction, and Ease of Use* (USE) dari Lund pada 2001. Model telah dinilai oleh lima (5) pakar daripada Universiti Pendidikan Sultan Idris (UPSI), termasuk pakar bidang, pensyarah dalam bidang kimia pendidikan, dan pensyarah yang mempunyai pengalaman sekurang-kurangnya tiga (3) tahun dalam pembangunan bahan bantu mengajar. Model FOP telah memperolehi nilai *Content Validity Index* (CVI) 0.99 iaitu nilai yang baik. Nilai peratus persetujuan yang diperolehi melebihi 85%. Selain itu, maklum balas pengguna pertama telah dijalankan terhadap tujuh (7) guru kimia di Hulu Selangor dan Hulu Perak. Analisis kebolehgunaan menunjukkan min yang tinggi bagi aspek kebergunaan (M=6.19; SD=0.84), mudah digunakan (M=5.77; SD=1.32), mudah dipelajari (M=5.82; SD=1.36) dan kepuasan hati (M=5.94; SD=1.13). Kesimpulannya, kajian ini telah membangunkan model FOP yang sah dan boleh digunakan. Implikasi kajian menunjukkan model FOP sesuai digunakan sebagai bahan bantu mengajar alternatif untuk mengajar konsep jirim.

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LIST OF ABBREVIATIONS

CD	Compact Disk
CVI	Content Validity Index
FOP	Fountain of Phase
KBSM	Integrated Curriculum for Secondary schools
KBSR	Integrated Curriculum for Primary schools
KSSM	Standard Based Curriculum for Secondary schools
KSSR	Standard Based Curriculum for Primary schools
MOE	Ministry of Education
MUQ	Model Usability Questionnaire
MVQ	Model Validity Questionnaire
PMR	Malaysian Lower Education Certificate
PPD	District Education Office
SPM	Malaysian Education Certificate
SPSS	Statistical Package for the Social Sciences
STPM	Malaysian Higher Education Certificate

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CHAPTER 1

INTRODUCTION

1.1 Introduction

Moving to the 21st century, most educational experts agree that teaching and learning methods must be changed according to the development of technology. Conventional learning methods like “Chalk and Talk” are simply less successful at attracting students (Hsiung, 2018). It requires a more dynamic and creative method with the relevant lesson content that suits the current educational development. The existence of 21^{st} century learning appeared when the government took the steps to change the teaching and learning methods in schools in order to produce students who are able to compete globally. It is believed that when students have 21^{st} century skills, including three main categories, they may help to contribute to a student's future career (Hadinugrahaningsih, Rahmawati & Ridwan, 2017).

Hence, lowering the student's misconceptions in understanding the concepts is one of the issues that arise to fit with the objective of Malaysian Philosophy. In chemistry, the study of misconceptions of chemical concepts has already attracted the attention of researchers for over 30 years (Guzel & Adadan, 2013). Some research has been done regarding the misconceptions of chemistry topics at the secondary level of education, such as chemical bonding (Tsaparlis, Pappa & Byer, 2018), redox reaction (Shehu, 2015), and acid bases (Talib, Aliyu, Malik & Siang, 2018).

Thus, there are several methods initiated by the chemistry teacher in developing students' conceptualizations, such as constructivist approach and analogies. Closely related to the sociocultural theory by Vygotsky (1978), the constructivist approach suggests the students be socially involved in the learning process as they create their own presentations, exchanging ideas that guide them to elucidate the scientific concepts (Yaseen & Aubusson, 2018). While analogies impart new information by generating real-life experiences to explain the unfamiliar abstract (Yaseen & Aubusson, 2018). Nevertheless, the analogies approach may lead to misconceptions in the absence of teacher support (Orgill, 2013). Hence, the model-based method is suggested as one of the powerful tools to visualise chemistry concepts (Broman, Bernholt, & Parchmann, 2018).

