THE DEVELOPMENT OF AN INSTRUMENT TO ASSESS PRIMARY SCHOOL MATHEMATICS TEACHERS' VALUES IN TEACHING FRACTIONS

JEYASINGAM A/L GOVINDARAJ

FACULTY OF EDUCATION
UNIVERSITY OF MALAYA
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JEYASINGAM A/L GOVINDARAJ

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ABSTRACT

The purpose of the study was to develop an instrument for assessing primary school mathematics teachers' values in teaching fractions. There are few instruments available for assessing mathematics teachers' values. This study was guided by the theory universal integrated perspective. Respondents were selected using the purposeful sampling method. Items were generated based on the analysis of literature and relevant documents. The initial instrument items were tested for content validity and refined through the focus group feedback, experts' panel consensus, and pilot study. The pilot study was conducted on 150 national primary school mathematics teachers in Kuala Lumpur. The refined scale contained 36 items organised into three sub-constructs and nine dimensions. The self-report perception questionnaire was used in the real study, conducted on 250 primary school mathematics teachers in Kuala Lumpur, using a 5- point Likert scale. Both the pilot study and real study results analysis determined the unidimensionality of the items and goodness of fit. Internal consistency, item reliability, and construct reliability of the instrument were determined by Rasch analysis, exploratory factor analysis and Confirmatory factor analysis. The one-way Analysis of Variance showed that the demographic factors except the teaching experience did not show a significant difference in the respondents' scores. This developed instrument may be used by the curriculum developers, educators, textbook writers, researchers and preservice teachers looking for appropriate outcomes through the implementation. The study provides a starting point for further research on values assessment and values development for other mathematics topics in primary schools and secondary schools.

PEMBINAAN INSTRUMEN UNTUK MENTAKSIR NILAI GURU MATEMATIK SEKOLAH RENDAH DALAM PENGAJARAN PECAHAN

ABSTRAK

Tujuan kajian ini ialah untuk membina instrumen bagi mentaksirkan nilai yang dimiliki oleh guru matematik sekolah rendah dalam topik pecahan. Terdapat hanya sedikit instrumen untuk mentaksir nilai yang dimiliki oleh guru dalam pengajaran matematik. Kajian ini berpandukan teori perspektif bersepadu sejagat Responden dipilih menggunakan kaedah persampelan bertujuan. Item telah dijanakan dengan berasaskan analisis literatur dan dokumen yang relevan. Item-item awal instrumen telah diuji untuk kesahan kandungan dan dimurnikan melalui maklum balas kumpulan fokus, panel pakar, dan kajian rintis. Kajian rintis telah dijalankan ke atas 150 orang guru matematik sekolah rendah kebangsaan di Kuala Lumpur. Skala yang dimurnikan mengandungi 36 item, disusun dalam tiga subkonstrak dan sembilan dimensi. Soal selidik pesepsi itu telah digunakan dalam kajian benar ke atas 250 orang guru matematik sekolah rendah dari Kuala Lumpur menggunakan skala Likert 5- poin. Kedua-dua kajian rintis dan kajian benar menentukan item unidimensionaliti dan ‘goodness of fit.’ Konsistensi dalaman, kebolehpercayaan item dan kebolehpercayaan konstruk instrumen ini telah ditentukan oleh pengukuran Rasch, analisis faktor dan analisis faktor ‘confirmatory’. Analisis varians sehala menunjukkan faktor demografi kecuali pengalaman guru tidak menunjukkan perbezaan signifikan ke atas markat responden. Instrumen ini boleh digunakan oleh pembangun kurikulum, pendidik, penulis buku teks, pengkaji dan guru pelatih yang inginkan keputusan berguna melalui implimentasi. Kajian ini merupakan titik permulaan untuk kajian hadapan tentang pentaksiran nilai dan perkembangan nilai untuk topik matematik lain di sekolah rendah dan menengah.

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CHAPTER 1: INTRODUCTION

Values are absolutely necessary for positive human behaviour. Education from ancient time has focused on values. Values form the core of all educational objectives and goals. Almost all the countries in this world has emphasized the role of education in fostering values. Values are deeply held beliefs about what is important or desirable. They are expressed through the ways in which people think and act (Te Riu Roa & Flockton 2009). Values ought to be in mathematics curriculum (Matthews, 2001). Issues about values in mathematics education have been increasingly discussed, and recognised as an important domain of portraying teachers' thinking and classroom practice, in education conferences (Bishop, FitzSimons, Seah & Clarkson,2001; Chin, 2002; Seah, 2005). Teaching about values affects teachers' thinking, and consequently the teaching methodology.Teachers understood values, as values are embedded within their attitudes and projected through their behaviour. The teachers in the society have a vital role to play in the social reconstruction and in the transmission of knowledge, experiences and wisdom, from one generation to another. School children are considered as the wealth of a country. They are constantly exposed to the information given by their teachers. Teachers can achieve all round development with the help of a group of teachers who acts as agents in transmitting its treasured values. The qualities of primary schools are dependent largely upon the character and quality of the teacher.

Background

Kietel (2003) said that the meaning and significance of mathematics not revealed by the teaching practice. Mathematics cause learners stress and anxiety (Ollerton, 2006). Many education systems in the world are trying ethical and moral values to be inculcated amongst children through mathematics (Australian Curriculum, Assessment and Reporting Authority, 2013b) and Singapore (Wong, Lee, Kaur, Foong, & Ng, 2009). The issue of values has been a concern of mathematics education research for many years. Attempts have been made to analyse the specifically mathematical values which characterize the practice of mathematics teachers. Mathematics is usually considered as a subject that has no values. That is the main reason why few studies about values teaching were done in mathematics education. Mathematics has various values in it that needs immediate attention. Values are taught implicitly rather than explicitly in mathematics classes when comparing to others. The study Values in Mathematics Teaching (VIMT) have demonstrated that the role of values and their importance are situated and content-specific in mathematics education (Leu & Wu, 2000). These studies show the role played by values in mathematics education and instruction; but there are not many studies focused on finding out or measuring preservice and in-service teachers' values, which influence a person's choices and behaviours (Yero, 2002). The education system and school always been considered as an institution for values formation. The influence of mathematics teachers' pedagogical values on their classroom practice and debates about values formation through schooling has been going on for many years. Values are very important in research studies and teachers' professional development since the values which teachers of mathematics bring to various aspects of their work profoundly affect what and how they teach, and therefore what and how their students learn (Bishop, Seah, & Chin 2003). Mathematics classrooms can be regarded as places where values are expressed, communicated and taught. Mathematics involves logical reasoning, observation, simulation, and experimentation to discover truth.

Values determine the content and the methods of learning for the students in a particular subject. Values influence all actions and decisions of schools, not only in classrooms but in the wider community. The wide range of positive human values encouraged in schools include patience, respect, fairness, tolerance, respect, compassion and collaboration. Students learn what values are, how to recognise them, and how people react to them, equipping them with invaluable social skills and emotional intelligence. The world's education system expects ethical values, moral values and in some countries spiritual values like in Malaysia to be inculcated in the younger generations through the various school subjects, including mathematics.

Values are a significant feature of education in any field, but it is only recently that values in mathematics education have been considered significant. It is a new research focus in mathematics education as compared to learning, teaching, evaluation, problem-solving, curriculum development and teacher education. The research in values in mathematics education gained importance since two decades ago, (Bishop, Clarke, Corrigan, & Gunstone, 2005). This provides a historical perspective on the growing relevance of values in mathematics education (Bishop, 2014). According to Clarkson, FitzSimons, Bishop and Seah (2000), values reveal indications of mathematics teachers' beliefs about their teaching in a mathematics classroom. Values established within human souls become deeper and more important and necessary (Seah, 2003). Nik Azis (2009) did an extensive analysis of values from the universal integrated perspective which is based on faith and religion. He productively and successfully produced a framework for the hierarchy of values and even suggested a model for values development in mathematics education.

The research on values in mathematics education did not receive much attention. This was due to several factors as follows: (a) a blurred understanding of affective variables such as emotion, interest, beliefs, likes, attitudes, motivation, feelings, and values; (b) the ambiguous usage of terms such as faith, beliefs, patriotic, confession and values that were wrongly thought has the same meaning; (c) the term values has many meanings; and (d) the reliability and validity of affective studies were always questionable (Nik Azis 2008, 2014).

This study was to develop an instrument to assess primary school mathematics teachers' values in teaching fractions for the Malaysian education system which is based on faith and religion as stipulated by the National Educational Philosophy. It is stated in the Malaysia Education Blueprint 2013 – 2025, that rightly give importance to values education related to the moral and spiritual development of students in Malaysian schools. This research conducted was necessary because it helps (a) develop a measurement instrument for assessing primary school mathematics teachers values involved in teaching fractions (b) established the importance of a mathematics teachers' values assessment instrument (c) to understand teachers awareness of values in mathematics education (d) to understand the changes in attitudes and beliefs that teachers have on teaching values and (e) to establish future research in this area. The education system need a change that schools in Malaysia accept the challenge of renewing the system of educating students that in time decline in usefulness based on values development. Studies on values in mathematics education constantly been carried out in Malaysian universities namely the University of Malaya, National University of Malaysia (UKM), University of Science Malaysia, University Putra Malaysia, University of Technology Malaysia and International Islamic University of Malaysia.

Developing an instrument was the main focus of the study. In addition, it involved the teaching of fractions. The topic Fraction was chosen because it is important in the Malaysian mathematics curriculum from Year One to Year Six primary school and also in the Secondary school. Fractions are one of the main mathematical concepts that students continue to struggle with both the primary and secondary schools. Students do not see fractions as numbers because they usually work with real numbers. Students have difficulty understanding the concepts of decimals or fractions as numbers between two whole numbers because they are unable to readily see them. This is where the student's prior preparation and readiness are important. These students also have trouble understanding decimal place value.

The authors revealed the significance of values in the mathematics curriculum (Bishop 2010; Nik Azis, 2009, Seah, 2012). Values, an important construct can be developed through mathematics textbooks, syllabus descriptions, test questions, mathematics examinations, mathematics teaching practices and mathematics learning practices. Values can be taught explicitly and implicitly through teaching, curriculum materials, and resources and by the modelling of teachers and other students. The present challenge for teachers is to understand what values pupils learn and what values teachers can impart in a mathematics classroom. Teachers are trying their level best to improve the quality of teaching and learning of mathematics. Teachers make values more explicit by discussing the meaning of core values as they occur in their lessons that help students to develop their understanding of these values and how they operate in a variety of contexts.

Critical Issues of Values in Mathematics Education

There were several critical issues of assessing values in mathematics education in Malaysia, where three of them are lacking instruments to assess mathematics teachers' values in mathematics education, lacking research on values in mathematics education, and lacking understanding of how to develop and impart values in a mathematics classroom (Bishop 1998; Nik Azis, 2008; Jeyasingam & Nik Azis, 2014).

The first critical issue is the lacking instrument to assess primary school teachers' values in mathematics education involved in teaching fractions. The instrument that researchers had developed earlier are limited in scope concerning affect, attitudes, motivation and beliefs (Bishop & Seah, 2002; Nik Azis, 2009). According to Nik Azis (2008), Jeyasingam & Nik Azis (2014), Nik Azis and Ruzela (2013), based on the literature review indicated there is less psychometrically based instruments which adopted holistic well-defined constructs for values in mathematics education between the years 1985 and 2012.

The previous instruments focused on affective and general issues and not on a particular topic such as fractions. There is a need for such an instrument because Bishop (2000) in his study, the case of values, had reiterated that it is time to develop more research that focuses on the nature of practice relationships in mathematics education, in areas such as assessment and teacher education. There is less assessment instrument that specifically deals with assessing teachers' values in mathematics education have been identified. There are inadequate instrument and research to assess how teachers understand and convey values in their own mathematics classrooms, to bring about effective student understanding of values and performance in their own practice. Teachers have been assessed of values in mathematics education through observations and interviews (Court, Merav & Ornan, 2009; Lin, Wang, Chin & Chang, 2006; Nik Azis, 2009).

According to DeBellis and Goldin (1997) and Goldin (2000), mathematics educators and educational psychologists have been creating instruments to assess the domain of affect for the past 40 years. Many of the early instruments were created to assess only one component of affects such as the Mathematics Attitude Scale (Aiken, 1972) and the Math Self-Scale (Opachich & Kadijevich, 1997). The Fennema-Sherman Mathematics Attitude Scales (1976) which is comprised of nine scales, four of which assess affects component became one of the most popular instruments used in research at that time. The attitude toward Mathematics Inventory, developed by Tapia and Marsh (2004) measure students' attitudes toward mathematics. Most instruments were rarely created for direct teacher use in the classroom. One of the first instruments developed was the Dutton Scale (Dutton, 1954; Dutton & Blum, 1968), which measured feelings toward arithmetic. Some researchers developed mathematics anxiety scales such as the Mathematics Anxiety Rating Scale (Richardson & Suinn, 1972), the Mathematics Anxiety Rating Scale -Revised (Plake & Parker, 1982) and the Mathematics Anxiety Questionnaire (Wigfield & Meece, 1988).

Teachers make decisions in the classroom and make judgments between two or more competing values. There are differences between the values that are officially planned and those espoused by teachers as well as between teachers' espoused beliefs and their actual classroom practices Lim & Ernest, (1997). According to Bishop, Clarkson, FitzSimons and Seah (1999), Nik Azis (2009), the instrument is needed to understand the current situation regarding values teaching in mathematics. The instrument would highlight those values the mathematics teachers think they are teaching. The instrument would reveal whether teachers have sufficient control over their values teaching to teach other values besides those which they currently teach. The teachers could gather what values are being learned by students. Data provided by such an instrument could inform the projected influence of mathematics values upon improving the teaching methodology in schools. The related instruments were reviewed on definitions of constructs and sub-constructs, designs of instruments, theoretical bases, samples, validity and reliability process (Seah & Wong, 2012).

The second critical issue is the lacking research for values development and assessment instrument development in mathematics education. Bishop, Seah and Chin (2003) verified that values in mathematics education, values education and teaching in mathematics were neglected. The researchers could not see any changes in mathematics teaching for more than 40 years because the recommendations put forward for changing teaching have not been adopted. This was greatly due to ignorance about the need to take value changes into account in any move to achieve reform. The mathematics education researchers and mathematics teachers ignored the topic for two reasons. Firstly, the beliefs about mathematics being culture-free and, therefore, value free. Secondly, the ignorance about the importance of values in mathematics education relates to the beliefs that mathematics teachers do not need to take 'human' or 'social' aspects of mathematics education into account in their teaching. Mathematics teaching in most countries of the world is still based on a technique-oriented curriculum, with skill teaching and learning being the main approach in the mathematics classroom (Bishop, 1988). The researchers (Kohlberg, 1981; Eckermann, 1994; Neuman, 1997; Veugelers & Kat, 2000; Alexander, 2002) agreed about values in education that whenever and wherever any teaching takes place, values are being taught and learned.

It was also due to the vague understanding of agreement to, and distinction among the various affective variables such as attitudes, beliefs, and values (Krathwohl, Bloom, & Masia, 1964; McLeod, 1992). Before the 1980s, research was conducted on attitudes of students. Similar researchers on attitudes were continued during the 1990s and the 2000s. Much of mathematics education research into values been devoted to exploring and identifying value qualities as they are concerned to mathematics teaching and learning and not assessing mathematics teachers' values (Dede 2006; FitzSimons, Bishop, Seah, & Clarkson, 2001; Keitel 2003). Research on values in mathematics education in the early 2000s focused on how values were portrayed in the intended curriculum and the implemented curriculum and the attained curriculum

(Chang 2001; Chin & Lin 2000; Leu & Wu 2001; Lim & Saleh 2002; Seah, Bishop, FitzSimons, Clarkson, 2001; Brown 2001). Research in the affective component of school mathematics has mainly focussed on gender, and attitudes and beliefs (Anderson, 1998; Galbraith & Haines, 1998; Gervasoni, Perry & Howard, 1999; Philippou & Christou, 1998; Wang, 1999).

It is a widespread misunderstanding that mathematics is the most value-free of all school subjects among teachers, parents, university mathematicians and employers (Bishop, 1998; Bishop, 2002; Ernest, 1991). It was found out that values are the most important factors in raising the quality of mathematics education (Seah, 2002). Students can understand the precision, beauty, aesthetics, consistency, abstractness and the progressive aspect of mathematics only if the values education dimension is given enough attention (Dede, 2007). The quality of mathematics teaching would be improved if there were more understanding about values and their influences.

In addition, less research was also due to the fact that values in mathematics education did not get attention from the researchers (Bishop, 1999; Nik Azis, 2009). To identify values as a concept or an idea about the value of anything has always been difficult (Swadener & Soedjadi, 1988). McLeod (1992) identified three concepts used in the research on affect in mathematics education: beliefs, attitudes, and emotions. The scope has broadened to include the study of beliefs and emotional reactions (McLeod, 1994). Attitude has been studied widely in mathematics education. Emotion is probably the most fundamental concept when discussing affect. Value is the concept that has probably been least used of the four, and thus relevant research is needed. The prevailing view of mathematics as a purely intellectual endeavour, where emotion has no place, is perhaps just one reason for the relatively little attention devoted to research on affect in mathematics education. There seems to be no appropriate research design and methodology to conduct reliable empirical studies of values in mathematics education. The researchers do not have a precise, shared language for describing the affective domain, within a theoretical framework that permits its systematic study.

Less research in values in mathematics education was also due to the confusion in the usage of the word ‘value'. It was assumed to be synonymous with faith and beliefs and also the different usage in the language, contributed to some uncertainties with peers and teachers to get involved in a research project (Clarkson, Bishop, FitzSimons, & Seah, 2000; Nik Azis, 2013). According to Southwell (1995), the reliability of affective studies has generally been questionable in the academic field. Values play a vital role in any culture, values in mathematics education are thus regarded not as an affective factor, but more a socio-cultural product, drawing their form and meaning from discourses, practices, and norms of participants and the interaction among themselves (Seah & Wong, 2012). Values are often talked about, especially in educational circles, but are hard to control and even harder to educate. Research should be able to help, but there is not much research on the topic happening in mathematics education.

Students do not understand in recognising values when they do mathematics or fractions. Despite their use, values in mathematics education have been misinterpreted by authors and misunderstood by students. There is an apparent need to improve understanding of values in mathematics, especially in learning fractions. Fractions tend to be one of the most difficult concepts for students to learn in primary school. It needs to be implemented in the primary grades before students can move to the complex understanding of fractions in the secondary schools.

The third critical issue is the lacking understanding how to develop values in a mathematics classroom. Furthermore, there is very little learning modules concerning values in mathematics education for teachers to follow. Some mathematics teachers are less competent in knowledge of the subject-matter. Some are ignorant of methodologies of effective contents. According to Clarkson, FitzSimons, Bishop and Seah, (2000) earlier, teachers were unable to interact with one another to discuss the importance of values in mathematics education. According to Rosnani (2001) and Suhailah (2000) teachers have inadequate knowledge and skills in the area of critical and creative thinking also strategies required for teaching them. These factors have the effect on the students' values development. Teachers' command of vocabulary and conceptual knowledge is dissatisfactory as such find difficulty to develop the values in mathematics education explicitly. Teachers have difficulty in discussing values in mathematics. Teachers chose to make explicit certain mathematics or mathematics education values or they showed them implicitly. According to Bishop (1988), teachers easily could think about and recognise the mathematics values they were teaching, instead of implementing new values. Studies also reiterated that most mathematics teachers were unaware of their own values in relation to mathematics instruction (Bishop, 1988; 2002 & Seah, 1999). According to Bishop (1988), more research is needed to develop mathematical values among teachers and to solve educational problems and develop their students. Teachers' values in mathematics classroom could strongly influence students to affect negatively or positively (Frade, Carneiro & Faria, 2008).

According to Bishop (2002), experience and assessment based analysis on mathematics values revealed that there were rarely considerations of values in mathematics teaching and learning in most mathematical discussions. Therefore, teachers find difficulty to bring changes in mathematics education in relation to Mathematics Values and Mathematics Project (VAMP). The VAMP acknowledged the fact that teacher's values in mathematics education and mathematics pedagogy are important in improving students discipline and learning (Chin & Lin, 2000). This shows that mathematics teachers need to be informed and convinced about the educational values of the subject. The teachers own conviction enables them to convince the students, parents and the society on values imparted from mathematics lesson in the classroom. The inculcation of sociological and educational mathematical values occurs through the nature of mathematics and acquired mathematics teaching experience (Bishop, Clarkson, & Seah, 2010). In addition, the realisation of mathematics teaching and learning as value-laden school subject does not mean that there are clearly identified set of mathematical values that every mathematics teacher adhered to or any other forms of ideas on how to convey values in the mathematics classroom. Mcleod (1992), Fitzsimons, Seah, Bishop and Clarkson (2000) found out that limited empirical researches were conducted on mathematical values inculcation.

There were less serious discussions on values in mathematics education at educational conferences and meetings. Mathematics teachers do not teach values during mathematics lessons but are interested in one answer operations (Clarkson, FitzSimons, Bishop, & Seah, 2000). Teachers do not understand that Mathematics contains special values which are transmitted during mathematics education subtlety (Bishop, 2004). Mathematics as a difficult subject and fraction as a difficult topic hindered effective inculcation of mathematics education values. This instrument is intended to be a tool for the study in the development of values in mathematics education in Malaysia.

The researchers suggest that teachers should understand their own values, able to express their intended values and implement them in their classroom. The researchers found that values did not seem to mean much to the mathematics teachers.

They did not find it easy to identify their own values, or to think about how, if at all, they portrayed them. One teacher complained that as he taught mathematics, he did not have to teach values. One of the barriers to progress is that teachers do not address values openly in mathematics classrooms and mathematics education. Teachers could not enculturate students properly by realising their inherent values and later make those values explicit. The implicit philosophy should become explicit so that teachers are conscious of what they teach.

Habibah Elias, Rahil Mahyuddin, and Zaidatol Akmaliah Lope Pihie (2004) suggested that the inculcation of values in mathematics and different subject areas is urgently needed to have a positive impact on character education. Internalising of values through proper methods of teaching need to be seriously considered. The teachers have to practice what they teach. The teacher education programme at university level needs to review the effectiveness of the inculcation of values in their subject areas. The student teachers needed guidance in teaching the subject and approaches in the inculcation of values. The pedagogical content knowledge should give more emphasis on the inculcation of values to develop knowledgeable, competent, and virtuous students and citizens.

The Malaysian Education System

Generating an Illustrious Generation is the vision of the Malaysian Ministry of Education. The education purpose in Malaysia is to develop individual potential through quality education by preparing committed citizens and a generation that has the ability to think. Ministry of Education continuously reviews the curriculum to ensure that the implementation of the curriculum in schools equips pupils with knowledge, skills and values to face current and future challenges. The rationale is that Mathematics is the best platform to develop individual intellectual proficiency in making logical reasoning, space visualisation, abstract thinking skills and analysing. Pupils develop numeracy skills, reasoning, and thinking and problem-solving ways of thinking through learning and application of mathematics. Mathematics provides opportunities for students to perform creative tasks and experience the fun and excitement of learning something new. Such experiences increase interest and are the driving forces for students to learn mathematics outside the classroom and at the higher level of education. The Aim of the Primary School Standard Curriculum for Mathematics is to develop pupils' understanding of the concept of numbers, basic calculation skills, understanding simple mathematical ideas and are competent in applying mathematical knowledge and skills effectively and responsibly in everyday life.

Based on the focus of National Curriculum Framework, Mathematical teaching and learning process gives priority to mastering knowledge and understanding to enable pupils to apply concepts, principles and the mathematical processes they have learned. Emphasis on the development of mathematical thinking is built and developed through the teaching and learning in the classroom based on the following principles, which are, problem-solving, communication, reasoning, making connections, making representations and the application of technology in mathematics. The Standard curriculum is based on six pillars, namely Communication; Spiritual, Attitudes and Values; Humanity; Physical Development and Aesthetic; Personal Experience; and Science and Technology. The six pillars are the main domain that supports each other and are integrated with critical thinking, creative and innovative thinking. This integration aims to develop balanced, knowledgeable and competent human capital.

The aim of the nurturing of values and attitudes in Mathematics curriculum is to produce competent individuals with virtuous moral standards. In addition, the appreciation of attitudes and values can shape a well-mannered and noble younger generation. Understanding and awareness of the attitudes and values in the Malaysian society should be directly or indirectly fostered in line with universal values. Values and attitudes are instilled through learning experiences provided by teachers. It involves an element of trust, interest, appreciation, confidence, efficiency and endurance. Instilling of values and attitudes also include personal aspects, interaction, procedural and intrinsic.

In mathematics, attitudes and values need to be moulded through appropriate context. Attitudes in mathematics refer to the affective aspects of mathematical learning that covers: (a) positive response towards mathematics and the usefulness of mathematics (b) Interest and joy in learning mathematics, (c) Appreciation of the beauty and mathematical ability, (d) Confidence in using and applying mathematics. Steadfast and perseverance in solving problems related to mathematics. Personal values refer to the values that are related to the formation of individual traits and personality such as honesty, systematic, perseverance, hardworking and steadfast, creative, confidence, conscientious, good time managers, independent, trustworthy, efficient, responsible, patience and dedication. Interaction values are related to the installation of good behaviour in the classroom context. The value refers to the emphasised values in the interaction during mathematical activities such as appreciation for mathematics, teamwork, discussion and sharing of ideas, tolerance, fair, open-minded, and respectful. Procedural values associated with specific activities in mathematics such as reasoning, making representations, solving problems, communication, making the connection, and using technology. Intrinsic values associated with the formation of mathematical content and its discipline such as the epistemology, cultural and historical value. In several parts of the Malaysia Education

Blueprint 2013 – 2035, one can find several statements that rightly give importance to values education related to the spiritual and moral development of students in Malaysian schools. Every student will have ethics and spirituality (Adapted from Curriculum Development Centre, Ministry of Education, 2011).

Problem Statement

There is lacking instrument to assess primary school mathematics teachers' values in teaching fractions specifically and values in mathematics education as a whole. Based on the review and analysis of literature in Malaysia and around the world, the researcher identified a research gap that no instruments are available to assess teachers’ values in mathematics education involved in teaching fractions. There are a few assessment instruments that specifically deals with assessing values such as assessing mathematics educational values of college students towards function concept (Dede, 2006). More than forty years of research in mathematics education still leaves a gap to develop an instrument to assess values in mathematics education.

There is a need for an instrument to assess and understand better how effective teachers master the skill of values in a mathematics classroom, to bring about effective student understanding of and performance in their practice. This is due to the fact that teachers are unaware that they are disseminating values in a mathematics classroom. Teachers are ignorant that they are imparting values to pupils implicitly in a mathematics classroom. Teachers do not know whether students learn values in a mathematics classroom (Chin & Lin, 2001). A psychometrically sound measure should be developed for teachers for a more comprehensive understanding of the influence of the values on students’ behaviour. Unless values are measured accurately, it is impossible to know to what extent and in what ways teacher influences such behaviour. This instrument would enable accurate screening of teachers’ values.

Appropriate action can then be planned, namely connecting parents or guardians of students to programs within the school that enhance the family relationship. (FitzSimons, 1994). Wee Tiong Seah (2001) discusses how we might go about doing the needed research on values in mathematics education. Wee stresses that researchers need to measure these values, and how we can apply the knowledge derived from these studies to improve mathematics teaching and learning.

Values should be measured accurately to understand to what extent and in what ways teacher influences pupils' behaviour. The teachers would be fully aware the importance of values and belief that values in mathematics classroom should not be neglected in the future. Thus, the awareness or clarification of values that teachers posit can bring them more concentrated on the classroom teaching and learning activities that values are loaded (Chang, 2005).

The integration of values through teaching fractions in a mathematics classroom is a challenge to mathematics teachers. Mathematics teachers often find it difficult to discuss and examine the relevant values. The instrument will make explicit the teaching of values that will contribute positively to the mathematics education of the pupils. The instrument should function as a true scale to measure teachers' perception towards values in mathematics education. The instrument will assess teachers' knowledge of values, values dissemination in the classroom and teaching methodology (Bishop et al., 1996).

Instruments in the past were less capable of assessing teachers' values in mathematics education. Most of the earlier instruments were on other affective factors such as beliefs and attitude. There is no instrument and research to understand how teachers impart values in mathematics education in their own classroom, to bring about effective student understanding of values and performance in their own practice.

Despite the use of questionnaires in other areas of study such as the Portrait Values Questionnaire, educational research has been assessing values through methods such as observations and interviews (Court, Merav & Ornan, 2009).

A few assessment instruments that specifically deals with assessing values have been identified. According to Bishop (1991), values are embedded in four levels namely societal level, institutional level, pedagogical or teaching level, and individual level. Luttrell (2000) developed a self-report inventory called Mathematics Value Inventory (MVI) measures students' interest, utility, attainment, and personal cost. Dede's (2006) instrument assessed college students function concept on mathematics educational values. Durmu and Biçak (2006) instrument revealed the prospective mathematics teachers' values. Dede's (2011) instrument assessed Turkish and German mathematics teachers' mathematics education values. According to Chin (2006), Turkish Mathematics Education Values Questionnaire reveals students' attainment of mathematical knowledge and mathematical values during mathematics lesson.

There is inadequate information also on values assessment instrument development. Teachers find easier to implement existing values and not new ones. Values are the crucial components of mathematics education but it did not get much attention (Clarkson et al., 2000; Seah & Bishop, 2000). The past researchers identified the idea, pattern, and characteristics that could be expected and not test or approve hypothesis for the studies (Bishop, 2001; Nik Azis, 2009).

There are instruments that measure affective domain, however, there is no instrument that assesses solely on primary school teachers' values in mathematics education. Many researchers have the notion that mathematics has no values and does not contain social preferences (Wong, 2005). Bishop (2004) had proven that mathematics has own values and these values have been taught in a mathematics classroom implicitly. As such, the researcher requires an appropriate instrument that is quickly available and applicable to precisely measure teachers' values in a mathematics classroom. Values are developed actively by a thinking individual in a social context (Nik Azis, 2009). Bishop (1999), in his study, had reiterated that it is time to develop more research on values assessment and teachers values education.

Fractions were chosen for this study because very few types of research were carried out on a particular topic to assess values in mathematics education as stated by (Dede, 2005; Nik Azis, 2009). Fraction is an important mathematical topic with applications in other fields of mathematics (Booth & Newton, 2012; Brown & Quinn, 2007; Chinnappan, 2005). Students find difficulty in learning fractions and teachers find difficulty in teaching fractions (Nunes & Bryant, 2009; Wu, 2005). Teachers are responding to meet the challenges of these development efforts. The researchers are ready to support teachers so that all students can succeed in mathematics and learn the values in mathematics education.

There is an alarming gap in the literature regarding what is considered the most effective method to appropriately assess values in mathematics education. Classroom teachers may also be unprepared to assess values of students in a mathematics classroom. The absence of reliable and valid measures of teacher development provides support for the development and validation of the MTV Scale.

The researcher viewed that a faith-based theory should be appropriate. The researcher chose universal integrated perspective to guide the study, to create the conceptual framework and to develop the instrument.

Theoretical Framework

Universal integrated perspective was used to guide the study. The theory was chosen because universal integrated perspective is a faith based theory. Universal integrated perspective, an approach that existed since human existence. It encompasses ideas on philosophy, psychology, and sociology. The theory upholds the first Rukunegara principle "Belief in God" whereby it does not discriminate other religion and race. Universal integrated perspective has high hopes for intellectual development, values development, moral development, civilisation development based on a religious environment vision.

Universal integrated perspective is based on theocentric approach, free from secularism and subjectivism ideology and not anthropocentric or existentialism. The theocentric approach is called universal integrated perspective (Syed Muhammad Naquib, 1995). The theory defined values concepts as an individual or a group of individual beliefs on the desired subject which is different from preferences, a belief that drives towards an appreciated subject, balancing between the good and the bad behaviour and events, selection or evaluation on certain targets, ways to react and to lead a life.

According to universal integrated perspective, God created the environment and all the matters and phenomenon in it including humans and mathematics. The theory is based on ontology, epistemology, and axiology and logical. That knowledge is full of values and relative since the knowledge was obtained from social-cultural contexts and not represented by the true reality of the universal phenomenon. It denies that all values are relative depending on situation and personality (pragmatism). All the knowledge comes from God, obtained by human beings through the development process using the five senses, reports from the respected authority, intellectual thoughts, and intuition.

Universal integrated perspective assumes that values, beliefs, attitudes, emotions and conceptions as an entity that has overlapping characteristics. It also assumes that beliefs involve more cognitive elements than affective elements and that remains in the cognitive domain. Values involve more affective domain than the cognitive domain. Values refer to a concept or belief that satisfies certain criteria. Although values, beliefs, conceptions, emotions, and behaviour interrelated with one another, the values system, beliefs system, and knowledge system are entirely different. Values are one of the elements in the affective domain. To determine a subject matter has value, it should be endorsed as true by an individual (Nik Azis, 2009).

According to universal integrated perspective, the value is a multidimensional concept that involves spiritual, cognitive, and affective and behavioral dimensions. Values exist in the human soul, formed through common sense, obtain the meanings from the heart, and manifestation did through behaviour. The sources of value comprise of the five senses (empirical experience), rational thinking (healthy mind), true news (authoritative) and intuition (spiritual experience). Values can be in the form good or positive and bad or negative elements. Values could function as criteria in selecting certain actions, making considerations, determining priorities and choices. Values development is influenced by self-maturity, physical experience, balance and social interaction. The basic value is the belief in God. Other values that are compatible with basic values are known as noble values.

According to universal integrated perspective, values in education, assumed as an activity based on an educational institution could be disseminated implicitly or explicitly to help students to understand values and develop skills and interests so that the pupils will appreciate specific values as a good and productive individual, pupil, family member, member of society, citizen and world inhabitant. Values in education also could train a pupil to give proper justification for their actions, moral judgments, overcome immoral attractions and cultures. Mathematics is an instrument to develop such values and ethics. Mathematics education, according to universal integrated perspective, cannot be separated from the humanitarian dimension.

According to universal integrated perspective, an individual form and develop life values based on own experiences in social contexts and not passively from the environment (Nik Azis, 2008). The theory states that knowledge could not be transferred from a teacher to a pupil perfectly. The pupil has to build his or her knowledge through active participation, reflection, and abstraction (Nik Azis, 2008). The theory refers to the conception that has been strengthened through repetition, standardised through interaction, and related with specific words. The truth is vital in the discussions and meticulous concerning beliefs and values.

The universal integrated perspective improved the conceptual framework for the study. It helped to organise the sub-constructs, value indicators and the formation of the items. The theory also influences the decisions made by the focus group and the expert's panel.

The National Philosophy of Education stresses that the education in this country is an ongoing process that is based on faith in God (Nik Azis, 2009). This theory also helps to measure data that are relevant to answer the research questions. The study will be based upon several assumptions. Assumptions are those things researchers take for granted in the study: statements by the researcher through observations and experiences that certain elements of the research are understood to be true without proofs (Nik Azis, 2014). This study was based on the following assumptions:

1. The reality of primary school mathematics teachers was assumed to be part of values in mathematics education constructed intersubjective through the meanings and understandings developed socially and experientially.
2. Knowledge of values in mathematics education holds that all knowledge is affected by the values of the person who produces or receives it.
3. The origin of knowledge on values in mathematics education comes from the perspective of inculcation, see values as socially or culturally accepted standards or rules of behaviour.
4. Every item in the questionnaire furnishes to the assessment of the unidimensional construct on values in mathematics education irrespective of agreeable or disagreeable items.
5. Primary school mathematics teachers have learned fractions in primary schools and secondary schools and taught fractions in primary schools without knowing its values.
6. The respondents provided information independently as directed by the researcher.
7. The respondents truthfully and honestly responded to the questionnaire.

In mathematics education, values involves how an individual or those who involved in mathematics education thinks or do not think, feel or do not feel, accept or do not accept, do or do not do a particular thing in education where what they have done are influenced by various factors such as beliefs, knowledge, feelings, conception, perception, choices outcomes, emotions, attitudes, and their motivation. All the meanings of basic concepts in values definition are faith based (Nik Azis, 1999a). The universal integrated perspective puts forward principles such as actualisation and value development where only God’s guidance can be made as a base for value development and ethics. At the same time, intellectual abilities and soul development are emphasised (Nik Azis, 2009a). Integration of aspects such as affective, cognitive, and psychomotor and the soul are based on religious teachings and this creates divine values which will develop and gain stability in the education system. Hence, universal integrated perspective is relevant to be used in the study.

Objectives of the Study

The purpose of the study was to develop an instrument to assess primary school mathematics teachers’ values in mathematics education in teaching fractions. Data was collected from focus group feedback, experts’ feedback, peer group feedback, pilot study outcomes and experts’ final comments and suggestions on items evaluation. Data analyses were carried out using factor analysis, Rasch measurement model, confirmatory factor analysis and ANOVA. The objectives are:

1. To find out the dimensions of the mathematics teachers’ values in teaching Fractions?
2. To find out the psychometric properties of the mathematics teachers’ values Scale?
3. To find out the relations between mathematics teachers’ values in teaching Fractions and age, gender, race, educational level and teaching experience?

The following research questions guided the study. The study specifically answered the following questions.

Research Questions

1. What are the dimensions of the mathematics teachers' values scale (MTVS) in teaching Fractions?
2. What are the psychometric properties of the mathematics teachers' values scale in teaching Fractions?
3. Do the mathematics teachers' values in teaching Fractions differ by age, gender, race, the level of education and teaching experience?

Rationale of the Study

The problem addressed in this study was that no instrument has been developed that assess only primary school mathematics teachers' values in mathematics education in teaching fractions. Teachers would be aware of values embedded in mathematics education in teaching fractions. Primary school children would benefit from obtaining valid and reliable information from the teachers who had responded to the questionnaire. The principles of values education could be taught through existing subjects and topics. This study suggested that one of the many ways in which values education can be incorporated into existing mathematics curriculum and approaches to teaching mathematics.

Significance of the Study

The research results would be of great interest to scholars in the field of mathematics education such as university education lecturers, teacher education lecturers, school mathematics curriculum developers, mathematics education researchers, primary school mathematics teachers and school mathematics textbook writers. For university and teacher institute lecturers, the research results would help to raise the awareness and widened the scope of values in mathematics education. The lecturers could apply its utility as a measure in the field of teacher education programmes and professional development. It will be informative for lecturers to understand what preservice teachers believe when they enter their programme and how preservice teachers' values change as they progress through the programme, complete the program, and enter the teaching force. It will also be informative for lecturers to understand how preservice teachers' values affect their teaching practice or vice versa, and systematically investigate whether, and in what specific ways, their programme can make an impact on preservice teachers' values and teaching practices. If there are any inconsistencies between teachers' values and their instructional practice, sources of inconsistency should be identified by lecturers to better understand the relationship between values and practice to support teachers' learning to teach. Such an instrument will be a contribution to the field of teacher education and teacher professional development because it will provide a way to establish baseline data on values and thus provide a gateway to changing them. The lecturers would try the new instrument on their trainee teachers to gather feedback to improve the instrument. If necessary the mathematical values or the content could be revised. In other words, the Ministry of Education through the assessment instrument could produce teachers who will be well versed in disseminating values explicitly and implicitly in a mathematics classroom.

The research results would revise the curriculum that will enhance values teaching by preservice teachers and the present teachers.The school mathematics curriculum developers would usually include values in policy documents, determining values in textbooks content, and to the method of teaching and learning in classrooms. The curriculum developers would think what and how values should be learned by students. The curriculum developers would be able to find ways of values assessment and to improve on the previous curriculum. Values-based school reform would renew the curriculum and development of pedagogy. It will give opportunities for values to be explored thus providing a meaningful and valued teaching culture.

The mathematics education researchers may be eager to know the outcome of this study to understand how teachers perceived and have responded to educational change. The researchers would gather information about the process in classrooms, and in the teacher professional development. This information will be a stronghold for future development. This study is expected to contribute to the literature that will examine the mathematical values present in fractions. To date, there has been no published report on assessing teachers' values in mathematics education involved in teaching fractions. This finding enhances the theory and laid a path for new researchers and mathematics education reforms. The study thereby makes a direct contribution to values research in mathematics education.

Primary school teachers encourage students' mathematical thinking through findings from research on values in mathematics education. This knowledge help teacher to deliver a better mathematics education than before for their students. The results could bring about introducing professional development programs for teachers. The development and use of a new instrument have the potential to illustrate how the Ministry of Education could assess teachers' mathematics values involved in teaching fractions. Teachers could use this instrument to assess the effectiveness of specific teaching materials and methods for teaching fractions in primary schools. With a validated instrument, teachers can proceed to investigate in detail the relationship between teachers' engagement and learning outcome in a mathematics classroom through imparting values in mathematics education. The quality of mathematics teaching would be improved due to the understanding about values and their influences. The teachers intended values and their portrayal of values in the classroom could be highlighted during a lesson. The instrument from the study would offer teachers the correct strategies for developing values in mathematics education in teaching fractions in particular and mathematics education as a whole.

As for the school mathematics textbook writers, they would make sure the textbook contents portray values in mathematics education. Mathematics textbook is main teaching tools. Mathematics textbooks are perceived as the mathematics curriculum. They have conveyed the values. In the future textbook, writers would be more careful in writing the contents and forming different types of questions based on the available mathematical values. The Ministry of Education could use values-based approaches to strengthen teaching and learning values implicitly and explicitly. This will reject the belief that mathematics as a values-free subject.

This study contains several basic terms. The terms are values, General Education Values, Mathematics Education Values, Mathematics Values, assessment, fractions, and teaching was defined to provide a clear understanding of their usage in the study.

Definition of Terms

Values. The term values refers to conceptions or beliefs which are important to individuals and serve as guiding principles in their lives based on religious teachings and spiritual elements, a cognitive and affective quality which education aims to foster through general education values, mathematics education values and mathematics values in a mathematics classroom (Nik Azis, 2011).

General education Values. Values associated with the norms of the particular culture, of the particular society, and of the particular educational institution. They contain ethical values such as; good behaviour, integrity, obedience, kindness and modesty philanthropy and responsibility. (Bishop et al., 1999; Fitzsimons et al., 2000).

In this study, it comprises of basic values, core values, main values and expanded values.

Mathematics Education Values. Values embedded in the curriculum, textbooks, classroom practices, etc. as a result of the other sets of values. Some of the values related to mathematics education are listed as follows: Formalism, activism, instrumental learning, relational learning, relevant, theoretical, accessibility, specialism, evaluating, reasoning and pleasure (Chin & Lin, 2001; Clarkson et al., 2000; Horzum & Kiymaz, 2011; Seah & Bishop, 2000). In this study, it comprises of teaching values and learning values.

Mathematics Values. Values which have developed as the subject has developed within the particular culture. Mathematical values are the values that reflect the nature of mathematical knowledge. They are produced by mathematicians who have grown up in different cultures (Bishop et al., 1999). They are values like openness, mystery, rationalism, objectivism, progress and control which mathematics carries in its nature. In this study, it comprises of ideological values, sentimental values and sociological values.

Assessment. Assessment is the systematic process of defining, selecting, designing, collecting, analysing, interpreting quantitative and qualitative empirical data from teachers' responses regarding perceptions on values in mathematics education. The gathered information was discussed based on certain principles, rules, criteria and standards for the purpose of improving values development and mathematics teaching. It is accomplished by direct observation and analysis of feedback obtained through focus group interviews, experts' panel, pilot study and real study using a survey questionnaire (Allen, 2004; Nik Azis, 2015).

Fractions. A fraction is a number which explains the relationship between two quantities that provide information about the parts, the units under consideration and the whole that can represent a measure of a quantity relative to one unit of that quantity. Fraction referred to as measure, is based on the Fraction's distance from zero and allows for the numerical value of the fraction to be located relative to the unit of 1. Fractions act as division relationships (quotients); fractions as performing an operation on a set, shape or quantity; fractions as measures; and fractions as ratios (part-to-part relationships). Many of these constructs develop the understanding that a fraction can also represent a single number (rational number) and has a value. It is often summarised as part–whole, measure, the quotient (division), operator, and ratio (Kieren, 1980).

Teaching. Teaching is a moral activity in which teachers have to consider the ethical complexity of teaching and the moral impact they have on their students (Carr, 2011; Lovat, Dally & Toomey, 2011; Sanger & Osguthorpe, 2005; Shapira-Lishchinsky, 2009, 2011). Teaching is a process of engaging students in activities that will enable them to acquire the fractions knowledge, skills as well as worthwhile values and attitudes. It is concerned with the activities which are concerned with the guidance or direction of the learning of others towards values in mathematics education. It is an arrangement and manipulation of a situation in which an individual will seek to overcome and from which he will learn mathematics values in the course of doing fractions (Skinner, 1968).