These model-based methods are aligned with the observational learning theory that was introduced by Albert Bandura in 1977, which states that children can learn through observing real situations or phenomena as they influence the cognitive skills in a child's learning process (Harinie, Sudiro, Rahayu & Fatchan, 2017). By repeating the demonstration, people might achieve the ultimate understanding of the topic. In other words, Bandura proposed that the teachers implement observational learning in explaining the concept and provide a model in the class. In contrast to the traditional classroom, the modelling classroom culture seems to have an impact on the students as it reported that the majority of students are able to represent the scientific ideas better after a year of implementing the model in the class (Dikerich, 2015).

This chapter includes the background of this study that gives an overview of the state of matter's topic in Malaysian school curricula. Research problem arise together with objectives, hypotheses and questions across the study. This chapter also discusses the conceptual framework, significance, limitation and operational definition in this study.

1.2 Background of the study

The concept of matter is part of the main core of chemical education. According to Guzel and Adadan (2013), in universal, one of the target roles in school curricula is basic chemistry knowledge on the structure of matter. In Malaysia, the concept of matter has been emphasised by the Malaysian Ministry of Education (MOE) since it is known as a crucial concept that must be mastered by the students (Kementerian Pelajaran Malaysia, 2012) before they proceed with another chemistry concept. It is proven when the matter's topic has been implemented in the school curricula at each level of education. The theory regarding the matter was initially introduced in primary school, then repeated in secondary school. The following level of Malaysian education includes the Malaysia Matriculation programme and Malaysian Higher Education Certificate (STPM), which also meet with the concept of matter broadly.

In primary school, students start to acquire knowledge on states of the substances or matter in their science subject started in Year 5. The list of the topics which are covered in Year 5 syllabus of primary school is shown in Table 1.1. Three basic states, which are solid, liquid, and gas, were introduced to Year 5, aged 11-year-old students. Students assimilated the characteristics of each state, including their structures, physical arrangement, and how the particles interact with each other. The teaching and learning process continued to the following subtopic, which covered the process involving the states of matter, also called the “Phase Transition Process”, which includes six processes including melting, boiling or evaporation, condensation, freezing, sublimation, and deposition. The subtopic called the “water cycle” is learned as the application of the phase transition concept.

Entering the secondary level, students aged 13 years old (Form 1) frequently learn the matter’s topic as it is implemented in the science syllabus as shown in Table 1.1. At this level, students were exposed to the arrangement and movement of particles in each state of matter. The knowledge was then applied to the following subtopic: Density and Use of Matter in Daily life.

After students accessed by Malaysian Lower Education Certifcate (PMR), those students in science stream were introduce to chemistry subject specifically. This level of education emphasizes conceptual understanding of matter. The knowledge on matter is included in one of the theme focused known as “Matter Around Us”, which is covered in Chapter 2-5 in the Form 4 Chemistry subject as highlighted in Table 1.1. The concept of matter is once more included in teaching and learning sessions. This time, the knowledge is in-depth as it covers how the phase changes relate to the kinetic theory of matter.

In addition, analysis shows that the states of matter's topic also concludes in the Malaysian Higher Education Certificate (STPM) and Matriculation Programme syllabus. Both are in Chapter 4 during Semester 1.

Table 1.1

The Topic of Matters in Malaysian Science Syllabus

Level		Subject	Name of the topic
Primary School		Science Year 4	State of Matter
Secondary School	Form 1	Science Form 1	Matter
	Form 4	Chemistry Form 4	Matter Around Us
Malaysian Higher Education Certificate (STPM)			
Matriculation Programme Semester 1		Chemistry Semester 1	States of Matter

(Source : Official Portal Ministry of Education Malaysia)

Based on the above description, it is proven that the topic of the matter is very important at every level of education and should not be taken lightly. If students encounter difficulties or have the highest misconceptions at the beginning of the matter's topic, it may affect their further learning in chemistry (Li & Arshad, 2014). Hence, it is important for students to understand the concept of matter, especially at the lower level of education, as a failure to understand will make it hard for the student to carry on with the next syllabus (Saleh & Ahmad, 2015). One survey study that was conducted by Othman, Azraai & Dani in 2015 in determining the matriculation students' view towards the level of difficulty in chemistry topics also shows that states of matter were the third most difficult topic with a mean score of 3.67 (High Mean Value) in the student's perspective. This shows that the students need to acknowledge the basic concept of matter and its process since this topic will be taught until the higher education stages. It is a need to strengthen the student's understanding starting from school so that they have prior knowledge before entering the higher educational level.

Specifically, for the state of matter topic, previous research has shown that students have encountered conceptual difficulties. Even in basic chemistry concepts, students frequently develop their own conceptions, which may vary from those of the scientific community (Guzel & Adadan, 2013). A study by Christopher and Villarreal (2015) also shows the misconception of 155 chemistry students on the concept of physical change, as they cannot relate knowledge of particle position during phase change. It is affirmed that students need to properly correlate the multiple levels of representation (macroscopic, submicroscopic, and symbolic) in order to develop a full understanding of chemistry (Rau, 2016).

The macroscopic level describes the visible things based on our senses, the submicroscopic or also known as particulate, provides information that cannot be seen through our senses, while the symbolic uses the symbol to describe the invisible particles (Koopman, 2017). Treagust and Harrison (1996) insist that the chemistry teacher must be able to engage with all three levels of representation in the teaching and learning sessions. Besides helping the students to conceptually understand chemistry, the use of the levels of representation also boosts the students' learning. However, it may be tough for students to learn with all the multiple levels of representation (Guzel & Adadan, 2013).

Understanding the physical state of each phase (solid, liquid, or gas) was easier to assimilate students' understanding macroscopically because it can observed through naked eyes (Maarten, Peter, Henny & Ton, 1998), however, it was difficult to associate with the submicroscopic level that requires students' understanding of molecule interaction that led to phase changes (Farida, Helsy, Fitriani & Ramdhani, 2017). As a result, the student has misconceptions about molecule reactions, physical and chemical changes in matter, the system of atom, molecules, and particles

(Hadenfeldt, Liu & Neumann, 2015). Therefore, learning about the states of matter does not only involve leaning session in class but also involves the used of other learning methods, including experimental methods and the use of teaching aids.

Since the topic of phase changes in the state of matter could be observed at a macroscopic level and needed a student to engage with the real phenomenon, it was also included in the science practical session. Using the experimental method gives a vision of how the process takes place, which allows students to engage with the real phenomenon. Furthermore, according to research conducted by Cobun in 1968, students were able to absorb 50% of what they heard and saw because messages received through multiple senses are better understood and retained (Kapur, 2018). Providing the learning session with the ability to allow the students to observe and gain direct experience with the phenomena should not be ignored. The Fountain of Phase (FOP) model offers the same function as the experimental method, which provides a macroscopic view of the phase transition process. Therefore, using the FOP model as a teaching aid in explaining the phase change process is essential, as it allows the student to conceptualize the process by providing a clear image of the processes that can be seen with the naked eye.

1.3 Research Problem

There were several findings that gave the major factors which contributed to this study. A problem arises regarding the problem faced by the students in learning the matter's topic. Based on the need analysis (Table 1.2), result shows the highest percentage (44%) of teachers stating that students cannot imagine the phase transition process physically. It is affirmed that students are not able to understand the matter's knowledge at the macrospic level. It is a problem because students have the potential to have difficulties understanding the concept at the submicroscopic level, as stated by Rau in 2016, which highlighted that students need to properly correlate at macroscopic and submicroscopic levels in order to develop an understanding of chemistry knowledge.