Primary school. In Malaysia, primary education takes six years. Children go to school at the age of seven. Primary education is a continuation of pre-school education. In addition to reading, writing and arithmetic, children will be exposed to other subjects such as science, physical education, Islamic and moral education. At the end of their studies in year 6, they will sit for the Primary School Achievement Test (UPSR). It will test (a) Mastery of comprehension, writing and oral for Malay and English (b) Mastery of mathematical skills and (c) Mastery of science concepts.There are three types of government-aided primary schools in Malaysia. Firstly, the National primary school where the medium of instruction is National language or Bahasa Malaysia. Secondly, the Chinese national-type schools where the medium of instruction is the Chinese Language. Thirdly, the Tamil national-type schools where the medium of instruction is the Tamil language. Children in Year 1, Year 2 and Year 3 is called level One and Year 4, Year 5 and Year 6 is called level Two (Ministry of Education).

Limitations of the Study

There are several limitations and delimitations in this study. Three of them are related to research design, data collection techniques, and sampling method whereas three of the delimitations are related to critical issues, research topic, and research respondents. Limitations are elements such as shortcomings, conditions or influences over which the researcher has no control by the researcher that place restrictions on the study's methodology and conclusions. Delimitations are specific choices made by the researcher. Delimitations refer to relevant characteristics that researchers would not interfere but under their control. These characteristics come from limitations in the scope of the study. The researcher explained the things that the researcher not doing and why chose not to do them, about the literature not reviewed and why chose not to, about the population involved in the study and why and the methodological procedures used and why.

The first limitation is related to research design. This study used instrument design and item development approach. Both qualitative and quantitative data were collected. A purposeful sampling technique was carried out. This technique is unsuitable for making generalisations that limit the ability to make statistical inferences from the sample to the population being studied. This approach is too systematic and too time-consuming to implement. Analysing is lengthy, time-consuming and it tends to be inefficient because it is not iterative.

The second limitation is related to data collection. A significant limitation concerning the validity and reliability of the data collected during fieldwork is the poor quality of descriptive statistics available to answer the research question. If the data collection is too narrow, the researcher could only collect one field of data, could miss something. When there are no alternatives, the researcher might use such statistics in choosing fieldwork sites and respondents from each site with the goal of making the information collected meaningful to different situations.

The third limitation involves to sampling technique. This study chose purposeful sampling. Purposive sampling procedure decreases the generalizability of findings. The study will not generalizable to all areas of teachers. Purposeful sampling is the most widely used sampling method especially in the context of qualitative research. The researcher select subjects who have experience or knowledge of the issue being addressed in the research. The sample size is more of the function of available resources, time constraints, and objectives of a researcher's study. Sampling is a process of selecting subjects to take part in a research investigation on the ground that they provide information considered relevant to the research problem. In most cases, it is not possible to collect information from all members of the target population of a research inquiry. It is not essential to collect information from everyone. Only a subset of the population known and referred to as sample is selected for a given research. The results generated using a sample and the ones arrived at using the population would necessarily be different, deviation of the results from the population relative to sample is referred to as sampling error.

To overcome the first limitation, the researcher should concentrate on the designing process such that developing and experimenting with the content actually saves time and shapes the final design. Developing may affect the outcome and that the researcher finalises all of the requirements before developing the content. Implementation will be carried out if necessary. The evaluation process can significantly increase the time to create a suitable design, which can be difficult especially if time is limited. To minimise the impact of the second limitation, the researcher should avoid relying too heavily on inaccurate data and the information triangulated with as many other sources as possible such as the existing research by academics. The study should have a clear research question before beginning collecting data. To minimise the third limitation, adequate sampling is necessary to minimise the sampling error as much as possible. Sample size must be large enough to ensure that the widest possible coverage of research respondents' perceptions is accounted for. Increasing the sample and assembling it from a wider pool would come up with credible findings. In the real study, two hundred and fifty respondents took part compared to one hundred respondents in the pilot study. Different techniques of data collection were implemented to tackle the problem stemming from sample selection bias.

The first delimitation in this study is related to the critical issue, the lack of the instrument to assess values in mathematics education. This study focuses only on developing an instrument assessing primary school mathematics teachers' values involved in teaching fractions. The developmental study was chosen because it defines the nature of the instrument development, survey methodology, and type of assessment that will be used to gather data and is designed to gather that particular type of data. The questionnaire was administered using a Likert scale. Others such as experimental research design not suitable for this study.

The second delimitation is related to the research topic. It focused on the development of an instrument to assess primary school mathematics teachers' values involved in teaching fractions. Fractions were chosen and no other topic. This study was focused on an academic discipline Mathematics that is based on quantitative aspects. The latent variable values were chosen and not attitudes or beliefs. It is not easy to generalise the results of the study to other areas involving more qualitative topics. The choice of variables depends on researcher's knowledge of his area of study, information gained from relevant literature, and clues from the ongoing study.

The third delimitation is related to the study that focused on one community. The respondents were primary school mathematics teachers, both male and female and ranged in ages from 23 to 60 years old and multi-racial that depicts our country Malaysia, provided a particular scope for the study. Mathematics teachers from the private school and the government secondary school were not included in the study.

The first delimitation was to overcome by the choice of the research design. The developmental study is the only design used to develop an instrument. Data was collected efficiently and effectively. All the data acquired were used in the study. The second delimitation was overcome by the choice of the topic. This study adheres to the contents of the area under study. The third delimitation was overcome by the choice of the respondents. The researcher adheres to the ethical considerations of respondents.

Summary

This chapter outlined the research background and identified three critical issues related to the study. One critical issue was chosen and described together with the justification explanation of the selected issue. Furthermore, the explanation was given concerning problem statement, theoretical framework, the purpose of the study and research questions. Finally, definitions of terms were given, limitations and delimitations of the study explained, and significance of the study was discussed. Chapter Two presents the review of the literature of this study, provides previous and current literature related to values in mathematics education, theory discussion, discussion of the psychological term, mathematical term, and another term. Chapter Three, describes the research design, population and sample, data collection instrumentation, pilot study, and analysis procedures and summary. Chapter four, presents the focus of Chapter Four, data analysis, research results, and a discussion of the findings of the study. Chapter Five presents discussions, conclusions, and implications. This chapter consists research summary, research results summary, discussion, summary, theoretical implications, implications to practical education, implications to further studies and a conclusion.

CHAPTER 2: REVIEW OF LITERATURE

Introduction

Chapter Two provides a detailed review of the research and literature that was utilised throughout the completion of this study. This chapter consists of eight main parts. The first part focuses on the theory that is used as a base for this study. The faith-based theory used is Universal integrated perspective. It also discusses the conceptual framework that is the construct, sub-constructs, dimensions and values indicators with a diagram. The second part focuses on values where definitions of values and concept of values by various authors were discussed. The third part focuses on the learning and teaching of fractions and the problems faced in the mathematics classroom. The fourth part discusses values development on human values, about the related studies internationally and locally and the values project at the University of Malaya. The fifth part discusses research on affective domain namely beliefs, attitudes, emotions and values. The sixth part discusses values in mathematics education. The seventh part discusses research and measuring values in mathematics education where the previous assessments were verified. The eighth part discusses on instrument development briefly, as it was explained in Chapter Three. The chapter ends with a summary.

Universal Integrated Perspective

A theory explains how some aspect of human behaviour or performance is organised. It thus enables researchers to make predictions about that behaviour. Theory guides research. This study was based on the theory universal integrated perspective. The approach existed since humankind. The universal integrated perspective, a theory which discusses ideas on psychology by forming an ideology that does not separate human beings lives and religious teachings (Nik Azis, 2009a). It is opposite of secularism and rationalism. According to this theory, all activities that are carried out by human beings can exist in the best possible way on earth. The perspective involves reality from the physical domain without avoiding the metaphysics domain based on a few concepts which form a base; that is the understanding of the soul or ontology, knowledge or epistemology, values or axiology, and reasoning or logic (Nik Azis, 2009a).

Within the domain of philosophy, two of the most significant branches are devoted to ontology and epistemology. The term ontology, which comes from the Greek, is fundamentally the study of what exists or what is. From the ontological point of view, the universal integrated perspective explains that human beings are created by God and are formed from the combination of two elements, body and soul (Syed Muhammad Naquib, 1995). The body is made of elements on earth, can be seen, is real and is temporary. The soul is created by God, cannot be seen, and is abstract and everlasting. The body functions to carry out duties to achieve divinity that is required by the soul to live on earth as a slave and leader. The soul functions in the mind and within (Nik Azis, 2009a).

Epistemology is the branch of philosophy that deals with the nature, source, and limits of knowledge. From the epistemological point of view, this perspective claims that all knowledge possessed by human beings comes from God. This knowledge is given to human beings either directly in the form of intuition or words from God or from knowledge built by individuals through empirical experience that involves active participation, reflection, and abstraction (Nik Azis, 2009a). Therefore, human beings must try to acquire knowledge. This perspective emphasises on criteria such as development, meaning, God-centred, actualisation, holistic, and unity (Nik Azis, 2009a).

According to the universal integrated perspective, through the process of actualisation and unity of knowledge, human beings can understand knowledge better. The understanding of knowledge can help human beings identify the correct method to put something in its right place. The action of putting something in its right place portrays fairness in action and thoughts. The fairness creates happiness to human beings (Nik Azis, 1996a). From the values point of view, universal integrated perspective explains that only God knows the value of something. The absolute value is determined by God whereas values that are determined according to an individual's thinking are relative (Nik Azis, 2008). Values reveal an individual's cognitive, affective, behaviour and beliefs aspects of learning. Values could be discussed in various contexts such as in the classroom, personal, institution, and epistemology, society, country and religious personnel. In this context, values reveal what we have known (cognitive), what we feel (affective), how we perform (behaviourism) and what we belief (spiritual).

In the cognitive domain, the values have a relationship with cognition, perception and conception. Based on the affective domain, the values have the relationship with interest, feelings, emotions, attitude, motivation and inclination. In addition, values exist as beliefs. According to universal integrated perspective, the source of values comes from reports, intuition, expressions and real senses (Nik Azis, 2008). The values formed and developed by an individual. The values domains namely, the brain where it was formed, the heart where it received the meanings and the soul where it operates. The categories of values are general education values, mathematics education values and mathematics values.

From the reasoning point of view, the universal integrated perspective assumes that empiric sources and rational thinking that are used to explain something must be parallel and not different from the religious source and guidance of God so that the truth can be determined (Nik Azis, 2008).

When discussing mathematics education, the universal integrated perspective emphasises that the aim of learning mathematics is for actualisation, which means to live a good life by carrying out our responsibilities to God, ourselves, the community, and the environment (Nik Azis, 2009a). Therefore, mathematics and mathematics education cannot be separated from human beings. Religion is the mould in forming all knowledge.

The universal integrated perspective states that God created the universe and everything in it including human beings and mathematics. Integrated perspective or the holistic perspective is predicted on a perspective of faith and devotion to God. According to the theory, mathematics comes from God, and an individual constructs his or her own mathematics. Therefore, mathematics is related to God and man or simply mathematics is centred on the Creator (Roselah, Nik Azis, & Ida Rosmini, 2010). The meaning of mathematics belongs to everybody as well as pupils. Mathematics knowledge that is built based on an individual experience at a certain socio-cultural context makes the knowledge full of values according to that particular culture (Nik Azis, 2003). Apart from this, universal integrated perspective states that mathematical knowledge cannot be perfectly transferred from the teacher to the pupil (Nik Azis, 2009a). The mathematical knowledge possessed by the pupil should be learnt and self-built by the pupil based on experiences (Nik Azis, 2009a).

From the learning point of view, universal integrated perspective emphasises that knowledge cannot be transferred from the teacher to pupils in a proper manner. The teaching of mathematics is an activity that guides pupils to build mathematics knowledge through five interrelated processes such as active participation, reflection, abstraction intellect intuition, and appreciation. In this context, the teacher plays a role in guiding pupils to form sophisticated mathematics through certain conducts. For pupils to build values through learning, teachers ought to prepare a conducive environment and help the pupils to form, maintain or develop good values (Nik Azis, 2007). Mathematics learning will be more meaningful with mathematics actualization and master the mathematical content as well as efficiency in using mathematics without leaving out religion as guidance. Strong mathematics development based on the universal integrated perspective is done in a complete and integrated context because this process involves both cognitive and moral development (Nik Azis, 2009a).

On the contrary, social constructivism was not chosen as the basis of this study. Social constructivism is based on specific assumptions about reality, knowledge, and learning. Social constructivists' belief that reality is constructed through human activity. Social constructivism belief that knowledge is the result of social interaction and language usage, and thus is a shared, rather than an individual experience (Prawatt & Floden, 1994). For the social constructivists, reality cannot be discovered and it does not exist prior to its social invention. To social constructivists, knowledge is also a human product and is socially and culturally constructed (Ernest, 1999). Individuals create meaning through their interactions with each other and with the environment they live in. Social constructivists view learning as a process. It does not take place only within an individual, nor is it a passive development of behaviours that are shaped by external forces. The social constructivism is more concerned with meaning than structure. Social constructivists emphasise the construction of an agreed upon, socially constructed reality. The truth is socially constructed and agreed upon truth resulting from co-participation in cultural practices (Cobb & Yackel, 1996). Social constructivism posits that we rely on other people to both challenges and confirm our ways of knowing. When they have been mutually agreed upon, they become our ontological reality (our truth). Social constructivism concentrates on the influence of social interaction, culture and historical factors on cognitive development. This psychological theory like the others is secularism based and does not involve metaphysics and God's role in human and humanitarian discussions.

Universal integrated perspective provides an appropriate theoretical framework for the study. It is the only theory that contains the characteristics of constructivism, behaviourism, cognitivism and in addition faith-based. Unlike the social constructivism, universal integrated perspective did not relinquish metaphysical realism once and for all. It established a connection between human cognitive constructions and God's creation.

Universal integrated perspective enables the researcher to collect, analyse and interpret data. The instrument was developed in line with the definition of the values based on this theory. Furthermore, the theory answers the research questions and helps in the creation of research format and development of metaphysical items. Universal integrated perspective allowed the researcher to have a good view of the pupils' learning methods teachers' teaching approaches, cultural and social characteristics and belief in God, and assist in the formation of values and knowledge in the classroom. Through the universal integrated perspective, mathematics helps an individual to visualise the beauty of God's creation. Hence, mathematics is highly connected to God.

Bishop's socio-cultural approach was also not chosen as the basis of this study due to several reasons. The rationale for choosing universal integrated perspective for Bishop's socio-cultural approach is discussed below. The universal integrated perspective discusses the values in mathematics education based on the analysis on mathematics development as a knowledge discipline in history, culture and Islamic civilisation. Bishop's socio-cultural approach discusses the values in mathematics based on the analysis on mathematics development as a knowledge discipline in history, culture and western civilisation.

The universal integrated perspective discusses the values based on mathematics development from four aspects that are ideology, reality, sentiments and sociology and humanities. The discussion is based on Islamic idea and Islamic civilisation. Bishop's socio-cultural approach discusses the values based on mathematics development in culture and Western civilisation from three aspects that are ideology, sentiments and relationship or sociology and humanities. The discussion is based on secularism and secularism process.

Ideology refers to the body of doctrine, myth, belief, a set of ideas that constitute one's goals, expectations and actions. In this aspect, both universal integrated perspective and Bishop's socio-cultural approach examines own philosophy based on mathematics development in culture and their own civilisation.

The reality is the state of things as they actually exist, existed, will exist, not just in the mind rather than as they may appear or may be thought to be. In this aspect, universal integrated perspective examines the type of reality that forms the base for mathematics development in culture or Islamic civilisation. Bishop's socio-cultural approach did not touch on this matter.

The sentiment is the thought, view or attitude, especially one based mainly on emotion instead of reason. In this aspect, both universal integrated perspective and Bishop's socio-cultural approach examines own attitude based on mathematics development in the culture of their own civilisation.

Relationship refers to the mutual dealings, connections, or feelings that exist between two parties, or people. Both universal integrated perspective and Bishop's socio-cultural approach examines the relationship between the person, who produces or develops mathematics knowledge with another person, potential ownership of mathematics knowledge or the distance between the creators or developers of mathematics knowledge with another person. Both approaches give the opinion that values based on the development of mathematics discipline in culture or their own civilisation are important values which act as a base for the development of mathematics thinking in the classroom (Bishop, 2008; Nik Azis, 2009).

The universal integrated perspective discusses values in mathematics on the pedagogy aspects and culture that involves eight aspects altogether. Bishop's socio-cultural approach discusses values in mathematics on the pedagogy aspects and culture that involves five aspects altogether.

From the above comparisons, it is appropriate for this study to choose the theory, universal integrated perspective. The differences mentioned above show that the universal integrated perspective is the most suitable framework to carry out the current research on the development of an instrument for assessing primary school mathematics teachers' values in mathematics education involved in teaching fractions as compared to Bishop's socio-cultural approach. The teachers are moulding the students for a better life in the society and be productive at work. Hence, good values are needed for the conception of mathematics as being values store is increasingly being recognised.

Teachers should engage students in various activities that use manipulatives and guide them to collect and analyse data. Teachers should stress the importance of mathematics in everyday life that is given by God. Deep belief in God and not just human beings thoughts and preferences make the universal integrated perspective a faith-based perspective (Nik Azis, 2009a).

In mathematics education, values involves how an individual or those who involved in mathematics education thinks or do not think, feel or do not feel, belief or do not belief, do or do not do a particular thing in education where what they have done are influenced by various factors such as beliefs, knowledge, feelings, conception, perception, selection, outcomes, emotions, attitudes, and their motivation. All the meanings of basic concepts in values definition are faith based (Nik Azis, 1999a). According to universal integrated perspective, there are three categories of values (refer Appendix A) that could be developed by teachers and pupils in a mathematics classroom. Those values could be exposed through the implementation of the teachers' role, textbooks and syllabus (Nik Azis, 2009; Bishop, 1988). The values in schools and in the society are interrelated to one another.

The general education values are related to human development. The values are connected to certain culture and society, of the particular educational institution. From the hierarchy aspect, universal integrated perspective classifies the general education values into four types such as basic values, main values, core values and developmental values. The basic values related to life principles, core values related to life necessities, main values related to individual personality and developmental values related to self- development. Politeness, respect, fairness and belief in God are examples of general education values. Mathematics education values are values associated with mathematics teaching and learning. These values were found in the curriculum, textbooks and classroom practices. Mathematics values are found in the subject itself. Values related to characteristics, sources, truth, or mathematics knowledge application. Mathematical values related to the discipline of mathematics.

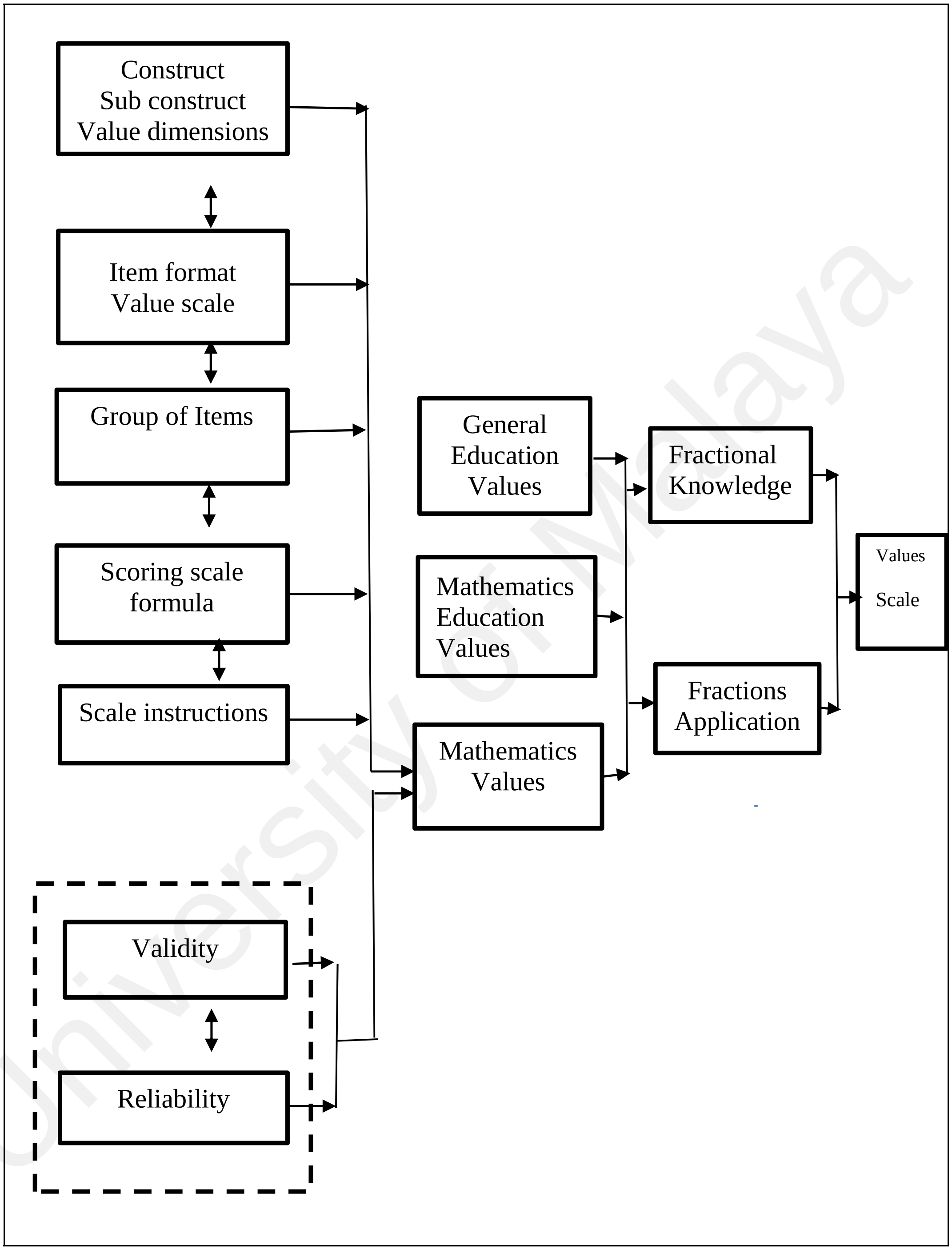

Figure 2.1 Conceptual Framework for Values Assessment Scale

Three complementary pairs of mathematics values are rationalism and objectivism, control and progress, mystery and openness, Bishop (1988; 2001). Memorisation, ethics, reflection, participation, communication and mathematics for the utility are examples of values. The mathematics values encompass ideology values, truth, sentimental and sociology.

For the purpose of this study, the conceptual framework was created from the literature. Figure 1.1 represents the basis for the development of the instrument. The conceptual framework illustrates the potential relationships among constructs, sub-constructs, dimensions and values indicators. Values at the micro level form the construct. General educational values, mathematics education values and mathematics values formed the sub-constructs. The dimensions include the developmental values, main values, core values, basic values, teaching approach, understanding of structure, elements of teaching, type of knowledge, the purpose of questioning, type of participation, objectives of mathematics education, usage of technology, ideology values, truth, sentimental, and sociology.

The literature analysis revealed many instruments used in previous studies. A pool of items was constructed in the initial step of instrument development. The scoring format was decided. The proportion of items created to each values indicator aimed to be proportional to the importance of that values indicator in contents of fractions and application of fractions. The number of items depending on how the items are assessed based on the developed scales. A larger pool of items was used in the final form, to ensure that statistical information, item difficulty and item discrimination be obtained, and an adequate number of items were available in the final pool after modification and item analysis. The scoring format was decided.

Values influence students thinking, speaking and behaviour. The researchers constantly focus on the importance of values in relation to the educational goals achievement and outcomes of the school system.The related literature has been divided into various subheadings as the concept of values adult perspective, learning and teaching fractions, values in mathematics education, and measurement in mathematics education.

Teachers able to show the interrelationship between mathematics and God. Deep belief in God and not just human beings' thoughts and preferences make the universal integrated perspective a faith-based approach (Nik Azis, 2009a). Universal integrated perspective is in use, explicitly or implicitly in our Rukunegara's principles, National Philosophy of Education and National Education Policy. This chapter continues to explain further on the selected terms used in the study.

Values

According to Lewis (2002) "Education without values, as useful as it is, seems rather to make man a cleverer devil." This statement reveals the importance of values in upbringing a well behaved student and human being. More than three decades, many values studies were conducted. Values and beliefs guide humans to behave and interact. According to universal integrated perspective, values have a few definitions that are interrelated to one another. Values are basic principles to determine human beings behave. They act as a standard measure or a source of reference to judge the importance, advantages, aesthetic values, the outcomes, quality or the usage of any matter. Values are concepts or preferences given to certain matters in the process of living and determining matters that will be appreciated (Nik Azis, 2002). There are three categories of values proposed by universal integrated perspective. They are general education values, mathematics education values and mathematics values (Nik

Azis, 2009). The general education values are values associated with the qualities important for human development in relation to society and educational institution. Mathematics education values associated with qualities important for mathematics as an academic and scientific discipline. The universal integrated perspective reveals that mathematics values could be determined by various aspects. Four of them are ideology, truthfulness, sentimental, and sociology or humanities. From the ideology aspect, values can be divided into four types namely empiricism, rationalism, pragmatism, and Islamic philosophy.

Definitions of Values

According to universal integrated perspective, values are conceptions or beliefs of individuals concerning the norms to their behaviour (Nik Azis, 2009). Values involve more cognitive involvement and fewer beliefs and attitudes (Krathwohl, Bloom & Masia, 1964). Frondizi (1970) said values are personal experiences and psychological phenomena. A value is a concept considered important to any individual's life (Fraenkel 1977). According to Raths, Harmin and Simon (1987) values are general guidelines resulting from individuals relationship and experience in life. Swadener and Soedjadi (1988) identify values as a concept or an idea about the value of anything. Values are mutual individual and community interactions (Tan, 1997). Values reveal individuals attitudes, aptitudes, actions, choices, visions and dreams (Pathania, 2011). According to Seah (2002), values are part and parcel of mathematics learning and teaching. Values in mathematics education are deep affective qualities which mathematics teaching fosters and they are a crucial component of the mathematics classroom affective environment (Bishop, 1991). Values refer to orientations such as interests, pleasures, duties, moral obligations, desires, goals, needs, aversions and attractions, and others (Williams, 1979).

It is not easy to identify values (Brown, 2001). Values influence emotions and attitudes (Tavsancıl, 2002). Values embedded in human souls (Seah, 2003). Values generally and indeed in mathematics education can be said as a deeply held view of what we belief to be important and worthwhile (Fall, 2009).

Seah and Andersson (2015) define values as the convictions which an individual has internalised as being the things of importance and worth. Valuing provides the individual with the will and determination to maintain any course of action chosen in the learning and teaching of mathematics. They regulate the ways in which learner's or teacher's cognitive skills and emotional dispositions are aligned to learning or teaching in any given educational context. Schwartz (1992, 2003) defined basic human values as cognitive representations of desirable goals that go beyond certain situations and actions. Values evaluate actions, events, and people. Ernest (1989) defined values as teachers' mathematical conceptions and ideologies and makes arguments that conceptions have a powerful impact on teaching. Values identify the right and the wrong, the good and the bad (Şişman, 2002). Values describe behaviour that is accepted by people (Hökelekli, 2010). According to Nixon's (1995), values are agreeable and recognisable logical explanations.

There are two types of values aesthetic and ethical. The former is about beauty and the latter about concepts and behaviour. Both values cooperate with education (Swadener & Soedjadi, 1988). Few studies about values make difficult to understand the similarities and differences of affective aspects (Seah & Bishop, 2000). Allport et al. (1960) categorised values as theoretical, economic, aesthetic, social, political, and religious.

Values are those qualities to which the society ascribe worth and that influence individuals thinking and behaviour. They represent deeply held beliefs that are not easily changed and are primarily learnt in the home. Within the literature, there are many definitions of values and they can be described as a small number of principles or a multitude of characteristics.

Concepts of Values

According to Matthews (2001*)*, values could transform individuals to become leaders and have good behaviour. Fraenkel (2003) described values as a concept or an idea*.* Rokeach (1973) acknowledges values as a structure of beliefs related to behaviour. Allport (1961) states that a value is a belief upon which a man acts by preference. Values develop behaviours from real life situations and experiences (Rath, Harmin &Simon, 1987). Earnest (1989) defined values as teachers mathematical conceptions and ideologies and makes the argument that conceptions have a powerful impact on teaching. Hill (1991) states values as individual's beliefs that direct their lives.

Halstead and Taylor (2000) refers values as the principles and beliefs that guide to good and desirable behaviour. Values are vital for individual behaviours, and future outcomes (Fitzsimons et al., 2001). Values in mathematics education are installed through the structure of mathematics and through the student's experience (Seah, 2005). Values are personal convictions that individual regards as important enough to be emphasised (Seah & Kalogeropoulos, 2006).

According to Wan Zah (2005), mathematics values are the affective characteristics that are perceived in depth rose from the understanding concerning truth in mathematics knowledge. According to Fatimah (2007), values are important aspects in the secondary schools integrated curriculum, but this domain not given proper attention. Values in mathematics education refer to values that are connected to norms and practises of teaching and learning, that is in the curriculum, textbooks, and classroom practices (Nik Azis, 2009a). Sharifah (2007) found that among the noble values that were emphasised in mathematics classroom was honesty, cooperation, diligence and self-reliance.

The mathematics values taught in western culture are rationalism-objectivism, control-progress, and openness, mystery (Bishop, 2000). Mathematics education values were categorised into positivist and constructivist values. Positivist values contain values namely accuracy, clarity, objectivity, control, and mystery. Constructivist values contain values namely rationalism, progress, openness, creativity, enjoyment, flexibility, and open-mindedness. The developed instrument should reveal these values and reflect them through teacher centred and student centred teaching practices.

There are only a few studies about values (Seah & Bishop, 2000). The concept of values is related to various concepts in the cognitive domain and affective domain such as beliefs, attitudes, emotions, motivation, interests, feelings, needs, priorities, desires, vision and conceptions.

In this study, general educational values contain moral values such as belief in God, cooperation, good personality, courage, self-confidence, responsibility, perseverance, patience, fairness, discipline, accountability, innovation, integrity, and accuracy, Mathematics educational values are found in the procedural knowledge, conceptual knowledge, curriculum, textbooks, algorithms, and formulae. Mathematics values are found in the subject itself.

Learning and Teaching Fractions

Fraction an important topic in mathematics both in primary and secondary schools. It is challenging topic for most students (Test & Ellis, 2005). A fraction is a number that is an integer, multiple of some unit fraction. There are three strands of fraction knowledge. They are procedural, conceptual, and factual. The conceptual and procedural will lead to accuracy in fractional estimation skills. The factual knowledge (memorisation) contributes little to the accurate student performance. The fraction is not represented by a single number, but instead by the relationship between two whole numbers is conceptual. The procedures used to compute and manipulate fractions are much more complicated that those used with whole numbers is procedural. The nature of the relationship between the numerator and denominator can vary across different contexts is contextual.

Concepts of Fractions

Fractions have connections with many algebraic concepts (NCTM, 2000; Perie, Grigg, Dion, 2005). According to Van de Walle (2007), students should be good at fractions in order to solve other mathematics concepts. Students solve certain fractions concepts but they have difficulties in solving partitioning and fraction equivalence and conceptualising fractions.

Fractions are taught from Year One from 2011 following the new KSSR syllabus (Ministry of Education, 2011) in Malaysia. The components of fractions that will be exposed to primary school pupils are proper fractions, improper fractions, operations in fractions and problem-solving. Teachers should be well versed in all the above-mentioned areas.

Mathematics is generally accepted as an important curriculum domain in elementary education (Hecht, Vagi, & Torgesen, 2009; Keijzer & Terwel, 2003). Within the mathematics curriculum, fractions are a vital skill in mathematics, but students and teachers find difficult to learn and teach respectively (Hecht, Close, & Santisi, 2003; Newton, 2008; Van Steenbrugge, Valcke, & Desoete, 2010; Zhou, Peverly, & Xin, 2006). Students experience difficulties when learning fractions were also proven by mathematicians such as (Bulgar, 2003; Hecht, Close, & Santisi, 2003; Lamon, 2007; Newton, 2008). The range of studies over the past years revealed that this is a persistent problem.

Learning of Fractions

According to universal integrated perspective, fractions are part of a whole and as quantities in their own right. By comparing fractions, students come to understand them as something more, numbers that have magnitude. The learning of fractions is an area of mathematics which children find particularly challenging (Pearn & Stephens, 2004). To teachers and researchers, learning fractions are challenging (Gould, Outhred, & Mitchelmore, 2006; NAEP, 2005). They have tried to find methods of teaching fractions to be simpler, relevant, meaningful and understandable to students. Fractions play an important role in everyday tasks, but adults continue to struggle with fractions concepts (Lipkus, Samsa, & Rimer, 2001; Reyna & Brainerd, 2007).

The research indicates that students in the United States have been facing difficulty in learning fractions since long time ago (Test & Ellis, 2005). This difficulty is caused by the traditional methods of teaching fractions and the many mathematics meanings that it has.

Kieren (1988) identified five fractions constructs namely part-whole, quotient, operator, measure, and ratio based on his experiences. Part-whole representations involve symbols and language that provide a basis for teaching. Powell and Hunting (2003) acknowledge the part-whole relationships are the foundation for young children's developing multiplicative structures. They advocate spending time developing the foundations for fractions concepts fractions in the early grades. They advocate spending time developing the foundations for fractions concepts fractions in the early grades. Quotient involves partitive and quotative constructs based on the type of division. One cake divided equally among four students is partitive whereas how many 1/4 litre servings of milk are in 5 litres of milk is quotitive. Operators involve transformations that act as a function to operate' on a quantity. The unit fractions modelled first with the area and then with discrete materials. Fractions as a measure involve a number line. It shows that a fraction can be positioned on a number line. Ratios involve a quantitative relationship between two amounts that can be modelled using discrete items.

Using pattern blocks is one way to help students bring fractions from an abstract idea to a concrete idea by using a hands-on approach with pattern blocks. Roddick and Silvas-Centeno (2007) developed a series of lessons on fair trade and equivalence of fractions, using pattern blocks. Pattern blocks are something concrete that students can see, can hold, and can work with to arrive at answers. Students do not just need to sit with pencil and paper but can actually work through the problem with something in their hands. Pattern blocks can be used starting with even the simplest idea of visualising fractions.

Fractions are developed from whole numbers. Fractions consist of improper fractions, equivalent fractions, mixed fractions, fractions to decimal conversions, addition, subtraction, multiplication, division and problem solving of fractions. Students have difficulty in learning fractions while teachers have difficulty in teaching. Researchers and teachers have shown a concerted effort to improve the methodology of teaching fractions. According to Wu (2005), fractions represent a student’s first serious involvement into abstract mathematics. The study of fractions not only enables students to compute but also provides a foundation for work with rates, percentages, slope, and many other topics in secondary school mathematics. Research has long reported that many students and even adults have difficulties in understanding operations with fractions. Adults continue to struggle with fractions concepts although it is known to be relevant to daily tasks (Lipkus, Samsa, & Rimer, 2001; Reyna & Brainerd, 2007). The available related literature was reviewed.

Knowledge of fractions is important for students' future success in mathematics and science, and in daily life (Kloosterman, 2010; Lamon, 2007; NCTM, 2007; Siegler, Carpenter, Fennell, Geary, Lewis, Okamoto, Thompson, & Wray, 2010). Students find it difficult to understand the part, whole relationships, complex procedures and related notations.

Difficulty in Learning Fractions

Fractions are critical (Kilpatrick, Swafford, & Findell, 2001; Kloosterman, 2010; NCTM, 2007; Siegler, Carpenter, Fennell, Geary, Lewis, Okamoto, Thompson, &Wray, 2010; Van de Walle, 2010). The other authors considered fractions not only critical but difficult subject for students to learn (Bulgar, 2003; Hecht, Close, & Santisi, 2003; Lamon, 2007; Newton, 2008; Siegler et al., 2010). Studies focused on numerous difficulties that students encounter when learning fractions were done (Cramer, Post, & delMas, 2002; Keijzer & Terwel, 2003; Lamon, 2007; Siegler, Thompson, & Schneider, 2011; Stafylidou & Vosniadou, 2004).

There are four reasonable explanations given by educational researchers as why students find fractions so difficult and challenging: (a) fractions are irregularly used in everyday life (b) complicated fraction notations; (c) difficult to understand fractions on a number line; and, (d) there are many complex rules related to the procedures of fractions.

Moss and Case (1999) agreed to the above and found out other obstacles related to children's difficulties with fractions (1) more time is spent on teaching the procedures of manipulating rational numbers and less time is allocated to teaching their conceptual meaning; (2) Teachers do not encourage spontaneous strategies, but discouraging children's initiative to understand these numbers on their own. Rational numbers were not introduced differently from whole numbers such as the using of pie charts as models for introducing children to fractions. The above studies proved that pupils do not understand at all the value, truth in fractions. Pupils score in through rote memorising techniques.

Dumont (1994) discerns two types of learning problems, primary and secondary learning problems. Primary learning problems or 'learning disabilities' are situated in the child's own cognitive development. The cause of secondary learning problems or 'learning difficulties' is situated outside the child that is the way the teacher sets up instruction, the design of instruction in curriculum materials, and difficulties inherent in the specific content) or another child-related problem (visual impairment). Fractions need deep conceptual knowledge of part-whole relationship and understanding that fractions can be shown on a number line, and ratios (Hecht, Close, & Santisi, 2003). This problem was identified in the United States that only one-third of 13-year old students were able to answer correctly a fraction question on a number line. Word problems involving manipulating of fractions for algebraic expressions and numbers are difficult. Boaler (1993) found that 12-13-year-old students in a school practising traditional mathematics curriculum could not understand simple tasks fractions when presented in problem-solving.

According to Saxe, Taylor, McIntosh and Geahart (2005), primary and middle schools students showed difficulties in understanding and using written notations thus making learning and mastering fractions an obstacle. Students have a good knowledge related to whole numbers and fractions. They believe that multiplication makes values larger and division makes them smaller. This misconception of multiplication and division does not apply in solving multiplication and division involving rational problems. Students lack a conceptual understanding of division of fractions because teachers emphasise the traditional invert-and-multiply algorithm without providing justification (Siebert, 2002). Adding and subtracting fractions are among the most challenging skills for students at any grade level to learn, but the concepts behind the skills are foundational to many higher mathematics courses. According to recent research, students' lack of proficiency in performing problems involving adding and subtracting fractions is due to the misconceptions that they continue to carry without properly correcting the concept (Bogen, 2008).

Pupils make mistakes in doing fractions because they did not understand that natural and rational numbers involve different ideas. For example, pupils think that 1/2 of a cake is smaller than 1/4 because 2 is less than 4. According to the National Council of Teachers of Mathematics (2007), only 50% of American 8th graders arranged three fractions correctly from smallest to largest. The average student lacks conceptual knowledge of fractions in many countries. Students in Japan and China where they have good conceptual understanding also consider fractions difficult. Among the difficulties is that the introductory lesson shows many properties that are true of whole numbers are not true for all numbers. Vamvakoussi and Vosniadou (2010) found out that many high-school students have difficulty in understanding the occurrence of an infinite number of numbers between any two fractions. No doubt, the learning of algebra, geometry and higher mathematics require a good understanding of fractions.

Equivalent fractions require a deep understanding of the concept fraction. According to NCTM (2006), equivalent fractions are difficult to teach and learn due to the fact that the concept fraction happens to be the core of knowledge in learning equivalent fractions. The whole numbers are easy to understand but the concept fraction is more abstract that the children face difficulty in learning. So this brings obstacles for students' understanding of equivalent fractions. The fractions' complex semantics is also another difficulty in learning fractions (Ohlsson, 1988).

Li (2006) found out that Taiwanese students' at ages 12 and 13 do not have a good command of conceptual and procedural knowledge of fractions. Many students use algorithms to solve fractions without understanding the concept that underlies the operations. According to National Assessment of Educational Progress (2005), the North American students felt that fractions challenging and difficult to understand fractions concepts. Understanding fractions are important in solving algebraic equations. Understanding fraction magnitudes would help students to use of fractions arithmetic procedures correctly (Hecht & Vagi, 2010; Siegler, et al., 2011). According to researchers, some algorithms pertaining to fractions are among the least understood in all of the elementary school (Bulgar, 2003; Tirosh, 2000).

Students obtain knowledge about fractions and rational numbers from the home environment and others. Students with this constructed knowledge interact with the instructed knowledge offered by the mathematics curriculum and teachers in school (Smith, 2002). The main source producing difficulties is that students' prior knowledge on natural numbers interferes the learning of fractions (Stafylidou & Vosniadou, 2004). On the other hand, fractions knowledge is vital to numerical development. This resulted in number bias that leads to errors and misconceptions (Ni & Zhou, 2005). Students should overcome this bias between natural numbers and fractions and reconstruct their understanding of numbers.

In addition to students' lacking understanding of fractional numbers versus whole numbers, most students have difficulties understanding the size of fractions. Clarke, Roche and Mitchell (2008) said that students were taught to operate on fractions with all four operations without recognising that they need to understand what fractions are about so they can reason proportionally rather than just do computations. Furthermore, students often learn the concept of adding and subtracting fractions by memorising the steps without developing a conceptual understanding of why each step is necessary. Without a conceptual understanding of why each skill is required to solve the problem, students may struggle with retaining such skills when applying the concept.

Conceptual understanding of fractions is considered of major importance for students to be able to apply their knowledge of fractions in non-routine problem-solving activities (Siegler et al., 2010). According to Bulgar (2003) and Prediger (2008), many studies revealed that students' conceptual knowledge of fractions is poorer than their procedural knowledge of fractions. Hence students develop an instrumental understanding of fractions (Prediger, 2008). For example, students with procedural knowledge of the multiplication of fractions may forget the rule to multiply both the numerators and both the denominators not be able to come up with a correct answer. On the other hand, students with a conceptual understanding of fractions may come up with a good answer based on their conceptual understanding and may retrieve the rule. Students are able to solve the part-whole sub-construct but they have developed little knowledge of the other sub-constructs (Charalambous & Pitta-Pantazi, 2007; Clarke, Roche, & Mitchell, 2007; Martinie, 2007).

Procedural knowledge is necessary for the implementation of the different steps in fractions calculations. Several studies mention a gap between students' conceptual and procedural knowledge level of fractions. In particular, students' conceptual knowledge of fractions is reported to be problematic whereas students' procedural knowledge of fractions is reported to be better (Bulgar, 2003; Post, Cramer, Behr; Prediger, 2008). Some students do not develop a deep conceptual understanding resulting in a rather instrumental understanding of the procedures (Aksu, 2003; Prediger, 2008).

To help students develop a better conceptual understanding, research suggests that allowing students to communicate orally or in writing among peers and themselves enhances their proficiency, especially for English Language Learners (Chen & Li, 2008). The above studies proved that pupils do not understand at all the value and truth about fractions. Pupils score in through rote memorising techniques.

Teaching of Fractions

The competence of teaching fractions is a new and underdeveloped area of study (Lamon, 2007; Siegler et al., 2010). In teaching mathematics, there is a good relationship between teacher knowledge and classroom instruction (Ball, 2000; Dewey, 1964; Ma, 1999; Shulman, 1987). There is a known misconception that fractions in elementary school mathematics are easy to teach (Jacobbe, 2012; Verschaffel, Janssens, & Janssen, 2005).

According to Brousseau, Brousseau, and Warfield (2004) teachers should place more emphasis on the conceptual understanding of fractions to provide students with different algorithms to execute operations on fractions, instead of rushing to provide students with different algorithms to execute operations on fractions. The teaching of the different operations of fractions should be directly linked to specific interpretations of fractions. Teachers who are not mathematics teachers in primary schools and secondary schools lack the conceptual foundations required to develop a deep understanding of fractions. Previous studies found that non-mathematics option teachers often confused about core fractions concepts (Marnich, 2002). This gave rise to the improper teaching of fractions in schools.

Teachers' weak knowledge of equivalent fractions, students' learning characteristics, and the complicated representational systems make teaching mathematics difficult in schools. Research indicates that many elementary school teachers have limited knowledge of fraction concepts and procedures (Garet, Wayne, Stancavage, Taylor Walters, Song, & Warner, 2010).

Interviews with United States elementary school teachers showed that a high percentage of them were unable to explain computational procedures for fractions. Another study found that some elementary school teachers had difficulty ordering fractions, adding fractions, and solving ratio problems. Many of the teachers who solved problems correctly could not explain their own problem-solving process. The panel views this limited knowledge of fractions as problematic, given evidence that teachers' mathematical content knowledge is related to students' learning, Hill et al. (2005).

Teachers should be well versed in fractions knowledge in both subject matter and understanding of cognitive processes, to correct students' mistakes in dividing fractions. According to Ma (1999) United States teachers depended on the traditional algorithm and lacked the conceptual understanding to produce suitable representations. To help students, teachers have to acquire conceptual understanding of division of fractions, meaningful procedures and their connectivity to relevant mathematical topics.

Teachers should study students' thinking processes, their conceptions and misconceptions about the division of fractions to develop their understanding (Tirosh, 2000). Aksu (1997) stated that a common mistake in the teaching of fractions is expecting students to compute fractions before they have an understanding of the meaning of fractions.

Students understanding of fractions concepts develops and changes in the elementary grades (Saxe et al, 2005). Teachers play a vital role in helping students to make the connection between their constructed knowledge and their instructed knowledge. Yet, more research on fractions is still needed, especially studies addressing the efficacy of teaching fractions (Siegler et al., 2010). Also more broadly, there is a growing interest in the actual teaching of mathematics which stems from research on teachers' use of curriculum materials (Lloyd, Remillard, & Herbel-Eisenman, 2009). Furthermore, teaching is seen as the next frontier in the struggle to improve schools.

Teachers' Knowledge of Fractions

More studies focusing on pre-service and in-service teachers' knowledge of fractions are needed (Moseley, Okamoto, & Ishida, 2007; Newton, 2008). It was indicated that teachers should be exposed to fractions knowledge during training to develop a deep understanding of fractions (Newton, 2008; Toluk-Ucar, 2009; Zhou, Peverly, & Xin, 2006). A major concern related to increasing the mathematics standards expected of students should be teachers' preparation to address these standards (Jacobbe, 2012; Siegler et al., 2010; Zhou et al., 2006).

In contrast to a lot of studies analysing students' knowledge of fractions, less is known, however, about preservice and in-service teachers' knowledge of fractions (Moseley, Okamoto, & Ishida, 2007; Newton, 2008). A major concern regarding increasing mathematics standards expected of students should be teachers' competence in teaching (Jacobbe, 2012; Siegler et al., 2010; Zhou et al., 2006). Research on fractions lacked to some extent an explicit focus on the teaching of this. Studies have shown that pre-service, elementary teachers have a limited knowledge of fraction concepts (Newton, 2008). To teach fractions, teachers need to have more than a surface understanding. Students learn more when their teachers know more. If pre-service teachers struggle with fraction concepts, it is not surprising, then, that fractions are a difficult topic for many children (Cramer, Post & del Mas, 2002). To date, there is a consensus among researchers that teaching and learning fractions are complicated because fractions comprise a multifaceted construct (part-whole, ratio, operator, quotient and measure (Brousseau, Brousseau & Warfield, 2004; Lamon, 2001).

Teachers can help students construct their understanding of equivalent fractions by understanding the content themselves and how students learn this content. Teachers should develop students understanding of the concept fraction and equivalent fractions through transforming alternative representations. Saxe et al. (2005) found that the students' knowledge of notations and part-whole references developed independently. Students' use of notations does not lead to their development of part-whole relationships. Teachers should have the awareness of students' learning difficulties in the knowledge of notations and part-whole references to construct students' understanding of equivalent fractions.

The past studies showed that teachers have problems in teaching fractions in the form of fractional knowledge and teaching methodology. Pupils have problems in understanding the concepts of fractions and problem-solving. The problems faced by both teachers and pupils are not due to cognitive factors alone. It could be due to affective factors. The development of mathematics values in the teaching and learning of mathematics is embedded in the cognitive and affective domains of Bloom's taxonomy of educational objectives. Previous studies reiterated that teachers should integrate the affective and cognitive dimensions into the teaching and learning of mathematics (Amato, 2004; Zan, Bronw, Evans & Hannula, 2006; Furinghetti & Morselli, 2009; Blanco et al., 2010). On the other hand, Furinghetti and Morselli

(2009), suggested that cognitive and affective factors be integrated into teacher education programs.

According to Chin and Lin (2000), the teaching of mathematics should trigger desire, expectation, and enjoyment of knowledge among students. Teachers supposed to teach students the nature of mathematical knowledge. They have to interact with students, motivate their interest and willingness to learn through their teaching. According to Clarke (2004), teachers should build connections from previous lessons and experiences and use data effectively to inform learning.

Values Development

Rokeach (1968, 1973, 1979) developed (a) a theoretical perspective on the nature of values in a cognitive framework and (b) a value measurement instrument, both of which are widely used and accepted by psychologists, political scientists, economists and others interested in understanding what values are, what people value, and what is the ultimate function or purpose of values. Rokeach Value Survey (RVS), an instrument which was designed to operationalize the value concept, has been used as an instrument for measuring personal and social values. The present study was initiated to empirically investigate the structure of human values. Its aim was to evaluate the coherence between the 36 values as specified by the RVS. The RVS was constructed to distinguish between terminal and instrumental values. Terminal values are ultimate goals that may be self-centred or society-centred, intrapersonal or interpersonal. Terminal values are an exciting life, pleasure, mature love, true friendship, inner harmony, and social recognition, a sense of accomplishment, family security, national salvation, equality, wisdom, a world at peace, and a world of beauty. Instrumental values are standards that guide the conduct of behaviour and consist of moral values and competence values (Rokeach, 1973). Instrumental values are ambitious, broad-minded, capable, clean, cheerful, courageous, forgiving, helpful, honest, imaginative, independent, intellectual, logical, loving, obedient, polite, responsible, and self-controlled. The selection of items was not theory-driven, so predictions and explanations based on it are typically ad hoc. Finally, on technical grounds, it is both too long (36 items) for the European Social Survey and too abstract for use with the less educated subgroups in representative samples.

Rokeach carried out semi-structured interviews with respondents. Similar to focus group interviews were also carried out but do not have experts' panel feedback. The most important human values were correlated with one another. Some of the values could be found in general education values of this study. RVS does cover items on traditional religiosity and religious commitment similar to the belief in God items of this study.

The first instrument developed to measure values based on the theory is known as the Schwartz Value Survey (Schwartz, 1992, 2006a). The Schwartz Values Survey (SVS) is an instrument Schwartz (1994) created as a result of value surveys conducted through 20 countries as well as a thorough study of psychological value theories. The SVS specifies the dynamic relations among the motivational value types leading to a three-level hierarchy containing 56 basic human values. It provides a conceptual framework that is culturally universal in its context and structure. The SVS has both theoretical and empirical grounds and has been applied to various domains such as psychology and political science research. The SVS presents two lists of values items. The first contains 30 items that describe potentially desirable end-states in noun form; the second contains 26 items that describe potentially desirable ways of acting in adjective form. Each item expresses an aspect of the motivational goal of one value. Respondents rate the importance of each value item "as a guiding principle in MY life" on a 9-point scale labelled 7 (of supreme importance), 6 (very important), 5, 4 (unlabelled), 3 (important), 2, 1 (unlabelled), 0 (not important), 1 (opposed to my values). The Schwartz (1992) Value Survey (SVS) is most widely used by social and cross-cultural psychologists for studying individual differences in values. On the other hand, the length of this scale precludes its use in the European Social Survey. Moreover, people with little or no education encounter difficulty when responding to it.

The theory concerns the basic values that people in all cultures recognise. It identifies ten motivationally distinct types of values and specifies the dynamic relations among them. Some values conflict with one another such as benevolence and power whereas others are compatible such as conformity and security. The structure of values refers to these relations of conflict and congruence among values. Values are structured in similar ways across culturally diverse groups. This suggests that there is a universal organisation of human motivations. Although the nature of values and their structure may be universal, individuals and groups differ substantially in the relative importance they attribute to the values. That is, individuals and groups have different value priorities as compared to this study’s outcome.

The Portrait Values Questionnaire (PVQ) is an alternative to the Schwartz Value Survey developed in order to measure the ten basic values in samples of children from age 11-14 and of persons not educated in western schools that emphasize abstract, context-free thinking (PVQ; Schwartz, 2003; Schwartz, Melech, Lehmann, Burgess, & Harris, 2001). According to Schwartz (1992), ten motivational value types and their goals are found within all cultures. However, it presents respondents with a more concrete and less cognitively complex task than the earlier value survey. This makes it suitable for use with all segments of the population including those with little or no formal schooling. The PVQ includes short verbal portraits of different people. Each portrait describes a person's goals, aspirations, or wishes that point implicitly to the importance of a single value type.

The Life Values Inventory (LVI) is developed by Crace and Brown (1995) to assess values that guide behaviour and decision-making. It contains 14 values that were generated from an initial pool of 190 items selected from values literature and has been validated through pilot studies and evaluated by domain experts. The LVI has been used in counselling, therapy, and team development (Brown & Crace, 2002).

Values are general principles that are used to judge the worth of an idea or action. They provide the criteria by which individuals decide whether something is good or bad, right or wrong. Values involve strategies that assist adults and students in exploring, discussing, analyse and act on values in the context of their learning and their interaction with others. Values regulate and guide human behaviour and action in everyday life. Values are embedded in every word an individual select and speak, the clothing they wear, their interaction and perceptions, and interpretation of others reactions towards opinions.

Values Education

Values education is about making the core values explicit in all school activities through modelling, discussion and critical reflection. Values education is not a separate program to be added to a busy school curriculum. Students explore values and discuss them in their learning. Values are taught in the classroom and through the activities and relationships of the school and its community. They can be taught explicitly by specific reference and implicitly by being embedded through teaching, curriculum materials and resources and by the modelling of teachers and other students. According to Lovat (2005) Values Education to become part and parcel of mainstream schooling, especially in public systems. Teaching has undergone a revolution in the recent past. It is now a profession whose systems have to find the point of relevance for the education of students across a vast array of academic and cultural starting-points. It also has to address dimensions of learning quite beyond the standard literacies because the social agency role of schooling has expanded beyond even the very lofty goals of its founders. Values Education with an explicit curriculum can make a difference to the ways students perceive and speak about moral issues (Lovat & Schofield, 1998; 2004). Values Education, the belief is around the teacher's capacity to make a difference by engaging students in the sophisticated and life-shaping learning of personal moral development.'

All kinds of activities in schools in which students learn or develop values and morality are often referred to as values education (Halstead, 1996; Lovat, 2011; Powney, Cullen, Schlapp, Johnstone & Munn, 1995; Taylor, 1994), and a distinction can be made between explicit and implicit values education. On the other hand, explicit values education refers to schools' official curriculum of what and how to teach values and morality, including teachers' explicit intentions and practices of values education, implicit values education is associated with a hidden curriculum and implicit values, embedded in school and classroom practices (Halstead, 1996; Thornberg, 2008a). Even though the concepts of values education and moral education sometimes are used interchangeably, we use values education in line with Taylor (1994, 2006) as an overarching concept including concepts such as moral education, character education, and citizenship education. Based on a comparative overview of a survey of 26 European countries, Taylor (1994) concluded that the scope of values education is often complex and includes a number of themes, many of which overlap, closely related to the historical and ideological evolution of each country. Examples of identified themes are moral, religious, civic, democratic, national, pastoral, personal, and social goals and issues.

Values education are usually described and contrasted in the literature in two general approaches (Halstead, 1996; Solomon, Watson & Battistich, 2001). The traditional approach emphasises adult transmission of the morals of society through direct teaching, character education, exhortation, and the use of rewards and punishments (Durkheim, 1961). The aim is to teach and discipline students to develop good character and virtues, and to conform to the dominant values, legitimate rules, and the authority of society. Values are taught through planned structured lessons, like any other subject. Examples of virtues to inculcate in character education are “being honest, hardworking, obeying legitimate authority kind, patriotic and responsible” (Jones, 2009, p. 39). Various activities like discussions, role plays, art, writing, debates, school-wide activities like surveys, dramas etc., could all be used to deal with the same issue. In contrast, the progressive or constructivist approach “emphasises children’s active construction of moral meaning and development of a personal commitment to principles of fairness and concern for the welfare of others through processes of social interaction and moral discourse” (Solomon et al., 2001, p. 573). Reasoning and explanations, deliberative discussion about moral dilemmas, and participation in decision-making processes are viewed as typical methods for this approach (Dewey, 1916; Nucci, 2006; Power, Higgins & Kohlberg, 1989). The aim is to promote moral autonomy, rational thinking, moral reasoning skills, and democratic values and competence among the students. A third approach in the field of values education is known as a critical approach, which claims that moral influence in school, especially in the practice of school discipline and in hidden curriculum, can be questioned and has far-reaching effects without being noticed (Bernstein, 2000; Giroux & Penna, 1983; Jones, 2009).

According to Jyoti Kumta (2013), the best way to implement a value Education program is through the holistic approach that integrates the teaching of values into each and every aspect of school life. For this to happen all the teachers and staff should be committed to the teaching of values and consider it as important as academics. Everything in the school should be centred on the development of good relationships between students, staff, parents, and the community at large. Social and emotional development should get as much importance as pure academics. Co-operation and personal excellence should have precedence over competition. Values such as honesty, respect, and compassion should be a part and parcel of daily lessons and children should have ample opportunity to practice good and helpful behaviour through activities like social service. Discipline should be democratic and teachers and students should hold class meetings to establish norms of behaviour, solve problems and build unity.

According to Lovat (2005) Values Education to become part and parcel of mainstream schooling, especially in public systems. Teaching has undergone a revolution in the recent past. It is now a profession whose systems have to find the point of relevance for the education of students across a vast array of academic and cultural starting-points. It also has to address dimensions of learning quite beyond the standard literacies because the social agency role of schooling has expanded beyond even the very lofty goals of its founders.

Values Education with an explicit curriculum can make a difference to the ways students perceive and speak about moral issues (Lovat & Schofield, 1998; 2004). Values Education, the belief is around the teacher's capacity to make a difference by engaging students in the sophisticated and life-shaping learning of personal moral development. The Ministry of Education in Malaysia through the implementation of the Malaysia Education Blueprint 2013 – 2025, give importance to values education related to the spiritual and moral development of students in Malaysian schools. One of the eleven shifts to transform the system into values-driven Malaysians. Values education was emphasised in the Malaysian curriculum where 'the 16 moral values' are explicitly spelt out in the Moral Education syllabus. These values were identified from the four main religious and ethnic groups of the country - Malay (Islam), Chinese (Buddhism and Taoism), Indian (Hinduism) and Christians. They are known as *Nilai-Nilai murni* (the pure, ethical or noble values) and include compassion, self-reliance, humility, respect, love, justice, freedom, courage, physical and mental cleanliness, honesty, diligence, cooperation, moderation, gratitude, rationality and public-spiritedness. The official policy is that these values are to be taught or inculcated indirectly through all school subjects, including mathematics and science.

Teaching about values affects teachers thinking, and consequently the way that they teach. Teachers are not neutral with regards to values, as values are embedded within their attitudes and exhibited through their behaviour. In order to determine whether certain values are more important in values education than other areas of learning, is to examine the teaching strategies that teachers adopted in facilitating each of the major contemporary approaches to values education, and to infer the teacher values that are needed to inform practice.

Ferreira and Schulze (2014) did a study on the teachers' experience of the implementation of values in education in schools: "Mind the gap" in South Africa. The study aimed to investigate teachers' experiences of the implementation of values in education in classroom practice. The study's research question was to know how teachers experience the implementation of values in education in the curriculum. The aim of this research was to reveal the problems teachers encounter when implementing values in education in terms of National Curriculum Statement (NCS) policy (DoE, 2000). Constructivism was used as a conceptual framework. Data were collected by means of interviews with 14 participants. The findings revealed that there was a gap between policymakers' intentions and teachers' perspectives. This gap related to the teachers' poor understanding of the concept 'values in education', exacerbated by a lack of reflexivity about the issue; a failure to address the influence of teacher identity on values in education; a need for suitable training; a lack of knowledge on how to address practical challenges with values in education or how to consider the hidden curriculum, and how to use different strategies effectively to facilitate values in education. The conclusion is that education initiatives so far have had little impact on the implementation of values in education in selected schools. The study hoped to stimulate further reflection and debate on values in education.

Teaching has undergone a revolution in the recent past. It is now a profession whose systems have to find the point of relevance for the education of students across a vast array of academic and cultural starting-points. It also has to address dimensions of learning quite beyond the standard literacies because the social agency role of schooling has expanded beyond even the very lofty goals of its founders. The evidence is mounting that values education is providing positive outcomes for students, teachers and schools (Benninga, Berkowitz, Kuehn, & Smith, 2006; DEST, 2008; Hattie, 2003; Lovat, Clement, Dally, & Toomey, 2010). Despite this, Australian pre-service teacher education does not appear to be changing in ways necessary to support skilful teachers to teach with a values focus (Lovat, Dally, Clement, and Toomey, 2011). According to Solomons (2009), it is assumed that teachers have the expertise to navigate impartially between conflicting value-orientations that may co-exist in multicultural classrooms such as in South Africa. Rhodes and Roux (2004) have therefore indicated that there is a lack of comprehensible directives on how to deal with values in education in the classroom. The evidence is mounting that values education is providing positive outcomes for students, teachers and schools (Benninga, Berkowitz, Kuehn, & Smith, 2006; DEST, 2008; Hattie, 2003; Lovat, Clement, Dally, & Toomey, 2010).

The effective implementation of values in education has been hampered in various ways. The teachers should understand how to construct learning environments which are appropriately contextualised, and communicate effectively showing recognition of and respect for differences in values. Moreover, teachers should act as facilitators of learning. Values education helps to develop young people who will contribute to a society that is comfortable with diversity, socially cohesive, rejects violence and negative forms of discrimination, and is civil and socially just.

Research in Affective Domain

According to Lomas, Grootenboer and Attard (2012) there has been a great deal of interest in the affective domain and mathematics education over many years. Affective variables are assumed to be important for learning (Boekaerts, 2003). The affective domain is a complex structural system consisting of four main dimensions that are widely accepted, namely emotions, attitudes, values and beliefs (Goldin, 2001).The affective domain and its dimensions are difficult to define precisely. It is important to understand beliefs, values, attitudes and emotions as complexly inter-related to cognition and psychomotor dimensions. McLeod (1992) stated that the affective domain refers to a wide range of beliefs, feelings, and moods that are beyond the domain of cognition. McLeod (1992) defined attitudes as, affective responses that involve positive or negative feelings of moderate intensity and reasonable stability. Philipp (2007) defined attitudes as manners of acting, feeling, or thinking that show one's disposition or opinion. Terms like anxiety, confidence, motivation, enjoyment, feelings and beliefs are often used when discussing attitudes. Philipp (2007) defines values as the worth of something. Values are less context-specific than beliefs. Values are also closely related to attitudes, with values being held in a deeper and more central position.

Research into values in mathematics education has been developing in two different directions. One is concerned with the fostering of desirable civic, ethical and moral values in the younger generations through mathematics learning (Seah & Kalogeropoulos, 2004; Wong, 2005). The other direction relates to ways in which mathematics learning including performance might be enhanced through the teaching of values for a review of research conducted in recent years in Australasia (Seah, Atweh, Clarkson & Ellerton, 2008). It appears that between these two research directions, interest amongst mathematics education researchers has been understandably more evident in the latter.

According to Bishop's (2001) and Nik Azis (2008) critical issues find three principal sources for theoretical ideas which can be used to think about developing values teaching in mathematics. These are the literature on the affective domain and values education generally, on affective aspects of mathematics education, and on social and cultural aspects of mathematics education. McLeod (1992) identified three concepts used in the research on affect in mathematics education: beliefs, attitudes and emotions. He cites no research on values, ideas about both beliefs and attitudes towards mathematics do relate to values held by both teachers and students. DeBellis and Goldin (1997) added a fourth element, values. Most research on affect in mathematics education has used one or more of these four concepts. The theoretical foundation beneath these concepts is not quite clear. Attitude has perhaps the longest history in mathematics education, it is important to explore what a research focus on values in mathematics education can offer to our concerns about affect (Bishop, 2001).

Mathematics educators have been creating instruments to assess affects for at least 40 years (Goldin, 2000). Hence, three criteria were used to identify instruments for discussion: statistical data, innovation, and the usage from the field of mathematics education. Each instrument discussed has some component of statistical data, innovation, and attention. Krathwohl, Bloom & Masia's (1964) book focused on the affective domain that was based on a behaviourist approach and was hierarchical in structure. The researchers found out that values are less important to the mathematics teachers. Teachers could not identify their own values easily or to portray them. One teacher complained that he taught mathematics, and not values.

The first study of affect in mathematics was innovative and had high reliability ranging from 0.59 to 0.85, though it did not result in the creation of an instrument that was widely used. The study was conducted on a curriculum that was developed by the School Mathematics Study Group (Higgins, 1970). For this study, researchers focussed on student attitudes with the use of 18 scales developed by the National Longitudinal Study of Mathematical Abilities (NLSMA). Their focus was on trying to identify an attitude shift from before instruction to after instruction. Hence, a pre and post assessment paradigm was used. Results indicated that attitude shifts existed, but that they were rather nominal. Moreover, the attitude shifts, which in many cases were downward shifts, had no significant impact on achievement.

The second study was conducted by Richardson and Suinn (1972). They developed the Mathematics Anxiety Scale (MARS). It was widely used to assess student anxiety and it was one of the seminal instruments in the field in the early 1970s. This instrument had impressive reliability with ranges from 0.78 to 0.96 and high validity to substantiate its effectiveness at measuring student anxiety in mathematics (Capraro, Capraro & Henson, 2001). A 98 item scale was comprised of concise descriptions of mathematical situations in which college students rated their anxiety.

The third study that had a major impact was by Aiken (1974). He realised that one of the faults of the NLSMA study was that it viewed attitude as a one-dimensional concept. As an ancillary by-product, Aiken claimed that attitude may be multidimensional rather than one dimensional. Aiken's components of attitude were enjoyment and value of mathematics.

The fourth study was conducted by Fennema and Sherman (1976). Fennema and Sherman Mathematics Attitude Scale were composed of nine separate but intricately intertwined scales. Technically, four scales measured student affect and the other five scales concentrated on issues such as gender, student perception of mother interest in mathematics, student perception of father interest in mathematics, student perception of teacher attitudes towards mathematics, and the usefulness of mathematics as a domain. It was the first instrument to assess four components of affect and helped the area of gender issues emerge in the field of mathematics. The four affective scales in the Fennema and Sherman Mathematics Attitude Scale are student attitude, self-efficacy anxiety and value of mathematics.

The fifth study that has had a major impact on the field of mathematics education was conducted by Tapia and Marsh (2004). They developed the attitude towards Mathematics Inventory (AtMI). This instrument is innovative that it incorporates confidence or self-efficacy, anxiety and value as well as enjoyment, motivation and parent-teacher expectations. The 49 item instrument reported on the alpha reliability of 0.96. When altered to 40 item instrument, this reliability rose to 0.97.

Ma and Kishor (1997) meta-analysis on attitude towards Mathematics (ATM) and its relationship to achievement in Mathematics (AIM) should be noted. The emphasis was on attitude and achievement. They did not have an instrument but used statistical procedures data from 113 studies. Data suggest that the effect in males (26%) is greater than it is in females (23%).

Educational psychology and mathematics education have been creative in producing affective instruments. The first instruments created to assess affect often only assessed one area of affect. Researchers quickly realised that multiple areas of affect should be researched simultaneously with the use of one instrument rather than the use of multiple instruments. The field of mathematics education had paid much attention to content areas related to affect. However, the full value of affect yet to be realised. This is due to the fact that affective instruments need to be created and easily implemented. Another reason is that intense pressure on standardised assessments may create a barrier for assessing affect since schools are serious in assessing academic achievement.

McGregor (2014) suggested that students' beliefs and attitudes towards mathematics and learning mathematics influence students' propensity to use mathematics in non-educational settings. It seems that although it is difficult to disentangle affective and cognitive dimensions of learning mathematics, students' cognitive competencies influence their confidence in learning, but affective factors are better determinants of further mathematical study and participation in careers that involve mathematics (Frenzel Thrash, Pekrun, & Goetz, 2007). Thus, mathematical beliefs, attitudes, emotions and dispositions are critical factors in nature, quality and degree of future mathematical engagement.

According to Sosniak, Ethington, and Varelas, (1991) there are striking inconsistencies between different mathematics teachers to the extent that sometimes there were conflicting belief statements given by some mathematics teachers about the concept of mathematical values inculcation. That is why it is necessary to study values rather than beliefs in order to determine the deeper affective qualities that underpin teachers' preferred decisions and actions. Teachers can believe different things to be true or important, but when sharing knowledge, mathematics teachers have to make decisions on the types of values to be conveyed in the classroom and that choice should be made immediately. The researcher suggests that it is one's deeply held values which determine the choices the teachers make.

Buxton (1981), Fasheh (1982) and McLeod (1992) separated the field of research on mathematical values into studies of beliefs, attitudes, and emotions. They asserted that ideas about both beliefs and attitudes towards mathematics were related to values held by both mathematics teachers and learners. Thompson (1992) also discusses the research on teacher beliefs, particularly in relation to mathematics teachers' actions in classrooms. She refers to a repeated finding that mathematics teachers' actions frequently bore no the relationship to their professed beliefs about mathematics and mathematics teaching.

The affective variable, values is increasingly being emphasised in mathematics education research (Bishop, 2001; FitzSimons, Bishop, Seah, & Clarkson, 2001; Jurdak, 1999). Numerous studies have been conducted on mathematics values such as Krathwohl, Bloom and Masia, (1964); Raths, et al., (1987); Tomlinson and Quinton, (1986) on the affective aspects of mathematics education. Buxton, (1981); Fasheh, (1982); McLeod, (1992); Thompson, (1992); Sosniak, Ethington, and Varelas, (1991) addressed the social and cultural aspects of mathematics education. Bishop, (1988; 1991; 1999; 2002); Davis and Hersh, (1981; 1986); Joseph, (1993) and Wilson, (1986) made tremendous contributions to values education.

Mathematics has not enjoyed as much academic and research attention in affective issues as any other subjects, such as the languages, literature studies, history, physical education and the sciences. These subjects deal with aspects of life experiences more directly and more explicitly so that values can be easily associated and discussed with them. Mathematics, on the other hand, often deals with abstract entities and ideas, and with how these are applied to real-life situations.

Studies on Values in Mathematics Education at University of Malaya

Studies on values in mathematics education were also conducted in Malaysia. In 2007, Values Development Project in Mathematics Education and Science (*Project Pengembangan Nilai Dalam Pendidikan Matematik dan Sains*) was started at Mathematics and Science Department, Faculty of Education, in University of Malaya. This six-year project was pioneered by Nik Azis (2007) that had six phases. The research was conducted by University postgraduate students who did Master's degree or Doctor of Philosophy degree in mathematics education supervised by professors Nik Azis and Sharifah Nurul Akmar.

The first phase was to identify critical issues which began in 2007. Nik Azis (2007) started off with values development in mathematics education: challenges and needs. Sharifah Norul Akmar (2007) did a study on noble values in Malaysian primary mathematics education, a teachers' perspective. Fatimah (2007) did a study on the application of values in mathematics education, reality or rhetoric? Nik Azis, (2008a) did a study on critical issues in mathematics education. Nik Azis (2008b) did another study on the dynamics meaning of values in mathematics education. Nik Azis, (2008c) did a study on values in mathematics education and science. Nor Afizah (2008) did a study on values in Form One mathematics textbooks in Malaysia and Singapore. Nor A'idah (2008) did a study on Form Four students' understandings of values in learning mathematics using the Geometer's Sketchpad. Nurul Aduliena (2008) did a study on Form Four students' values in doing science homework. Nurhayani (2008) did a study on Form Four students' understanding the usage values of the graphic calculator in learning statistics. Piriya (2008) did a study on Form Four students' understanding of values development in learning logarithms using a scientific calculator. Roslaini (2008) did a study on values in the syllabus and Form Two mathematics textbook in Malaysia. Seleby (2008) did a study on Form Four students' understanding of values in learning trigonometry using a scientific calculator. Norliha (2008) did a study on values that were given priority by Form Four mathematics teachers in teaching statistics using a scientific calculator. Siti Aishah (2008) did a study on Form Four students understanding of values in learning integrated Chemistry. Siti Azzah (2008) did a study on Form Four mathematics teachers' understandings of values in teaching straight lines. Shiyhaamhalhaa (2008) did a study on Year Five teachers understanding of values in teaching fractions. Yogeswaran (2008) did a study on Form Two mathematics teachers understanding of values in teaching linear equations.

The second phase was the values and ethics definition analysis which was completed in 2009. Nik Azis (2009a) did a study on values and ethics in mathematics education. Nik Azis (2009b) produced a learning module on values development in school mathematics. Noor-Raini (2009) developed a learning module on values development on the topic "Standardised Table" for Form four students. Raiha (2009) studied on Form Two students' mathematics homework values. Sin Min (2009) developed a module on learning fractions using the computer for Year Five pupils. Su Moi (2009) studied on values in mathematics tests and examinations in secondary schools.

The third phase identified the conceptions and analysis of the curriculum contents. Most of the studies were based on the understanding of values. Manimaygelai (2008) did a study on Year Three teachers understanding of values in teaching whole numbers addition. Lalitha (2008) did a study on values priority of Form Four mathematics teachers in teaching trigonometry using a scientific calculator. Juraidah (2008) did a study on values in the Form Four mathematics syllabus and test book in Malaysia. Chew (2008) did a study on Form Four students understanding of values in learning acid and base through the computer. Che Saidin (2008) did a study on Form Four teachers understanding of values development in a mathematics classroom. Saleha (2009) did a study on Year Five mathematics teachers' understandings of values in learning fractions. Sin Sau (2009) did a study on Form Four students understanding of learning electrochemical. Yahaya (2009) did a study on Form Four students understanding of values in mathematics reasoning.

The fourth phase was the development of values learning module. Azizah (2009) developed a learning module on values development on the quadratic equation using the graphic calculator for Form Four students. Mazli (2009) developed a learning module on values development on shape and space using the computer for Form Five students. Maszuin (2009) developed a learning module on values development on learning time using the internet for Form Five students. Ismail (2009) developed a learning module on values development on electro-chemicals for Form Four students. Chew (2009) developed a learning module on values development on mass for Form Five students. Salmiah (2009) developed a learning module on values development on the matrix using the graphic calculator. Samsuddin (2009) developed a learning module on values development on decimals for Form Five students. See Yang (2009) developed a learning module on values development on microorganism for Form Five students. Naliny (2010) did a study on values in Form Four mathematics textbook. Nik Azis, Sharifah Norul Akmar, Nor Afizah and Naliny (2011) did a study on values presentation in primary and secondary mathematics textbook.

The fifth phase was the implementation of values learning module. Nooraini (2013) did a study on Form Five teachers' module usage on decimals. The final phase is to develop values measurement scale. Jeyasingam (2012) did a proposal on the development of an instrument for assessing primary school mathematics teachers. Nik Azis and Jeyasingam (2013) developed an instrument to Assess Primary School Mathematics Teachers' Values in Teaching Fractions.

The final phase is the development of an instrument to measure values in mathematics education. Nik Azis and Jeyasingam (2014) reveal the results of the preliminary analysis for the study, the Development of an Instrument to Assess Primary School Mathematics Teachers' Values in Teaching Fractions. Nik Azis and Ruzela (2014) developed an instrument to assess matriculation teachers' values in teaching mathematics.

The ongoing studies in various research areas on values development in mathematics education conducted by University Malaya students at Master Level and doctorate level on Values Development Project in Mathematics Education and Science acknowledged the importance and successful implementation of values in mathematics education in Malaysia. These theses on modules development, instrument development, analysis of mathematics textbooks, mathematics topics analysis and values understandings enhanced the growth of values development in mathematics education. It is still at an infant stage at the school level. The developed modules on values have been tried by the respective researchers in the schools. Further studies should be done by the new researchers in the future. This study is an initial step in developing instrument measuring values in mathematics education for the Malaysian education system which is based on faith and religion as stipulated by the National Educational Philosophy which is not aligned with the western culture. The ministry of education has reinforced the importance of values inculcation through the Malaysian Education Blueprint 2013-2015.

Studies on Values in Mathematics Education

Values assume an important role in the optimisation of mathematics teaching and learning. The most complex educational objectives in both the cognitive and affective domains of the Taxonomy of Educational Objectives namely evaluation and characterisation are concerned with values (Bloom, 1956; Krathwohl, Bloom, & Masia, 1964). Alan Bishop's (1988) in his book Mathematical Enculturation: A Cultural Perspective on Mathematics Education gave a thorough explanation of values as they relate to the learning and teaching of mathematics.

In general, these research highlight the relevance of values in mathematics education, the roles played by mathematics teachers in the transmission of values about mathematics and mathematics learning to their students, and how a greater understanding by teachers of their own values contributes to a more effective mathematics learning process for students. The notion of values in mathematics education is a relatively new concept, teachers of mathematics often find it difficult to discuss and examine the relevant values. In particular, there is a need for the relevant language and for a more developed conceptualization of values (FitzSimons, Bishop, Seah, & Clarkson, 2001).

Research into the role of values in mathematics and mathematics education is often attributed to the original work by Alan Bishop and his colleagues in Victoria, Australia through the Australian Research Council-funded *Values and Mathematics Project* [VAMP] (1999 – 2002). Research on values in mathematics education in the early 2000s focused on how these were portrayed in the intended curriculum (Cao et al. 2002; Seah 1999), the implemented curriculum (Chang 2001; Chin and Lin 1999, 2000; Leu and Wu 2001; Lim and Saleh 2002; Seah et al. 2001), and the attained curriculum (Brown 2001). Much of mathematics education research into values has so far been devoted to exploring and identifying these qualities as they relate to mathematics teaching and learning (Dede 2006; FitzSimons et al. 2001; Keitel 2003).

Bishop in "Mathematics Teaching and Values Education – An Intersection in need of Research" (Chapter 16) argues that the study of values in mathematics teaching and learning is important and has been given little attention. In "Valuing Values in Mathematics Education" (Chapter 17), Wee Tiong Seah discusses how we might go about doing the needed research on values in mathematics education. Wee analyses what we might mean by values in mathematics education, how we might measure these values, and how we can apply the knowledge derived from these studies to improve mathematics teaching and learning.

Comparisons of how these values were represented across these different levels of the curriculum were also made by Lim and Ernest (1997), as well as by Chin and Lin (2000). Tirosh and Graeber (2003) provided an overview of research that demonstrated how changes in values have led to changes in teachers' practice in the mathematics classroom. A review of mathematics education research in values was included in the current edition of the International handbook of mathematics education (Bishop et al. 2003). According to Seah (2014) values are at the core of teaching any subject, but are rarely explicitly addressed in the mathematics teaching literature. Moreover, research on values in mathematics education is sadly neglected. Moving to the limited research on values in mathematics education, there is a discussion of values in the increasingly researched area of socio-cultural aspects of mathematics education.

Dede (2007b) investigated preservice mathematics teachers' values toward their mathematics teaching with regard to their grade level, gender and departments. Dede adopted a five-point Likert-type scale developed by Durmu and Bicak (2006) to collect data. Developers of the instrument Cronbach's alpha reliability coefficient were found 0.73 for the whole instrument. The instrument was administered to 231 pre-service mathematics teachers who were randomly selected to a four-year teacher education program at the Primary Mathematics Education and in a five-year teacher education programme at the Secondary Mathematics Education Department of one university in Turkey during the spring semester of 2007-2008 academic years. It took about thirty minutes to complete the questionnaire. Unlike in this study, Dede found that female preservice teachers had higher scores for mathematics education values than the males in general. It is left to the new researchers to find out whether the effect of culture, teaching methods, individual differences, and teacher attributes would affect these results.

Earnest (1989) conducted a research study, which related to the knowledge, values and attitudes of the mathematics teacher. He argued that besides mathematical knowledge, it is important to consider teachers' values and attitudes. He defined values as teachers' mathematical conceptions and ideologies and makes the argument that conceptions have a powerful impact on teaching. Therefore, based on their conceptions, teachers select their mathematical content, styles of teaching and modes of learning for the students. Earnest (1989) measured teachers' mathematics values and advocated that it is important to measure teachers' attitudes, which include liking, enjoyment, enthusiasm for the teaching of mathematics, and their confidence in their mathematics teaching abilities.

Existing literature on mathematical values in Turkey revealed a few studies examining pre-service teachers' mathematical values (Durmu and Bicak, 2006). Based on behavioural, cognitive constructivist approaches, (Durmu and Bicak, 2008) categorise the mathematical and mathematics education values into two dimensions such as positivist and constructivist values. Positivist values put more emphasis on teaching mathematics as teacher-centred, abstract and not relating mathematics to the real life experiences.

On the other hand, constructivist values put more emphasis on teaching mathematics as student-centred methods, concretely and relating it to real life experiences. The studies on mathematics teachers or pre-service mathematics teachers, mathematical and mathematics educational values are getting more attention in world literature (Australian VAMP and the Taiwanese VIMT projects). These studies have revealed mathematics teachers or pre-service mathematics teachers' values and how these teachers explicitly or implicitly convey their values into their classroom environment or why mathematics teachers could not hold values (Lin & Tsai, 2006).

Values in Mathematics Education

There are numerous studies on values education generally but less is known about values teaching in mathematics class (Tomlinson & Quinton, 1986). Sam and Ernest (1997) classify the values about mathematics education as epistemological values, social and cultural values and personal values. Epistemological values are the values which are about the theoretical side of mathematics learning and teaching such as accuracy, systematicness, rationalism, characteristics, appreciation and acquiring of mathematical knowledge. Social and cultural values are values that indicate people's responsibilities about mathematics education for society such as compassion, integrity, moderation and gratitude. Personal values are values that affect a person as an individual or a learner such as curiosity, thriftiness, patience, trust and creativity.

Sam and Ernest (1997) did a study on teachers' values in mathematics education: what is planned and what is espoused? The researchers analysed the curriculum and prepared a questionnaire with open-ended questions for three groups of teachers with teaching experiences ranging from 1 to 20 years. The kindergarten teachers stressed the epistemological values most, followed by personal values. The primary mathematics teachers put equal emphasis on cultural, social values and personal values. The secondary mathematics teachers most emphasised personal values, followed by epistemological values. The distribution of values in the mathematics syllabus matches best with the secondary teachers. Most of the explicitly stated values are epistemological, followed by personal values. The researchers compared the explicit and implicit values of the mathematics curriculum with those espoused by the three groups of school mathematics teachers. Not all intended values are mentioned by the teachers and not all values mentioned by the mathematics teachers are explicitly or implicitly expressed in the curriculum.

Values such as effectiveness, responsibility, accuracy and analyticity which are much emphasised in the curriculum were rarely mentioned by the teachers. However, the teachers tend to express values such as careful, cautious, and decisive and differentiate. These are values related directly to mathematics learning. All the teachers emphasised both the importance of valuing of time and the valuing of thrift in mathematics lessons. These two values explicitly spelt out in the detailed primary mathematics syllabus. Thus what is included in the planned syllabus is reflected in teachers' espoused values. The value, not easily deceived by others was selected by most of the teachers especially primary and kindergarten teachers. The values persistence, patience and discipline selected by mathematics teachers because they are related to the process of mathematical problem-solving. Some of the 16 moral values namely freedom, love, respect, humility and physical and mental cleanliness neither occur explicitly or implicitly in the mathematics curriculum documents nor were they espoused by any of the mathematics teachers. They are supposed to be inculcated via all subjects including mathematics but apparently, they are not. In conclusion, most of the values expressed either explicitly or implicitly in the mathematics curriculum are espoused by the mathematics teachers.

However, the study found out that what is mentioned by the mathematics teachers may not reflect the values reflected and enacted in the mathematical classroom. Sam and Ernest's findings revolve more on general educational values rather than mathematical educational values and mathematics values. Further study is needed to investigate the extent to which the values mentioned are actually integrated into mathematics teaching as enacted values.

Bishop (1999) classifies values taught in mathematics lessons into three different types by making them more specialised than that of Sam and Ernest (1997). General education values are related to general societal values which help teachers, schools, culture, society and students to improve. Generally, they contain ethical values such as; good behaviour, integrity, obedience, kindness and modesty, philanthropy and responsibility. (Bishop, 1999; Fitz Simons, Seah, Clarkson, & Bishop, 2000). Warning a student who has been cheating during the examination can be given as an example for such kind of values (Seah & Bishop, 2000).

Mathematics education values are related to the pedagogy of mathematics that is, to the practices and norms emerging from mathematics instruction. These values which emerge in environments where mathematics is learnt and determines teachers' and students' tendencies towards mathematics education. Some of the values related to mathematics education are listed as follows: Formalism, activism, instrumental learning, relational learning, relevant, theoretical, accessibility, specialism, evaluating, reasoning and pleasure (Chin & Lin, 2001; Clarkson et al., 2000; Horzum & Kiymaz, 2011; Seah & Bishop, 2000). These values are embedded in the curriculum, textbooks, classroom practices, as a result of the other sets of values. The responses indicated a strong preference for values associated with problem-solving and investigations. These values embody non-standard ways of doing mathematics. They emphasise understanding over the result, a statement which nearly all the teacher respondents agree to the research fields of values in school mathematics teaching and learning. Teaching mathematics education values may show differences according to countries, cities, and schools.

Mathematics values are related to the scientific discipline of mathematics, the values that reflect the nature of mathematical knowledge. They are produced by mathematicians who have grown up in different cultures (Bishop et al., 1999). Culture stands as a powerful determiner of mathematics values. Studies show that basic values of all cultures have not been shared. Mathematics teachers' work in different cultures does not teach the same values, even if they have taught them the same curriculum (Bishop et al., 2000). Bishop (1988) classifies mathematics values taught in western culture into three categories as complementary of each other. Mathematics values are values like openness, mystery, rationalism, objectivism, progress and control which mathematics carries in its nature. Proving Pythagorean Theorem in three different ways and their appreciation is an example of mathematics values (Seah & Bishop, 2000).

Values in mathematics education were vastly discussed by Bishop in the aspect of sociocultural approach whereas Nik Azis discussed in the aspect of universal integrated perspective. Some values may be related to two or three of these categories at the same time. For example, the values of progress and creativity are both related to mathematical, mathematics educational and general educational values (Seah & Bishop, 2000; Seah, 2008).

Mathematics is just as much human and cultural knowledge as is any other field of knowledge. Teachers inevitably teach values, and adults certainly express feelings, beliefs and values about mathematics which clearly relate to the mathematics teaching they experience at school (FitzSimons, 1994). The quality of mathematics teaching would be improved if there were more understanding about values and their influences. The notion of values is not new in anthropology (Kluckhohn, 1962; Hofstede, 1997). In the context of mathematics education values is a relatively new area of research interest.

According to Chin, Leu, and Lin (2001), the values portrayed by teachers in mathematics classrooms are linked to their pedagogical identities. The mathematics educational values identified from the study reported in Chin and Lin (2000) take quite a different form: ‘mathematics education seeks to develop students’ knowledge, abilities, intellect and personality’ and ‘mathematics education seeks to improve students’ involvement and to like mathematical knowledge. Values in mathematics education are the deep affective qualities which education aims to foster through the school subject of mathematics (Bishop, FitzSimons, Seah & Clarkson, 1999). They are important components of the classrooms’ affective environment.

According to universal integrated perspective, there are three categories of values that could be developed by teachers and pupils in a mathematics classroom. They are general education values, mathematics education values and mathematics values that could be exposed through the implementation of the teachers' role, textbooks and syllabus (Nik Azis, 2009). The values in the mathematics classroom, in schools and in the society are interrelated to one another.

The general education values are related to human development. The values are associated with the norms of the particular culture, of the particular society, of the particular educational institution. From the hierarchy aspect, universal integrated perspective classifies the general education values into four types such as basic values, main values, core values and developmental values. The basic values related to life principles, core values related to life necessities, main values related to individual personality and developmental values related to self-development. Politeness, respect fairness and belief in God are examples of general educational values.

The mathematics education values are values related to teaching and learning of mathematics. Values embedded in the curriculum, textbooks, classroom practices and others because of other sets of values. Mathematics education values are carefully associated with the norms of the institution within which mathematics education is formally conducted (Bishop, 1996) and include the norms and practice of teachers in the mathematics classroom. Values like authority, technology and tool in exemplifying these values portrayed by teachers, schools, and education boards. The mathematical values are values which have developed as the subject has developed within the particular culture. Values related to characteristics sources, truth, or mathematics knowledge application.

Mathematics values relate to qualities of the discipline of mathematics to which an individual attribute worth and importance. Bishop (1988; 2001) suggests three complementary pairs of these that are rationalism and objectivism, control and progress, mystery and openness. Memorisation, ethics, reflection, participation, communication and mathematics for the utility are examples of values in mathematics education. The mathematics values encompass ideology values, truth, sentimental and sociology. Mathematics values relate to the epistemology of mathematics as a discipline.

Values in mathematics education may reflect differences according to country, city, school type, and grade. Research on studying values in mathematics classroom was to explore the educational values that mathematics teachers have concerning mathematics and pedagogy, and its effects on their classroom teaching and student learning.

Learning and Teaching of Values in Mathematics Education

According to Bishop (1990) like any other education, values teaching and learning does occur in the teaching and learning of Mathematics and numeracy. Nevertheless, values are never conveyed explicitly but implicitly in mathematics classrooms. The values the pupils learnt are not what the teachers expected. The question arises, why is there little explicit values education in Mathematics classrooms and why do Mathematics teachers know so little about values in this context? This implies that changing teachers' values and understandings of the subject being taught may well change the values they can emphasise in class. The best time to develop mathematical value competences is during teacher training.