Table 1.2

Students' Issues in Understanding the Matter's Topic

Issues	Need Analysis Results (%)
Students cannot imagine the phase transition process physically	44
Less interested in topics related to the environment	12
Learning environment	16
Limited time frame for teachers to provide the explaination.	28

The lack of equipment and facilities is not a new issue. Several studies reported on how impactful the issues were on the student's learning progress. A study by Kamba, Libata, and Usman (2019) reported that teachers believed that a lack of teaching and learning facilities had an effect on the academic achievement of their students. The findings from the need analysis also found that most of the teachers (22%) use the experiment method to teach the matter's topic compared to other methods such as textbooks, modules, animation videos, and demonstrations (Table1.3). However, teachers also mention that they also need to use alternative teaching methods such as modules due to a lack of equipment and facilities for the experimental method in their schools.

This study could overcome those problems by providing teachers an alternative that is adaptable, which reduces the use of experimental methods in explaining the matter's topic. In addition, one study by Ibrahim, Surif, Hui, and Yaakub (2014) shows that students learn passively during the experiment without engaging in thinking and only following the procedures given by the teacher. In addition, need analysis also found that 100% of teachers state that they need teaching aids in the form of models to help increase the students' understanding of the matters' topic (Table 4.1).

Table 1.3

Teaching Methods for Explaining the Matters' Topic

Teaching Methods	Need Analysis Results (%)
Doing the experiment	22
Demonstration	15
Using a computer simulation/animation	11
Using the teaching aids	17
Using the module	4
Group discussion	11
Textbook	20

Inside Malaysian chemistry education, the knowledge of the matter seems to be a major topic and has been continuously implemented at each level. It is proven when questions about matters are required in all secondary school examinations; Malaysian Lower Certificate of Education (PMR) and Malaysian Certificate of Education (SPM). The need analysis also shows the necessity of questions in topic states of matter to be provided by the teachers in any examination or quiz. A number of new teaching method have arisen to help students achieve conceptual understanding regarding the matter's topic. Examples of teaching aids in the form of models available in the state of matter's topic include computer modeling (Wei, Liu, Wang & Xingqiao, 2012), interlocking toy building blocks (Geyer, 2016), students-generated animations on identifying the nature of phase changes (Yaseen & Aubusson, 2018), and gas-simulator using smartphones on the learning behavior of gas (Ibrahm & Harun, 2020). However, no concrete model tools regarding the phase transition process are currently available. Therefore, there is a need for a model development in order to fill the research gap regarding the conceptual understanding of phase change in the state of matter.

Hence, the model named Fountain of Phase (FOP), which shows the real phenomenon of all the phase transition processes starting from solid-liquid-gas, has developed. This model is the innovation that combines all the elements, including education and technology, since the development of the FOP model includes an engineering element. The FOP model allows students to see the real phenomenon through their own eyes. By having experience of how the phase could change from one state to another state, students could link the knowledge from macroscopic to submicroscopic levels of chemical representations (Treagust, Chittleborough & Mamiala, 2010). Teachers may use the FOP model as an alternative if the experiment method cannot be done due to a lack of time, equipment, or another problem. The FOP model gives students an opportunity to deeply observe how the phase change process takes place.

1.4 Research Objective

This study will embark on the following objectives:

i. To develop the concrete model named Fountain of Phase (FOP), which includes the processes of melting, boiling, freezing, condensation, sublimation, and deposition.
ii. To determine the validity of the Fountain of Phase (FOP) model by the experts.
iii. To test the usability of the Fountain of Phase (FOP) model.

1.5 Research Question

This study addresses the following research questions:

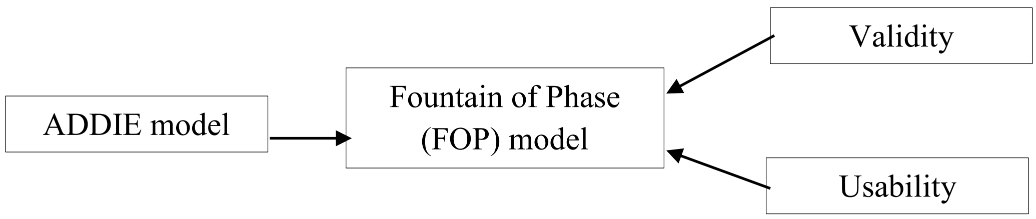
i. How is the Fountain of Phase (FOP) model developed?
ii. Is the Fountain of Phase (FOP) model has a good validation from the experts to be used in teaching and learning?
iii. Is the Fountain of Phase (FOP) model has a good usability to be used in teaching and learning?