According to Seah (2002), values are crucially important parts of mathematics learning and teaching. Clarkson and Bishop (1999) also supported a similar approach.

They indicated that the importance of values is not very well known by mathematics teachers. Clarkson and Presmeg (2008) found out that mathematics teachers replied that they are not teaching values in the classroom, only mathematics. In the mathematics classroom, it is important that the teacher provides students with regular opportunities to reflect on the values and issues that arise from the subject matter and from the interaction of the students and the teacher. Teachers' beliefs and values may also be an essential aspect of their classroom practices (Ambrose, Clement, Philipp, & Chauvot, 2004). A Recent study has shown that teacher beliefs about mathematics had a stronger effect on teachers' practice than beliefs about teaching (Philipp et al., 2007; Wilkins, 2008).

Teaching values are not like teaching fractions. There is no right answer of teaching values. Even though one can expertise on teaching fractions, one may not always be adequate in teaching values. But, it is an obligation that one has more information about values which play a vital role in mathematics educational development (Bishop et al., 2000). It is important for teachers to be aware of the values they have and develop an awareness of values and value preferences toward teaching (Chin, 2006).

In the early 2000s, the 'Values and Mathematics Project' investigated the range of values espoused by classroom teachers, and found that partly due to the lack of a shared language, teacher awareness and control of what they value in mathematics teaching practice can be enhanced (Bishop, FitzSimons, Seah & Clarkson, 2001). In another project, Bishop, Clarke, Corrigan and Gunstone's (2005) experience with the teacher participants revealed that the values that were portrayed were influenced by their respective disciplines of mathematics and science. Values represented in mathematics textbooks in countries such as Australia, China, Turkey and Vietnam have also been examined and it was found that the espoused values were dependent to some degree to culture (Cao, Seah, & Bishop, 2006; Dede, 2006). Research studies have been directed to how these can be utilised to foster mathematical wellbeing (Clarkson, Bishop, & Seah, 2000), and the extent to which particular commitments are co-valued by teachers and their students across eleven nations and regions (Seah, 2000).

The teaching of mathematics is also value-laden, but there is no clear thought about how the values are taught (Bishop, FitzSimons, Seah & Clarkson, 1999) or that each philosophy of mathematics has a separate effect on educational practices (Ernest, 1991). Values are generally taught implicitly rather than explicitly in mathematics (Bishop, 2004). He also conceptualised five pairs of complementary mathematics educational values: formalistic view–activist view, instrumental understanding–relational understanding, relevance–theoretical knowledge, accessibility– special, and evaluating–reasoning. Seah & Bishop (2000) explained that the five pairs involve: Mathematical values explore the abstract and axiomatic structure of mathematics and it's complementary a concrete progressive continuum. Mathematics education values require that mathematics teaching takes into consideration features such as consistency, flexibility, creativity, enjoyment, and persistence. Generally, these values can be regarded as three pairs of the complementary mathematics educational values mentioned above.

Both teachers and students even mathematics are value-carriers (Bishop et al., 2003). Several researchers have developed instruments to measure values among in-service teachers and pre-service teachers. Developing preservice teachers' mathematics knowledge and values, before they begin their classroom practice, may enhance the mathematics knowledge and values that these teachers will bring to the classroom (Kajander, 2005; Sowder, 2007). It is also relevant to measure their mathematical values and attitudes (Stipek, Givvin, Salmon & MacGyvers, 2001; Ernest, 1989). It is well documented that teachers' content knowledge of mathematics is crucial for improving the quality of instruction in classrooms (Hill & Ball, 2005). Influencing teachers' beliefs and values may also be essential to changing teachers' classroom practices (Stipek et al, 2001). Hill and Ball feel that teachers can deepen their mathematics knowledge for elementary school teaching in the context of a single professional development program and that a feature of successful programs is to foreground mathematical content.

Teachers are often reminded of their role as an educator of human character, not just as a teacher of subject content (Pantić & Wubbels, 2012). Indeed, teachers play the roles of both moral agents and values educators (Campbell, 2006). Forster (2012) traced the development of the kinds of values teachers in Australia have been expected to teach. Teachers harness what is valued by the classroom community and inculcate other appropriate values as needed with the aim of fostering student understanding of and performance in mathematics. However, values are rarely taken seriously at mathematics educational discussions and mathematics teachers are generally interested in operations that have only one answer. They do not believe values teaching in mathematics lessons (Clarkson et al., 2000).

Many mathematics teachers found themselves in need of a common vocabulary with which to talk about what each of them values, possibly because these values may be so much part of the individual's life that they may not be made consciously aware of, as conceptualised when they regarded values as the most internalised affective quality of an individual Krathwohl et al (1964). These teachers might not have considered these values worthy of mention (Seah, Bishop, FitzSimons, & Clarkson, 2001). There is also the possibility of teacher sensitivity about talking about one's own values pertaining to education and mathematics education (Clarkson, Bishop, FitzSimons, & Seah, 2000).

Values in mathematics education are those values conveyed in mathematics teaching and learning that are used to facilitate mathematical understanding of concepts and relationships between mathematical abstractions and real life applications. This process conceptualised as the deep affective qualities which mathematics teachers promote and foster through formal school mathematics teaching and learning. Teachers play a vital role in the social reconstruction and in the transmission of wisdom, knowledge and experiences of one generation to another. Children, the leaders of tomorrow always rely on their teachers for knowledge and information. It is, therefore, necessary to realise that the emerging Malaysian society can achieve all round development with the help of the teachers who powerfully transmit their cherished values. The standard of primary school' mathematics lesson in the classroom is dependent largely upon the quality and character of the teacher. Values in mathematics education need to make explicit in order that they are affirmed, challenged or rejected allowing teachers to act in good faith for the ultimate benefit of their students.

Many teachers transfer and clarify values to their students in the mathematics classroom. The transfer of values develops their personal interpretations to values to a certain extent. In the clarification of values, the teacher supervises the process of values development of students. Teachers are looking for a pedagogical and didactic approach in which they seek to do justice to the students' own development as well as stimulating the values that are important to themselves. The interaction between the teacher and pupils in mathematics classroom activities is considered as the place where social mediation and negotiation of teacher and pupils are taking place. What the teacher values as important for their pupils will be enacted and emphasised in teaching. Teachers believe that mathematics learning has value for their students, may have never considered the particular values they are imparting. The values taught, whether explicitly or implicitly, seems to depend heavily on one's personal set of values as a person and as a teacher. Teachers are also a role model for their students to demonstrate certain values and skills. However, it was postulated that values inculcation in mathematics teaching and learning occurs consciously or unintentionally as is the case in other disciplines (Seah & Bishop, 2010 & FitzSimon et al., 2000).

Cai and Wang (2010) found that mathematics teachers from the Eastern China and the United States of America differed in their view of effective mathematics teaching, and this difference was closely related to their values about the nature of mathematics. International comparative studies such as PISA 2003 (OECD, 2004) have shown that effective teaching is more about responding to the socio-cultural aspects of the learning environment rather than adopting a particular pedagogy. Recognising that values play a central role in any culture, values in mathematics education is thus regarded not as an affective factor, but more a socio-cultural product, (Seah & Wong, 2012). Consequently, mathematics classroom is considered an important venue where teachers and students negotiate their values, and where complex interaction and discourse exchanges are being carried out.

Many mathematics educators believe that the values which mathematics teachers bring to various aspects of their work profoundly affect what and how they teach, and therefore what and how their students learn (Bishop et al., 2003). This resulted in the mathematics teachers understanding about their own pedagogical value positions, more flexibility in their thinking about and practice of classroom teaching of mathematics (Chin & Lin, 2001). Based on a case study of one expert secondary mathematics teacher's value positions and value clarification process, a 5-stage cognitive-affective transition process was suggested, and the teacher's values teaching was closely related to both his awareness of and willingness to, teach such values in the classroom (Chin & Lin, 2001).

Pollard (2002) indicated the importance of identifying the present value-positions from three aspects. First, it helps the teacher to assess whether we are consistent, both in what we believe and in reconciling differences which may exist in a school. Second, it helps the teacher to evaluate and response external pressure. Finally, it can help the teacher to assess whether what we believe is consistent with how we actually behave. According to Chang (2005), the awareness or clarification of values that teachers posit can bring them more concentrated on the classroom teaching and learning activities that values are loaded.

Bishop (2008) in his study Teachers' Mathematical Values for Developing Mathematical Thinking in Classrooms: Theory, Research and Policy discusses assisting teachers to nurture mathematical thinking in their students by using findings from research on mathematical values. The author begins by sharing three theoretical perspectives on how mathematical thinking develops in a student from Lancy (1989), Billett (1998), and Bishop (1988). Using White‟s (1959) three-component analysis of culture, the author presents 6 mathematical values which are important to the development of Mathematics and thus underpinning the development of mathematical thinking in the classroom. An exploratory Values and Mathematics Project (VAMP) shows that teachers found it difficult to discuss values they held about Mathematics education in relation to Mathematics. The introduction of some of the theoretical terminology helped teachers to discuss their teaching. In conclusion, the author proposes some implications for practice and policy.

Measuring Values in Mathematics Education

Several researchers have developed instruments to measure values in mathematics education among in-service teachers and pre-service teachers (refer Appendix B). One of the pioneers in the values research is Bishop. Bishop made use of three theoretical ideas such as Lancy's development theory of cognition, Billett's (1998) analysis of the social genesis of knowledge and Bishop's (1988) socio-cultural dimension and its levels as bases for the development and validation of an instrument. Using White's (1959) three-component analysis of culture namely ideological component (composed of ideologies, dependent on symbols, philosophies), sentimental (attitudinal) component (attitudes, feelings concerning people, behaviour) and sociological component (the customs, institutions, rules and patterns of interpersonal behaviour), Bishop presents six mathematical values which are important to the development of mathematics, and the development of mathematical thinking in the classroom. Bishop (1996) classified three types of values observed in the mathematics classrooms. They are general educational values, mathematical values, and mathematics educational values. Bishop (1988, 2004) outlines three dimensions of complementary value pairs: Ideology: Rationalism and Objectivism Sentiment: Control and Progress Sociology: Openness and Mystery. On the other hand, Bishop (2004) conceptualised mathematics educational values as being formalistic view and activist view, instrumental understanding and relational understanding, relevance and theoretical knowledge, accessibility and special, evaluating and reasoning.

Bishop did his research on educating student teachers about values in mathematics education. He developed students' questionnaires and teachers' questionnaires as instruments. Bishop's instrument was based on sociocultural approach compared to this study's universal integrated perspective. Bishop's (1986) instrument had three values dimensions and six mathematics values indicators. The instrument consisted of student questionnaire and teachers' questionnaire. Bishops' Student Questionnaire consists of four main questions. Question1 consists of 18 ranking scale items.

Question 1 involves the teachers' emphasis on the ideological components of Mathematical values namely rationalism and empiricism, the sentimental (Attitudinal) components of Mathematical values namely valuing Control and valuing Progress, the sociological components of Mathematical values are Openness and Mystery. All the items are related to student centred learning. Ideology concerns the ideas of mathematics, while Rationalism deals with the deductive reasoning, about proof and building an argument on stated axioms and definitions. The sentiment-dimension is concerned with feelings and attitudes. Control is related to materialism and being able to predict and describe objects. Progress is a more dynamic feeling, related to development, choice and improvement. The sociology-dimension describes relationships between people, and between people and mathematics. Openness means that mathematical principles are regarded as universal truths, open for anyone to learn and use, so, in that way, mathematics is democratic subject. Mystery describes mathematics as being an abstraction. Mathematical facts and algorithms can be understood, and real world phenomena, like planet movements, can be described by mathematics, which gives a feeling of security and control.

Question 2 consists of six preference items. It involves eighteen aspects of teaching and student centred learning. Question 3 consists of 12 rating scale items that teachers have to answer why Mathematics is valued in the school curriculum. Question 4 consists of 19 Likert scale items to answer why Mathematics is valuable knowledge. Bishops theory, nobody is doing the valuing as mathematical values exist in the cultural context of Western mathematics. These three dimensions are values that are typical for “western mathematics”, the mathematics taught through school and in university, based on the axiomatic systems.

This study is similar to Bishop’s in terms of construct and sub-constructs but not similar to the number of values dimensions and values indicators. The current study has nine values dimensions and 36 values indicators. Teachers were supposed to answer the questions based on general education values and fractional knowledge. The 250 respondents who are teachers answered on a 5-point Likert-scale. There were differences in terms of theory used, research design and methodology, the purpose of the study, data collection, data analysis and data interpretation. Bishop’s study did not answer the current study’s research questions.

Values in mathematics education became important in Turkey. Dede (2005) did a study on mathematics educational values of college students towards function concept. The subjects for this study consist of three hundred forty-three students. They are the first, second, third, and fourth-year students from the Primary Mathematics Education at Cumhuriyet University (CPME). The students’ ages were approximately between 17 and 25. The students were asked to answer five of ten open-ended questions relating to the function concept. The test consisted some chosen items adapted from the research done Chin and Lin (2000). Data were collected from 10 open-ended and 11 items reasons of question choose. The findings showed that the students from all grades preferred, in terms of learning the function concept, those questions that hold the formalistic view values, relevance values, instrumental understanding and learning values, accessibility values, and reasoning values. The students usually responded to the questions in the test by taking into consideration the mathematical educational values that they own. The first five questions preferred have familiarity with the topics that the students studied in their maths textbooks and during the lessons. This study only determined mathematics students' mathematics educational values towards function concept. The general education values and mathematics values were not taken into consideration. Social constructivism was used to guide this study. Dede's study answered different research questions, used different design and methodology and the students' answered items on function. Dede's research is to find out how much mathematics educational values take place in the function concept teaching. In this study, the researcher intended to find out how much general education values, mathematics educational values and mathematics values takes place in the teaching of fractions.

In another study, Dede (2010) developed an instrument, the Mathematical Educational Values Questionnaire (MEVQ) to measure Turkish preservice teachers' mathematics education value toward their mathematics teaching. The sample consisted of 107 preservice primary mathematics teachers (62 males and 45 females) enrolled at Cumhuriyet University in Sivas, Turkey. Items for the MEVQ were developed based on the VAMP literature (Bishop, 2002; Seah & Bishop, 2000). Twenty-nine items were positive statements anticipating agreement, while 23 items were negative statements anticipating disagreement answered on a 5 point Likert-type items. The MEVQ's structural and predictive validities were examined using exploratory factor analysis and item analysis, item–total correlations and comparison of differences in means for distinctly different groups. The varimax rotation showed that the MEVQ included four factors; 37 of the 52 original items that did not significantly load on any of these factors were deleted.

The revised questionnaire was administered to 107 preservice mathematics teachers. The mathematical values examined in the questionnaire are rationalism and objectivism, control and progress, and openness and mystery. The mathematical educational values are: formalistic view and activist view, instrumental understanding and relational understanding, relevance and theoretical knowledge, accessibility and special, evaluating and reasoning. Dede's study is similar to this study in the development process but used a different theory and did not include general education values. Dede used both positive and negative items as compared to only positive items in this study.

Researchers Luttrell, Callen, Allen, Woods, Deeds, and Richard (2010) developed a self-report inventory that measures individual differences in the perceived value of mathematical literacy for general education students. The survey started with an initial 88 items for the Mathematics Values Inventory (MVI). Five experts evaluated the items. 15 items were eliminated after two rounds of item sorting. The instrument was tested with 38 students. The 70-item instrument was done on 944 non-mathematics major students where 39 items were eliminated. The second large scale item tries out was done to 1096 non-mathematics major students. The gender-related differences in mathematics value and reported relations between task-related value and mathematics participation were studied. The 5-point Likert scale instrument was used. A test re-test study on the 28 item instrument the MVI focuses on the value students place on mathematics, where students value different subjects in different ways. The four components of mathematics value were correlated.

Each item was evaluated for skewness, kurtosis, and inter-item correlations. Inter correlations on the final inventory ranging from r = .42 to.59. The strongest correlations were found between students' interest in mathematics and the three other facets of mathematics-related value, with the most robust relationship found between interest and utility scores. The normality test, principal components analysis, factor analysis and Cronbach alpha was used to identify items with high structure correlation. It was found that (a) MVI scores for students who were not majoring in mathematics did not differ by gender, (b) students who had higher MVI scores had completed more college course work in mathematics than did students with lower scores, and (c) MVI scores were not related to scores on a measure of social desirability.

Values in mathematics education gained importance in Taiwan. The study of Lin, Wang, Chin, Chang (2006) focussed on Taiwanese student teachers in the Values in Mathematics Teaching (VIMT) project. The constructs were based on values such as mathematical communication, mathematical essence, mathematical forms, reasoning, thinking individually, and learning with pleasure. The case study method, also a longitudinal study, conducted a questionnaire survey, interviews and classroom observations, investigated the pedagogical values of a group of six student teachers. The study was based on the grounded theory. The study found out that teachers are all aware of certain values, but they may not have the willingness to teach them. The study indicated that teachers may acknowledge some pedagogical values and regard them as important ones, but does not assure that they will actually teach them in the classroom. The findings did not answer this study's research questions and showed that most teachers are not transmitting values in a mathematics classroom.

A research on values in education was conducted in Malaysia. Ernest and Sam (1977), explored values that are explicitly and implicitly documented in the Malaysian school mathematics curriculum and to compare them with mathematics teachers' perceptions of what values are appropriate to be taught through mathematics. The researchers analysed the official school curriculum and the questionnaires completed by teachers. Three groups of teachers were given a questionnaire with open-ended questions. They were opportunity samples, with teaching experiences ranging from 1 to 20 years. The kindergarten and primary school teachers were given the questionnaires during in-service courses on mathematics whereas the secondary teachers when the first author visited their schools.

The study finds that what is planned only partially matches what is espoused by the teachers in the sample. The kindergarten teachers stressed the epistemological values most, followed by personal values. The primary mathematics teachers put roughly equal emphasis on the three categories stressing cultural and social values a little more on those of the 16 moral values that fall within this category, followed by personal values. The secondary mathematics teachers most emphasised personal values, followed by epistemological values. Some of the 16 moral values such as freedom, love, respect, humility and physical and mental cleanliness neither occur explicitly or implicitly in the mathematics curriculum documents nor were they espoused by any of the mathematics teachers. Values are supposed to be inculcated via all subjects including mathematics but it was not done. Furthermore, the researchers found out that values expressed either explicitly or implicitly in the mathematics curriculum are espoused by the mathematics teachers. What is mentioned by the mathematics teachers may not reflect the values reflected and enacted in the mathematical classroom? It was suggested that further study is needed to investigate the integration of mentioned values into mathematics teaching. Based on the findings, values get less importance in a mathematics classroom.

Durmu and Bicak (2008) developed a scale to investigate pre-service teachers' mathematical values. Based on behavioural, cognitive constructivist approaches, (Durmu and Bicak, 2008) categorised the mathematical and mathematics education values into two dimensions such as positivist and constructivist values. The sample consists of 214 participants, from the department of elementary school (101), mathematics teaching (66) and department of science (47). The participants answered the 40-item scale. The principal component factor analysis verified factor loadings of the mathematical and mathematical educational values. The items of the scale were reduced to 34. Twenty of 34 items were loaded to constructivist and 14 of 34 items were loaded to positivist mathematics and mathematics educational values. Rest of the items, which were loaded correlated weakly were extracted from the scale. The mean scores of pre-service teachers indicate that the mean scores of constructivist values (M= 3.97; SD=0.43) is higher than the mean scores of positivist values (M=2.85; SD=0.52) in general. It was found that there were no significant differences among mean scores of the departments. Positivist values put more emphasis on teaching mathematics as teacher centred, abstract and not relating mathematics to the real life experiences.

One of the recent studies was from the Third Wave Project initiated in 2008 at Monash University in Melbourne, Australia (Seah & Wong, 2012). It is an international research project investigating teachers' and students' values in mathematics learning in different cultures and to develop a survey tool to continue investigating values, independently of culture (Seah 2012). "What I find important when learning mathematics (WiFi) is a survey study, conducted in countries such as Australia, Brazil, China, Hong Kong SAR, Malaysia, Singapore, Sweden, Taiwan, Turkey and the United States. In the WIFI-study, the three categories namely mathematical values, mathematic educational values and cultural values were studied. This is although similar to Bishop's study and this study, general education values were not taken into consideration. All have sub-dimensions of values, and the study deals with a set of 24 different values. The questions posed are about different learning activities, regarded as value indicators. In the designing stage of the WIFI questionnaire, the learning activity "Learning the proofs" is categorised as an indicator of the mathematical value of rationalism similar to Bishop (1988), and "Doing mathematics by myself" is categorised as an indicator of the cultural value of individualism (Hofstede 2005).

This investigation consists of a web-based questionnaire with 89 questions. The WIFI Questionnaire consists of three sections. Section A is made up of 64 five-point Likert scale items, absolutely important, important, neither important nor unimportant, unimportant, or absolutely unimportant. Section B of the WIFI Questionnaire is made up of 10 slider rating scale items. Each item presents the respondent with a pair of opposing values at the ends of a line. The last section of the WIFI Questionnaire was designed to identify student values which might not have been covered in the previous sections. Thus, the four items here are open-ended and contextualised in a scenario. An interview session with each of the teacher participants was also held after each of the student focus group sessions. These were designed to be semi-structured in nature to allow for exploration into emerging issues and topics. The main aim of these interviews was to gather from the teachers their reflections on the lessons just observed.

A total of four teacher participants and six students from each class, 24 student participants aged between 11and 15 year old for each participating nation. The last 2 years of primary school and the first 2 years of secondary school students were selected. The study was based on socio-cultural perspective similar to Bishops. To investigate cultural values, the project uses the theoretical framework of Hofstede and Hofstede (2005). These various sources of data were analysed qualitatively. An efficient way of finding out what students' value is through the administering of an appropriate questionnaire. The 'What I Find Important [WIFI] in mathematics learning' questionnaire is one such instrument which had been designed and subsequently validated cross-culturally for this task specifically. WIFI study will give us the distribution of value indicators rather than values. Seah (2012) concluded that value indicators can be measured, compared and analysed but values still seem immeasurable.

Researchers Liman, Sahari, and Shittu (2012) did a study on exploration and evaluation of the mathematical values inculcation instrument. The study aims at investigating and understanding the underlying factors of values inculcation in mathematics teaching and learning among mathematics teachers in the Northeastern region of Nigeria. The study involved 509 secondary school mathematics teachers in the Northeastern region of Nigeria. Data was collected using a self-constructed survey instrument made up of five latent constructs of values inculcation in mathematics teaching and learning. They were ideological mathematical values measured by twelve (12) items, attitudinal mathematical values measured by twelve (12) items, sociological mathematical values measured by seven (7) items, computational mathematical values measured by twelve (12) items and motivational mathematical values measured by nine (9) items. A seven-point Likert-type measuring scale of 1 to 7 with one (1) being Strongly disagreed (SD) and seven (7) being Strongly Agree (SA) as well as one (1) being Never (N) and seven (7) being Always (A) were the options presented to the respondents. This paper explores some of the universal values that are supposed to be teleguiding mathematics instructional content delivery. This study showed the importance for teachers to improve values inculcation in mathematical content delivery. Mathematics teachers have the opportunity to inculcate the values that are embedded in mathematical contents to the students in a mathematics classroom. The students could see the beauty of learning mathematics rather than concentrating on the procedural aspect of mathematical contents.

The study is different from the current study since it was an evaluating instrument rather than developing a new instrument. The questionnaire is to evaluate secondary school mathematics teacher' attitude and competence in mathematical values. The latent constructs are not similar to this study. Most likely, the three sub-constructs general education values, mathematics education values and mathematics values were divided into five latent constructs to give more items.

The teaching of values in mathematics education goes beyond the cognitive domain, to encompass the affective domain, and even the embodied, enactive domain as in the case of practical activities or the physical formation of students into small groups. On the other hand, the studies on mathematics teachers, mathematical and mathematics educational values are getting more attention in world literature such as the Australian VAMP and the Taiwanese VIMT projects. These studies revealed mathematics teachers values and how these teachers explicitly or implicitly convey their values into their classroom environment or why mathematics teachers could not hold values (Lin, Wang, Chin & Chang, 2006). The teachers involved in this project are being made aware of a wider range of values, including the values associated with the discipline of mathematics and those of mathematics education whether these values might be planned for explicitly or not or whether they might be implemented explicitly or not (Bishop, Clarkson, Fitzsimons, & Seah, 2000).

According to Bishop et al (2000), there is relatively little knowledge about what values teachers are teaching in mathematics classes, about how aware teachers are of their own value positions, about how these affect their teaching and about how their teaching thereby develops certain values in their students. Values are rarely considered in any mathematics teaching discussions and teachers, when asked about their values they are teaching in mathematics lessons, do not believe they were teaching any values at all. All teachers teach values but that most values teaching and learning in mathematics classes happen implicitly. A number of teachers who believe that mathematics learning has value for their students may have never considered the particular values they are imparting. The values taught whether explicitly or implicitly seem to depend heavily on one's personal set of values as a person and as a teacher (Bishop et al., 2000).

Trujan (2001) emphasised that teacher's commitment, dedication and creativity are the most important characteristics that a teacher should possess especially for social transformation. Miliband (2004) said that teachers must teach the right things in the right way with the right values. Teaching values have become important in education during recent years. What teachers do explicitly and implicitly in and out of the classroom has a definite impact on the values students' learn. The extent to which teachers actually practised shared values had an important influence on students' values development (The Curriculum Corporation, 2003).

According to Kajander (2005), the teacher's impact on students' success found in previous research led to the investigation of pre-service teachers' perceptions of conceptual and procedural knowledge and values at the junior intermediate level. Developing pre-service teachers' mathematical knowledge and values, before they begin their classroom practice, may enhance the mathematical knowledge and values that these teachers will bring to the classroom (Kajander, 2005; Sowder, 2007). Further teachers cannot withdraw from showing the values that are important to them. This relationship amongst values, mathematics and society has been found to be the source of cognitive dissonance amongst immigrant teachers of mathematics in Victoria (Seah, 2002).

In the context of mathematics education, values are a relatively new area of research interest. Chin, Leu and Lin (2001), said that the values portrayed by teachers in mathematics classrooms are linked to their pedagogical identities. Seah and Bishop (2001), describe the values held by teachers as representing their magnetisation of affective variables such as beliefs and attitudes, and the subsequent internalisation of these values into their respective cognitive personal system.

Since the last two decades, research in values in mathematics education gained more attention compared to previous years (Bishop, Clarke, Corrigan, & Gunstone, 2005). The researchers showed differences on research focus, values definition, basic theory, literature review, research design, data collection and data analysis techniques. None of them included religious teachings.

In general, research in values in mathematics education involves areas such as cognitive, affective, teaching and learning, teachers' education and education's curriculum. According to Leu and Wu (2005), research on cognitive including mathematics teachers' pedagogy values was done. Hannula (2002) had done research on affective including emotion, attitude, hopes and values in mathematics. Seah (2002b) had done research on perception, interaction and differences in value among mathematics teachers. Lim and Fatimah (2002) had done research on differences in culture and values in mathematics education. In teaching and learning area, Bills and Husbands (2005) had studied values in mathematics and values in mathematics education in a mathematics classroom. The values in using technology in learning mathematics topics were done by Nik Azis and Nurhayani (2008).

Dede (2006) investigated how much importance do mathematics and its educational values have, in the mathematics textbooks in 6th and 7th primary school grades in Turkey. A total eight 6th and 7th-grade mathematics textbooks that were chosen by random approach are analysed with semantic content analysis. As a result of the analysis, it has been fixed that rationalism, control and openness values among mathematical values are emphasised more than complementary pairs of formalistic view, theoretical knowledge, instrumental understanding, accessibility and evaluation both in 6th and 7th grades mathematics textbooks. Dede (2006) did a study on mathematics educational values of college students towards function concept. He found out that the students from all grades preferred, in terms of learning the function concept, those questions that hold the formalistic view values, relevance values, instrumental understanding and learning values, accessibility values, and reasoning values.

Ersen Yazici, Murat Peker, Erhan Ertekin and Bulent Dilmac (2011) did a study to determine the relationship between pre-service teachers' mathematics values and their teaching mathematics anxieties in mathematics in Turkey. The respondents were 359 teacher candidates from the elementary school mathematics, secondary school mathematics, and primary school teaching programs. 23 items Mathematics teaching anxiety scale and the 34 items Mathematics Value scale was administered to the preservice teachers included in the sampling. The results showed that there was a low-level positive correlation between the Mathematics Values of the preservice teachers and their Mathematics teaching anxieties in mathematics. Among the Mathematics Values, the constructive value preferences of the preservice teachers directly affect the mathematics teaching anxieties and possible to reduce the mathematics teaching anxieties by affecting the Mathematics value preferences of the candidates.

Research on values assessment is less compared to other affective domain and cognitive domain. The research on values in mathematics education that included the designing and validation of tools to assess what students and teachers' value in mathematics pedagogy were conducted in the mid-2000. The knowledge derived from the research findings on values in mathematics education assessment can be applied to improve mathematics teaching and learning. The results from this study also add to the existing literature on teachers' values assessment practices. This study will add a different dimension to the literature on assessment on teachers' perception.

Factors Affecting Values in Mathematics Education

In the 1970s, Fennema and Sherman's Mathematics Attitudes Scales (MAS) were used to measure gender differences for self-confidence, mathematics anxiety and mathematics ideas. Trends in International Mathematics and Science Study (2011) results showed male students performed much better than female students in mathematics achievement. Luttrell (2010) found that women showed seriousness in studies thus performing better than men. According to Hyde, Fennema, Ryan, Frost, and Hopp (1990), Gender differences made an impact on mathematics tests performance, signing for courses, and career planning. Lascu, Manrai, and Manrai (1996) found out that females scored higher than males, thus showing that women gave importance to values more than men.

Teachers' gender biases can cause positive or negative connotations for students' success (Scantlebury, 2009). Teachers consider talent and hard work for the boys' and girls' success (Leedy, LaLonde, & Runk, 2003). Turkish mathematics teachers concluded that students' gender does not affect mathematics achievements (Dursun & Dede, 2004). Values can influence gender differences in academic achievement (Inglehart & Brown, 1987). Dede (2010) found out that females had higher mean scores than the males for reducing the theoretical nature, basic mathematics teaching and concrete mathematics teaching while males had higher mean scores than the females for importance to values in mathematics teaching and importance to both affective and cognitive outcomes in mathematics teaching.

Durmu and Bıcak (2006) revealed that pre-service female mathematics teachers preferred constructivist values in their future instructions than positivist values did. Vale (2008) found that gender influence in affective variables towards mathematics in New Zealand and Australia. Seah (2007) determined gender differences occur during values instruction and explanation where symbolic representation being important for male students and whole-class settings and interest is important for female students. According to Zerpa (2008), academic background and mathematics courses taken at university do not play a significant role in enhancing preservice teachers' conceptual mathematical knowledge. Gender, age and mathematics anxiety did not significantly affect achievement in Algebra.

According to Bishop (2008) in his study Research, policy and practice: The case of values stressed that there is a need to develop more research of the kind that can best be described as policy studies in mathematics education that are studies that focus on the determination of policy, and on the nature of policy and practice relationships in mathematics education, in areas such as curriculum, assessment, teacher education, technological developments and others. We lack studies in the area of mathematics education policy and practice.

Instrument Development

There are three types of instruments. They are cognitive instruments, affective instruments, and projective instruments. Cognitive instruments measure an individual's attainment in academic areas typically used to diagnose strengths and weaknesses. It comprises of achievement tests and aptitude tests. The affective instruments measure characteristics of individuals along a number of dimensions and to assess feelings, values, and attitudes towards self, others and a variety of other activities, institutions, and situations. The attitude scales include self-reports of an individual's beliefs, perceptions, or feelings about self, others, and a variety of activities, institutions, and situations. It frequently uses Likert, semantic differential, Thurstone or Guttman scales. The values test measure the relative strength of an individual's valuing of theoretical, economic, aesthetic, social, political, and religious values. The personality's inventories deal with an individual's self-report measuring how behaviours characteristic of defined personality traits describe that individual. The projective instruments measure a respondent feelings or thoughts to an ambiguous stimulus. It has associational tests where participants react to a stimulus such as a picture, inkblot or word onto which they project a description.

The development of reliable and valid instrument undergoes several phases, in which each phase consists of a number of steps. Benson and Clark (1982) presented "A guide for instrument development and validation," that illustrates the steps involved in planning, constructing, evaluating and validating a measure. Many researchers and experts in the field of the psychometric theory have described similar processes and approach to scaling development (DeVellis, 2003; Cox, Green, Seo, Inaba, & Quillen, 2006, Nik Azis, 2009). The major phases and steps involved in scale development have a common task of enhancing construct validity. Several existing instruments were reviewed to develop an instrument capable of measuring teachers' perceptions of values in the mathematics classroom. To construct this instrument, varied affective based documentation including associated instruments were sought and reviewed. In addition, the constructs of learning theory were also explored, giving attention to the cognitive, affective, and behavioural domains related to values. Instruments offered a strong basis for an instrument design but did not easily transition to a scale to measure teachers' perceptions of values in mathematics education.

This study used instrument design and item development to develop the instrument. Five phases were involved namely Analysis, Design, Development, Implementation and Evaluation. One of the most important components of a research design is the research instruments because they gather or collect data or information. These research instruments or tools are ways of gathering data. Without them, data would be impossible to put in hand. This study is about developing an instrument to assess the primary school mathematics teachers' values in teaching fractions. This instrument measures the teachers' perception of values in mathematics education. It is fundamentally different from instruments developed in the past. It conveys teachers' perceptions on imparting values in a mathematics classroom.

Summary

The review of literature is an important area of this study. The studies in the affective domain was reviewed to show that studies of values in mathematics is scarce. This analysis helped determine what is already known about values and values in mathematics education and how extensively this topic has already been researched. The literature review revealed the researchers and experts who had written the most on the research area. The literature analysis justified the study and ensured it is not a replication. The researcher analysed previous theory, research design and methodology on values in mathematics education. The literature review highlighted the flaws and gaps in previous research and helped the researcher to refine, refocus and answer the study's research questions. The researcher discovered new angles that need further exploration by reviewing what has already been written on values in mathematics education. The analysis was very useful to review the types of studies that previous researchers have conducted, the instrument developed and used as a means of determining what approaches might be of most benefit in further developing a topic. A review of previously conducted studies gives ideas to researchers determining a new angle for approaching research.

Within the literature, there are many definitions of values and concept of values that can be described as principles or a multitude of characteristics. Few authors in the sources above directly addressed general values in mathematics education, yet no one has done on mathematics values in learning fractions. None of the research questions in this study was answered by them. Most of the discussion of values were based on socio-cultural aspects of mathematics education.

Values are embedded in this mathematical aspect of our culture and how they differ from attitudes, beliefs and other affective dimensions that have been explored in education. The various values research studies that were conducted over the years had been helpful in supporting the nature of the difference between values and beliefs. The literature analysis showed that several studies recognised the importance of integrating the affective and cognitive dimensions into the teaching and learning of mathematics.

Based on the past studies, teaching about values affects teachers thinking, and consequently the way that they teach. Teachers find difficult to articulate values they are teaching in the mathematics classroom. Teachers of mathematics are rarely aware of the values associated with teaching mathematics. Analysis of literature on mathematics values revealed that there were rarely considerations of values in mathematics teaching and learning in most mathematical discussions. The past studies showed that teachers have problems in teaching fractions in the form of fractional knowledge and teaching methodology.

The studies at present continued to grow and strengthen in the areas of students' learning and teachers' teaching of values in mathematics education. The issues in this research area that have already been studied are the difficulty in learning fractions, the gap in knowledge concerning pupils' understanding of values and how they go about developing values in the mathematics classroom and lacking instruments to measure pupils' values toward their fractional learning. The evidence is available that values education is providing positive outcomes for students, teachers and schools.

Although a variety of journals and conference proceedings were inspected, there was a relatively little indication that ongoing deep research into values is taking place. With the recognition of mathematics that has different values with the traditional values, mathematics teacher training programs need to be addressed again. It has been intended to contribute the implementation of the program by examining the profiles of prospective mathematics teachers in the current state and the views for modelling. The studies into the role of values in mathematics and mathematics education were pioneered by Bishop in Australia and Nik Azis in Malaysia.

There is still a deficiency of research in this area. The comprehensive review of the literature shows that there was the relatively little indication that ongoing deep research into values in mathematics education is taking place. Further study is needed to investigate the extent to which the values mentioned are actually integrated into mathematics teaching as enacted values. The work of Bishop and others in Australia has been very influential in evolving an active area of research around the world on values in mathematics education. In Malaysia, a concerted effort is being done by Nik Azis (2008, 2009, 2013, 2014) to enhance values development in mathematics education. The Chapter Three discusses research design and methodology of the study.

CHAPTER 3: RESEARCH DESIGN AND METHODOLOGY

Introduction

Chapter Three provides a description of all the procedures appropriate to the development of an instrument. This chapter consists of eight parts namely introduction, the instrument design and item development, population and sample, data collection procedures, instrumentation, pilot study, a real study, data analysis and summary. In the first part, the contents of Chapter Three was outlined whereas the research design and justification of using the research design was explained in the second part. Then, population, location, research sample and sampling method were explained in the third part while the fourth part explains about types of data collected and data collecting procedures. The fifth part describes type, purpose and research methods used for instrument development. The sixth part describes the pilot study and the use of its research results whereas the seventh part describe real study and research results. The eight-part describes the research findings of the study. Finally, the ninth part is the summary of the main contents of Chapter Three.

Instrument Design and Item Development

The study followed the descriptive-developmental design utilising quantitative and qualitative approaches. A research design is a logical step taken to relate the problem and the research questions in order to collect, analyse, and interpret data coherently. It is an initial set of results that involve the basic plan to reveal the procedures for relevant and logical data collected and analysed that relates to the data that would be collected and the conclusions that would be made based on the initial research questions to determine the coherence (Nik Azis, 2009, p 400-414). It is an overall plan to obtain answers to the research questions in the study and to overcome difficulties faced during the study (Polit & Beck 2004). Research designs fulfil the needs of a study. The purpose of the study was to develop an instrument to assess primary school mathematics teachers' values in teaching fractions. The study used five phases to develop the instrument.

Analysis

The first phase of instrument development begins with analysis. The analysis phase is the most important phase in the process. It appears to be the foundation for all other phases. Planning and organising information are very important during this stage. It helps the researcher to determine the basis for all future decisions. The analysis phase involves several steps namely (a) determining problem through literature review, (b) formation of research purpose and research questions, (c) theoretical framework explanation to develop scales, and (d) values construct definition and values sub-construct explanation. The purpose of this phase was to identify the probable causes for the lacking instrument to assess mathematics teachers' values involved in teaching fractions specifically and values in mathematics education as a whole. The analysis phase involved determining the objectives, critical issues were identified, research problems were determined, theory explained, terms were defined, confirmed the intended audience and identified a pool of items relevant to this study. The teachers' existing knowledge and skills in delivering values in the mathematics classroom identified. The literature review identifies best practices and innovation in the teaching of values in a mathematics classroom.

A comprehensive review of the literature on values, values education, and values in mathematics education and related studies on affect such as beliefs, attitudes, perception, motivation, and aptitudes was carried out. Based on the literature review, the researcher identified critical issues of values in mathematics education and formed problem statement, purpose of the study, research questions, identified the theory to

Table 3.1
Instrument Design and Item Development to Assess Mathematics Teachers' Values

Level	**Phase**	**Focus**	**Main Activity**	**Process**
Identification	Analyses	A. Problem identification B. Theory formation	1. Determining problem through literature review. 2. Formation of research purpose and research questions. 3. Theoretical framework explanation to develop scales. 4. Values construct definition and value sub-construct explanation.	Qualitative
Generate	Design	Scale design	5. Scale development 6. Determining scale questionnaire format 7. Generate items pool 8. Develop formula for scale scores. 9. Instructions for respondents	Qualitative/ Quantitative
Generate	Development	Precision	10. Focus group to evaluate, critic items pool and questionnaire. 11. Check and correct items pool and questionnaires based on focus group feedback. 12. Expert panel to evaluate items pool and questionnaire. 13. Check and refine items, questionnaires based on experts' panel.	Qualitative/ Quantitative
Preparation	Implementation	Testing	14. Pilot study Initial instrument try-out 15.Respondents comments Data analysis 16. Real Study	Quantitative
Confirmation	Evaluation	Validity and Reliability	17. Pilot study findings evaluation. 18. Items revision, analysis and modification. 19.Real study findings evaluation 20. Determine validity and reliability.	Quantitative

be used, explained about the theoretical framework, defined the constructs, sub-constructs, identified dimensions and value indicators. The literature was reviewed to gather information about existing instruments in mathematics education and how others have assessed the same or closely related constructs. The analysis on existing instruments were based on the field of study, the instrument developer, the objectives of the scale, theory, research questions, the constructs, sub-constructs, dimensions and value indicators used, the target population, the scope of the scale, the design, format, item contents, item examples, score formula, number of items, chronology and rational for item analysis, reliability and validity, and the advantages and disadvantages of the scale.

It is hard to find an existing instrument that supports exactly the present study's objectives. The range of questions contained within existing instruments varies widely with some utilising less than ten items and others in excess of 50 items. The intended target audience also varies between instruments; some are designed to target a single grade level while others target a restricted grade-level range, such as middle or high school. A new instrument should be developed so that the researcher can customise the instrument to achieve a very strong accommodation with the values in mathematics education. Using an existing instrument is convenience. Researchers must establish the instrument's reliability and validity for their sample in case they decided to use a pre-existing scale. In this study, where an appropriate scale does not exist, the researcher needs to use a panel of experts to assist in developing items that measure each construct they plan to investigate. It is also necessary to provide definitions for each construct before item generation begins. Developing a new instrument is a resource-intensive endeavour. The researcher decided to develop a new instrument.

A pool of items was created from the literature review. In addition, the conceptual definition and operational definition for the study was found. The systematic and critical review of the literature is accessed to select appropriate instruments (Nik Azis, 2014; Creswell, 2003). This phase identified the need for the development of an instrument and to understand why a gap existed. All the information gathered at this phase assisted the researcher in verifying the reasons for developing the instrument. Data were analysed through this critical review of literature and document analysis.

This study outlined nine value dimensions and thirty-six value indicators from values in mathematics education. The first value dimension is basic value. This value signifies belief in God. The second value dimensions are core values. This value signifies basic human needs. The four core values are good personality, courage, wisdom and fairness. The third value dimensions are main values. These values based on quality living and character. The four main values are discipline, cooperation, accountability and innovation. The fourth value dimensions are expanded values. These values based on a few groups of values that are related to self-development. The five expanded values are the worth of film, the success of perseverance, the importance of quality, the virtue of precision and the power of integrity. The fifth value dimensions are teaching values. These values are based on teaching mathematics. The four learning values are theoretical, utilitarian, function and appreciation. The sixth value dimensions are learning values. These values are based on learning mathematics.

The four learning mathematics values are the mastery of skills, information processing ability, knowledge building and knowledge acquisition. The seventh value dimensions are ideology values. These values are based on mathematics knowledge epistemology. The four ideological values are rationalism, empiricism, pragmatism and universal integrated perspective. The eighth value dimensions are sentimental values. These values are based on the relationship of the individual with mathematics. The three sentimental values are control, developmental, and civilisation. Finally, the ninth value dimensions are sociology. These values are based on the relationship of society with mathematics. The three relevant sociological values are separation, relationship and integration.

Design

The second phase of instrument development begins with the Design process. The process of specifying how teachers' values in mathematics education to be assessed. These include determining the items structure, duration to answer the questionnaires, specify assessment and evaluation, selecting a delivery system, and sequencing the instruction. The design phase for the instrument development was planned using the outcome from the Analysis phase. The design phase includes several steps namely (a) scale development, (b) determining scale questionnaire format, (c) generate items pool, (d) develop a formula for scale scores and (e) instructions for respondents.

The researcher focus on the research design scale. A scale development was planned. The researcher determined the scale and scoring format. Every item was analysed separately. The researcher determines the kind of items required for the respondents in order to meet the goals identified in the Analysis phase. The pool of items was generated based on the values sub-construct. Careful attention was given to create the items. The formula for scale scores was developed. Instructions for the respondents were written following the required criteria such as (a) instructions should be short, precise and clear (b) explain what to be measured (c) must have response keys to the items (d) explain where to show the responses (e) inform respondents that there is no right or wrong answers (f) respondents should answer honestly and voluntarily and (g) respondents cooperation is appreciated and responses are confidential. The design scale was further refined after extracting information from the data received from administering the instruments from the Design phase.

Based on the critical review of the literature and document analysis, the objective to develop the instrument determined, items format verified, relevant items were formed, the scoring formula was ascertained, and questionnaires instructions were addressed. The content and subject matter analysis was done. It verified the desired performances and determined appropriate assessing methods.

Development

The development phase builds on both the Analysis and Design phases. The development phase is very important because it adapts to fit the study and respondents' needs. This process consumes much of the time spent in creating a valid and reliable instrument. The development phase has one focus, to review thoroughly the instrument. It includes four main steps such as (a) value and criticise the items and questionnaires, (b) check and improve the items and questionnaires based on focus group feedback (c) experts panel value the items and the questionnaires and (d) check and refine the items and questionnaires based on experts' panel feedback. The objective of this phase is to develop a quality scale based on the feedback.

The researcher created and assembled the content regarding values in mathematics education that were blueprinted in the design phase. Relevant items were selected and the instrument guidelines determined. Qualitative data was collected from the focus group interview and quantitative data was collected from the experts' panel feedback. Suggestions and comments were obtained from the focus group and item evaluation from the experts to improve the quality of items. It also involved providing instructions to the respondents, to the evaluator, and developing the scoring criteria for each question answered. The implementation of the instrument identified. Formative revisions of the items were done for the implementation of the pilot study.

All the existing instruments from literature review were analysed. After reviewing, initial items pool was created for each of the constructs. The questionnaires were constructed based on the three categories of values namely general educational values, mathematical educational values and mathematics values. The items were administered to the focus group.

A focus group is a small group of people led through an open discussion by a researcher or skilled moderator. In this study, the researcher acted as the moderator. The focus group respondents are national primary school mathematics teachers from Selangor. They are the head of mathematics department in their respective schools. The average mathematics teaching experience was fifteen years. There are two males and four females, comprised of two Malays, two Indians and two Chinese teachers. All the respondents have a Bachelor's degree in Mathematics. Thirty-six items were selected from the pool of 96 items that were developed based on the literature review and document analysis.

Focus group discussions are a qualitative research technique. The focus group interviews are very similar to other interviews for data collection. A focus group should not be more than eight respondents. The focus group should have a homogeneous group as they find it easier to discuss the content and for easier reflection on collaborative experiences (Adams, Anne & Cox, Anna L, 2008; Bruseberg & McDonagh-Philp, 2002). In this study, the focus group comprised of six experienced primary school mathematics teachers. The purposeful sampling of focus group increases the chances that the group recruited includes individuals the researcher knows can provide the data needed to measure the outcome (Bogden & Bilken, 2003).

A focus group study was carried out for the identification of relevant items from the pool of gathered items. The focus group method is a flexible research tool because the method can be applied to elicit information from any topic, from diverse groups of people and in diverse settings (Stewart et al. 2009). Holloway and Wheeler (2002) state that in focus group discussion researchers interview participants with common characteristics or experience for the purpose of eliciting ideas, thoughts and perceptions about specific topics or certain issues linked to an area of interest. The use of focus groups became important in educational research particularly useful in the evaluation, collecting qualitative data to evaluate viability, to anticipate effects, to evaluate implementation or as a means of collecting input during instrument development (Aday & Cornelius, 2006). The focus group share their ideas, experiences, and attitudes about a topic or set of issues (Kruger & Casey, 2000; Wilkinson, 2004). The researcher's acts as that of moderator, listener, observer, and analyst. Focus group data could be in the form of individual data, group data, or group interaction data (Duggleby, 2005). Trochim and Donnelly (2008) also reported an increase in the use of focus groups in social research as a method to gather detailed information about a group's preferences.

Focus groups had many advantages. Holloway and Wheeler (2002) list the following strengths of focus group discussion: (a) the dynamic interaction among participants stimulates their thoughts and reminds them of their own feelings about the research topic, (b) all participants including the researcher have an opportunity to ask questions, and these will produce more information than individual interviews, (c) informants can build on the answers of others, and (d) the researcher can clarify conflicts between participants and ask about these different views. One of the great advantages of the focus group method is its ability to cultivate people's responses to events as they evolve enables more deeply into the ways in which teachers perceive the value in mathematics education (Barbour, 2007). The focus group concentrated item generation to finalising logistics necessitates identifying appropriate items for inclusion provide an efficient means for the purposes of both item generation and refinement. According to Hendrick (2002), focus groups are less costly in terms of time and financial resources than individual interviews.

The selected focus group respondents discussed thirteen aspects of the study with the researcher such as (a) readability, whether the items created suitable for their reading capability; (b) clarity, whether the items contained words and sentence structure are simple, concise and clear; (c) understanding, whether the understanding and meaning given by the respondents for the phrases, concepts and sentence of the items are acceptable; (d) difficulty, whether the items are easy or difficult to answer based on the respondents perceptions; (e) representations, whether the items represent the expected sub-construct or dimension; (f) simplicity and compactness, whether the items used clear, precise and concrete statements; (g) uniqueness, whether the items are unique, different and did not overlap with other items; (h) comprehensive, whether the given scale is complete and covers a wide area, embrace every important aspect of values for the construct and sub-constructs; (i) suitability, whether the arrangements of the items, questionnaires length and format suitable; (j) instructions clarity, whether the questionnaires instructions are clear; (k) time allocation, whether the time given is appropriate to answer the questionnaires; (l) improvements, whether the questionnaires need improvements or suggestions for improvements and (m) social advantage, whether every item minimises social desirability bias including language tone as suggested by Nik Azis (2014).

In this study, the researcher facilitated the focus group discussion. The facilitator's role was to direct the discussion and take notes (Krueger & Casey, 2000). The interview protocol and questionnaire were sent to the focus group respondents via email earlier. The focus group answered the questionnaire based on the thirteen aspects. The feedback was received in about two weeks. The researcher read through the comments, corrections and suggestions. The researcher discussed the focus group suggestions over the phone individually. The researcher corrected the items based on the feedback. Once the corrected version was ready, the researcher emailed the corrected version to the focus group respondents. After a week, the researcher met all the six respondents in person to discuss the items content validity and the new instrument based on the six criteria mentioned in the questionnaire. The focus group discussed and elaborated based on their personal teaching experiences. The respondents were asked to revise the items and the format of the questionnaire.

For clarity, the focus group respondents made sure that the items are clear, brief and unambiguous. The respondents were able to interpret the question as the researcher intends. The respondent should understand the question consistently. They re-stated the items in their own words to demonstrate item clarity and overall communication of the instrument. For relevance, the focus group respondents made sure the items are related and useful to the main study, the development of an instrument on values in mathematics education. Participants felt the research is relevant to them and feel motivated to complete it. The respondents were willing and performed the tasks required to provide accurate and complete answers. The respondents were attentive and interested in the questionnaires. For language, the focus group respondents made sure the items are simple, unambiguous language, which was instantly understood. The English language and Bahasa Malaysia translation were also reviewed. No jargon or abbreviations were used. Respondents have no difficulty in understanding words, terms or concepts. The statements explored respondents' feelings towards values in mathematics education more generally. For understanding, the focus group respondents made sure the items were related to an abstract or physical object, whereby one is able to think about it and used concepts to deal adequately with that object. Understanding is a relation between the knower and an object of understanding. The researcher determined how respondents interpreted keywords, terms, and phrases and questions as the researcher intends. The researcher received the feedback how the focus group understands and interprets the concepts of values found in those items.

The researcher refined the items again based on the focus group feedback. The statements were revised and corrected as suggested by the focus group respondents. The researcher revised items such that important aspects of the content domain of a construct have not been covered. The researcher reviewed each item in the questionnaire based on the focus group's thirteen aspects mentioned earlier. The thirty-six items were refined and finalised and given to the expert panel. This process reduced measurement error. The responses to the focus group questionnaire were on a Likert scale, analysed and tabulated. These steps provided greater content validity and statistical data analysis. Focus groups are an appropriate method data collection when one is interested social representations because they are based on communication and it is the heart of the theory of social representations (Kitzinger, Markova & Kalampalikis, 2004). Next, the experts' panel reviewed, revised and provided comments for the created items.

An expert panel comprises independent specialists, provides the knowledge and expertise in a specific subject for a project. The experts' panel comprised of a small number of people who evaluate the questionnaire from various angles. They are experts in various fields relevant to the study and researchers experienced in survey design, data collection, coding, and data analysis. Experts' panel determines content validity for the study. The researcher refined the items based on the experts' analysis, comments, suggestions and evaluation.

In this study, experts' panel opinion was chosen to collect information from a panel of educational experts from the universities. Skulmoski, Hartman, and Krahn (2007) defined it as a repetitive process to gather information from experts through professional discourse, feedback, data collection, and analysis. Experts' panel allows the collection of expert judgments when less knowledge is available in regard to a problem and the researcher seeks to increase understanding and opportunities for solutions (Simon & Francis, 2004). This technique encourages creativity and honesty through panellist anonymity and reduces the opportunity for conflict or alignment found in live groups who may conform or stand defiant (Iqbal & Pipon-Young, 2009). According to Skulmoski et al. (2007), experts should meet the following general criteria: (a) knowledge and experience with the topics in mathematics or mathematics education and values; (b) ability and consent; (c) availability of time to participate; and (d) ability to communicate effectively in writing. Professors and lecturers who meet the general criteria were considered as experts. Akins, Tolson, and Cole (2005) argued that there is no rule on the number of experts to be selected. Test items development recommended that expert judgment is commonly used in the judgment-qualification stage in content-related validation (Scapolo & Miles, 2006).

The researcher considered all the above expert's panel criteria. The letter of consent and the questionnaire were sent to one hundred lecturers and professors in Peninsula Malaysia who were attached to the education faculty in the field of

Mathematics, Science, Statistics, Measurement, Moral Education, Psychology, Islamic religious studies, English and Bahasa Malaysia in government universities. The researcher selected experts' panel using the purposive sampling. Purposive sampling allowed the researcher to choose participants that best suited the criteria for the research (Ary, Jacobs, Razavieh, & Sorensen, 2006). According to Berg (2007), researcher's use this sampling for their special knowledge or expertise about some group to select subjects. The selection of the panellists had to be purposeful to provide unique perspectives on the study. This sampling was the most appropriate for the goals of this study.

Of the one hundred professors and lecturers contacted from the faculty of education nationwide, only nineteen experts from the main universities in Malaysia participated in this survey. The experts' panel comprised of ten experts from Mathematics Department, three from English Department, three from Bahasa Malaysia Department and three from Educational Psychology Department. The panel analysed the mathematics content of the items based on the given six characteristics. The language lecturers looked into the back to back English language and Bahasa Malaysia translation used and edited the items for grammar and meanings in English Language and Bahasa Malaysia respectively based on the given six characteristics. The three educational psychology lecturers analysed the items on values based on the given nine dimensions. The experts' panel examined the items based on the content defined by the sub-constructs, value dimensions and value indicators. The experts determined the content validity of the thirty-six items based on six characteristics namely (a) level of difficulty (b) clarity (c) readability (d) relevance (e) content representation and (f) language compatibility.

Experts as persons who have sufficient knowledge and experience to have mastered the advanced skills of a particular domain of knowledge or experience; they are proficient in their actions and have special ways of applying the knowledge to a task in their area of expertise; they are proficient at identifying problems in their areas and then being able to tell if the problem is solvable, and if it is solving the problem. Expert panels are used when specialised input and opinion is required for an evaluation. The experts' panel examined the items based on the content defined by the sub-constructs, value dimensions and value indicators. The experts determined the content validity of the thirty-two items in the pilot study and 36 items in the real study. The study's success was also based on each selected expert's specialised knowledge and experiences.

The experts were given the chosen and refined items from the focus group. The expert panel verified the items based on the following aspects; (a) content relevancy, that the items content relevant to the respective value dimensions; (b) content representations, that the items represent the value dimensions appropriately; (c) content comparability, that the items meanings in Bahasa Malaysia same as the translated items in English Language (d) content clarity, that the items were written clearly and coherently; (e) readability, that the items statements consist of words, vocabulary, grammar and concept understood by the respondents and finally (f) improvements were made based on the expert panel's suggestions.

The content validity was confirmed by analysing content relevance, content representativity and content comparability. Content relevance was determined by verifying the items relevancy on values constructs, sub-constructs and dimensions and verified to what extent the items measure values construct, sub-constructs and dimension. Content representativity was determined to what extent the items represent the construct, sub-construct or value dimensions. Content comparability verified that the items in Bahasa Malaysia version and English Language version have the same meanings. The experts analysed on the given criteria. They commented and gave suggestions to improve (Refer Appendix F). The goal was to ensure each item is of high quality and valid, and that the items within each domain followed an ordinal scale in terms of agreeability. Although both face validation and content validation of a measurement are judgmental, the criterion for judgment is different. While the belonging of each item to the concept being measured is to be determined in the evaluation of face validity, content validation determines whether any left-out item should be included in the measurement for its representativeness of the concept.

The items were refined by focus group, an expert panel and the researcher. The irrelevant items were eliminated before submitting to the experts. The amended items based on the three categories of values in mathematics education namely general educational values, mathematics education values and mathematics values were created. Firstly, the consensus process begins. The expert panel was asked to complete a survey rating of the quality of each item, appropriateness for the domain, and the perceived level of agreeability for that item using based on a Likert scale. The experts rated the importance of the competencies as represented using a 5 point Likert scale. The Likert scale existed as: 1 = Strongly Disagree, 2 = Disagree, 3 = Neither Disagree nor Agree, 4 = Agree, and 5 = Strongly Agree. This rating helped to determine which competencies and objectives should be selected.

The researcher examined and refined the items after the expert review. For each item, mean median, mode, and standard deviation were calculated. In each case, comments from the expert panel members were taken into consideration in the decision to retain or to eliminate an item. These items were used as the instrument for the pilot study. Data collected from the pilot study analysed. The items were refined based on the pilot study results. The amended set of items was sent to the experts' panel for the second time. The objective for the second round is for the expert panel to review and comment on the appropriateness of the items. The experts responded to the questionnaires. They commented and made suggestions on the questionnaires based on the pilot study outcome. The responses were used to develop the final questionnaires. The questions become more focused now. These items formed the new instrument that was implemented in the real study.

Implementation

This phase was done based on the results from the above three phases. The pilot study was done. The initial instrument was tested. This phase prepared the questionnaire with all the instructions and items. The validity and reliability of the initially developed instrument were tested together with item analysis. This phase evaluated and refined the items for the real study is ready. The real study was implemented once the items were refined based on the pilot study respondents feedback.

Evaluation

This evaluation phase encompasses both the pilot study and the real study. The evaluation phase measured the instrument's effectiveness and efficiency. The instrument design and item development methodology involve formative and summative evaluation and management of data. The formative evaluation involved validating instructions before it is implemented and revising instruction to improve the instrument prior to its implementation. This process uncovered obstacles, barriers or unexpected opportunities that emerged. This study involves both quantitative data and qualitative data. From the data gathered during the conduct of evaluation, the results are analysed and interpreted to evaluate the instrument. This process managed the documentation of evaluation results and recommendations for revising and refining the instrument items to be clear, concise, and accurate. It allowed complete analysis and provided feedback to improve the items. Items analysis was done through focus group feedback, experts' panel consensus, exploratory factor analysis, confirmatory factor analysis and Rasch model analysis. The validity and reliability of the instrument were ascertained.

Under quantitative data analysis procedure, descriptive statistics such as frequencies, percentages, means and standard deviations were used. With the pilot study analysis, the researcher was able to determine the validity and reliability of the initial instrument. Based on the preliminary findings, the researcher refined the instrument and identified factors that influence the respondents' feedback. From the real study, the researcher compared the validity and reliability of the developed instrument with that of the initial instrument. The researcher calculated Cronbach's alpha to assess the internal consistency reliability of the items. The researcher determined the psychometric characteristics of the developed instrument and created the respondent's profile.

Factor analysis was conducted to investigate the construct validity. The researcher used factor analysis to choose the best items to represent a construct and to see if the construct has one dimension or multiple dimensions (factors). The researcher calculated Cronbach's alpha to assess the internal consistency reliability of the items. The factor extraction method was a Principle Component Analysis (PCA). Prior to the factor analysis, the suitability of the correlation matrix for a factor analysis was examined with the Kaiser-Meyer-Olkin (KMO) and Bartlett's test of sphericity. A Pearson product correlation was employed in this analysis.

Variance analysis ANOVA was used to compare means between groups. ANOVA procedure determined the level of significant difference between the dependent variable that involves three values' subscales with the independent variable that involves demographic factors such as gender, age, teaching experience, race and level of education. The researcher interpreted the results carefully. ANOVA analysis of variance was conducted to discover the significant differences among variables. The researcher carried out item analyses based on mean, variance, standard deviation, missing values, skewness, kurtosis and total item correlation. In the real study, the researcher determined the differences between groups.

Population and Sample

The target population is government primary school mathematics teachers. The study involved mathematics teachers from primary schools in Kuala Lumpur except for the focus group respondents who were from Selangor. A few schools were selected to represent as samples and focus group. The second group of respondents is the experts' panel. The expert panel was formed by the education faculty lecturers from the universities in Peninsula Malaysia.

Sample and location

The pilot study respondents were from selected co-educational national primary school mathematics teachers in Kuala Lumpur. The researcher personally went to the schools and conducted the survey after obtaining written permission from the Ministry of Education, state education department and the respective school headmasters. The real study respondents were from all primary school mathematics teachers in Kuala Lumpur. The real study was carried among teachers from co-education national primary schools, national-type primary Tamil and Chinese schools in Kuala Lumpur. This survey was done during a primary school mathematics teachers seminar conducted at the state education department, Kuala Lumpur (JPWP). They are urban schools. The schools have an enrolment of about 200 pupils to 1200 pupils and about twenty to one hundred teachers in each school. Each standard has two classes or more from Year One to Year Six. Most of the pupils and teachers in national type primary schools are of Malay origin. Most of the pupils and teachers in national type primary Tamil schools are of Indian origin. Most of the pupils and teachers in national type primary Chinese schools are of Chinese origin. One hundred fifty mathematics teachers for the pilot study and two hundred fifty mathematics teachers from schools in Kuala Lumpur were involved in the study. The respondents are Malays, Indian and Chinese teachers, male and female who have more than 3 years of teaching experience between 25 years to 60 years old.

Purposive sampling can be applied to research in a number of ways, such as in preliminary studies where the researcher is still testing the feasibility of a proposed study, sampling informants with a specific type of knowledge or skill (Li, Liu, Lee, Guo, Li & Liu, 2006; Prance 2004, Vargas & van Andel 2005). Purposive sampling was chosen because this study relies on the selective and judgement of the researcher in selecting the respondents. It is a type of non-probability sampling that is most effective when the researcher decides what needs to be known and sets out to find people who can and are willing to provide the information by virtue of knowledge or experience (Bernard 2002, Lewis & Sheppard 2006). The rationale for choosing homogeneous sampling, a type of purposive sampling that brings together people of similar backgrounds and experiences was that the researcher was seeking knowledge about assessing teachers' values involved in teaching fractions which the respondents would provide by virtue of their experience. In this study, eligible primary school mathematics teachers were purposively chosen to participate in this study. The advantages include the people who do not fit the requirements were eliminated and the sample is an accurate representation of the population. The results are expected to be more accurate, less time consuming and less expensive as it involves lesser search costs. Schools were selected in Kuala Lumpur and Selangor (focus group) because of convenience.

Validity

Validity is the most important consideration in developing and evaluating measuring instruments (Ary et al., 2006). The general concept of validity was traditionally defined as "the degree to which a test measures what it claims, or purports, to be measuring" (Brown, 1996, p. 231). Validity was traditionally subdivided into three categories: content, criterion-related, and construct validity (Brown 1996, pp. 231-249). Joppe (2000) provides the following explanation of what validity is in quantitative research:

> Validity determines whether the research truly measures that which it was intended to measure or how truthful the research results are. In other words, does the research instrument allow you to hit "the bull's eye" of your research object? Researchers generally determine validity by asking a series of questions, and will often look for the answers in the research of others. (p. 1)

Validity refers to the degree of accuracy and appropriateness of inferences made from scores; is a unitary concept; is a matter of degree rather than an absolute, all-or-nothing determination; and requires multiple types of evidence before a judgment can be made regarding the validity of a measure for a particular use or interpretation. The common procedures for determining the validity of an instrument are faced validity, content validity, and criterion validity and construct validity (Nik Azis, 2014). Wainer and Braun (1998) describe the validity in quantitative research as "construct validity". The construct is the initial concept, notion, question or hypothesis that determines which data is to be gathered and how it is to be gathered.

Content validity is focused on the item-pool generation process to assess the extent to which the domains of the constructs are fully represented by the items. Content validity includes any validity strategies that focus on the content of the test. Content validity has been defined as the extent to which an instrument adequately samples the research domain of interest when attempting to measure phenomena'' (Wynd, Schmidt, & Schaefer, 2003). Polit and Beck (2004) defined content validity as the degree to which an instrument has an appropriate sample of items for the construct being measured. In this study, content validity was carried out with focus group and the experts' panel. To demonstrate content validity, testers investigate the degree to which a test is a representative sample of the content of whatever objectives or specifications the test was originally designed to measure. To investigate the degree of match, researchers often enlist well-trained colleagues to make judgments about the degree to which the test items matched the test objectives or specifications. In this study, the researcher used focus group analysis and expert panel consensus. Content validity by experts to determine instrument's credibility, accuracy, relevance, and content of knowledge regarding values. Content validity is verified, firstly, the literature is adequately searched and dimensions and items are purposefully selected and secondly, the instrument items are validated by a panel of experts (DeVellis, 2003). According to Gall, Gall and Borg (2003), content validity, the representation of a sample of items intended to cover the phenomena being studied, can be evaluated by experts' panel to determine how well the test reflects the range of content being measured.

Face validity refers to researchers' subjective assessments of the presentation and relevance of the measuring instrument as to whether the items in the instrument appear to be relevant, reasonable, and unambiguous and clear (Oluwatayo, 2012). Face validity evaluated the instrument to determine usability, clarity, and readability. Face validity is simply whether the test appears at face value to measure what it claims to. Face validity is a casual subjective examination of the questionnaire to ensure it has relevant components for the topic being studied and that the instrument has good readability (Gall, Borg, & Gall, 2003). In this study, face validity was verified by the teachers' focus group and a peer group with their interpretations of the items. Their insight was vital to establishing item face validity that the created items were better understood by the respondents. Face and content validity were finalised through a focus group, experts' panel and teachers who judged the questionnaires appearance, relevance, clarity, difficulty, language and representations. Face and content validity were also ascertained by the pool of gathered items from the literature review. Face and content validity also determined construct validity due to the accuracy and connection between the questions and variables measured. According to Creswell (2008), content validity is evaluated based upon examining the content areas and difficulty level of the questions by a group of experts.

Construct validity has traditionally been defined as the experimental demonstration that a test is measuring the construct it claims to be measuring. Construct validity is the evidence based on response processes focusses on the extent to which the tasks or types of response required of examinees fit the intended (Goodwin & Leech, 2003). Construct validity provides the researcher with confidence that a survey actually measures what it is intended to measure. Researchers obtained relevant findings conclusion from construct validity. Construct validity is now generally viewed as a unifying form of validity for psychological measurements, subsuming both content and criterion validity, which traditionally had been treated as distinct forms of validity (Landy 1986). In this study, construct validity was verified by the two round experts' panel consensus, exploratory factor analysis, confirmatory factor analysis and Rasch analysis. Construct validity assessment ensured that the instrument is suitable for the study.

Reliability

Joppe (2000) defines reliability, whereby results obtained, are consistent over time that represents accurately the total population under study. The research instrument for a study is considered reliable if the results can be reproduced using a similar methodology. Reliability analysis is an important process in scale development as it provides evidence of the internal consistency of items under different aspects. Items were entered into a reliability analysis based on their conceptual grouping and on whether the item was still deemed to be a good fit for the scale. The experts' panel addressed reliability in two ways. First, the number of panellists increased the response of the experts and permitted patterns in responses to be identified and outlier perspectives to be noted and minimised, increasing the reliability of the experts (Linstone & Turoff, 2002). Second, reliability will be increased through adherence to the procedures of the method, including a pilot test, and the two rounds.

Reliability of the survey was assessed after results from the pilot survey were obtained. The data were analysed using factor analysis, Rasch analysis and confirmatory factor analysis. Internal consistency reliability coefficients (Cronbach's alpha) were calculated to determine how well each set of items measured a single construct and to facilitate further development of scales. The value of the coefficient alpha Cronbach for this study scale should be greater than 0.8 which is an extra good value for the internal consequence of the conceptual construction of the investigated scale (Anastasiadou, 2010; Nouris, 2006). After determining the reliability of the survey the second phase of the study was completed. An item-total analysis was done to identify any weakest correlations. The weakest items would be removed from the study in an effort to increase overall reliability.

The pilot study and real study was conducted in selected primary schools in Kuala Lumpur. This reliability assessment was used to correlate between the item score and the total. The items that were not correlated with the total would be eliminated. Subsequent data were summarised using the totals.

Data Collection Procedure

Data collection is the process by which the researcher collects the information needed to answer the research questions. In this study, both qualitative data and quantitative data were collected. This also includes ordinal data and nominal data. Data was collected through the five phases of instrument design and item development. In the Analysis phase, data were collected from the comprehensive review of literature and document analysis. Books, journals and articles were reviewed based on values in education, values in mathematics education and other affective domain. Related items found in the literature were gathered. In the design phase, data were collected in the same manner as the analysis phase. The design of other similar studies was reviewed and the researcher chose the developmental design. In the development phase, data were collected from the focus group interviews, self-administered survey questionnaire from the experts' panel and respondents' feedback from the pilot study and real study. The questionnaire was answered using a five-point Likert scale.

The focus group comprised of six mathematics teachers from Selangor national primary schools. In this research, the questions asked in the focus group were the same as those in the questionnaire. The focus group answered the draft questionnaires and met face to face meeting with the researcher. The focus group commented on the thirteen issues as stated earlier using the given forms. The researcher received more specific information in relation to answers regarding the use, the meaning of words, phrases, understanding, clarity, and difficulty of the questionnaires. The data obtained is a result of a conversational process; thoughts can be stimulated by previous comments. The verbal feedback an initial stage of the study, a rough version of the instrument was pre-tested indirectly. The focus group sessions were audiotaped. Focus groups can supplement quantitative or other qualitative techniques; resulting in data that are useful in and of itself. The focus groups were designed and executed for the purpose of refining the items on the instruments, as well as generating additional ones. Items found to be irrelevant were revised. The focus group finalised thirty-six items from a pool of items for the Likert scale questionnaire.

The thirty-six items were refined and sent to the selected one hundred experts by e- mail. Only nineteen experts agreed and answered the panel's questionnaire based on the six criteria as stated earlier. The experts commented on the instrument using the item scale forms. The outcomes were analysed and the mean, mode, and median tabulated. Items found to be irrelevant were revised. The items were refined for the second time before the pilot study. The instrument consisted of thirty-six items were given to one hundred fifty primary school mathematics teachers in Kuala Lumpur. The outcomes were analysed and the mean, mode, and median tabulated. Some of the Items were re-worded.. The items were refined for the third time by the researcher. The researcher then tested the questionnaire on peer group who are masters and doctorate students from the Mathematics Department University Malaya and pursuing a mathematics education degree. They gave their comments and views on the questionnaire. The researcher made the necessary amendments to the instrument to suit the respondents. The final instrument also consists of thirty-six items.

Instrumentation

The instrument is the device and instrumentation are the course of action, the process of developing, testing, and using the device. The dependent variables were the respondents and the independent variables are gender, age, the level of education, race and years of teaching experience. Survey method is the most extensively used technique for data collection. In order to efficiently use the survey method, a questionnaire was developed. A questionnaire is a set of systematically structured questions used by a researcher to get needed information from respondents (Dornie, 2007). Questionnaires were chosen as an instrument because of the following advantages: (a) Large amounts of information can be collected from a large number of people in a short period of time and in a relatively cost effective way; (b) It could be carried out by the researcher or by any number of people with limited affect to its validity and reliability; (c) people's opinions, feelings experiences, values and others. can usually be quickly and easily quantified by either a researcher or through the use of a software package; (d) It could be analysed more 'scientifically' and objectively than other forms of research.; (e) When data has been quantified, it can be used to compare and contrast other research and may be used to measure change.

The questionnaire was created after an extensive review of the literature, focus group responses, experts' panel feedback, peer group feedback and researcher's involvement. The questionnaire was intricately designed to assess the primary school mathematics teachers' values in teaching fractions. The questionnaire was chosen as an instrument because it allows the researcher to assess teachers' values in teaching fractions. They are a simple way to gather short responses to questions from people. Questionnaires are less time consuming than interviews and can easily be kept anonymous.

The instrument was divided into three parts. The questionnaire consists of thirty-six items for the pilot study. The first part was based on general education values that consist of 18 items. The second part was based on mathematics education values that consist of eight items. The third part was based on mathematics values that consist of ten items. The scales used for responding to items on affective tests is the five-point Likert scale. It is best to use a five-point scale to suit statistical tools. The main advantage of Likert Scale questions is that they use a universal method of collecting data, which means it is easy to understand them. Working with quantitative data, it is easy to draw conclusions, reports, results and graphs from the responses. Furthermore, because Likert Scale questions use a scale, people are not forced to express an either-or opinion, rather allowing them to be neutral should they so choose. Once all responses have been received, it is very easy to analyse them. Moreover, it is very quick and easy to run this type of survey and it can be sent out through all modes of communication, including even text messages.

The Likert scale existed as: 1 = Strongly Disagree, 2 = Disagree, 3 = Neither Disagree nor Agree, 4 = Agree, and 5 = Strongly Agree. Likert scales were used for this study because they are relatively easy to construct, can be highly reliable and have been successfully adapted to measure many types of affective characteristics (Nunnally, 1978). All the items were stated bilingually, English and Bahasa Melayu. This is to give an opportunity for those teachers who could not understand items in English. This instrument assessed primary schools mathematics teachers' values in teaching fractions.

Content validity was verified when the literature is adequately searched and dimensions and items are purposefully selected. Second, the instrument items are validated by a panel of professionals (DeVellis, 2003). The reliability of the instrument was determined by factor analysis and Rasch analysis during the pilot study and the real study also used confirmatory factor analysis. The detailed results were discussed in Chapter four.

Instrument Translation

In Malaysia, the national language is Bahasa Malaysia. Most of the teachers are well versed in Bahasa Malaysia rather than the English Language which is the second language. There exists a difference in culture due to Malaysia's various ethnic groups. According to Hofstede (2001) culture is the shared values, attitudes, and beliefs among a group of people, which guides their way of thinking, doing, and living. There is a need to translate research instruments from one culture to a unique language to another culture with a different language. The cross-cultural translation and validation process from one language to another language is a critical first step to the appropriate use of that instrument (Fouad & Bracken, 1986). It is vital to ensure the validity of instruments in various cultures since the concepts in one culture may not be meaningful in another culture (Brislin, 1980; Hui & Triandis, 1985).

Brislin's model (1970, 1986) "for translating and back-translating instruments is a well-known method of preparing valid and reliable tools for cross-cultural research" (Jones et al., 2001). According to Brislin (1970), the researcher can combine different aspects of the translation methodology to suit the objectives of the study while resolving the limitations imposed by time, cost, and resource availability. The researcher chose to use back-translation approach. Back-translation involves a process where at least two bilingual translators who are from the target language are employed (Lomi, 1992). The back-translation method was suggested as the essential and recommended method for assessing linguistic equivalence or similarity in words and sentences and that it has shown to improve the quality of the translated version (Jones, Lee, Phillips, Zhang, & Jaceldo, 2001). In short, having at least one forward and one backward translation is minimally required (Bullinger, Anderson, Cella, & Aaronson 1993).

Equivalence in meaning is important in establishing cross-cultural validity in translations. The researcher should be aware that in translating an instrument from the source language into the target language it has the same meaning. Sechrest, Fay, and Zaidi (1972) suggested the need to consider grammatical-syntactical equivalence, vocabulary equivalence; idiomatic equivalence, experiential equivalence and conceptual equivalence when translating instruments. However, most importantly functional equivalence determines whether the items in the translated version of an instrument have a meaning similar to that of the source version (Hui & Triandis, 1985).

The scales used in this study were developed in English, a rigorous English-to-Bahasa Malaysia translation process was used that included an iterative process of backwards translation, assessment for clarity and correctness, and subjective and objective evaluation. The goal of the translation and various evaluation procedures was to produce Bahasa Malaysia version of the items that were equivalent in meaning to the original English versions. In this study, the process starts with three bilingual translators working independently translating an instrument from its original language into the target language. Next, another three bilingual translator working independently translates the instrument back into the original language. These back-translators should not have seen the original source language version of the instrument. The unsuitable meanings detected in the back-translated version when compared to the original, the terms which are in question are retranslated and again back translated by another bilingual expert. These processes are repeated until no error in meaning is found. To reduce bias, and to produce more accurate translations, Jones et al. (2001)

recommended including more bilinguals in the translation process and comparing both versions the original and the back-translated with a group of monolinguals from the source language, which, in turn, enhances functional equivalence like in this study. The objective was an equivalent translation, not an identical word-by-word translation. Equivalent translations emphasise functional equivalence or the equivalence of meaning of the survey items between the original and translated instruments. Functional equivalence helps to ensure that the measures work in the new target culture as well as they did in the original culture because the translation is based on achieving equivalence in meaning rather than just the form of the sentence or word-by-word translation. The original and the back-translated versions are evaluated to ensure equivalence in meaning (Brislin, 1970). The two versions are field tested with the three educational psychological experts to correct for any errors and discrepancies in words, statements and compare the meaning of the original statements and the translated statements. They also verified the statements content validity for values in mathematics education.

Pilot Study

A pilot study is the main study version that was implemented in a miniature form to determine whether the study's important components functions in a coherent and integrated manner (Nik Azis, 2014). The purpose of the pilot study was to increase the validity and establish the basic quality of the instrument (Neuman, 2006). In addition, Beebe (2007) stated that a pilot study helps the researcher identify design barriers, refine plans to collect and analyse information and gain experience with participants. Based on the extensive literature review, focus group feedback, experts' consensus and researcher's items refinement, a preliminary version of the instrument was developed. Thirty-two items on the three constructs general education values, mathematics education values and mathematics values were identified for the pilot study.

A pilot study was designed to increase the quality and efficiency of the main study (Nik Azis, 2014). Pilot study was conducted to (a) estimate the reliability and construct validity of the scales, (b) determine the internal consistency of the instrument with a larger sample, (c) investigate the number and kinds of factors that could be derived from the pilot data, (d) revise or delete items according to the results of the factor analysis, and (e) identify improvements needed in the format and directions for completion of the instrument.

The purpose of this study was to develop a new instrument to assess primary school mathematics teachers' values in teaching fractions. As in other studies, a pilot study was also carried out to test the instrument. For the pilot study, data collection at the analysis phase was conducted for the duration of two months after the instruments were verified by the focus group and expertly reviewed by the experts' panel. The researcher after getting permissions from the Ministry of Education (EPRD), the Kuala Lumpur education department and the Selangor education department went to selected schools to conduct the survey. Permission was also sought from the school Headmasters. A cover letter was attached to the survey to explain the purpose of the study and the agreement to participate in the study.The questionnaire was in the five-point Likert scale format as stated earlier. The researcher assured confidentiality to all the respondents' personal details and feedback. The questionnaire was personally given to the respective national primary school Headmasters to be delivered to the mathematics teachers. A pilot study was implemented in selected national primary schools in Kuala Lumpur. The researcher collected the answered questionnaires from the Headmasters after a week. Once all the questionnaires were collected, the teachers' responses were analysed.

The pilot study quantitatively evaluated initial items and gave a preliminary assessment of the instrument reliability. Data analysis was carried out using factor analysis and Rasch measurement model. Descriptive statistics were used to describe all demographic information. Descriptive statistics of mean, mode, standard deviation, and range were computed. The data from one hundred and fifty respondents who took part in the study were analysed.

Data collection at the analysis phase was conducted for the duration of two months after the instruments were expertly reviewed. Secomb and Smith (2011) stated that pilot studies highlight issues and concerns with the research framework and processes before the actual data collection takes place. Pilot study respondents were not allowed to take part in the real study to avoid any possible interferences to the overall validation of the study.

Data Analysis Procedure

Data analysis is a continuing activity for a study. Data analysis is a process of inspecting, cleaning, transforming and modelling data with the goal of underlining essential information, suggesting conclusions, and supporting decision making (Ader, 2008; Nik Azis,2014). It is the process which follows after data collection. There are two procedures namely quantitative data analysis and qualitative data analysis. The quantitative data analysis or the qualitative procedures help the researcher to arrive at the data analysis. Quantitative data is information gathered in a numeric form. The basic instrument for collecting quantitative data is a questionnaire. There are a number of steps that are involved in analysing quantitative data. These include data cleaning, data coding, data presentation and data interpretation and discussion. Quantitative data analysis involves using statistics to improve numerical data. Qualitative data is information gathered in a non-numeric form. Common examples of such data are interview guides, field observation notes, video, audio recordings, images, documents (reports, meeting minutes, e-mails). Qualitative data analysis is the range of procedures involving various steps: from collecting data to some form of explanation, understanding or interpretation of the people and situations under investigation. Qualitative data analysis is usually based on an interpretative philosophy of a researcher (Nik Azis, 2014). Data analysis consisted of five major phases: (a) Rasch model analysis; (b) exploratory factor analysis; (c) confirmatory factor analysis; (d) ANOVA.

Rasch Model Analysis

Rasch model is an Item Response Theory. The Rasch measurement model (Rasch, 1960) was chosen for this analysis because it is the only item response theory model that has the desirable scaling properties of linear, interval measurement (Embretson & Reise, 2000). Therefore, Rasch measures are the most valid for mathematical operations, such as correlation and regression analysis, as well for assessing change. The Rasch one parameter model fulfils the requirements of fundamental measurement that is linear interval scale and examines the data that is items and persons, for flaws or problems that are indicated by their failure to fit the model (Bond & Fox, 2007).

Item analysis for the newly developed instrument is the main focus of applying Rasch model measurement. The researcher chose Rasch model for data analysis because Mathematical analysis of this model has shown to be statistically strong (Bond & Fox, 2007; Wilson, 2010; Wright, 1977). Rasch model statistical measures have been the dominant method of analysing data and explaining relationships among variables in the social sciences (Bond & Fox, 2007). Rasch model measures one and only one construct at a time, measurements of latent traits. A latent trait is an underlying construct that is not readily visible such as efficacy or mathematical understanding (Bond & Fox, 2007). In other words, the construct being measured has unidimensionality. The construct is investigated by examining the relationship between two aspects: item difficulty and person ability. Bond and Fox (2007) observed that the model is based on the idea that useful measurement involves examination of only one human attribute at a time that is unidimensionality on a hierarchical 'more than or less than' the theoretical idealisation against which the researcher can compare patterns of responses that do not coincide with this idea. By using probabilities, items and respondents have the same distance in between on the construct map (Wilson, 2010). In traditional statistical analyses, standard errors of measurement apply to all the scores within a particular population. In Rasch modelling, the standard error of measurement differs across the scores but generalises across populations (Embretson, & Reise, 2000). Raw scores can be transformed into Rasch ability scores. Additionally, Rasch scores do not alter the placing of individuals on the continuum by their raw scores. Rasch modelling can also be applied to a polytomous case like this study. The basic Rasch model has based on the premise that an item is either correct or incorrect.

According to Wilson (2010), the first step is to develop a construct map once a specific construct has been decided upon to measure. The concept map provides a thorough definition of the construct and illustrates how the construct is displayed along a continuum from low to high. In this study, values in mathematics education are the construct, then a definition is given and a continuum is provided showing what constitutes low to high efficacy. The constructed map provides guide points of where respondents could be located along the developed continuum (Bond & Fox, 2007;

Wilson, 2010).The constructed map is then used as a guide for the development of items to be included in the measurement instrument. The item design consists of two components. The first is the construct component. The items developed and chosen should provide interpretational levels within the construct if items are properly developed with the construct map. The second relates to the descriptive components, such as deciding the self-report format. Likert scale was chosen. Likert scales have varying degrees of pre-specification and are often used in efficacy measurement instruments (Bond & Fox, 2007; Wilson, 2010). Likert scales are self-report scales that contain a range of responses to an item. The construct mapping concept was used at the initial stage of instrument development for the researcher to focus on the essential feature of what is to be measured, the individual performance.

The next step develops the outcome space for the construct that involves deciding on what aspects of the response to an item will be used and how those aspects will be categorised and scored. When using Likert scales, the respondents have already categorised their responses when they answered the various questions. Different responses are then identified with numbers chronologically in order to obtain scores of the respondents (Wilson, 2010).The final step is the development of the measurement model of the construct. The scored outcomes from the item design and outcome space are related back to the construct map. The analysis leads to the development of probabilities of items to respondents. Respondents and items have locations on the construct map and one can compare where an individual is in relation not only to others but the items as well (Wilson, 2010; Wright, 1977).

Wright (1977) explains how the Rasch model is used for latent trait analysis as the model is based on two parts: person ability and item difficulty. Rasch (1960) said that the model explains events that cannot be predicted to occur at specific moments in time, rather, probabilities of the occurrence can be assigned. The parameters represent the positions of the person and items on a continuum for the latent trait being measured. The difference in the two parts is compared, person ability minus item difficulty and this forms the base for developing probabilities used to predict how respondents will score on different items. The probability is evaluated using the difference and is applied as the exponent of the natural log function. The ratio acquired is the probability measure. When a person has more of a latent trait than an item requires, the respondent will have a higher probability whereas if a person has less of the trait than the item requires, the respondent will have a lower probability of getting that item correct (Wright, 1977).

Rasch analysis also has the potential to explain or inform why different items were problematic in earlier instruments, why certain items loaded on more than one factor or had a weak representation for the factor. Reliability and validity are central to Rasch modelling. Construct validity of Rasch methods stipulates that all items within the instrument should meaningfully contribute to the trait under investigation. Therefore, the results from the instrument should reflect the single underlying construct (Bond & Fox, 2007; Wright, 1979).

In Rasch measurement, data must fit the mathematical model. The fit of the data to the model is evaluated by fit statistics that are calculated for both persons and items. The infit is sensitive to unexpected behaviour affecting responses to items near the person ability level and the outfit is outlier-sensitive. Mean square fit statistics are defined such that the model specified the uniform value of randomness is 1.0 (Wright & Stone, 1979). Person fit indicates the extent to which the person's performance is consistent with the way the items are used by the other respondents. Item fit indicates the extent to which the use of a particular item is consistent with the way the sample respondents have responded to the other items. The values between .75 and 1.33 are considered acceptable for this type of analysis (Wilson, 2005). New data must be obtained if they do not. To meet the unidimensionality specification for all Rasch models, the developed items must measure only a single construct or latent trait. With regard to unidimensionality, if items are not measuring the same latent trait as indicated by Rasch fit statistics, they need to either be eliminated or modified to better fit the model. This specification of unidimensionality is a theoretical underpinning of measurement theory, in general, is very strictly adhered to with Rasch methods. Data that do not fit the model must be abandoned and theory reconsidered. In addition, to fit statistics, principal component analysis of residuals is used to examine whether a substantial factor exists in the residuals after the primary measurement dimension has been estimated (Linacre, 1998; Smith, 2002).

Briefly, Rasch measurement was chosen for the following reasons:(a) Rasch places person measures on a linear ability or attitude scale: Rasch places person measures and item difficulties on the same scale: Rasch places both person measures (person attitude) and item difficulties on the same scale thereby permitting the researcher to directly make inferences about a person's performance relative to the scale of items. Rasch establishes unidimensionality of measures: Rasch provides a person standard error: Rasch provides a way to verify construct validity: Rasch provides a way to ensure internal validity: Rasch allows for missing data: Rasch also provides step difficulties of the response categories in a measure.

Rasch model analysis uses separation, which shows the number of different groups within the sample and the number of different item difficulty levels (Fisher, 1992; Wright, 1996b). Separation estimates the number of levels from 0 to infinity into which the distribution of persons or items can be reliably distinguished where the unit of measurement is the logit (log odds unit) (Smith, 2001).

The questionnaire instrument's reliability was estimated using four statistics: (a) person reliability (to determine the consistency of person responses), (b) person separation (to estimate the ability of the instrument to separate participants into different levels of the construct), (c) item reliability (to estimate how well the items cohered), and (d) item separation (to estimate the ability of the participants to distinguish between items measuring different levels of the construct) (Wright & Masters, 2002).

Person reliability

Reliability of person separation was used to demonstrate whether respondents were being adequately separated by items along the continuum representing the construct, as well as provide an indication of replicability for person placement across other items measuring the same construct. Similar to Cronbach's alpha, perfect reliability would be 1.0 and random data would generate a relationship of 0.0. A Person separation reliability index corresponds to the traditional Cronbach alpha (Stone 2004).

Person separation

Person separation is used to classify people. Low person separation (< 2, person reliability < 0.8) with a relevant person sample implies that the instrument may not be not sensitive enough to distinguish between high and low performers. High Person separation: sensitive enough to distinguish between high and low performers. More items may be needed. The greater the spread of persons, the more chance the test has of assessing the tests-of-fit in a meaningful manner. Index values close to 1.00 indicate very small error variance is present and hence the instrument is displaying high reliability. An Index greater than 0.90 would be considered very satisfactory In this regard, person separation reliability is an estimate of how well a person can discriminate persons on the measured variable. This represents the replicability of person placement across other items measuring the same construct (Bond and Fox, 2001). Reliability is assessed using the Cronbach alpha coefficient.