1.6 Conceptual Framework

This section explains the conceptual framework of the study that focuses on how the Fountain of Phase (FOP) model is designed to help meet the needs in the learning process. Thus, a conceptual framework of the study has been framed based on the ADDIE-directed design model as in Figure 1.1 which consists of several stages; analysis, design, development, implementation, and evaluation.

Figure 1.1

Conceptual Framework



1.7 Significance of the study

Generally, this study has its significance for students, teachers, schools, and also the Malaysian Ministry of Education (MOE). Providing the Fountain of Phase (FOP) model in the classroom is expected to give students maximal knowledge since they will not only see the proper visualisation of the phenomenon but also trigger their attention towards the learning session. The question and answer session based on the FOP model helps students gain conceptual understanding at the submicroscopic and symbolic level.

Teachers in schools may encounter issues with their teaching methods that make it difficult to deliver their lessons in states of matter. By applying the FOP model, teachers will save more time because they do not have to demonstrate the experiments in the laboratory to make students understand. They were also able to save money by preparing other teaching aids in the form of cards and flashcards when teaching states of matter. The quality of teaching and learning sessions will be improved.

Besides, school may have the advantage of bringing together the best students who not only have theoretical knowledge but also the ability to compete globally.

Furthermore, implementing the FOP model in the learning session was one of the student-centered activities which aligned with the needs of MOE to ensure the students have 21st-century skills.

1.8 Limitation of the study

There are a few limitations identified in this study. First, there are only five (5) panels of experts involved to determine the model's validity in the aspects of usefulness, suitability, design, and user friendly. Second, for the usability testing, the study is limited to science stream teachers of both genders (male and female) only. The usability testing is done purposefully to get the initial feedback from the first users, science and chemistry teachers, who are directly involved in the teaching and learning process of the matter's topic. Since the researcher used the Usefulness, Satisfaction, and Ease of Use (USE) questionnaire by Lund (2001), which recommends a small sample size, the sample size for the usability testing is only seven (7). The small sample size might not be enough to represent the majority of chemistry teachers across PPD Hulu Selangor and PPD Hulu Perak in Malaysia. Hence, for the future study, a larger sample size is required in order to generalize the future.

Besides the nature of the usability instrument having a small sample size, this study also faced the Malaysian Movement Control Order (MCO) due to the COVID-19 pandemic (Fareez, 2021). The researcher's access to the students and teachers at the school is limited to avoid any disease infections from both parties. Due to a limited time constraint, the researcher decides to have virtual communications with the teachers during the data collection process. Online communication may not be effective in receiving feedback from the users, particularly as this study includes concrete educational tools that require users to have direct experience using the model.

Additionally, this study is also limited to the development of the prototype of the model. The process of development may take a longer time because some of the designs and materials chosen may not be suitable for use. Researchers need to make several changes, which will be explained in detail in Chapter 4, in order to ensure the model can be run effectively. As an example, researchers expect the square shape of the liquid tank with the perspex material to be convenient to use, but unfortunately, the structure melts when exposed to the heat after 20 minutes.

1.9 Operational Definition

Model

The model in this study is a concrete model that is able to show the real phenomenon of phase transition in the matter's topic. The concrete model, also known as the concrete media used to represent physical phenomena and abstract concepts in mathematics, physics, and chemistry in a physical form (Thayban, Habiddin & Utomo, 2020). Although concrete media is said to be no longer relevant to use due to the rise of virtual media that is more high technology, concrete media still has its own advantages, which is that it can help students achieve a level of understanding at a macroscopic level. The macroscopic level describes something that can be observed through natural phenomena that occur around us and also through experiments in the laboratory. For the phase transition concept, a learning session comes with the laboratory session (experiment method) or demonstration on how the process from solid-liquid-gas occurred. By using those methods, students can clearly see the phenomenon. Similar to the experiment method, the use of the model (the FOP model) as a concrete teaching aid can provide a more concrete learning experience that will be more appropriate for students. This can also help the students get the correct concept of what they are learning. The FOP model gives real-life meaning because students gain direct experience with the phase transition process.