Item reliability

Item reliability depends chiefly on item difficulty variance. The wide difficulty range shows a high item reliability. The large person sample also shows high item reliability. Low reliability means that your sample is not big enough to precisely locate the items on the latent variable. It is independent of test length. It is largely uninfluenced by the model fit. The item reliability measure indicates how well items can be discriminated from one another based on their difficulty and has no traditional equivalent in classical test theory. Low values indicate a narrow range of item measures or a small sample and can likely be increased by testing more people (Linacre, 1991-2005).

Item separation

Item separation is used to verify the item hierarchy. The value of the item separation refers to the number of strata of item difficulties obtained in the questionnaire. Low item separation (< 3 = high, medium, low item difficulties, item reliability < 0.9) implies that the person sample is not large enough to confirm the item difficulty hierarchy (= construct validity) of the instrument. High item separation: the person sample is large enough to confirm the item difficulty hierarchy (= construct validity) of the instrument. The value of the separation index for all respondents and the item constructs are inlined with the recommendations by Linarce (2005) which states that the separation value index of > 2.0 is good. The value of separation index

>2.0 is grade measurement system caused by only one or two observation, the value of between 1.5 to 2.0 is not productive for the development of measurement but not demeaning. Item separation was used to determine how well the survey separates the items. The higher the separation, the more confidence can be placed on the replicability of item placement across samples (Bond and Fox, 2007).

Reliability was also assessed through an examination of the person and item separation. Person and item separation and reliability of separation assess instrument spread across the trait continuum. Separation is a measure of the spread of the estimates relative to their precision (Linacre, 2006) and is calculated as the ratio of "true" (sample) standard deviation to the error standard deviation. Person separation was used to describe how well the survey identified individual differences.

For an instrument to be useful, separation should exceed 1.0, with higher values of separation representing the greater spread of items and persons along a continuum. Lower values of separation indicate redundancy in the items and less variability of persons on the trait. To operationalize a variable with items, each item should mark a different amount of the trait, as for instance, the way marks on a ruler form a measure of length. Separation, in turn, determines reliability. Higher separation in concert with variance in person or item position yields higher reliability. Reliability of person separation is conceptually equivalent to Cronbach's alpha, though the formulas are different. The Rasch reliability ratio is the statistical reproducibility of a set of values. It is computed for person abilities and item difficulties (or enforceability). The ratio ranges from 0.00to 1.00 and is interpreted the same as the Cronbach's α. Reliability of .70 is considered "acceptable," .80 is "good," and .90 is "excellent" (Duncan et al., 2003).

There are three fundamental criteria for Rasch models, namely item fit, unidimensionality, and item invariance (Bond & Fox, 2001). A Rasch model analysis was conducted to further evaluate the psychometric properties and to assess the appropriateness of this instrument as a measure of values for teachers. Specifically, the analyses examined the study's item fit, response scale structure, dimensionality, item invariance, and reliability. In addition, an item map detailing the locations of the items and distribution of participants' scores is included in the final group of items.

Construct validity

In this study, construct validity as the degree to which the order of the empirical item difficulties agrees with the conceptual difficulties of the items. Using the item difficulty scores (which order items based on their difficulty within a measure), one can ascertain whether the items included in a particular measure match the conceptual difficulty of the items (e.g., an item the researcher believe many teachers will agree with has a lower difficulty level than an item that you believe few teachers will agree with). The alignment of item difficulties with conceptual difficulties indicates that we are measuring what we really want to measure.

Internal validity

In this study, internal validity is defined as having measures that are unidimensional, meaning that they are measuring one, and only one, concept. The Rasch model calculates an expected response for each person to each item and produces fit statistics indicating the degree to which people and items are acting in accordance with expectation. For example, a person with a high person measure will be expected to score highly (or on a survey, endorse more items), especially items that are more easily endorsed by everyone. The difference between the expected response and the observed response for that person is the residual. The person fits statistic is then just an aggregation of all the residuals from all items for that person. A person with a poor fit statistic is likely someone who has responded randomly. We are less likely to believe a person measure with a large misfit statistic. We can inflate the standard error of the person to reflect this uncertainty. Analogously, the item fit statistic is calculated from an aggregate of the residuals for all people to that item. This helps determine whether there are items measuring a concept other than the one being assessed by the remaining items in that measure (indicating that researcher should perhaps reject the presumption of unidimensionality). The researcher can increase the internal validity of their measures by removing items that are not related to the concept being measured, or add in other items that enhance the definition of the concept. Rasch models also provide point-biserial correlations, indicating how much the responses to each item within a measure are correlated with the overall measure. Rasch analysis uses the item fit statistics and point-biserial correlations to verify that our measures only include items that are measuring the degree to which people endorse a single, underlying concept.

Exploratory Factor Analysis

The researcher chose Exploratory factor analysis in order to examine the inter-correlations that exist between the developed items or questionnaire responses and whether they are interpretable in a theoretical sense. It reduces the items into smaller groups, known as factors or dimensions. The dimensions produced by factor analysis used as input for further analysis in the study. These factors contain correlated variables and are almost similar in terms of content. Exploratory factor analysis (EFA) does not discriminate between variables on whether they are independent or dependent, but rather it is an interdependence technique that does not specify formal hypotheses. It is exploratory in nature as it allows the researcher to determine the underlying dimensions or factors that exist in a set of data.

The researcher employed (EFA) to refine the number of items for the purpose of scale development (DeVellis, 2003). Factor analysis allows the researcher to determine the nature and number of latent variables (factors) underlying a set of items. One of the critical assumptions associated with scale construction is for items measuring a particular construct to be relatively homogenous or unidimensional that are it could load together on one factor. Exploratory Factor Analysis (EFA) explore the dimensionality of a measurement instrument by finding the smallest number of interpretable factors needed to explain the correlations among a set of variables, exploratory in the sense that it places no structure on the linear relationships between the observed variables and on the linear relationships between the observed variables and the factors but only specifies the number of latent variables. Exploratory Factor Analysis (EFA) has widely been suggested as the appropriate tool when a theory is absent or new scales are being developed (Hair et al., 2006; Schumacker & Lomax, 2004). These identified factors are tested by using EFA method to examine their construct validity (Schumacker & Lomax, 2004). Factor analysis is a cyclical process of continually refining and comparing solutions until the most meaningful solution is reached (Tabachnick & Fidell, 2007). EFA is heuristic. The process of conducting an EFA involves three stages: Extraction, Rotation, and Interpretation.

Confirmatory Factor Analysis

Another data analysis method was based primarily on the use of confirmatory factor analysis using structural equation modelling (SEM). The researcher chose to perform Confirmatory Factor Analysis for all latent constructs involved in the study before modelling their inter-relationship in a structural model (SEM) since the researcher has a clear understanding of a number of factors underlying its items, the links between specific items and specific factors, and the association between factors. CFA is a statistical technique used to verify the factor structure of a set of observed variables. Confirmatory Factor Analysis is a special form of factor analysis to test whether the measures of a construct are consistent with the researcher's understanding of the nature of that construct (Suhr, 2006). The CFA method has the ability to assess the unidimensionality, validity and reliability of a latent construct.

Once the CFA procedure for every measurement model is completed, the researcher computes certain measures which indicate the unidimensionality, validity and reliability of the construct and that are required prior to modelling the structural model. Unidimensionality is achieved when all measuring items have acceptable factor loadings for the respective latent construct. In order to ensure unidimensionality of a measurement model, any item with a low factor loading should be deleted. The deletion should be made one item at a time with the lowest factor loading item to be deleted first. After an item is deleted, the researcher needs to run the new measurement model. The process continues until the unidimensionality requirement is achieved. Unidimensionality also requires all factor loadings to be positive.

Validity is the ability of the instrument to measure what it supposed to measure for a latent construct. Three types of validity could be achieved. Convergent validity is achieved when all items in a measurement model are statistically significant. The convergent validity could also be verified by computing the Average Variance Extracted (AVE) for every construct. The value of AVE should be 0.5 or higher for this validity to achieve. Thus, retaining the low factor loading items in a model could cause the construct to fail Convergent validity. Construct validity is achieved when the Fitness Indexes for a construct achieved the required level. The fitness indexes indicate how fit is the items in measuring their respective latent constructs. In SEM, there are several Fitness Indexes that reflect how fit is the model to the data at hand. However, there is no agreement among researchers which fitness indexes to use. Hair et al. (1995, 2010). Holmes-Smith (2006) recommend the use of at least one fitness index from each category of model fit. There are three model fit categories namely Absolute Fit, Incremental Fit, and Parsimonious Fit. Discriminant validity indicates the measurement model of a construct is free from redundant items. AMOS could identify the items redundancy in the model through a discrepancy measure called Modification Indices (MI). The high value of MI indicates the respective items are redundant. The researcher could delete one of the identified items and run the measurement model. The researcher could also constrain the redundant pair as "free parameter estimate". Another requirement for discriminant validity is the correlation between exogenous constructs should not exceed 0.85. The correlation value exceeding 0.85 indicates the two exogenous constructs are redundant or having serious multicollinearity problem.

Confirmatory factor analysis (CFA) is used to study the relationships between a set of observed variables and a set of continuous latent variables. It is used to test how well the measured variables represent the number of constructs. The researchers can specify the number of factors required for the data and which measured variable is related to which latent variable. It is used to confirm or reject the measurement theory. CFA enable the researcher to evaluate the model fit. It measures the chi-square goodness-of-fit test, goodness-of-fit index and adjusted goodness-of-fit index, (GFI, AGFI), the comparative fit index (CFI), and the root-mean-square error of approximation (RMSEA; normed fit index (NFI), rho 1, standardized root-mean-square residual (SRMR) Tucker–Lewis index (TLI)/non normed fit index (NNFI) relative non-centrality index (RNI).

With CFA, any item that does not fit the measurement model due to low factor loading should be removed from the model. The fitness of a measurement model is indicated through certain Fitness Indexes. However, the items deletion should not exceed 20% of total items in a model. Otherwise, the particular construct itself is deemed to be invalid since it failed the “confirmatory” itself. CFA corresponds to the measurement model of SEM and as such is estimated using SEM software. This document considers estimating confirmatory factor models using Amos 22.

ANOVA

The One-Way ANOVA ("analysis of variance") compares the means of two or more independent groups in order to determine whether there is statistical evidence that the associated population means are significantly different. One-Way ANOVA is a parametric test. In the One-way ANOVA, only one independent variable is considered. ANOVA is the most commonly used technique for comparing the means of groups of measurement data. Age, race, gender, teaching experience and level of education are independent variables in this study because they do not change. The researcher chose ANOVA to determine whether the mathematics teachers’ values involved in teaching Fractions differ by age, gender, race, the level of education and teaching experience.

Limitations

Statistical Package for the Social Sciences has the following limitations: (a) SPSS does not support Structural Equation Modelling, an extension method of regression models based on covariance matrix; (b) SPSS does not allow for simultaneous estimation of regression parameters and associations between independent variables, (c) SPSS does not provides model fit indices to evaluate how well data is represented, (d) SPSS does not allows including latent traits without building composite scores or extracting factor regression scores. To overcome the limitation, the researcher uses Rasch analysis as an alternative. A researcher often gets a large data the researcher generally uses SAS instead of SPSS to analyse the data.

To get a better understanding of instrument development, Rasch analysis was conducted. The Rasch measurement model (Rasch, 1960) was chosen for this analysis because it is the only item response theory model that has the desirable scaling properties of linear, interval measurement (Embretson & Reise, 2000). The Rasch rating scale model was applied because it was an adequate method for analysing summated rating scales and Likert-scales format and scales that had one format of responses options (Bond & Fox, 2001). The Rasch model was applied to test unidimensionality of the scale by examining the accounted total raw variance explained by measures and the residual matrix. The Rasch model was a one-parameter model of Item Response Theory (IRT) and is a probabilistic model. It helped test developers to create scales with equal intervals and construct objective and additive scales by use of the logit unit. By use of equal interval scale, it was possible to identify which items were more difficult and which persons had more ability or endorsement by indicating their locations on the continuum scale (logit scale). This model indicated that a more able person was more likely to pass more difficult items than a less able person (Bond & Fox, 2001). Rasch analyses were applied to examine the fit of the data to the Rasch model. Rasch analyses included the fit analysis for the overall scale and items level, Rasch Rating Scale analysis, the hierarchically structured order of the items, item-person map, and separation indices. In Rasch analysis, the item hierarchy that is created by the item difficulty estimates provides an indication of construct validity (Smith, 2001). These investigations were conducted to test the instrument quality and usability. Rasch measures are the most valid for mathematical operations, such as correlation and regression analysis, as well for assessing change.

Limitations of the Rasch model typically usually lie in two issues (Licarce, 1996). The main limitation of Rasch Model is the fact that applying the Rasch model requires some knowledge of and acquaintance with mathematics. Rasch Model requires a high level of software understanding. That's why; most researchers in the field of language testing put all the problems of sophisticated statistics on the shoulder of mathematicians or statisticians to analyse their data. Second, limitation of the Rasch model is the great number of observations or replications that are needed to estimate the parameters of the model. In fact, doing Rasch model without doing a large number of observations is impossible. Thirdly, the Rasch model holds strong assumptions, which are not easy to meet by the observations. In fact, Rasch specifications can never be met perfectly, but are nearly always met usefully by thoughtfully collected data. The Rasch model, however, does not have a guessing parameter, whereas most tests that require equating contain multiple-choice items subject to guessing. This limitation of the Rasch model has led many test developers to use a three-parameter model that accounts for guessing, though at the expense of increased difficulty in equating. In order for the Rasch model to produce true interval results, the researcher make sure that the data set must be infinite and the underlying assumptions must be perfectly met, fit to logistic item characteristic curves with common slopes, unidimensionality, local independence, and no guessing.

The study cannot confirm reliability and validity by conducting exploratory factor analysis only. The researcher conducted a confirmatory factor analysis to confirm the obtained reliability and validity. Confirmatory factor analysis allows the researcher to test the hypothesis that a relationship between the observed variables and their underlying latent construct exists. The researcher uses knowledge of the theory and empirical research, postulates the relationship pattern a priori and then tests the hypothesis statistically. Confirmatory factor analysis does have limitations to the study. The use of confirmatory factor analysis could be impacted by the moderate sample size and modifications made to the items for the real study, measurement instruments, multivariate normality, parameter identification, outliers, missing data, and interpretation of model fit indices (Schumacker & Lomax, 1996).

These limitations overcome through the review the relevant theory and research literature to support model specification, specify a model with diagram and equations, determine model identification using degrees of freedom, df, for model testing is positive, data collection, conducting preliminary descriptive statistical analysis such as scaling, missing data, collinearity issues, outlier detection, estimating parameters in the model assessing model fit and presenting and interpreting the results.

Summary

In this chapter, the development and the validation of the instrument have been discussed. The various phases of the process were reviewed towards the collection of data for the production of the final version of the instrument. Data sources from literature and document analysis, focus group feedback, expert input, individual responses from respondents were all crucial to refining the development of a reliable tool. The content and face validity was established through the use of a focus group and panel of experts that were proficient in mathematics education content areas. Also, a teacher peer group was utilised to represent the population for which the values instrument was intended. Construct validity was established by the implementation of exploratory factor analysis, Rasch model analysis, and confirmatory factor analysis of the pilot study and real study data. Chapter 4 provides and explains in greater depth the analyses performed for the main study.

CHAPTER 4: RESEARCH RESULTS

Introduction

This chapter provides a detailed account of the results of the five phases of the instrument design and item development. This Chapter discusses the results from the Analysis phase, the Design phase, the Development phase, the Implementation phase and the Evaluation phase. It explains how all the data was obtained, the procedures for the expert and empirical validation portions of the study are discussed along with all results of the collected data as they pertain to each research question. Rasch analysis, exploratory factor analysis, confirmatory analysis and ANOVA were used to analyse the results obtained from the pilot study and real study.

Analysis

A within-study literature analysis was carried out for this study. The literature review includes published information on findings, theoretical and methodological contributions involving current and past scholarly writings, books, and conferences proceedings by researchers, postgraduates' theses and dissertations in the selected area of research. It helps in the understanding of the topic, developing new ideas and knowledge and connecting ideas to the topic under study. According to Onwuegbuzie Collins, Leech, Dellinger, and Jiao (2010), literature review includes selected published and unpublished scholarly articles or documents from various sources on a topic involving, analysis, evaluation, synthesis and summarization of the documents. A thorough, comprehensive literature review gives a strong base and motivation for substantial relevant research (Boote & Beile, 2005).

The researcher, from conducting a thorough review of the literature, accomplished the following: (a) what research has been done and not done; (b) identify relevant variables for the topic; (c) identify theory and practice relationships; (d) discriminate commendable research; (e) understanding the applied research methodologies and designs; (f) determine discrepancies and inconsistencies; (g) understanding strengths and weaknesses of previous studies; (h) prevent replication; (i) determine researchers and documents; and (j) new research area; (k) understanding the research problem correctly; (l) identify appropriate secondary sources; (m) select and scrutinise reference works; (n) identify terms, key words or phrases relevant to the problem; (o) analyse relevant primary sources; and (p) summarize relevant facts from the relevant primary sources (Fraenkel & Wallen, 2006); Onwuegbuzie et al. 2010; Nik Azis, 2014). The analysis phase focused on the first research question: What are the dimensions of the mathematics teachers' values scale (MTVS) involved in teaching Fractions?

Some of the recent instrument studies that were discussed in the literature review were shown in Table 4.1. Leaving behind the other affective domain except for values, the researcher found out that there is no instrument that assessed primary school mathematics teachers' values involved in teaching fractions. In response to this absence of such an instrument, the researcher decided to develop the (MTVS).

Table 4.1
Recent Instruments on Values

Theory	Definition of values	Subconstruct	Instrument Design	Mathematics Content	Users
Sociology and culture Social interaction	Bishop (1991) Values in mathematics education are deep affective qualities which mathematics teaching fosters and they are a crucial component of the mathematics classroom affective environment .	**General educational values**: ethical values such as; good behaviour, integrity, obedience, kindness and modesty **Mathematical values:** values that reflect the nature of mathematical knowledge rationalism and objectivism **Mathematics educational values:** formalistic view and activist view, instrumental understanding and relational understanding, relevance and theoretical knowledge, accessibility and special, evaluating and reasoning	1. Open ended questionnaires-6 2. Likert scale Q-19 3. Ranking-12 4. Itemised rating scales -8	General	Develop instrument 1.Seah 2.Dede 3.Luttrell 4.Ernest 5. Clarkson 6. Atweh 7. Durmus and Bicak
Sociology	Chin and Lin (2000) Values were defined as a teacher's pedagogical identities concerning teaching, learning and the curriculum.	Pedagogical values 3 phases- Intention, Implementation and Self 5 Components: i. Social ii. Educational iii. Mathematical iv. Mathematics educational v. Pedagogical	questionnaire surveys, interviews, and classroom observations	1.mathematical induction, 2.circle and 3.permutation	1. Yazici, Ersen; Peker, Murat; Ertekin, Erhan; Dilmac, Bulent

Table 4.1 continued

Theory	Definition of values	Sub construct	Instrument Design	Mathematics Content	Users
Sociology	Dede 2006 As Bishops definition	Function concept	1. The Function Test - ten open-ended questions. 2. Rationality Test	Function concept	1.Yazici, Ersen; Peker, Murat; Ertekin, Erhan; Dilmac, Bulent 2.Ernest
Sociology	Dede 2010 As Bishops definition	constructivist values, positivist values	52 Likert-type items 107 preservice primary mathematics teachers	Mathematics teaching	1.Yazici, Ersen; Peker, Murat; Ertekin, Erhan; Dilmac, Bulent 2. Ernest
Sociology Values Theory	Rokeach, 1973 Value concept as an enduring belief that a specific mode of conduct or end-state of existence is personally or socially preferable to an opposite or converse mode of conduct or end-state of existence.	Human values 1. terminal values 2. instrumental values	36 item Questionnaire ranking all values	General	1.Schwartz 2.Chin and Lin 3. Luttrell
Eccles et al. (1983, 1984) theory of achievement-related choices motivation Sociology	As Bishops definition	interest, utility, attainment, and personal cost	28 items 5-point Likert-type response format	General	1.Luttrell

Table 4.1 continued

Theory	Definition of values	Subconstruct	Instrument Design	Mathematics Content	Users
Sociology	Durmu_and Bıçak (2008) As Bishops definition	constructivist and objectivist mathematics and mathematics educational values	40-item scale, a five-degree scale Likert scale	1.mathematics conceptions and beliefs 2.mathematics teaching	1.Dede Ins for data c
Psychology	Yazici, Ersen; Peker, Murat; Ertekin, Erhan; Dilmac, Bulent (2011) As Bishops definition	Mathematics, teachers, students	Mathematics Teaching Anxiety scale-23 items Mathematics Value Scale-34 items	Mathematics anxiety	
Expectancy-value theory of achievement motivation	Luthrell et al. (2010) Mathematics value aspects as covering those values that bear directly on a person's motivation for engaging, persisting, and excelling in mathematics	Interest Utility Attainment Personal cost	Mathematics Values Inventory (MVI) (28 items) 5 point Likert Scale	general	Develop instrument
Sociology Values Theory	Schwartz (1992) Value as a belief pertaining to desirable end states or modes of conduct that transcends specific situations; guides selection or evaluation of behaviour, people, and events; and is ordered by the importance relative to other values to form a system of value priorities.	Human values 1. Self-Direction. 2. Stimulation 3. Hedonism 4. Achievement 5. Power. 6. Security 7. Conformity. 8. Tradition 9. Benevolence 10. Universalism	56 items 5-point Likert-type response format	Nil	1. Portrait Values Questionnaire (PVQ 2.European Social Survey 3. ESS Human Values Scale 4. Shaw et al 5. Glazer, Daniel, and Short (2004)

Table 4.2 displays six studies and explains their characteristics namely theory and instrument format, sub-constructs, dimensions and number of items of the studies. The Table shows that the Bishop's study on values in mathematics education was based on sociocultural theory. Bishop categorised values in mathematics education as general education values, mathematics education values and mathematics values that formed the three sub-constructs in his study. Bishop's study questionnaire was developed using two sub-constructs and eight dimensions. Six dimensions were from mathematics values and two dimensions from mathematics education values. It focused on teacher's questionnaire. It has four main questions. The question one is, "When you are teaching mathematics to students in Years 5 and 6, how often you emphasise the following?" It consists of 18 items for mathematics values. Three items each for rationalism, objectivism, control, progress, openness and mystery. The teachers were asked how often they emphasise the eight dimensions in their mathematics teaching. The question two is, "How frequently do you use each of these activities below in your mathematics teaching at Years 5 and 6?" It has 17 items involving mathematics education values for teaching. The teachers were asked how frequently they use each of the stated activities such as group discussions and mathematics investigations in their mathematics teaching. Both question one and question two was answered on a 5-points Likert scale. In question three, the teachers were asked how mathematics is valued in the school curriculum. It has six items involving teaching values. In question 4, the teachers were asked whether mathematics is valuable knowledge for society. It has six items involving learning values. Both question three and question four are related to mathematics education values that were answered on a ranking scale. Some sample questions were displayed in Table 4.3. One item was

Table 4.2
Values in Mathematics Education Study Analysis

Study	Characteristics	Subconstruct	Dimension	Items
Bishop (1988)	• Used Sociocultural theory. • Instrument involved 5 points Likert scale and Ranking scale.	Mathematics Values. Mathematics Education values.	• 8 dimensions: Rationalism, Objectism, Control, Progress, Openness, Mystery. • Involved teaching and learning values.	Question 1: 18 items. Question 2: 17 items. Question 3: 6 items. Question 4: 6 items.
Dede (2010)	• Used Radical Constructivism. • Instrument involved 5 points Likert scale.	Mathematics Values. Mathematics education values	• 16 dimensions: Rationalism, Objectism, Control, Progress, Openness, Mystery, Formalistic view, Activist view, Instrumental understanding, Relational understanding, Relevance, Theoretical Knowledge, Accessibility, Special, Evaluating, Reasoning.	29 positive and 23 negative worded items.

chosen from each dimension. The table shows eight sample items from eight dimensions. Table 4.2 also explains Dede's study. Dede's study was based on radical constructivism. Dede (2010) developed a study that measured preservice mathematics teachers' mathematics values and mathematics educational values.

Table 4.2: continued

Study	Characteristics	Subconstruct	Dimension	Items
Seah (2012)	• Used Sociocultural theory. • Instrument involved 5 points Likert scale, Slider rating scale and Open-ended questions.	Mathematical values. Mathematics educational Values. Cultural values.	• 3 dimensions: Mathematical Values. Mathematics educational values, Cultural Values.	Section A: 64 items. Section B: 10 items. Section C: 4 items.
Durmu and Bicak (2006).	• Used Radical Constructivism • Instrument involved 5 points Likert scale.	Mathematics Education Values. Mathematics Values	• 2 dimensions: Constructivist and objectivist mathematics. Mathematics educational values	Constructivist: 20 items. Positivist: 14 items.
Chin and Lin (2000)	• Used Radical Constructivism. • Instrument involved Observation, interview and 5 point Likert Scale.	Pedagogy	• 5 dimensions : Social, Educational, Mathematical, Mathematics Educational, Pedagogical	6 set Questionnaires.
Nik Azis (2014)	• Used Universal Integrated Perspective. • Instrument involved 5 point Likert scale.	General Education values. Mathematics Education Values. Mathematics Values.	• 9 dimensions: Basic values, Core values, Main values, Expanded Values, Teaching values, Learning values, Ideology values, Sentimental values, Sociology values.	36 items

The study had two sub-constructs and six dimensions for mathematics values and ten dimensions for mathematics education values. The initial instrument consisted 52 items involving mathematics values and mathematics educational values that comprised of 29 positive and 23 negative items tested on a five-point Likert scale.

Chin and Lin (2000) study was based on radical constructivism. It is a case study to determine the impact of mathematics teachers' pedagogical beliefs consistency on their classroom instructional practices and students conceptions. The main construct is pedagogical beliefs involving five dimensions. Chin and Lin (2000) study setup teacher's value system from social, educational, mathematical, mathematics educational, and pedagogical aspects. Chin and Lin model's sample items of a secondary teacher's values statements shown in Table 4.3.

Durmu and Bicak (2006) study categorised values into two main categories namely constructivist and objectivist mathematics and mathematics educational values to determine values of pre-service teachers. Preservice teachers answered the 40 items on a five-point Likert scale. The items were reduced to 34 items. Of the 34 items, twenty were loaded to constructivist and the rest 14 items were loaded to positivist mathematics and mathematics educational values. Sample items were shown in Table 4.3. The items emphasis is on teachers and students active participation in mathematics knowledge development. This study could be used for in-service teachers to reveal their values and guide them to reconstruct their teaching practices. The items on mathematical values were similar to Bishop's that examined on rationalism, objectivism control, progress, openness, and mystery. The items on mathematical educational values examined items on formalistic view, activist view, instrumental understanding, relational understanding, relevance, theoretical knowledge, accessibility, special, evaluation and reasoning. Six sample items for Dede's study were shown in Table 4.3.

Nik Azis's study on mathematics values development comprises of a construct, made up of three sub-constructs namely general education values, mathematics education values and mathematics values. The general education values comprise of four value dimensions namely (a) basic values, (b) core values, (c) main values and (d) expanded values. Items one to five represent basic values, items six to nine represents core values, items ten to thirteen represent main values and items fourteen to eighteen represent expanded values. Mathematics education values comprise of two dimensions namely (a) teaching values, and (b) learning values. Items nineteen to twenty-two represent teaching values while items twenty-three to items twenty-six represents learning values. Mathematics values comprise of three dimensions namely (a) ideology values, (b) sentimental values and (c) sociology values. Items twenty-seven to thirty represent ideology values, items thirty-one to thirty-three represent sentimental values while items thirty-four to thirty-six represents sociology values. All in this instrument has nine dimensions and 36 items or value indicators.

The above six studies on values in mathematics education were discussed based on their characteristics, sub-constructs, dimensions and items. Those studies were chosen since they have been influenced directly or indirectly by studies done by Bishop and human values.

Table 4.3
Sample Items

Study	Sample items
Bishop (1988)	• Do you encourage your students to argue in your classes? Is a rationalism item. • Do you use geometric diagrams to illustrate algebraic relationships? Is an Objectivism item. • Do you encourage the analysis and understanding of why routine calculations and algorithms 'work'? Is a Control item. • Do you emphasise alternative, and non-routine, solution strategies together with their reasons? Is a Progress item. • Do you encourage your students to defend and justify their answers publicly to the class? Is an Openness item. • Do you tell them any stories about Mathematical puzzles in the past, about, for example, the 'search' for negative numbers, or for zero? Is a Mystery item. • For me, Mathematics is valued in the school curriculum because it develops rational thinking and logical argument. • For me, Mathematics is valuable knowledge for society because It emphasises argument, reasoning and logical analysis.
Dede (2010)	• Mathematics should be essentially composed of formulas and theorems (rationalism). • Mathematics teaching should not be carried out as relevant to daily life (relevance). • Assessment in mathematics should be done by focusing on open-ended questions. • Mathematics curriculum always should be updated according to new teaching methods, strategies, and techniques. • Mathematics textbooks should not include values. • Mathematics should not help us to be successful problem solvers in daily life.
Durmu and Bicak (2006)	• New subjects in mathematics cannot be learned without knowing previous subjects. • Mathematics can be understood only by people who are clever. • Teacher centred activities are essential in mathematics teaching. • Mathematics has a vital role in the development of civilisations. • In mathematics teaching, activities should be designed in a way that students are actively involved. • Teachers and students should construct mathematical knowledge together.

Table 4.3: continued

Study	Sample items
Seah and Wong (2012)	• Do you value Rationalism as Important when learning mathematics? • "What do you find important when learning mathematics?" • "How would you design maths lessons if you were to decide yourself?" • Working Step by step. • Appreciating the Beauty of Mathematics. • Memorising Facts. • Knowing the Times Tables. • Given the Formula to Use. • Working Out The Maths By Myself. • Feedback from My Teacher. • Learning Through Mistakes. • Understanding Concepts Processes. • Knowing the Steps of the Solution. • Stories about Mathematicians.
Chin and Lin (2000)	• We want our school to be caring and Christian, disciplining, encouraging, happy. • Mathematics teaching is an activity to initiate desire, expectation, and enjoyment of knowledge. • Mathematics teaching is an activity to increase students' motivation and anticipation for learning. • Mathematics teaching seeks to teach students the nature of mathematical knowledge rather than mathematical forms. • Mathematics teaching seeks to motivate students' interest and willingness to learn. • Mathematics is a useful and interesting subject
Nik Azis (2014)	• I am willing to pay attention in a mathematics classroom based on belief in God is a basic value. • I always give priority to fairness in the mathematics classroom is a core value. • I always give priority to discipline in the mathematics classroom is the main value. • I always give priority to accuracy in the mathematics classroom is an expanded value. • I always give priority to teaching mathematics for mathematics is a teaching value. • I always give priority to mastery of skills in the learning of mathematics is a learning value. • I always give priority to logical thinking and proving ideas in mathematics lessons is an ideology value. • I always give priority to mastery of rules and procedure in mathematics lessons is a sentimental value. • I always give priority to the relationship between mathematics knowledge and religion in mathematics lessons is a sociology value.

Design

Based on the instrument design and item development format, the study discussed the format used by the researcher to develop the instrument, the measurement scale used to rate the responses for the items developed and the structure of sub-constructs, dimensions and items of the instrument. This phase also revealed the characteristics of the items developed, the scoring format used to measure the individual score, sub-constructs and the total score and the evaluations of the experts' panel on the initial instrument and items based on content relevance.

The research instrument used is a self-report survey questionnaire. After comparing all the studies, the researcher chose an instrument based on Nik Azis's study. This is because Nik Azis pioneered the values in Mathematics education project at University Malaya, Kuala Lumpur, Malaysia. As a researcher and Nik Azis's student, the researcher was part of this project in the development of an instrument to assess values in mathematics education since July 2010. The researcher analysed all the items from various literature and documents based on values and other affective domain as stated in the literature review. A pool of 96 items was first gathered for 32 values indicators, that is three items for each indicator. After screening with respect to the values' sub-constructs and dimensions based on Nik Azis's study, it was reduced to 36.

The Nik Azis's study emphasised that teaching and learning mathematics in a mathematics classroom involves at least seven main focus namely introduction, exploration, formation, reinforcement, application, actualisation and evaluation. According to Nik Azis's study, the values development in a mathematics classroom could be done using at least twelve different contexts such as historical context, relationship, technology application, epistemology, reasoning, questioning, acculturalisation, enrichment, representation, assessment and problem-solving. The combination of three factors mentioned above, that is the sub-constructs, main focus and contexts result in the formation of an integrated study for values development in a mathematics classroom (Nik Azis, 2014, p.803).

In addition, this study was based on universal integrated perspective, a faith-based theory not used in any studies in Malaysia. Universal integrated perspective acts as an umbrella theory for all the other theories such as constructivism, cognitivism and behaviourism. The main objective of values development based on universal integrated perspective is to produce well-mannered human beings. The study uses three sub-constructs similar to Bishops sub-constructs. The dimensions were clearly defined in all the three sub-constructs. The nine value dimensions gave rise to thirty-six value indicators or items for values in mathematics education in the real study. All of them were defined clearly.

The researcher found out that the Nik Azis's study is appropriate for the teacher respondents' values assessment that has well-divided dimensions and value indicators that could measure the study's desired outcome. It is not available in any other values studies based on the literature review. It is able to produce the data appropriate to address the research questions. It is adequately piloted and ethically sound. The instrument developed was agreed and accepted by the supervisor. It can be used appropriately in the context of its original formulation and development. The items wording and the respondents' responses identified values. Sample items from nine dimensions were shown in Table 4.3. This instrument can be used to by the researcher in the education and professional development of teachers. The constructs, dimensions and operational definitions are appropriate to the target group.

The format was based on close-ended questions. The researcher considered words to use in creating the items. The researcher decided which items need to be included in the instrument, as well as what type of items and responding options would be appropriate. Each item related directly to the survey questionnaire objectives and phrased so that all respondents interpreted it the same way. Items were brief and have higher response rates. The language used in the questionnaire was direct and simple; thus, respondents answered quicker and more accurately. Questions represented sub-constructs and clearly defined. Likert scale was used. Therefore, all items have five responses. The respondents were clearly instructed.

According to past studies, scales are commonly developed based on Thurstone's method, the Likert scale, or Guttman scaling. The researcher chose Likert scale as it is very suitable to be used together with Rasch Model analysis. Most questionnaires used this scale in survey research. A typical test item in a Likert scale is a statement, the respondent indicated their agreement or disagreement with the statement. The highest point value goes to the most positive attribute and the lowest point value goes to the most negative. To analyse the data it is usually coded as follows 1 = strongly disagree, 2 = Disagree, 3 = Neutral (Neither agree nor disagree), 4 = Agree, and 5 = strongly agree. A five-point scale was used to suit statistical tools such as chi square, ANOVA, and Pearson R. One reason for this greater accuracy is that Likert scales allow us to cover the various facets of what are often complex and multidimensional attitudes or values.

Items were generated deductively by comprehensive literature review to determine the definition for values construct, identified sub-constructs, dimensions and indicators or samples. Items were generated inductively through focus group feedback, experts' panel and respondents' feedback. That feedback again determined the definition for values construct, identified sub-constructs, dimensions and indicators based on the theory. The items were selected and tested empirically from a pool of items. The items were written based on the fifteen criteria suggested by Nik Azis (2014). The items require the respondent to choose from a predetermined set of responses or scale points as stated above. The researcher chose to use positive items. Sample items that have validity, reliability and factor analysis were shown in Table 4.3.

The researcher analysed each item response separately and also had a totalled score for related items. It has the same set of responses. The categories were defined as separate options and allowed respondents to choose one option. Each respondent was asked to rate each item on a response scale (rate each item on a 1–5 response scale) as stated above. The final score for the respondent on the scale is the sum of their ratings for all of the items. Individual's total score was obtained by the sum of the weights of all the items in the instrument were taken. In this study Strongly Agree' is coded as 5 and 'Strongly Disagree' is coded as 1. Scores on this scale would range between 36 (all 1s) and180 (all 5s). The general education value score was obtained by adding up the scores of respondents towards 18 items. The lowest score and the highest score were 18 and 90 respectively. The mathematics education value score was obtained by adding up the scores of respondents towards eight items. The lowest score and the highest score were 8

Table 4.4
Item Score

	Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree	Total	Mean
Weightage	1	2	3	4	5		
GE Q1: In my opinion, the teacher has to pay attention in a mathematics classroom based on belief in God.	3	5	28	90	124	250	
Respondent x Weightage	3	10	84	360	620	1077	4.38

and 40 respectively. The mathematics values score were obtained by adding up the scores of respondents towards ten items. The lowest score and the highest score were 10 and 50 respectively. The overall score was obtained by adding up the scores for all the three sub-constructs.

For example, Table 4.4 displays the responses of 250 respondents in a survey for the first item in the study's questionnaire. Three respondents chose Strongly Disagree, five respondents chose Disagree, twenty-eight respondents were undecided, ninety respondents chose agree and one hundred twenty-four respondents chose strongly agree. When summed up, the total score obtained was 1077. The response means for an item is given by the total score divided by the number of respondents (1077/250) that is 4.38. This item's score falls under the category 'Agree' which is acceptable. To obtain individual's total score, the sum of the weights of all the items in the instrument were taken. Likewise, the score for the three sub-constructs and overall construct calculated.

Development

The development phase builds on both the Analysis and Design phases. This phase discussed the development of the initial instrument, the evaluations and feedback given by the focus group and experts' panel on the initial instrument and items.

How the initial instrument was developed was clarified in the analysis phase. This study guided the researcher to develop the sub-constructs and value dimensions. The study has three sub-constructs, nine values' dimensions and thirty-six values' indicators. The literature analysis on past studies enabled the researcher to pool a total of ninety-six items based on thirty-six values indicators. Two or three items were selected for each value indicator. Those 96 items were verified with the peer group and the supervisor. The peer group consisted of five Masters and five Doctorate postgraduates who are also mathematics teachers from the same Mathematics and Science department. Once the items were evaluated, the number of items was reduced to thirty-two. Those items were formed into an initial questionnaire. The questionnaire was given to the focus group to be evaluated. Based on the focus group evaluations and feedback, the researcher refined the items. The initial instrument was developed with three sub-constructs, nine values' dimensions and thirty-two values' indicators or items.

Focus group discussions are a qualitative research technique. To date, no framework has been provided that delineates the types of qualitative analysis techniques that focus group researchers have at their disposal (Leech & Onwuegbuzie, 2008). The focus group interviews are very similar to other interviews for data collection. The respondents gave their feedback based on the thirteen aspects of the focus group requirement. The researcher analysed the data by grouping focus group respondents' answers to each question. The researcher revised all the 32 items based on the feedback given by the six focus group respondents. The new set of 32 items were then sent back to the focus group to determine the content validity. The focus group respondents interpreted the question as the researcher intends. The respondents understood the question consistently. Respondents felt the research is relevant to them and felt motivated to complete it. The focus group respondents cooperated and provided accurate and appropriate answers. The statements explored respondents' feelings towards values in mathematics more generally.

The content validity of the instrument is also considered necessary in measuring the scale's quality. Both qualitative and quantitative content validity were used. In the qualitative stage, the focus group evaluated the questionnaire for wording, grammar, and scaling as required by the thirteen aspects. The content validity index (CVI) and the content validity ratio (CVR) were applied for calculating the quantitative content validity. Content validity has been defined as the degree to which an instrument has an appropriate sample of items for the construct being measured Polit and Beck (2004). Content validity is a necessity to know whether or not the items sampled for inclusion on the tool adequately represent the domain of content addressed by the instrument (Waltz, Strickland, & Lenz, 2005). According to Waltz and Bausell (1981), these item ratings are typically on a 4-point ordinal scale.

A content validation will complete the development of the draft or the proposed items (Artino & McCoach, 2008). Therefore, the construct and content validation in this study utilised 4- scale rating of;

(1) Not relevant

(2) Relevant with major correction

(3) Relevant with minor correction

(4) Very relevant - as used in Winter (2011).

The focus group was provided with a 32 proposed items that comprise three sub-constructs and nine dimensions and comprehensive instructions for completing the content validation. Each of them was given enough time to analyse, rate and finish the validation. In this process they were required to review all items and perform the following three tasks: (1) indicate how relevant each item for the chosen category, and (2) indicate how relevant for the number of items assigned in each construct and (3) rate the relevant items in each construct. Additionally, the focus group respondents were asked to recommend wording changes for any items they felt were unclear. The content validation results were tallied and organised into a spreadsheet. Then, this rubric scale was analysed by arithmetic mean of the total score in each section. After entering all ratings in a spreadsheet and amend the questionnaire according to the comments given by expert, item-level CVI scores were then calculated based on the proportion of six respondents scale who scored the item as relevant. This analysis included calculation of both an item-level CVI and the scale average CVI.

Item-level CVIs of 0.83 to 1.00 was acceptable that the item was rated as relevant by 5 raters and 6 raters respectively. Item-level CVIs of 0.50 to 0.67 means that the item was rated as relevant by 3 raters and 4 raters respectively while

Table 4.5
Content Validity Index (CVI) of Survey Items

Items	F1	F2	F3	F4	F5	F6	CVI
General education values							
1	X	0	X	0	X	X	0.67
2	X	0	X	0	X	X	0.67
3	X	0	X	0	X	X	0.67
4	X	0	X	0	X	X	0.67
5	X	0	X	0	X	X	0.67
6	X	X	X	X	X	X	1.00
7	X	X	X	X	X	X	1.00
8	X	X	X	0	X	X	0.83
9	X	X	X	X	X	X	1.00
10	X	X	X	X	X	X	1.00
11	X	X	X	X	X	X	1.00
12	X	X	X	X	X	0	0.83
13	X	X	X	X	X	X	1.00
14	X	X	X	X	X	0	0.83
15	X	X	X	X	X	X	1.00
16	0	X	X	X	X	X	0.83
17	X	X	X	X	X	X	1.00
18	X	X	X	X	X	X	1.00
Mathematics education values							
19	X	0	X	X	X	X	0.83
20	X	X	X	X	X	X	1.00
21	X	X	0	X	X	X	0.83
22	X	X	X	X	X	0	0.83
23	X	X	X	0	X	X	0.83
24	X	X	X	X	X	X	1.00
25	X	X	X	X	X	X	1.00
26	X	0	X	0	X	X	0.67
Mathematics values							
27	0	X	X	X	0	X	0.67
28	X	0	X	X	X	X	0.83
29	X	0	X	0	X	X	0.67
30	X	X	X	X	X	X	1.00
31	X	X	X	X	X	X	1.00
32	X	X	X	X	0	X	0.83
33	X	0	X	X	X	X	0.83
34	X	X	X	0	X	X	0.83
35	X	X	0	X	X	X	0.83
36	0	X	X	X	X	0	0.67
Overall CVI							0.86

F1,F2,F3,F4,F5,F6 represents raters. X indicates items of relevance.

scores of 0.17 to 0.33 means that the item was rated as relevant by 1 and 2 raters respectively. The result of the construct and content validation applied for this instrument is shown in the table below (by constructs) and attached in Appendix. Based on the evaluation on CVI explained by Lynn (1986) overall mean is 0.86 which is above 0.75 indicated that all the constructs were highly acceptable by all the focus group respondents. No items were discarded. Items were modified, based on the focus group respondents' or raters' opinions.The content validity index of survey items was shown in Table 4.5.

The focus group respondents made sure that the items are clear, brief, simple and unambiguous which were instantly understood. They made sure the items are related and useful to the main study, the development of an instrument on values in mathematics education. They made sure the items were related to values construct. The statements were revised and corrected as suggested by the focus group respondents. The researcher also reviewed each item in the questionnaire. The thirty-two items were refined, finalised and given to the experts' panel.

The experts' panel feedback was considered in this development phase. An expert panel is a small group of people comprises independent specialists, provides the knowledge and expertise in a specific subject for a project. Expert panels critique the questionnaire from various angles. The panel includes subject matter experts and researchers experienced in survey design, data collection, coding, and data analysis. Expert panels can detect problems and ensures that the content is accurate. The experts systematically analyse the response task for each question in terms of comprehension, information retrieval, judgement and response generation. Content validity addresses the match between items and the content or

Table 4.6
Focus Group Sample items

Items	Corrected items
General Education Values/ Nilai pendidikan umum	General Education Values/ Nilai pendidikan umum
Beriman at beragama/Belief in God Kepercayaan kepada tuhan dan berpegang kuat kepada ajaran agama adalah sangat penting bagi aktiviti bilik darjah matematik. *Belief in God and strong religious faith are important in a mathematics classroom.*	Beriman atau beragama (Have Faith) Kepercayaan kepada tuhan dan ajaran agama adalah sangat penting bagi aktiviti bilik darjah matematik. *Belief in God and religious teachings is important in a Mathematics Classroom.*
Nilai pendidikan Matematik/ Mathematics Education Values	Nilai pendidikan Matematik/ Mathematics Education Values
Nilai teoretis /Theoretic value Pengajaran matematik untuk membolehkan individu mempelajari matematik pada peringkat yang lebih tinggi adalah sangat penting dalam bilik darjah matematik. *Teaching mathematics to enable an individual learn mathematics to a higher level is important in a mathematics classroom.*	Nilai theoretic (Theoretical) Penguasaan Pengetahuan matematik untuk mempelajari matematik pada peringkat yang tinggi adalah sangat penting dalam bilik darjah matematik. *Mathematics knowledge acquisition and enhancement* is important in a *Mathematics Classroom*
Nilai Matematik/ Mathematics values	Nilai Matematik/ Mathematics values
Nilai Ideologi (Ideology value) Perkembangan pengetahuan pecahan melalui taakulan deduktif seperti penghujahan,penaakulan berhipotesis, analisis logical, teori dan pemikiran logical adalah sangat penting dalam bilik darjah matematik. *Development of fractional knowledge through deductive reasoning such as explanation, reasoning, hypothesis, theory, logical analysis and thinking is important in a mathematics classroom.*	Nilai Ideology (Ideology value) Perkembangan pengetahuan pecahan melalui taakulan deduktif dan pemikiran logical adalah sangat penting dalam bilik darjah matematik. *Development of fractional knowledge through deductive reasoning and logical thinking is important in a mathematics classroom.*

the subject area they are intended to assess. Experts in a given performance domain generally judge content validity.

Nineteen experts from the main universities in Malaysia (University of Malaya, Universiti Kebangsaan Malaysia, Universiti Putra Malaysia, Universiti Sains Malaysia, Universiti Teknologi Malaysia, University Pendidikan Sultan Idris, and Universiti Utara Malaysia) participated in this survey. In this study, ten mathematics university lecturers analysed the mathematics content of the items based on the given six criteria as well as the compatibility of English language and Bahasa Malaysia translation used. The three English lecturers and three Bahasa Malaysia lecturers did the back translation, edited the items for grammar and meanings in English Language and Bahasa Malaysia respectively. The three educational psychology lecturers analysed the items on values in mathematics education. The experts' panel examined the items based on the content defined by the sub-constructs, value dimensions and value indicators. The experts determined the content validity of the thirty-six items based on the six criteria namely (a) understanding (b) clarity (c) readability (d) relevance (e) content representation and (f) language compatibility. The requirements are as follows:

The level of difficulty refers to what extent the items are understandable. The statements are simple, unambiguous language, which is instantly understood. No jargon or abbreviations. The statements explore respondents' perceptions towards values in mathematics more generally. The categories refer to 1: Very difficult; 2; Difficult; 3 Neutral; 4 Easy and 5 is very Easy.

Clarity refers to what extent the items are clear, brief and unambiguous. The respondents interpret the statements as the researcher intends. The respondent

Table 4.7
Individual Mathematics Experts' Item Content Validity (Sample)

Items	Understand	Clarity	Read	Relevance	Content	Lang	Min
GEV							
1	4	5	4	3	4	5	4.166667
2	4	5	5	3	4	5	4.333333
3	4	4	5	4	4	3	4.0
4	4	5	5	3	4	5	4.333333
5	5	5	4	5	5	5	4.833333
6	5	5	5	4	5	5	4.833333
7	5	4	5	5	5	5	4.833333
8	5	5	5	5	3	4	4.5
9	4	5	4	5	5	5	4.666667
10	5	3	5	5	5	4	4.5
11	5	5	5	4	5	5	4.833333
12	3	4	5	5	5	5	4.5
13	5	5	3	4	3	5	4.166667
14	4	5	5	5	5	5	4.833333
15	5	5	4	5	5	4	4.666667
16	5	4	5	5	5	5	4.833333
17	4	5	5	5	5	5	4.833333
18	5	5	5	4	5	5	4.833333
MEV							
19	5	5	5	5	4	3	4.5
20	5	4	5	5	5	5	4.833333
21	5	5	3	5	4	5	4.5
22	4	5	5	5	5	5	4.833333
23	5	5	4	5	5	5	4.833333
24	5	3	5	5	4	3	4.166667
25	3	5	5	4	5	5	4.5
26	5	5	3	5	5	5	4.666667
MV							
27	5	5	4	5	5	5	4.833333
28	4	5	5	4	5	5	4.666667
29	5	3	5	3	5	5	4.333333
30	3	5	5	5	4	4	4.333333
31	5	4	4	5	5	5	4.666667
32	4	5	5	5	3	5	4.5
33	5	5	5	4	5	3	4.5
34	5	4	5	5	5	5	4.833333
35	5	5	4	5	5	3	4.5
36	4	5	5	4	5	5	4.666667

does understand the statements consistently: The categories refer to 1: Not clear at all, 2: Slightly clear, 3: Somewhat clear, 4: Clear and 5: Very clear.

Readability refers to what extent the items are easy to read and understand. The categories refer to 1: Very unreadable 2: Slightly readable, 3: Somewhat readable, 4: Readable and 5: Very readable.

Relevance refers to the relevance of the contents of each item to the sub-constructs. Is the statement related or useful to what is happening or being talked about? The categories refer to 1: Very irrelevant, 2: Irrelevant, 3: Somewhat relevant, 4: Relevant and 5. Very relevant.

The content representations refer to what extent the sub-construct is represented by the items. The statement made to influence opinion or action on values in mathematics education. The categories refer to 1; Not at all represented, 2: Slightly represented, somewhat represented, 4: Represented, and 5: Very well represented.

The language compatibility refers to what extent the content in the Bahasa Malaysia version is comparable with the English Language version. Is it able to exist or occur together without conflict? The statements explore respondents' feelings towards values in mathematics more generally. The categories refer to 1: Not at all compatible, 2: Slightly compatible, 3: Somewhat compatible, 4: Compatible, and 5: Very well compatible.

The ten mathematics experts were given the refined items from the focus group. The response form was also sent to them as in Table 4.7. The experts analysed 36 items individually on the given six criteria using the Likert scale. The mean for each item for the six criteria was calculated as shown in Table 4.7.

Table 4. 8
Mathematics Experts' Item Content Validity

Mathematics Experts	Mean for Each Item
Expert 1	4 and more
Expert 2	4 and more
Expert 3	Less than 4
Expert 4	4 and more
Expert 5	4 and more
Expert 6	Less than 4
Expert 7	4 and more
Expert 8	4 and more
Expert 9	4 and more
Expert 10	Less than 4

Table 4.8 shows the mathematics experts' selection of items. Expert 1 evaluated the questionnaire and found that all 36 item's mean was more than 4. Expert 1 has verified that the items have content validity according to the six criteria. Expert's 1 verification accepted. Expert 3 evaluated the items and found that four items' mean was 3. Expert 3 gave comments and suggestions to revise the items. The researcher consulted other experts and the supervisor for the item corrections. The mean should be 4 and more to be included as a relevant instrument. This mean represents the experts' individual means determining the content validity index for the items and the questionnaire. The ten experts agreed that the instrument has content validity, relevant and acceptable to be used in the study. The researcher used two judgments to determine content validity that was the measurable extent of each item for defining the traits and the set of items that represents all aspects of the traits. The sample items were shown in Table 4.9.

Table 4.9
Experts Panel Sample Items

Items	Corrected items
General Education Values/ Nilai pendidikan umum	General Education Values/ Nilai pendidikan umum
Beriman atau beragama (Have Faith **)** Kepercayaan kepada tuhan dan ajaran agama adalah sangat penting bagi aktiviti bilik darjah matematik. *Belief in God and religious teachings is important in a Mathematics Classroom.*	Beriman atau beragama (Have Faith) Saya berpendapat guru harus memberi perhatian dalam darjah matematik berasaskan kepercayaan kepada Tuhan. *In my opinion, teacher has to pay attention in a mathematics classroom based on believe in God.*
Nilai pendidikan Matematik/ Mathematics Education Values	Nilai pendidikan Matematik/ Mathematics Education Values
Nilai teoretis (Theoretical) Penguasaan Pengetahuan matematik untuk mempelajari matematik pada peringkat yang tinggi adalah sangat penting dalam bilik darjah matematik. *Mathematics knowledge acquisition and enhancement are* important in a *Mathematics Classroom.*	Nilai teoretis (Theoretical) Saya berpendapat mengutamakan pengajaran matematik untuk matematik adalah sangat penting dalam pengajaran pecahan. *In my opinion, giving priority to teaching mathematics for mathematics is important in teaching fractions.*
Nilai Matematik/ Mathematics values	Nilai Matematik/ Mathematics values
Nilai Ideologi (Ideology value) Perkembangan pengetahuan pecahan melalui taakulan deduktif dan pemikiran logical adalah sangat penting dalam bilik darjah matematik. *Development of fractional knowledge through deductive reasoning and logical thinking is important in a mathematics classroom.*	Nilai Ideologi (Ideology value) Saya berpendapat mengutamakan penaakulan, pembuktian, dan pemikiran logik adalah sangat penting dalam pengetahuan pecahan. *In my opinion, giving priority to reasoning, proving and logical thinking, is important in fractional knowledge development.*

Implementation

The implementation phase discussed the descriptive statistics for sub-construct, dimensions and construct of the items and instrument developed for the pilot study. A pilot study was done to test the initial instrument consisting 32 survey items. The pilot study was implemented to gather feedback on sub-construct, dimensions and construct of the items and instrument from the 150 respondents. This pilot study is to finalise an instrument that assesses primary school mathematics teachers' values involved in teaching fractions for the real study. The researcher wanted to know if the instrument works as anticipated through the pilot study. This section describes the findings through Rasch analysis and exploratory factor analysis of the pilot study. The analysis was done on demographic characteristics of respondents, Rasch measurement reliability analysis on general education values, mathematics education values and mathematics values, principal component analysis of the Rasch residuals, point measure correlation, rating scale, and summary of the pilot study. Factor analysis discussions were based on the descriptive statistics, correlation of items, KMO and Bartlett's test, communalities, rotation, scree plot and summary of findings.

The 150 primary school mathematics teachers participated in the pilot study. They answered the questionnaire on a 5-point Likert scale. Mean was calculated for each respondents' responses for the 32 items. Mean was calculated separately for the three sub-constructs. The means for sub-constructs general education values, mathematics education values and mathematics values was 4.645, 4.403, and 4.449 respectively. Overall the pilot study's mean for values in mathematics education was 4.521. There was not much difference between

Table 4.10
Pilot Study Means and Variances of Sub-constructs and Construct

	General Education Values	Mathematics Education Values	Mathematics Values	Mathematics Education Values
Item Means	4.645	4.403	4.449	4.521
Item Variances	.301	.433	.431	.375

the means. All were within the range of 4.5. The means for the thirty-two items were shown in Table 4.10. The means was more than 4.5 except eleven items where the means was between 4.2 and 4.4. Based on the outcomes, the pilot study showed that all the items were in the agreeable zone of the Likert scale that could be considered for the real study.

The Table 4.11 presents the distribution of scores on mean, standard deviation, variance, skewness, kurtosis and the respective statistic for each item for the pilot study. Descriptive data identified scores on continuous variables, skewness and kurtosis. The skewness value show symmetry of the distribution. Kurtosis, show the peak of the distribution. The data in this study shows negative scores. The scores gathered to the left at the low values. Therefore, it is positively skewed (right-tailed). Kurtosis shows clustering of scores. Positive kurtosis values indicate that the distribution is rather clustered in the centre, with long thin tails. Kurtosis values below 0 indicate a distribution that is relatively flat, too many cases in the extremes. In this study, the scores were less than 0; negative values show no clustering and scores spread out. Kurtosis can result in an underestimate of the variance, but this risk is also reduced with a large sample of 200 cases, (Tabachnick & Fidell, 2001). The distribution is highly skewed**.**

Table 4.11
Pilot Study Descriptive Statistics

	N	Mean	SD	Variance	Skewness		Kurtosis	
	Statistic	Statistic	Statistic	Statistic	Statistic	SE	Statistic	SE
Q1	150	4.5733	.65893	.434	-1.558	.198	2.295	.394
Q 2	150	4.7933	.42247	.178	-1.731	.198	1.775	.394
Q 3	150	4.7400	.48369	.234	-1.633	.198	1.779	.394
Q 4	150	4.7467	.43638	.190	-1.146	.198	-.697	.394
Q 5	150	4.7200	.45050	.203	-.990	.198	-1.034	.394
Q 6	150	4.7333	.48697	.237	-1.937	.198	5.274	.394
Q 7	150	4.6867	.46540	.217	-.813	.198	-1.357	.394
Q 8	150	4.6467	.49340	.243	-.789	.198	-.963	.394
Q 9	150	4.6333	.48351	.234	-.559	.198	-1.711	.394
Q 10	150	4.5600	.61829	.382	-1.095	.198	.155	.394
Q 11	150	4.6400	.48161	.232	-.589	.198	-1.675	.394
Q 12	150	4.6533	.53075	.282	-1.460	.198	2.843	.394
Q 13	150	4.2867	.92929	.864	-1.570	.198	2.456	.394
Q 14	150	4.6200	.52673	.277	-.914	.198	-.320	.394
Q 15	150	4.3400	.80126	.642	-1.170	.198	.956	.394
Q 16	150	4.5533	.55001	.303	-.950	.198	1.334	.394
Q 17	150	4.4867	.62107	.386	-1.141	.198	1.878	.394
Q 18	150	4.3467	.83535	.698	-1.148	.198	.573	.394
Q 19	150	4.5133	.52758	.278	-.332	.198	-1.284	.394
Q 20	150	4.3267	.75526	.570	-1.003	.198	.715	.394
Q 21	150	4.5267	.52707	.278	-.386	.198	-1.243	.394
Q 22	150	4.5000	.54032	.292	-.388	.198	-1.063	.394
Q 23	150	4.5333	.56363	.318	-.930	.198	1.185	.394
Q 24	150	4.5733	.53529	.287	-.696	.198	-.713	.394
Q 25	150	4.5333	.52669	.277	-.414	.198	-1.220	.394
Q 26	150	4.3067	.74136	.550	-.863	.198	.358	.394
Q 27	150	4.3933	.67453	.455	-.801	.198	.088	.394
Q 28	150	4.4333	.59547	.355	-.512	.198	-.631	.394
Q 29	150	4.2600	.77225	.596	-.487	.198	-1.165	.394
Q 30	150	4.3533	.65678	.431	-.666	.198	.083	.394
Q 31	150	4.2533	.76137	.580	-.649	.198	-.384	.394
Q 32	150	4.3933	.69414	.482	-.953	.198	.624	.394

Table 4.12
Pilot Study Descriptive Statistics on Factors

	Mean	Std. Deviation	Skewness		Kurtosis	
	Statistic	Statistic	Statistic	Std. Error	Statistic	Std. Error
Factor 1	65.0333	4.97702	-.916	.198	-.175	.394
Factor 2	35.5933	3.56172	-.667	.198	-.194	.394
Factor 3	44.0333	4.92005	-.257	.198	-.389	.394
Overall	144.6600	12.18968	-.551	.198	-.972	.394
Valid N (listwise)						

Table 4.12 shows the influence of descriptive statistics on the three extracted factors after rotation. The skewness statistic should fall between -1 and 1. In this study, the skewness and kurtosis statistic have negative values and less than 1. If less than 1, then the distribution is negatively skewed.

Evaluation

The evaluation phase involves formative and summative evaluation. Throughout each phase of the instrument design and development, formative evaluation took place on a reoccurring basis during the establishment of validity. Summative evaluation took place after the pilot test. The evaluation phase consists of three parts: firstly was feedback from the respondents from the pilot study; secondly was feedback from the experts' panel and thirdly was the review of all the feedback and results of the real study by the researcher. The data were analysed and evaluated. This phase discussed the descriptive statistics for the sub-construct, dimensions and construct of the instrument and the findings of factor analysis, Rasch analysis, confirmatory factor analysis and ANOVA analysis for the instrument developed.

Table 4.13

Real Study Means and Variances of Subconstructs and Construct

	General Education Values	Mathematics Education Values	Mathematics Values	Mathematics Education Values
Item Means	4.529	4.432	4.545	4.502
Item Variances	.380	.361	.372	.371

The 250 respondents rated the importance of each values dimension or items from strongly disagree to strongly agree. In the first stage, the importance of the sub-constructs was calculated using mean. The means for sub-constructs general education values, mathematics education values and mathematics values was 4.529, 4.432, and 4.545 respectively. The overall mean for the instrument is 4.502. The means for the thirty-six items were shown in Table 4.13.

The means was more than 4.2. Based on the outcomes, the real study showed that all the items were acceptable. The items were in the category of 4, which is the level of agreement.

The Table 4.14 displays the distribution of scores on mean, standard deviation, variance, skewness, kurtosis and the respective statistic for each item for the real study. Standard Deviation (SD) provides an indication of how far the individual responses to a question vary or "deviate" from the mean. SD tells the researcher how spread out the responses are they concentrated around the mean or scattered far and wide.SD generally does not indicate anything, a lower SD is not necessarily more desirable. It is used purely as a descriptive statistic. It describes the distribution in relation to the mean. The Standard Error (SE), is an indication of the reliability of the mean. A small SE is an indication that the sample mean is a more accurate reflection of the actual population mean. A larger sample

Table 4.14

Real Study Descriptive Statistics

		Item		Variance	Skewness		Kurtosis	
		Statistic	Statistic	Statistic	Statistic	SE	Statistic	SE
Q1	250	4.3560	.86269	.744	-1.1515	.154	2.535	.307
Q2	250	4.5580	.63551	.404	-1.470	.154	1.800	.307
Q3	250	4.5280	.68344	.467	-1.357	.154	1.377	.307
Q4	250	4.5560	.65772	.433	-1.361	.154	1.317	.307
Q5	250	4.5680	.60568	.367	-1.193	.154	.934	.307
Q5	250	4.5080	.64778	.420	-1.058	.154	.395	.307
Q7	250	4.6320	.53076	.282	-1.194	.154	1.396	.307
Q8	250	4.6000	.54515	.297	-1.080	.154	1.036	.307
Q9	250	4.6160	.51925	.270	-.824	.154	-.581	.307
Q10	250	4.6000	.58769	.345	-.76	.154	.307	.307
Q11	250	4.6720	.47889	.229	.847	.154	-.996	.307
Q12	250	4.6200	.54108	.293	-1.027	.154	.014	.307
Q13	250	4.4160	.69590	.477	-986	.154	.594	.307
Q14	250	4.4580	.53361	.285	-.723	.154	-.673	.307
Q15	250	4.4320	.69231	.479	-1.035	.154	.657	.307
Q16	250	4.5960	.53095	.282	-.958	.154	.811	.307
Q17	250	4.4800	.60917	.371	-.944	.154	.972	.307
Q18	250	4.4480	.74936	.562	-1.293	.154	1.196	.307
Q19	250	4.4520	.58056	.337	-.991	.154	3.942	.307
Q20	250	4.3320	.67498	.456	-.831	.154	.824	.307
Q21	250	4.4560	.54521	.297	-.274	.154	-1.042	.307
Q22	250	4.4480	.53708	.288	-.183	.154	-1.158.	.307
Q23	250	4.5160	.53186	.283	-.387	.154	-1.163	.307
Q24	250	4.5040	54697.	.299	-.461	.154	-.926	.307
Q25	250	4.4960	.52448	.275	-.236	.154	-1.379	.307
Q26	250	4.3680	.65902	.434	-.903	.154	1.664	.307
Q27	250	4.4080	.64123	.411	-.711	.154	-.059	.307
Q28	250	4.4400	.59313	.352	-.522	.154	-.634	.307
Q29	250	4.3480	.69630	.485	-.594	.154	-.785	.307
Q30	250	4.3920	.59981	.360	-.420	.154	-.664	.307
Q31	250	4.2960	.65275	.426	-.389	.154	-.727	.307
Q32	250	4.3560	.66259	.439	-.710	.154	.176	.307
Q33	250	4.6720	.53438	.286	-1.995	.154	7.787	.307
Q34	250	4.5280	.58873	.347	-.823	.154	-.301	.307
Q35	250	4.6400	.49738	.247	-.783	.154	-.911	.307
Q36	250	4.6400	.57943	.336	-1.874	.154	5.764	.307

size will normally result in a smaller SE while SD is not directly affected by sample size. The Standard Deviation of this distribution of sample means is the Standard Error of each individual sample mean. Standard Error is the Standard Deviation of the population mean. The SD of this distribution helps the researcher to understand how far a sample means is from the true population mean, and to understand how accurate any individual sample mean is in relation to the true mean.SD tells us about the shape of our distribution, how close the individual data values are from the mean value. SE tells us how close our sample mean is the true mean of the overall population. In this pilot study, SD did not deviate from the mean as shown in Table 4.14.

Table 4.15
Pilot Study Extracted Factors

	Mean	Std. Deviation	Skewness		Kurtosis	
	Statistic	Statistic	Statistic	Std. Error	Statistic	Std. Error
Factor 1	65.0333	4.97702	-.916	.198	-.175	.394
Factor 2	35.5933	3.56172	-.667	.198	-.194	.394
Factor 3	44.0333	4.92005	-.257	.198	-.389	.394
Overall	144.6600	12.18968	-.551	.198	-.972	.394

Further, descriptive statistics analysis was done on the three extracted factors after rotation as shown in Table 4.15. The skewness values show symmetry of the distribution. Kurtosis values show the peak of the distribution. The skewness statistic should fall between -1 and 1. In this study, the skewness and kurtosis statistic have negative values and less than 1. The scores gathered to the left at the low values. Therefore, it is negatively skewed (left-tailed) where the mode is more than the median which is larger than the arithmetic mean. In this study, the scores were less than 0; negative values show no clustering and scores spread out. This study's distribution is highly skewed**.**

Demographic Characteristics of Respondents

The pilot study collected data from 150 respondents. They were from selected National Primary schools from Kuala Lumpur because the researcher teaches in Kuala Lumpur. The demographic data collected included gender, race,

Table 4.16
Pilot Study Profile of Respondents

Demography	Factor	Frequency	Percentage %
Age			
	21 years to 30 years	22	14.7
	31 years to 40 years	83	55.3
	41 years to 50 years	38	25.3
	51 years to 60 years	7	4.7
gender			
	Male	50	33.3
	Female	100	66.7
Race			
	Malay	121	80.7
	Chinese	18	12.0
	Indian	11	7.3
Education			
	Diploma	54	36.0
	Bachelor	89	59.3
	Master	7	4.7
Experience			
	1 year to 4 years	13	8.7
	5 years to 8 years	26	17.3
	9 years to 12 years	41	27.3
	13 years to 16 years	41	27.3
	17 years and above	29	19.3
Total		150	100

and level of education are nominal categorical variables and was described by frequencies and percentages. Age and teaching experience completed are continuous variables and were described using means and standard deviations. The analysis of the demographic subgroups, including sex, age, race, education, and teaching experience are represented in developmental studies to support the development of an instrument.

Table 4.16 shows the demographic profile of the respondents. The study respondents were teachers with different age, gender, race, the level of education and teaching experience. At the age criteria, 14.7 % of the respondents are in the age group 21-30, years old, 55.3 %, of the respondents, are in the age group 31 - 40 years old, 25.3 % of the respondents are in the age group 41 - 50 years old, and 4.7 % of the respondents are in the age group 51 years old and above. The respondents were made up of 33.3 % and 66.7% of male and female teachers respectively. On the level of the respondents' education, 36% were diploma holders, 59.3% were bachelor degree holders, and 4.7% were Master degree holders. On years of teaching experience, 8.7 % of the respondents have experience 1 to 4 years, 17.3% of them have experience between 5 to 8 years, and 27.3% of them have experience between 9 to 12 years, 27.3% of them have experience between 13 to 16 years and 19.3% of them have teaching experience above 17 years. The average age of respondents is between 31 to 40 years old and the average teaching experience is between 9 to 12 years. It was found that the majority of the respondents were female.

Factor Analysis

Factor analysis is a multivariate statistical approach commonly used in psychology and education. Factor analysis is used to find factors among observed variables. The researcher use factor analysis to reduce the number of variables if the data contains many variables. Factor analysis groups variables with similar characteristics together. Factor analysis helps the researcher to produce a small number of factors from a large number of variables which is capable of explaining the observed variance in the larger number of variables. The reduced factors can also be used for further analysis. There are three stages in factor analysis. First, a correlation matrix is generated for all the variables. A correlation matrix is a rectangular array of the correlation coefficients of the variables with each other.

Second, factors are extracted from the correlation matrix based on the correlation coefficients of the variables. Third, the factors are rotated in order to maximise the relationship between the variables and some of the factors. Factor analysis is used to explore relationships between variables to identify or confirm underlying dimensions to develop and validate an instrument. Factor analysis was done to determine how participants in a particular study respond to the survey questions. The researcher used factor analysis to choose the best items to represent a construct. The researcher calculated Cronbach's alpha reliabilities to test the consistency with which the participants respond to the measures. The field of application includes theory development and instrument development or validation (Spearman (1863-1945) & Thurstone (1887-1955).

KMO and Bartlett's Test

KMO and Bartlett's Test of Sphericity is a measure of sampling adequacy that is recommended to check the case to the variable ratio for the analysis being conducted. It measures the strength of the relationship among variables.

Table 4.17
KMO and Bartlett's Test

Kaiser-Meyer-Olkin Measure of Sampling Adequacy.		.894
Bartlett's Test of Sphericity	Approx. Chi-Square	3222.818
	df	496
	Sig.	.000

Interpretive adjectives for the Kaiser-Meyer-Olkin Measure of Sampling Adequacy were given as 0.90 marvellous, in the 0.80's as meritorious, in the 0.70's as middling, in the 0.60's as mediocre, in the 0.50's as miserable, and below 0.50 as unacceptable. The study presented the value of the KMO Measure of Sampling Adequacy for the set of variables in this study was .894 which would be labelled as meritorious. Since the KMO Measure of Sampling Adequacy meets the minimum criteria, the study does not have a problem that requires examining the Anti-Image Correlation Matrix. Bartlett's test of sphericity tests concluded that there were correlations in the data set that were appropriate for factor analysis. This analysis met this requirement. Table 4.17 shows Barlett's test of sphericity was highly significant ($p < 0.001$), and therefore from the perspective of Bartlett's test, factor analysis was appropriate.

Communalities

Communality is the proportion of observed variance due to common factors, or the total amount of variance for an item explained by the extracted factors. Communalities can range from zero (the variable has no correlation with any other variable in the matrix) to one (the variance of the variable is completely accounted for by the underlying factors). In PCA, communalities are set to one, as all observed variance is viewed as available to be modelled.” (Norris & Lecavalier, 2010)

The Table 4.18 shows communalities before and after extraction. Initial communalities are estimates of the variance in each variable accounted for by all components or factors. Extraction communalities are estimates of the variance in each variable accounted for by the factors (or components) in the factor solution. Communalities represent the proportion of the variance in the original variables that is accounted for by the factor solution. The factor solution should explain at least half of each original variable's variance, so the communality value for each variable should be 0.50 or higher. Small values indicated variables that do not fit well with the factor solution and should possibly be dropped from the analysis. In

Table 4.18
Communalities

	Initial	Extraction
Question 1	1.000	.717
Question 2	1.000	.755
Question 3	1.000	.598
Question 4	1.000	.590
Question 5	1.000	.591
Question 6	1.000	.760
Question 7	1.000	.671
Question 8	1.000	.675
Question 9	1.000	.609
Question 10	1.000	.697
Question 11	1.000	.649
Question 12	1.000	.508
Question 13	1.000	.756
Question 14	1.000	.652
Question 15	1.000	.684
Question 16	1.000	.632
Question 17	1.000	.735
Question 18	1.000	.691
Question 19	1.000	.409
Question 20	1.000	.660
Question 21	1.000	.693
Question 22	1.000	.771
Question 23	1.000	.697
Question 24	1.000	.659
Question 25	1.000	.657
Question 26	1.000	.698
Question 27	1.000	.705
Question 28	1.000	.696
Question 29	1.000	.739
Question 30	1.000	.686
Question 31	1.000	.746
Question 32	1.000	.671

this study, only item 19 has a communality value less than 0.5 that is .409. According to the result, 71.1 % of the variance associated with question 1 was common or shared variance. After extraction factors were not discarded and information was not lost. The amount of variance in each variable that can be explained by the retained factors was represented by the communalities after extraction. The Principal Component communalities in the pilot study range from .409 to .771 (Extraction, Initial are always 1.00) thus most of the variance of these variables were accounted for by this two-dimensional factor solution. Component Matrix shows the factor loadings for each variable. A rotation method gets factors that were different from each other as possible and helped the researcher interpret the factors by putting each variable primarily on one of the factors. In the Principal Components Output, the Rotated Component Matrix gave the correlation of each variable with each factor. Varimax rotation is an orthogonal rotation of the factor axes to maximise the variance of the squared loadings of a factor (column) on all the variables (rows) in a factor matrix, which has the effect of differentiating the original variables by extracted factor. Each factor will tend to have either large or small loading of any particular variable. Figure 4.1 shows the actual factors that were extracted. The section labelled "Rotation Sums of Squared Loadings," shows only those factors that met the cut-off criterion (extraction method). Using the output, there were six eigenvalues greater than 1.0. The latent root criterion for a number of factors to obtain would indicate that there were six components to be extracted for these variables. SPSS always extracts as many factors initially as there are variables in the dataset, but the rest of these did not make the grade. The "% of variance" column tells how much of the total variability in all of the variables together can be accounted for by each of these summary scales or factors. The

Factor	Initial Eigenvalues			Extraction Sums of Squared Loadings			Rotation Sums of Squared Loadings		
	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %
1	12.783	39.947	39.947	12.393	38.728	38.728	4.125	12.891	12.891
2	2.739	8.559	48.505	2.355	7.360	46.088	4.028	12.589	25.480
3	1.798	5.618	54.124	1.421	4.442	50.530	3.907	12.208	37.688
4	1.588	4.961	59.085	1.220	3.813	54.344	2.964	9.261	46.949
5	1.332	4.161	63.247	.904	2.826	57.170	2.385	7.453	54.402
6	1.225	3.828	67.075	.796	2.487	59.657	1.681	5.254	59.657
7	.984	3.076	70.151						
8	.897	2.802	72.953						
9	.782	2.444	75.397						
10	.705	2.205	77.602						
11	.696	2.176	79.778						
12	.611	1.911	81.688						
13	.574	1.793	83.481						
14	.512	1.600	85.081						
15	.486	1.520	86.601						
16	.467	1.458	88.059						

Figure 4.1. Total Variance Explained Before Rotation

the researcher was most interested in the "Extraction Sums of Squared Loadings" which represented the outcomes by the factor analysis.

Figure 4.1 shows factor extraction, list the eigenvalues associated with each linear component or factor before extraction and after rotation. Before extraction, SPSS identified 36 linear components within the data. The eigenvalues associated with each factor represent the variance explained by that particular linear component and also shows eigenvalue in terms of the percentage of variance explained.

As can be seen, the first eigenvalue is equal to 12.783 and corresponds to 39.947% of the variance in the original data. The second eigenvalue is equal to 2.739 and corresponds to 8.559% of the variance in the original data. The third eigenvalue is equal to 1.798 and corresponds to 5.618% of the variance in the original data. The fourth eigenvalue is equal to 1.558 and corresponds to 4.961% of the variance in the original data. The fifth eigenvalue is equal to 1.332 and corresponds to 4.161% of the variance in the original data. The sixth eigenvalue is equal to 1.225 and corresponds to 3.828% of the variance in the original data.

The Figure 4.1 extracts all factors with eigenvalues greater than 1 that leaves only six factors. It was displayed in the columns labelled extraction Sums of Squared Loadings. The values are the same as values before extraction, except the values for the discarded factors, are ignored. The last column Rotation Sums of Squared Loadings displayed the eigenvalues for the factors after rotation. The rotation has the effect of optimising the factor structure and the relative importance of data for the six factors equalised. The cumulative proportion of variance criteria for six components satisfies the criterion of explaining 67.075 % of the total variance more than the required 60%. The check of the suitability for the pilot study is made through the percentage of non-redundant residues which are greater than 0.05; in this case, the percentage is 29% (see Table Reproduced Correlations). For a better suitability, the percentage should be as small as possible. The rule is that the percentage of non-redundant residues above 0.05 to be under 50% (Labar, 2008).

Scree plot

The Scree test, articulated by Cattell (1966), represents a second popular criterion for determining the number of factors to retain. The Scree test plots the eigenvalues of each factor in descending order on a chart where the factors are placed on the x-axis and the eigenvalues on the y-axis. The factors on the vertical slope are retained as valuable factors, and those factors on the horizontal are

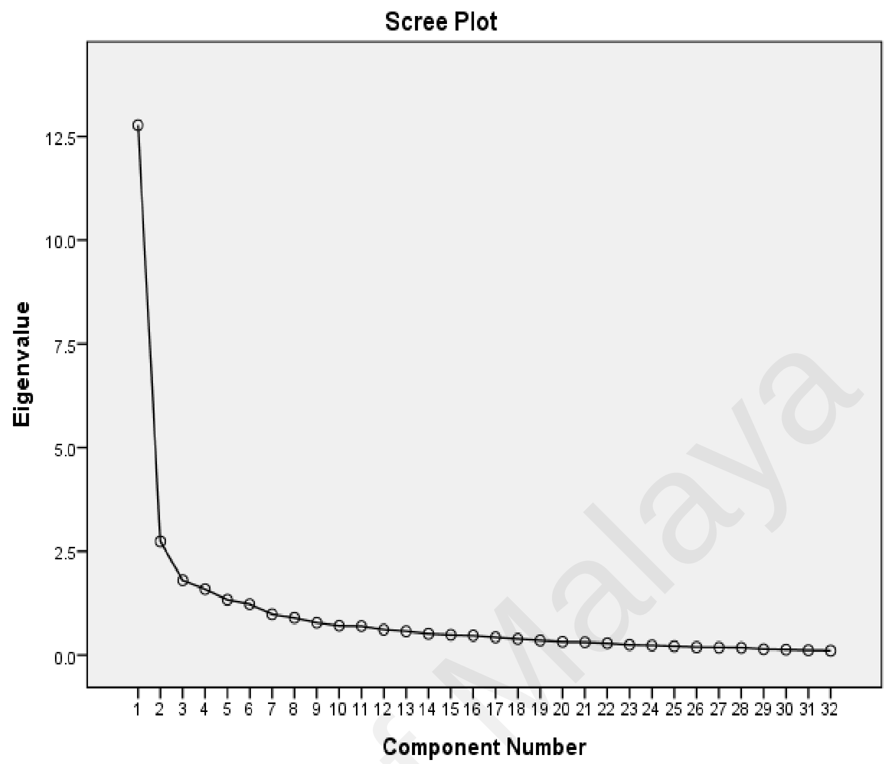

Figure 4.2. Scree plot

considered the scree (or rubble at the bottom of the mountain) and discarded (Comrey & Lee, 1992; DeVellis, 2003).

A Scree Plot is a simple line segment plot that shows the fraction of total variance in the data. It is a plot, in descending order of magnitude, of the eigenvalues of a correlation matrix. In the context of factor analysis or principal components analysis, a scree plot helps the analyst visualise the relative importance of the factors, a sharp drop in the plot signals that subsequent factors are ignorable. The scree plot involves examining the graph of the eigenvalues and looking for the natural bend or break point in the data where the curve flattens out. The Scree Plot has two lines: the lower line shows the proportion of variance for each principal component, while the upper line shows the cumulative variance explained by the first N components. The principal components are sorted in decreasing order of variance so the most important principal component is always listed first. The number of data points above the “break” that is not including the point at which the break occurs is usually the number of factors to retain, although it can be unclear if there are data points clustered together near the bend. It is intended to help in deciding where “trivial” dimensions begin. The scree plot in Figure 4.2 showed indicating the point of inflexion on the curve. The last big drop occurs between the second and third components. The curve begins to tail off after three factors before a stable plateau is reached. The researcher justifies retaining three factors that accounted for only 22.405 % of the variance as shown in Figure 4.3 but enhances the overview of the rotated component matrix considerably.

Rotation

Rotation is a method used to simplify interpretation of a factor analysis. The use of rotation in factor analysis often enhances interpretability of the factor structure by seeking to maximise simple structure. The simple structure implies that each variable has only one high factor loading and all other low or zero loadings (Browne, 2001; Thurstone, 1947).The Varimax with Kaiser Normalisation rotation method was applied. The Rotated Varimax rotation yields results which make it as easy as possible to identify each variable with a single factor. This is the most common rotation option. Initially, all 32 items were subjected to Exploratory Factor Analysis (EFA) to explore the factor structure of Mathematics Teachers Values Scale. Principal Component Analysis (PCA) with varimax rotation was conducted. To determine the number of factors, a priori theory about the number of factors, the absolute values of eigenvalues, scree test, parallel analysis, and the relative interpretability of rotated solutions criteria

Total Variance Explained

Component	Initial Eigenvalues			Extraction Sums of Squared Loadings			Rotation Sums of Squared Loadings		
	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %
1	12.769	39.904	39.904	12.769	39.904	39.904	7.170	22.405	22.405
2	2.741	8.566	48.470	2.741	8.566	48.470	6.863	21.445	43.851
3	1.801	5.628	54.098	1.801	5.628	54.098	3.279	10.247	54.098
4	1.587	4.959	59.057						
5	1.332	4.162	63.219						
6	1.227	3.834	67.054						

Figure 4.3. Total Variance Explained After Rotation

were applied. The inter-item correlation values were low to moderate. The Kaiser-Meyer-Olkin (*KMO)* was equal to .894 and Bartlett's Test of Sphericity [$\chi 2$ (496) = 322.818; $p < .001$] was significant, indicating that the inter-item correlation matrix was suitable for factor analysis. There were 6 eigenvalues greater than one that accounted for 67.075% of the total variance as in Figure 4.1 above. The visual inspection of scree test and the parallel analysis, the researcher retained three factors. Finally, Principal Component Analysis was conducted. Table 4.19 shows the eigenvalues (λ), the percentage of Variance Explained by Factors, and factor loading PCA. This analysis revealed that fourteen items Q9, Q14, Q7, Q6, Q13, Q5, Q12, Q11 Q8, Q10, Q2, Q3, Q4, and Q1constituted the first factor, eight items Q22, Q20, Q17, Q15, Q19, Q16, Q21 and Q18 constituted the second factor, and ten items Q26, Q29, Q32, Q23, Q27, Q31, Q24, Q30, Q28 and Q25constituted the third factor. Items in factor one revolved around general education values, items in factor two revolved around mathematics education values and, items in factor three revolved around mathematics values. In terms of variance explained by each factor, general education values 7.170%, mathematics education values for

Table 4.19

The Eigenvalues (λ), Percentage of Variance, Factor Loadings for Each Item in Pilot Study

	Loadings		
Item	Factor 1	Factor 2	Factor 3
Q9	.773		
Q14	.769		
Q7	.765		
Q6	.754		
Q13	.733		
Q5	.728		
Q12	.721		
Q11	.711		
Q8	.703		
Q10	.694		
Q2	.684		
Q3	.663		
Q4	.650		
Q1	.644		
Q22		.761	
Q20		.725	
Q17		.709	
Q15		.687	
Q19		675	
Q16		.576	
Q21		.571	
Q18		.570	
Q26			.618
Q29			.616
Q32			.599
Q23			.596
Q27			.594
Q31			.576
Q24			.571
Q30			.570
Q28			.565
Q25			.547
Eigenvalue	22.40	21.445	10.247
% of Variance	7.170	6.863	3.279

6.683%, and mathematics values accounted for 3.279%. The Cronbach alpha coefficients calculated for the general education values, mathematics education values and mathematics values are .894 .912and .832 respectively. Cronbach's alpha for the pilot version of the instrument was 0.949.

Point-Biserial Correlation

Correlation analyses were to assess both the strength and the direction of a linear relationship between two variables. This study explored whether the teachers had responded to one question in the same way to another question. Factor analysis was based on the correlation matrix of the variables involved. A correlation matrix is simply a rectangular array of numbers which gives the correlation coefficients between a single variable and every other variable in the investigation. The correlation coefficient between a variable and itself is always 1; hence the principal diagonal of the correlation matrix contains 1. The correlation coefficients above and below the principal diagonal were the same. A correlation matrix was used to check the pattern of relationships. The inter-item correlation matrix indicates that all items correlated positively with the other items. In this study, the inter-item correlation matrix mean was .372 and variance .016. The significant values for variables do not exceed 0.05.

Correlation Matrix Table presents the matrix of correlations between variables, it can be seen that there were most sets of correlations above 0.30, therefore the application of the factorial analysis on these variables was appropriate thus satisfying the requirement. The correlation coefficients were not greater than 0.9. Therefore, multicollinearity is not a problem for these data. All items correlated well and none of the correlation coefficients was large. So, eliminating

Table 4.20
Item-Total Statistics

	Scale Mean if Item Deleted	Scale Variance if Item Deleted	Corrected Item-Total Correlation		Cronbach's Alpha if Item Deleted
Question 1	140.0933	141.844	.411	.	.949
Question 2	139.8733	142.595	.591	.	.948
Question 3	139.9267	142.646	.507	.	.948
Question 4	139.9200	142.705	.560	.	.948
Question 5	139.9467	142.856	.527	.	.948
Question 6	139.9333	142.935	.478	.	.948
Question 7	139.9800	143.120	.485	.	.948
Question 8	140.0200	141.966	.555	.	.948
Question 9	140.0333	142.730	.499	.	.948
Question 10	140.1067	138.754	.659	.	.947
Question 11	140.0267	142.389	.532	.	.948
Question 12	140.0133	141.382	.560	.	.948
Question 13	140.3800	132.761	.706	.	.947
Question 14	140.0467	139.266	.739	.	.946
Question 15	140.3267	135.080	.699	.	.947
Question 16	140.1133	140.571	.603	.	.947
Question 17	140.1800	141.424	.469	.	.949
Question 18	140.3200	135.508	.644	.	.947
Question 19	140.1533	141.943	.518	.	.948
Question 20	140.3400	136.400	.667	.	.947
Question 21	140.1400	142.215	.496	.	.948
Question 22	140.1667	141.764	.519	.	.948
Question 23	140.1333	141.056	.550	.	.948
Question 24	140.0933	139.911	.674	.	.947
Question 25	140.1333	141.110	.587	.	.948
Question 26	140.3600	135.266	.749	.	.946
Question 27	140.2733	136.831	.725	.	.946
Question 28	140.2267	138.472	.706	.	.947
Question 29	140.4067	134.834	.742	.	.946
Question 30	140.3133	138.686	.622	.	.947
Question 31	140.4133	135.707	.702	.	.946
Question 32	140.2733	139.274	.548	.	.948

items were not necessary. Tabachnick and Fidell (2001) recommended inspecting the correlation matrix (often termed Factorability of *R*) for correlation coefficients over 0.30. It was categorised these loadings as ±0.30=minimal, ±0.40=important, and ±.50=practically significant. In this case, alpha was above 0.8 and was in the region indicated good reliability Kline (1999). Items need not be removed and that factor analysis was done again in the real study.

The values in the column labelled Corrected Item-Total Correlation in Table 4.20 are the correlations between each item and total score from the questionnaire. In a reliable scale, all items should correlate with the total. Items with low correlations may be dropped. High inter-item correlations were observed among items that were intended to represent the three sub-constructs. For these data, the minimum corrected item-total correlations were above 0.4, which was encouraging. As a result, only Cronbach’s alpha for the total scale was reported. Cronbach's alpha for the pilot version of the instrument was 0.950. The values in column Cronbach's Alpha if Item Deleted were the values of the overall alpha if the item was not included in the calculation. They reflected the change in overall alpha if a particular item was deleted. All the items showed alpha above .94. For these data, none of the items here would affect reliability if they were deleted.

Pilot Study Factor Analysis Summary

Factor analysis determined that all items included were unidimensional. In the pilot study, the factorability of thirty-two items was examined. Six factors were extracted. A positive loading will indicate a positive relationship with the factor, whereas one with a negative sign will suggest an inverse relationship. The researcher considers loadings greater than 0.6 to be very high, greater than 0.3 to be high, and less than 0.3 to be irrelevant and thus ignored. In this pilot study, the factor loadings are greater than 0.40. Principal components analysis with Varimax Rotation produces the dimension of differentiation was used in order to confirm the scale construct validity. Two statistical tests were used. The sample sufficiency index KMO by Kaiser-Meyer-Olkin, which compares the sizes of the observed correlation coefficients to the sizes of the partial correlation coefficients for the sum of analysis variables is .814, and it is reliable because it is greater than .70. The supposition test of sphericity by the Bartlett test to examine if the subscales of the scale are inter-independent shows 496 and Chi- Square = 322.818. The control of sphericity (Bartlett's sign < 0.001) proved that the principal component analysis is meaningful. Consequently, the coefficients are not all zero, so that the second acceptance of factor analysis is satisfied. As such, both acceptances for the conduct of factor analysis are satisfied and the researcher can proceed to it.