Matters

According to Aguilar (2016), matter states consist of various types of particles with mass and size (electrons, protons, and neutrons), and occupy physical space by having volume. A combination of these particles will form atoms, molecules, and ions that will go on to build the things that we see and touch every day (Chen, 2017). This study highlighted how the matter could change from one phase to another phase. Students are able to see the real phenomena of phase change through their naked eyes, which helps them gain a conceptual understanding of the concept.

Validity

Validity concerns the extend to which the instrument used measures the variables that should be measured (Ary, Jacob, Sorensen, & Walker, 2010). The instrument validation is done by referring to the subject-matter experts in order to ensure the instrument is valid to collect the data. The content of the instrument that will be used to collect the data was validated by the experts. In this study, the Cohen's Kappa index was employed to seek the validity of the need analysis instrument. The need analysis with inter-rater agreement on relevance was distributed to the respondents, which are chemistry teachers across PPD Muallim, Perak. However, for the validity of the second and third instruments, the Model Validity Questionnaire (MVQ) with twenty-five (25) item and Model Usability Questionnaire (MUQ) with thirty (30) items, the Content Validity Index (CVI) method has been used. According to Salbiah, Jamil, Mohd and Adibah (2019), the use of the CVI method is simple and easy. There are three experts included for the instrument validity of the second instrument, the MVQ, including a lecturer from the chemistry department with experience in instrument development, assessment and education, and physicist from the physics department with experience in the engineering field from Sultan Idris Education University (UPSI). While for the third instrument, the MUQ, there are five (5) experts approached for instrument validation, including a linguist expert and lecturers in the Creative and Arts department from UPSI. According to Polit and Beck (2006), an I-CVI value above 0.80 is considered high and acceptable.

Besides, the validity terms also refer to the model's validity, which is highlighted in this study. The validity of the FOP model is determined by obtaining the CVI value and the percentage of agreement of the FOP model. There are five (5) panels of experts, including subject matter experts and lecturers in chemistry in the education field, needed to validate the model before the usability testing is done. The percentage of agreement above 76% is considered very high and acceptable, referring to the development study on concrete teaching materials by Jessica and Saronom (2021).

Usability

Usability refers to the degree to which any product or design is capable for a specific user (Bevan, Carter, Earthy, Geis , & Harker, 2016). The rise of usability questionnaires such as the Website Usability Measurement Inventory (WAMMI)

(Kirakowski & Cierlik, 1998), the Computer System Usability Questionnaire (CSUQ) (Lewis, 1995), the Post-Study System Usability Questionnaire (PSSUQ) (Lewis, 1995), and the System Usability Scale (SUS) (Brooke, 1996) has been reported with high reliability properties (Gao, Kortum & Oswald, 2018). Therefore, in this study, a usability questionnaire USE (Usefulness, Satisfaction, and Ease of Use) conceived by Lund in 2001 with thirty (30) items was used to obtain the usability measurement. The back-to-back translation is done before the instrument is submitted to the validation process by three (3) linguist experts. Then, the data collection with seven (7) samples in area PPD Hulu Selangor, Selangor and PPD Hulu Perak, Perak are proceeds. The data is analysed descriptively by obtaining the mean value of each construct, the frequency and percentage of each items. The mean value intpreted with Survey of Attitudes Towards Statistics (SATS-36) instrument which emploeys the mean value in range 5.30 – 7.00 as high (Harpe, 2015).

1.10 Conclusion

In this chapter, the researcher has stated the background of this study, which gives an overview of the matter's topic in school. The research problem is also formulated with the objectives and questions for the study. Then, the research conceptual framework, including its significance and limitations, is also discussed. This chapter ended with the operational definition.