The criterion of eigenvalue or characteristic root (eigenvalue) ≥ 1 was used for defining the number of the factors that were kept. The instrument acceptance was based on two criteria: (a) each variable, in order to be included in the variable cluster of a factor, must load to it more than 0.5 and (b) less than 0.4 to the rest of the factors. Moreover, each factor must have more than two variables. In addition, it was considered, on the basis of common variable Communalities**,** that the variables with high Communality (h2) imply great contribution to the factorial model (Hair, Black, Babin, Anderson, & Tatham, 2006). This was shown in the study. From the values of the common communality the researcher ascertain for each question that the majority of them have a value higher than 0.50 which represents the satisfactory quality of the measurements from the scale of seven factors or components.

The coefficient of internal consistency (reliability) Cronbach's alpha was statistically significant and equals to 0.949 for the pilot study. This is over 80%, which is an extra good value for the internal consequence of the conceptual construction of the investigated scale (Anastasiadou, 2010; Nouris, 2006). The thirty-two items in the pilot study were considered reliable but needed refinement.

Reliability Analysis

In the pilot testing, the researcher made efforts to ensure the setting, choice of respondents and interview methods similar to the main study. The first sub-construct general education values consist 14 items. This analysis discusses the items reliability and validity of the instrument using Rasch model analysis.

Table 4.21
General education values

	Pilot study
Person mean	3.46
Person separation	1.53
Item separation	2.79
Cronbach's alpha	.89
Item Reliability	.89
Person reliability	.70
Standard deviation item	.64
Standard deviation person	1.48

Table 4.21 shows the pilot study summary statistics for the analysis of the150 respondents on the fourteen items on general education values. The *person* mean is 3.46 (SE .63) and the *person* separation is1.53. Separation of 1.50 is considered "acceptable," 2.00 is "good," and 3.00 is "excellent" (Duncan et al., 2003).The standard deviation for person measures is 1.48 logits, while the standard deviation for item measures is .64. The reliability person measure the value of > 0.8 is acceptable and reliability person measures < 0.8 which is less acceptable, Bond & Fox (2001). The *person* reliability is .70, which is less acceptable. The

Cronbach alpha is .89, a good reliability assessment of teachers' general education values. Cronbach's alpha reliability coefficient normally ranges between 0 and 1 (George & Mallery, 2003). The item separation is 2.79. The value of the separation index for all respondents and the item constructs are inlined with the recommendations by Linarce (2005) which states that the separation value index of > 2.0 is good. Higher values of separation signify greater spread of persons and items along the continuum, indicating increased variability between persons (i.e., number of distinct levels into which the sample of persons can be stratified) and items (i.e., the wider the range of the variable defined by the set of items), which yields higher reliability (Bode & Wright, 1999; Green & Frantom, 2002). The reliability is .89, is close to 1 indicates good instrument reliability in item-measuring teachers' general education values in mathematics education. The item reliability index is between 0 and 1 whereby 0.8 and above is strongly acceptable while a value less than 0.8 less acceptable Bond & Fox (2001).

Table 4.22 shows the pilot study summary statistics for the analysis of the 150 respondents on the eight items on mathematics education values. The *person* mean is 2.22 (SE .74) and the *person* separation is 1.64. The standard deviation for person measures is 1.54 logits, while the standard deviation for item measures is .38. The *person* reliability is .73, which is less acceptable Bond & Fox (2001).

Table 4.22
Mathematics education values

	Pilot study
Person mean	2.22
Person separation	1.64
Item separation	1.93
Cronbach's alpha	.83
Item Reliability	.79
Person reliability	.73
Standard deviation item	.38
Standard deviation person	1.54

The Cronbach alpha is .83, a good reliability assessment of teachers' mathematics education values. The item separation is 1.93 and the reliability is .79, which is good instrument reliability for item measuring teachers' mathematics education values in mathematics education.

Table 4.23
Mathematics values

	Pilot study
Person mean	2.63
Person separation	2.28
Item separation	2.87
Cronbach's alpha	.91
Item Reliability	.89
Person reliability	.84
Standard deviation item	.60
Standard deviation person	1.97

Table 4.23 shows the pilot study summary statistics for the analysis of the ten items on mathematics values. The *person* mean is 2.63 (SE.71) and the *person* separation is 2.28. The standard deviation for person measures is 1.97 logits, while the standard deviation for item measures is. 60. The *person* reliability is. 84, is high.The Cronbach alpha is .91, a good reliability assessment of teachers' mathematics values. The item separation is 2.87 and the reliability is .89, which is good instrument reliability in item-measuring teachers' mathematics values in mathematics education.

Table 4.24 shows the pilot study overall summary statistics of person and items for the thirty-two items. Separation refers to the ability of an instrument to define a distinct hierarchy of items along the measured variable (Bond & Fox, 2007). Separation and reliability indices for items and persons in the pilot study was excellent. The item separation is 3.82 and person separation is 3.25. Separation

Table 4.24
Reliability Analysis

	Pilot study
Person mean	3.46
Person separation	3.25
Item separation	3.82
Cronbach's alpha	.95
Item Reliability	.94
Person reliability	.84
Standard deviation item	.73
Standard deviation person	1.55
Number of respondents	150

of 1.50 is considered "acceptable," 2.00 is "good," and 3.00 is "excellent" (Duncan, Martin, Staudt, Yevich, & Logan 2003).

The separation indices for persons and items indicated an excellent degree of variability between persons and items making it appropriate for the study. The separation value is 3.25. A separation index should exceed 1.0, with higher values representing the greater spread of persons and items along the continuum (Green & Frantom, 2002). A statistically significant positive correlation was found between the instrument and teachers responses. The *person* mean is 3.46. The standard deviation for *person* measures is 1.55 logits, while the standard deviation for item measures is.73. The item reliability is .94 and person reliability is .84. Reliability of .70 is considered "acceptable," .80 is "good," and .90 is "excellent" (Duncan et al., 2003). The *person* reliability is. 84, is high and good. The Cronbach alpha is .95, a good reliability. Thus it could make a good instrument in item-measuring teachers' perception of values in mathematics education.

There are several tools available for assessing the psychometric unidimensionality in Rasch analysis such as the item Point Measure Correlation, and infit and outfit Mean Square fit statistics and the Principal Component Analysis of Residuals.

Principal Component Analysis

To examine the unidimensionality of the construct, Rasch Principal Component Analysis (PCA) of item residuals was carried out. PCAR intention is to identify the factor in the residuals that explains the most variance. If the factor is at the "noise" level, then no shared the second dimension. If the factor is above the “noise” level, then it is the "second" dimension in the data. Similarly, a third dimension is investigated.

```
TABLE 24.0 Math_Rasch.sav                                ZOU511WS.TXT  Oct 10 22:46 2014
INPUT: 150 PERSON  32 ITEM  REPORTED: 150 PERSON  32 ITEM  5 CATS WINSTEPS 3.72.1
--------------------------------------------------------------------------------

     Table of STANDARDIZED RESIDUAL variance (in Eigenvalue units)
                                                 -- Empirical --    Modeled
Total raw variance in observations     =       243.3 100.0%         100.0%
  Raw variance explained by measures   =       104.3  42.9%          41.7%
    Raw variance explained by persons  =        60.5  24.9%          24.2%
    Raw Variance explained by items    =        43.8  18.0%          17.5%
  Raw unexplained variance (total)     =       139.0  57.1% 100.0%   58.3%
    Unexplned variance in 1st contrast =        16.8   6.9%  12.1%
    Unexplned variance in 2nd contrast =        12.9   5.3%   9.3%
    Unexplned variance in 3rd contrast =        12.3   5.0%   8.8%
    Unexplned variance in 4th contrast =         9.4   3.9%   6.8%
    Unexplned variance in 5th contrast =         8.0   3.3%   5.8%
```

Figure 4.3. Principal Component Analysis

For the pilot study, the Rasch dimension explains 42.9% of the variance in the data with 24.9 % explained by persons and 18.0% explained by items which are good compared to the model 41.7%. This is more than the expectation and above the minimum requirement of 40% (Linacre, 2006; Conrad, Dennis, Bezruczko, Funk, & Riley, 2011). This indicated that a dominant first factor was present. According to Reckase (1979), the variance explained by the first factor should be greater than 20% as to be indicative of unidimensionality. The largest secondary dimension, the unexplained variance explained by first contrast in the residuals is 6.9 %, the level of ‘noise’, which does not exceed the 15% limit. The ratio of 42.9% to 6.9% is 6 to 1 which is supportive of good item unidimensionality

(Fisher, 2007). The eigenvalue of the biggest residual dimension is 16.8. In other words, the contrast between the strongly positively loading items and the strongly negatively loading items on the first factor in the residuals has the strength of about 17 items.

The variance explained in this study exceeded the requirement of this criterion, demonstrating a unidimensional trait of the data. This indicates that the items did fit the model well with relatively good item-person targeting and wide dispersion of the items and persons. There were small amounts of unexplained variances in the components which came from the residuals, 5.3%, 5.0%, 3.9%, and 3.3 % for the first, second, third, and fourth contrasts, respectively. Residual factor loadings suggested that the data closely approximated the Rasch model, and there were no meaningful components beyond the primary dimension of measurement. PCA demonstrated, by and large, that there was no extraneous dimensions or sub-dimensions related to sub-skills. Since unidimensionality was achieved by forming a single underlying pattern in a data matrix, it was assumed that local independence was met. Local independence was achieved by controlling for all the abilities so that responses to items could be independent of one another.

Item Fit and Item Misfit

The data acquired from the questionnaire instrument were input into the Rasch model and Rasch person fit analysis was conducted to determine whether all participant responses fit the model's expectations. Infit and outfit mean square fit statistics were used to examine how well individual items fitted the Rasch model. These information weighted index statistics assessed the extent to which unpredicted responses to an item was given by respondents whose position in the hierarchy, as determined by their values perception, is either close to the item's position (infit statistic) or far from the item's position (outfit statistic) in the hierarchy of items. Items found around the 1.0 value demonstrate better statistical "fit" than items that are further from the 1.0 value (Wright, 2004). Values greater than 2.0, one standard deviation above the centre of the distribution suggest the item does not belong to the group. Item fit is an important component of Rasch analysis. Two common statistics to use in testing for item fit are the Infit Mean Square and the Outfit Mean Square statistical analysis for suitability of items was carried out to identify items that have should be greater than 0.6 and less than 1.4 (Bond & Fox 2007). First, the fit statistic was performed on the outfit MNSQ then to the Infit MNSQ statistics (Bond & Fox, 2007).

Figure 4.4 shows the number of items based on the Infit MNSQ and outfit MNSQ statistics. The analysis shows that Infit MNSQ and outfit MNSQ value of all items and respondents that were measured. In the pilot study, the researcher used the total mean square infit and outfit mean square in the range proposed by Bond & Fox (2007). If the individual item does not fulfil the requirements, then the item will be considered to be eliminated. The analysis showed that mean square infit is 0.64 to 1.73 and outfit mean square value of the item is 0.60 to 2.46 for all constructs. As seen in Figure 4.4, it can be concluded that there is one item, Q1 should be improved or dropped because has exceeded the range suggested of 1.4. A total of 31 items were found to be fit and one item should be improved. This indicated that intervention must be done to check on the problems or weaknesses of the item. Item Q1 need to be revised before developing the new scale. There was no mismatch of items and all items fit respondents during the process of data analysis.

TABLE 10.1 Math_Rasch.sav ZOU091WS.TXT Dec 17 10:54 2015
INPUT: 150 PERSON 32 ITEM REPORTED: 150 PERSON 32 ITEM 5 CATS WINSTEPS 3.72.1

PERSON: REAL SEP.: 2.69 REL.: .88 ... ITEM: REAL SEP.: 3.82 REL.: .94

ITEM STATISTICS: MISFIT ORDER

ENTRY	TOTAL	TOTAL		MODEL	INFIT		OUTFIT		PT-MEASURE		EXACT MATCH		
NUMBER	SCORE	COUNT	MEASURE	S.E.	MNSQ	ZSTD	MNSQ	ZSTD	CORR.	EXP.	OBS%	EXP%	ITEM
1	686	150	-.16	.18	1.73	4.0	2.46	5.4	A .40	.58	59.7	74.3	Q1
13	643	150	.99	.15	1.39	2.5	1.19	1.3	B .65	.64	61.9	63.5	Q13
8	697	150	-.55	.19	.90	-.6	1.38	1.6	C .53	.55	77.7	75.9	Q8
18	652	150	.79	.15	1.37	2.3	1.38	2.4	D .60	.63	56.1	66.1	Q18
17	671	150	.30	.17	1.24	1.5	1.18	1.1	E .51	.61	69.1	71.5	Q17
32	659	150	.62	.16	1.18	1.2	1.19	1.2	F .58	.62	69.8	68.5	Q32
6	710	150	-1.08	.21	1.15	1.0	1.14	.6	G .46	.50	80.6	78.5	Q6
7	703	150	-.79	.20	.98	-.1	1.13	.6	H .48	.53	74.8	77.0	Q7
15	651	150	.81	.15	1.11	.8	1.12	.8	I .64	.63	61.2	65.9	Q15
3	711	150	-1.13	.21	1.11	.8	.99	.1	J .48	.49	80.6	78.7	Q3
9	695	150	-.48	.19	.95	-.3	1.06	.4	K .51	.56	73.4	75.5	Q9
12	698	150	-.59	.20	1.04	.3	.94	-.2	L .54	.55	79.1	76.1	Q12
20	649	150	.86	.15	1.01	.1	1.00	.0	M .64	.63	62.6	64.8	Q20
10	684	150	-.10	.18	1.01	.1	.89	-.5	N .61	.58	71.2	74.0	Q10
5	708	150	-1.00	.21	.90	-.6	1.00	.1	O .50	.51	79.9	78.0	Q5
4	712	150	-1.17	.21	.82	-1.3	1.00	.1	P .51	.49	85.6	78.9	Q4
16	683	150	-.07	.18	.87	-.8	.99	.0	p .59	.59	81.3	73.7	Q16
25	680	150	.03	.18	.81	-1.3	.99	.0	o .61	.59	77.0	73.2	Q25
23	680	150	.03	.18	.98	-.1	.81	-1.1	n .59	.59	74.8	73.2	Q23
11	696	150	-.52	.19	.90	-.6	.98	.0	m .53	.55	72.7	75.7	Q11
19	677	150	.12	.17	.92	-.5	.97	-.1	l .56	.60	71.9	72.7	Q19
21	679	150	.06	.18	.96	-.2	.97	-.1	k .55	.59	72.7	73.0	Q21
22	675	150	.18	.17	.92	-.5	.85	-.9	j .58	.60	72.7	72.2	Q22
31	638	150	1.10	.14	.85	-1.1	.91	-.7	i .70	.65	61.9	62.1	Q31
30	653	150	.77	.15	.88	-.8	.88	-.8	h .65	.63	66.2	66.3	Q30
29	639	150	1.08	.15	.80	-1.5	.84	-1.2	g .73	.65	65.5	62.2	Q29
2	719	150	-1.51	.23	.83	-1.2	.63	-1.0	f .52	.45	86.3	80.5	Q2
27	659	150	.62	.16	.76	-1.7	.75	-1.8	e .69	.62	74.1	68.5	Q27
26	646	150	.93	.15	.75	-1.8	.75	-1.9	d .73	.64	76.3	64.3	Q26
24	686	150	-.16	.18	.73	-1.9	.66	-1.9	c .65	.58	77.0	74.3	Q24
28	666	150	.44	.16	.66	-2.5	.66	-2.4	b .71	.61	77.7	70.2	Q28
14	693	150	-.41	.19	.64	-2.7	.60	-2.1	a .68	.56	84.9	75.2	Q14
MEAN	678.1	150.0	.00	.18	.97	-.2	1.01	.0			73.0	72.0	
S.D.	23.3	.0	.73	.02	.22	1.4	.32	1.5			7.8	5.2	

TABLE 10.3 Math_Rasch.sav ZOU091WS.TXT Dec 17 10:54 2015
INPUT: 150 PERSON 32 ITEM REPORTED: 150 PERSON 32 ITEM 5 CATS WINSTEPS 3.72.1

Figure 4.4. Misfit Order

Point Measure Correlation

A positive measure-item correlation indicates that the estimated correct responses by the respondents' on an item are related to the estimated respondents' values perception. Low correlation indicates that the item does not successfully measure respondents' values perception in the estimated continuum. As Linacre (2012) explains, the point-measure correlation is closely related to the point-biserial correlation that can be used for the same purpose as ID (Brown, 2005), so the closest analogue of ID is the point-measure correlation. Measure is the logit position of the item, with S.E. being the standard error of measurement for the item.

Fit statistics (mean square infit and outfit) show the amount of distortion of the measurement system. Values less than 1.0 indicate observations are too predictable that is redundancy, data overfit the model. Values greater than 1.0 indicate unpredictability (unmodeled noise). For the current study, the Mean-Square Values and Implications for Measurement were referred to Table 4.16 Linacre, (2002b). The infit and outfit values of less than 2.0 were considered acceptable. A value less than .15 indicates a potentially misfitting item. Figure 4.03 shows all the values greater than .15 that is the minimum value is .40 and the maximum value is .73. Therefore, the items are fitting items. From the Figure 4.02, none of the Point Measure values shows 0. The acceptable value for the Point Measure is $0.4 < x < 0.8$. Q1 has point measure equal to 0.4 not greater than 0.4. This is a borderline case and up to the researcher to consider the status of the item.

Table 4.25
Mean-square Value Implications for Measurement

> 2.0	Distorts or degrades the measurement system.
1.5 to 2.0	Unproductive for the construction of measurement, but not degrading.
0.5 to 1.5	Productive for measurement.
< 0.5	Less productive for measurement, but not degrading.

The acceptable value for the Outfit Mean Square (MNSQ), y-value must be in the range of $0.5 < y < 1.5$. From the Figure 4.02, it shows that Q1 is having MNSQ 1.73 not in the fit range. The Outfit z-standard (ZSTD) and the value must also be within the range of $-2 < z < 2$ or further check was needed. From the analysis, Q1 is having ZSTD value 2.46 outside the fit range. Therefore, Q1 need to be refined.

The rating scale analysis includes category frequencies, average measures, threshold estimates, probability curves, and category fit. An item's rating scale was considered appropriate if the threshold increased by at least 1.4 logits between categories. The rating scale in Figure 4.5 displayed how the response scale was used. The observed count indicated the number of times the category was selected across all items and persons. Almost zero percent of the 150 respondents chose score 1, one percent chose score 2, four percent chose score 3, 36 percent chose score 4, and 58 percent chose score 5. The observed average shows respondent's scoring pattern. The pattern increases in one direction from 0.29 logits to 4.38. It shows normal responses. The structure calibration is the dominant strength of Rasch model. In examining the five response options (1= strongly disagree, 2= disagree, 3= undecided 4= agree, and 5= strongly agree), the researcher observed a monotonic progression from one step calibration to the next, which is desirable; however, the steps are very small between #2 and #3 (-2.06 to -72).

In Rasch measurement, coherence statistics are examined to infer the empirical relationship between ratings and measures and measures and ratings. Coherence statistics are presented as the percentage of ratings that are in the same category as the model-based expected ratings that is observations imply measures and the percentage of model-based expected ratings that are consistent with the actual ratings that are measures imply observations. Linacre (2004) indicates 40% or higher as an empirically useful level of coherence for inference of measures-to-ratings and ratings-to-measures with otherwise satisfactory data sets. In this study, *Strongly Disagree* category and *Disagree* category did not meet the criteria, showed zero but the others showed greater than 40%. In the pilot study, response category frequencies demonstrated that some items failed to receive the recommended number of ten responses in categorical options Strongly Disagree and Disagree (Linacre, 2004). This pattern suggests the need to reconsider the

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TABLE 3.2 Math_Rasch.sav                             ZOU160WS.TXT  Jul  3 19:47 2015
INPUT: 150 PERSON  32 ITEM  REPORTED: 150 PERSON  32 ITEM  5 CATS WINSTEPS 3.72.1
--------------------------------------------------------------------------------


SUMMARY OF CATEGORY STRUCTURE.  Model="R"
-------------------------------------------------------------------
|CATEGORY   OBSERVED|OBSVD SAMPLE|INFIT OUTFIT||STRUCTURE|CATEGORY|
|LABEL SCORE COUNT %|AVRGE EXPECT|  MNSQ  MNSQ||CALIBRATN| MEASURE|
|-------------------+------------+------------++---------+--------|
|  1   1       3   0|   .29   .39|   .96   .88||  NONE   |( -3.33)| 1
|  2   2      40   1|   .77   .70|  1.04  1.07||   -2.06 |  -1.61 | 2
|  3   3     214   4|  1.01  1.28|   .81   .75||    -.72 |   -.38 | 3
|  4   4    1742  36|  2.53  2.48|  1.01  1.07||    -.29 |   1.49 | 4
|  5   5    2801  58|  4.38  4.40|  1.02  1.01||    3.07 |(  4.20)| 5
-------------------------------------------------------------------
OBSERVED AVERAGE is mean of measures in category. It is not a parameter estimate.

-------------------------------------------------------------------------------------------------------
|CATEGORY    STRUCTURE   |  SCORE-TO-MEASURE   | 50% CUM.| COHERENCE       |ESTIM| OBSERVED-EXPECTED |
| LABEL    MEASURE  S.E. | AT CAT. ----ZONE----|PROBABLTY| M->C C->M  RMSR |DISCR|RESIDUAL DIFFERENCE|
|------------------------+---------------------+---------+-----------------+-----+-------------------|
|   1      NONE          |( -3.33) -INF   -2.52|         |   0%   0% 2.4647|     |  -1.3%         .0 | 1
|   2       -2.06    .58 |  -1.61  -2.52   -.97|   -2.27 |   0%   0% 1.7027| 1.02|   -.8%        -.3 | 2
|   3        -.72    .16 |   -.38   -.97    .33|    -.89 |  53%  23%  .8431|  .98|   -.4%        -.8 | 3
|   4        -.29    .07 |   1.49    .33   3.17|     .07 |  65%  70%  .4547| 1.08|    .0%        -.8 | 4
|   5        3.07    .04 |(  4.20)  3.17  +INF |    3.11 |  80%  81%  .3991|  .96|    .1%        1.9 | 5
-------------------------------------------------------------------------------------------------------
M->C = Does Measure imply Category?
C->M = Does Category imply Measure?
```

Figure 4.5. Rating scale

choice of response options both in terms of the number of response options and the corresponding labels.

Variable Map

Variable map or item map was used as part of item fit analysis to provide a visual representation of person and item locations on the construct. The variable map presents a graphical display of the spread of respondents' responses (statistics achievement), rater measures (severity), item and question calibrations (difficulty), and the location of the thresholds for the rating scale categories, all on the same logit scale. It illustrates the relationship between person abilities and item-difficulties, examined to explore the spread of items, the spread of abilities, as well as gaps or overlaps in item difficulty and ability (Stelmack, Szlyk, Stelmack, Babcok-Parziale, Demers-Turco, Williams & Massof, 2004). Persons are located along the linear scale based on the level of construct that is the amount of construct present in individual respondents, while items are located based on their endorsement difficulty level that is the degree of difficulty of answering “agree” or “disagree”. Persons or respondents are to the left of the vertical line, and items are to the right. The first column shows the logit scale. The second column presents the respondent’s values perception. A person has a 50% chance of endorsing an item located at the same level of the construct on the opposite side of the vertical line (Bond & Fox, 2007). Items located above the person are more difficult to endorse and items located below the person are easier to endorse.

Figure 4.6 is a variable map of analysis showing the distribution of respondents on the left and the distribution of item agreement on the right, according to person number and item label respectively. The person and item distributions corroborate the results from the summary statistics. The variable map reveals substantial gaps in the continuum represented by the Scale. *Person* ability spans nearly 7 logits, items span less than 3 logits. A significant number of them can be considered high implementers and are not well-targeted by the scale, as revealed by a significant gap in the coverage of the construct at the upper end of the scale where there are people but no items. The variable map reveals considerable redundancy in the items making up the scale. For example, five items measure values assessment at the difficulty level corresponding to a logit value of 0 (the mean of the scale). Four of the five items could be eliminated, and the scale would still accurately measure values assessment of teachers with implementation levels at the mean of the scale. Furthermore, 13 of the 32 items in the scale (41 %) measure implementation at difficulty levels between 0 and -1 logits. The scale would be significantly improved by deleting many of these redundant items and

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TABLE 1.2 Math_Rasch.sav                                    ZOU129WS.TXT  Dec  9 16:27 2014
INPUT: 150 PERSON  32 ITEM  REPORTED: 150 PERSON  32 ITEM  5 CATS WINSTEPS 3.72.1
--------------------------------------------------------------------------------

         PERSON - MAP - ITEM
             <more>|<rare>
   7  XXXXXXXXXXX  +
            XXXXX  |
                  T|
                   |
                   |
   6        XXXXX  +
                   |
               XX  |
                   |
          XXXXXXX  |
   5     XXXXXXXX S+
     XXXXXXXXXXXX  |
          XXXXXXX  |
           XXXXXX  |
               XX  |
   4      XXXXXXX  +
         XXXXXXXX  |
               XX  |
            XXXXX M|
                X  |
   3        XXXXX  +
            XXXXX  |
         XXXXXXXX  |
            XXXXX  |
            XXXXX  |
   2         XXXX S+
             XXXX  |
          XXXXXXX  |
         XXXXXXXX  |T
             XXXX  |  Q31
   1        XXXXX  +  Q13    Q26    Q29
                X  |S Q15    Q18    Q20    Q30
                X  |  Q27    Q32
                  T|  Q28
                   |  Q17    Q19    Q22
   0               +M Q10    Q16    Q21    Q23    Q25
                   |  Q1     Q24
                   |  Q14    Q9
                   |  Q11    Q12    Q8
                   |S Q7
  -1               +  Q5     Q6
                   |  Q3     Q4
                   |T
                   |  Q2
                   |
  -2               +
             <less>|<frequ>
```

Figure 4.6. Variable Map

adding items that discriminate more effectively along more points on the scale. An examination of the variable map in Figure 4.04 reveals substantial gaps in the continuum represented by the Scale. While person ability spans nearly 6 logits, items span 2 logits. A significant number of them can be considered high implementers and are not well-targeted by the Scale, as revealed by a significant gap in the coverage of the construct at the upper end of the scale where there are people but no items.

Rasch Analysis Summary

The Rasch rating scale model was used in the development of the instrument and to investigate the overall fit of the data to the Rasch model whether the data meet the Rasch specifications, scale functioning, individual item and person fit and the underlying unidimensionality of the construct. Rasch analysis provided a new approach to assess primary school mathematics teachers' to assess values in mathematics education. The pilot study evaluated 32 items. The items were identified according to theory and evaluated according to the Rasch Measurement Model using Winsteps software, version 3.72.1.

This study tested the validity and reliability of the questionnaires in order to develop the instrument. Based on the results of the Rasch analysis measurement; item reliability was 0.94 > 0.50, item separation was 3.82 > 2.0, for the pilot study. Item separation refers to all participants able to answer all level difficulty of items. That means the participants can be separated based on those constructs that were measured. The criterion for usefulness of an instrument is exceeding its item separation (Linacre, 2007). A higher value of separation means greater spared of items and *persons* along a continuum. Lower values of separation indicated redundancy in items and less variability of persons on the trait. Item reliability refers to the consistency of item placement along the continuum. While *person* reliability refers to the consistency of *person* ordering that could be accepted if this sample of *persons* were given a parallel set of items measuring the same construct. The criteria for accepting reliability Rasch Model is exceeding 0.50 (Linacre, 2007; Bond & Fox, 2007).

For analysing construct validity, item polarity and dimensionality analysis were conducted. All values of point measure correlation (PTMEA) were positive for the pilot study. This indicated that all the items generally measured all the constructs. Item polarity or point measure correlation is the early detection of construct validity (Bond & Fox, 2007). Results of the dimensionality analyses show that the value of raw variance as explained by measure is more than 40% for the pilot study. The value of unexplained variance in the first contrast is less than 15% for the pilot study. This showed that there was no sub dimension that existed under the values dimension. Dimensionality aspects are important for determining the instrument was measured in one direction and one dimension (Linacre, 2003; Bond & Fox, 2007). Dimensionality aspect is one of the conditions in the analysis using the Rasch Model. This is to ensure content validity and construct validity of the instrument (Wu & Adams, 2007). Analysis of the study showed the reliability of 150 respondents with 32 items in the pilot study in these constructs was high to assess the values of teachers and presenting a strong acceptable level.

Items Revision

The instrument was revised based on the pilot study analysis but maintained the initial values structure based on literature and theoretical implications. The instrument used in the pilot study contained 14 items that were related to general education values, eight items on mathematics education values and ten items on mathematics values. Based on the expert's panel feedback, the items were revised and refined. The revised instrument contains 18 general education values, eight items on mathematics education values and ten items on mathematics values. The panel of experts was again contacted and used to review the 36 items for each content area. Corrections were made based on their suggestions and as agreed upon by the researcher. The revised questionnaires were administered to a larger sample. The process utilised in the development of this instrument does provide evidence suggesting that the items on the final version of the instrument are relevant to the stated objectives. The final version of the instrument shall be referred to hereafter as the Teachers' Values Assessment in Mathematics Education (TVAME).

Linguistics Aspect

The initial items seemed to be vague with respect to vocabulary, clarity, readability and understanding. The researcher applied the linguistic modification to reduce the language complexity. It does not affect the content and integrity of the items. The new items improved comprehension of items by encouraging the respondents to understand the meaning. Items 3,4,5,6,7,8,9,11,12,14,18,19,23, 24, 25, 26 and 27 were revised to add appropriate wordings or phrases. Other items were not revised since they were not commented on.

Spiritual Aspect

The respondents involved in the focus group, experts panel and pilot study came from different ethnic groups, different religion, different beliefs and different level of education. Their various ideas were considered in the development of the final item. Since the items were faith based, the instruments underwent some critical comments. Item 1 in the pilot study regarding belief in God was better explained through four items 1, 2, 3and 4 in the real study.

Procedural Aspect

The items were arranged in three sub-constructs. Vague items were rephrased without changing the content to give a better understanding. The instructions remained the same as the pilot study. The layout of the questionnaire was changed to give an attractive look. The items were developed based on an appropriate survey design, including defining the target population, designing the sampling plan, specifying the data collection instrument and methods. Advising potential respondents of a deadline for completing the survey helps make it a priority. Item 6 was added to give a better impact on the questionnaires.

Conceptual Aspect

The conceptual revision was applied where a preferred word or phrase improved the items. It detected the need to produce a clearer and reduce the complexity of the item. Items which were too long were modified.

Ethical Aspect

The survey was designed to achieve the highest practical rates of response, commensurate with the importance of survey uses respondent burden, to ensure that survey results are representative of the target population so that they can be used with confidence to inform decisions. Ambiguous meanings of words and their relationships to other words in the items were removed. The order of questions is polite and logical to the respondent. The items are relevant to the title and purpose of the study. Only positive questions were asked. The respondents' answers were confidential.

Strategy Aspect

The data collection instrument was designed in a manner that minimises respondent burden while maximising data quality. The questions are clearly written. The questionnaire is of reasonable length. The questionnaire includes only items that have been shown to be successful in the pilot study. A review of all survey data items, the justification for each item, and how each item can best is measured. The physical format of how pages are oriented, stapled, and folded was made simple for the respondent to work with. Visual layout is clean, simple, and consistent. A booklet format was done so that it stands out from just paper.

Evaluation of Real Study

The real study was done to test the final instrument consisting 36 survey items. This section describes the findings through Rasch analysis and factor analysis of the real study. The analysis was done on demographic characteristics of respondents, Rasch measurement reliability analysis on general education values, mathematics education values and mathematics values, principal component analysis of the Rasch residuals, point measure correlation, rating scale, and summary of real study based on Rasch analysis. Factor analysis discussions were based on the descriptive statistics, correlation of items, KMO and Bartlett's test, communalities, rotation, scree plot and summary of findings.

Demographic Characteristics of Respondents

The real study collected data from 250 respondents. They are mathematics teachers from government primary schools in Kuala Lumpur. The demographic data collected included age, gender, race, and educational level and years of teaching experience. In the real study, 14 % of the respondents, are in the age group 21 years and 30 years old, 61.6 %, of the respondents, are in the age group 31 years and 40 years old, and 21.2 % of the respondents are in the age group 41 years and 50 years old 3.2 % of the respondents are in the age group 51 years old and more. The respondents in the real study were made up of 31.6 male and 68.4% of female teachers respectively. On the level of the respondents' education, 27.2 were diploma holders, 66.8 % were bachelor degree holders, and 6 % were master degree holders. On teaching experience 8.8 % of the respondents have experience between 1 to 4 years, 20 % of them have experience between 5 to 8 years, 31.2 %

Table 4.26
Profile of respondents

Demography	Factor	Frequency	Percentage
Age		Real Study	
	21 years to 30 years	35	14.0
	31 years to 40 years	154	61.6
	41 years to 50 years	53	21.2
	51 years to 60 years	8	3.2
Gender	Male	79	31.6
	Female	171	68.4
Race			
	Malay	181	72.4
	Chinese	39	15.6
	Indian	30	12.0
	Others		
Education			
	Diploma	68	27.2
	Bachelor	167	66.8
	Master	15	6.0
Experience			
	1 year to 4 years	22	8.8
	5 years to 8 years	50	20.0
	9 years to 12 years	78	31.2
	13 years to 16 years	72	28.8
	17 years and above	28	11.2
Total		250	100

of them have experience between 9 to 12 years, 28.8% of them have experience between 13 to 16 years and 11.2 % of them have teaching experience more than 17 years.

Factor Analysis for Real Study

Factor analysis is used to reduce the data from a large set of measures to a smaller set of factors that retain all the basic information of the measure but does not reflect redundancies found in the original measures. Factor analysis determines how respondents in a particular study respond to the survey questions. The researcher used factor analysis to choose the best items to represent a construct and to see if the construct has one dimension or multiple dimensions (factors). The researcher calculated Cronbach's alpha reliabilities to test the consistency with which the participants respond to the measures.

Descriptive Statistics

Descriptive statistics provide some information concerning the distribution of scores on continuous variables, skewness and kurtosis. Skewness an indicator used in distribution analysis as a sign of asymmetry and deviation from a normal distribution. Kurtosis an indicator used in distribution analysis as a sign of flattening or "peakedness" of a distribution. That is, data sets with high to a normal distribution. Table 4.27 displays the distribution of scores on mean, standard deviation, variance, skewness, kurtosis and the respective statistic. The data in this real study shows negative scores. The scores clustered to the left at the low values. Therefore, it is negatively skewed (left-tailed). According to Tabachnick and Fidel (2001), with reasonably large samples, skewness will not make a substantive difference in the analysis. Kurtosis shows clustering of scores. Positive kurtosis values indicate that the distribution is rather clustered in the centre, with long thin tails. Kurtosis values below 0 indicated a distribution that is relatively flat, too many cases in the extremes. In this study, the scores were less than 0; negative

Table 4.27
Skewness and Kurtosis

		Item		Variance	Skewness		Kurtosis	
		Statistic	Statistic	Statistic	Statistic	SE	Statistic	SE
Q1	250	4.3560	.86269	.744	-1.1515	.154	2.535	.307
Q2	250	4.5580	.63551	.404	-1.470	.154	1.800	.307
Q3	250	4.5280	.68344	.467	-1.357	.154	1.377	.307
Q4	250	4.5560	.65772	.433	-1.361	.154	1.317	.307
Q5	250	4.5680	.60568	.367	-1.193	.154	.934	.307
Q5	250	4.5080	.64778	.420	-1.058	.154	.395	.307
Q7	250	4.6320	.53076	.282	-1.194	.154	1.396	.307
Q8	250	4.6000	.54515	.297	-1.080	.154	1.036	.307
Q9	250	4.6160	.51925	.270	-.824	.154	-.581	.307
Q10	250	4.6000	.58769	.345	3.76	.154	.307	.307
Q11	250	4.6720	.47889	.229	.847	.154	-.996	.307
Q12	250	4.6200	.54108	.293	-1.027	.154	.014	.307
Q13	250	4.4160	.69590	.477	-986	.154	.594	.307
Q14	250	4.4580	.53361	.285	-.723	.154	-.673	.307
Q15	250	4.4320	.69231	.479	-1.035	.154	.657	.307
Q16	250	4.5960	.53095	.282	-.958	.154	.811	.307
Q17	250	4.4800	.60917	.371	-.944	.154	.972	.307
Q18	250	4.4480	.74936	.562	-1.293	.154	1.196	.307
Q19	250	4.4520	.58056	.337	-.991	.154	3.942	.307
Q20	250	4.3320	.67498	.456	-.831	.154	.824	.307
Q21	250	4.4560	.54521	.297	-.274	.154	-1.042	.307
Q22	250	4.4480	.53708	.288	-.183	.154	-1.158.	.307
Q23	250	4.5160	.53186	.283	-.387	.154	-1.163	.307
Q24	250	4.5040	54697.	.299	-.461	.154	-.926	.307
Q25	250	4.4960	.52448	.275	-.236	.154	-1.379	.307
Q26	250	4.3680	.65902	.434	-.903	.154	1.664	.307
Q27	250	4.4080	.64123	.411	-.711	.154	-.059	.307
Q28	250	4.4400	.59313	.352	-.522	.154	-.634	.307
Q29	250	4.3480	.69630	.485	-.594	.154	-.785	.307
Q30	250	4.3920	.59981	.360	-.420	.154	-.664	.307
Q31	250	4.2960	.65275	.426	-.389	.154	-.727	.307
Q32	250	4.3560	.66259	.439	-.710	.154	.176	.307
Q33	250	4.6720	.53438	.286	-1.995	.154	7.787	.307
Q34	250	4.5280	.58873	.347	-.823	.154	-.301	.307
Q35	250	4.6400	.49738	.247	-.783	.154	-.911	.307
Q36	250	4.6400	.57943	.336	-1.874	.154	5.764	.307

values show no clustering and scores spread out. The distribution is highly skewed**.**

Table 4.28 shows the influence of descriptive statistics on the three extracted factors after rotation. The skewness statistic should fall between -1 and 1. In this study, the skewness and kurtosis statistic have negative values and less than 1. If less than 1, then the distribution is negatively skewed (left-tailed).

Table 4.28
Real Study Descriptive Statistics on Factors

	Mean	Std. Deviation	Skewness		Kurtosis	
	Statistic	Statistic	Statistic	Std. Error	Statistic	Std. Error
factor1	81.7960	7.05702	-.849	.154	.216	.307
factor2	35.5720	3.41342	-.106	.154	-1.221	.307
factor3	44.7200	3.91188	-.288	.154	-.823	.307
General	162.0880	12.77800	-.464	.154	-.631	.307

KMO and Bartlett's Test

Kaiser-Meyer-Olkin measure of sampling adequacy (KMO) determines the suitability of the correlational matrix for factor analysis. The KMO is an index for comparing the magnitude of the observed correlation coefficients to the size of the partial correlation coefficients (Zillmer & Vuz, 1995). A partial correlation exists between two variables when the added effects of other variables on the correlation have been eliminated (Zillmer & Vuz, 1995). When the KMO approaches 1.0, the sum of the squared partial correlation coefficients between all pairs is small, compared to the sum of the squared correlation coefficients (Zillmer & Vuz, 1995). A KMO index < .50 indicates the correlational matrix is not suitable for factor analysis. The value of the KMO Measure of Sampling Adequacy for the set of variables in this study is .918 which would be labelled as marvellous. Since the KMO Measure of Sampling Adequacy meets the minimum criteria, the study does not have a problem that requires examining the Anti-Image Correlation Matrix.

Bartlett's test of sphericity tests conclude that there are correlations in the data set that are appropriate for factor sphericity is highly significant ($p < 0.001$), and therefore from the perspective of Bartlett's test, factor analysis is the appropriate solution. This analysis meets this requirement. Table 4.29 shows Barlett's test of sphericity is highly significant ($p < 0.001$), and therefore from the perspective of Bartlett's test, factor analysis is an appropriate solution.

Table 4.29
KMO and Bartlett's Test

Kaiser-Meyer-Olkin Measure of Sampling Adequacy.		.918
Bartlett's Test of Sphericity	Approx. Chi-Square	5898.993
	df	630
	Sig.	.000

Communalities

The Table 4.30 shows the seven factors and communality for Principal Component Analysis for eigenvalues more than 1. The sum of the squared factor loadings for all factors for a given variable (row) is the variance in that variable accounted for by all the factors, and this is called the communality. Communality, h^2, is the squared multiple correlations for the variable as dependent using the factors as predictors. The communality measures the percent of the variance in a given variable explained by all the factors jointly and may be interpreted as the reliability of the indicator. In this study, items 19 and 34 have communality values 0.451 and 0.474 respectively less than the required 0.50. All the communalities indicate 50% or more of the variance in each variable is explained by the components; with two exceptions, for Q19 and Q34 seems low but meaningful. This is the % variability in a specifically observed variable that is not predicted by the study. The items are contributing to a well-defined factor. That is, what is critical is not the communality coefficient per se, but rather the extent to which the item plays a role in the interpretation of the factor, though often this role is greater when communality is high. The communalities of a variable is high, the extracted factors account for a big proportion of the variance of the variables. Since the variable factor is reflected via the extracted factors, the factor analysis is reliable. If the communalities are low, the extracted factors account for only

Table 4.30
Principal Component Analysis

	Factors						
F1	F2	F3	F4	F5	F6	F7	Communality
Q7							.608
Q8							.654
Q9							.694
Q10							.748
Q11							.603
Q12							.583
Q14							.659
	Q1						.692
	Q2						.870
	Q3						.797
	Q4						.819
	Q5						.729
	Q6						.641
		Q27					.669
		Q28					.646
		Q29					.779
		Q30					.732
		Q31					.762
		Q32					.689
			Q21				.726
			Q22				.771
			Q23				.743
			Q24				.679
			Q25				.705
				Q13			.699
				Q15			.698
				Q18			.667
				Q20			.618
				Q26			.655
					Q33		.550
					Q34		.474
					Q35		.657
					Q36		.621
						Q16	.601
						Q17	.691
						Q19	.451

a little part of the variance and more factors might be retained in order to provide a better account of the variance. The Communalities tell us what proportion of each variable's variance is shared with the factors which have been created.

Figure 4.7 shows the actual factors that were extracted. The same procedure was applied as the pilot study. In this case, there were seven factors with eigenvalues greater than1. The Figure shows factor extraction, list the eigenvalues associated with each linear component or factor before extraction and after rotation. Before extraction, SPSS identified 36 linear components within the data. The eigenvalues associated with each factor represent the variance explained by that particular linear component and also shows eigenvalue in terms of the percentage of variance explained. The first eigenvalue is equal to 12.916 and corresponds to 35.878% of the variance in the original data. The second eigenvalue is equal to 3.686 and corresponds to 10.239 % of the variance in the original data. The third eigenvalue is equal to 2.287 and corresponds to 6.351% of the variance in the original data. The fourth eigenvalue is equal to 1.894 and corresponds to 5.260% of the variance in the original data. The fifth eigenvalue is equal to 1.364 and corresponds to 3.789% of the variance in the original data. The sixth eigenvalue is equal to 1.177 and corresponds to 3.268% of the variance in the original data. The seventh eigenvalue is equal to 1.057 and corresponds to 2.936% of the variance in the original data. The Figure extracts all factors with eigenvalues greater than 1 that leaves only seven factors. It was displayed in the columns labelled Extraction Sums of Squared Loadings. The values are the same as values before extraction, except the values for the discarded factors, are ignored. The last column Rotation Sums of Squared Loadings displayed the eigenvalues for the factors after rotation. The rotation has the effect of optimising the factor structure

Component	Initial Eigenvalues			Extraction Sums of Squared Loadings			Rotation Sums of Squared Loadings		
	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %
1	12.916	35.878	35.878	12.916	35.878	35.878	4.143	11.509	11.509
2	3.686	10.239	46.117	3.686	10.239	46.117	4.123	11.452	22.961
3	2.287	6.351	52.468	2.287	6.351	52.468	3.993	11.093	34.053
4	1.894	5.260	57.728	1.894	5.260	57.728	3.877	10.769	44.822
5	1.364	3.789	61.517	1.364	3.789	61.517	3.546	9.850	54.672
6	1.177	3.268	64.786	1.177	3.268	64.786	2.469	6.857	61.529
7	1.057	2.936	67.722	1.057	2.936	67.722	2.230	6.193	67.722
8	.948	2.633	70.355						
9	.779	2.164	72.519						
10	.741	2.058	74.577						
11	.709	1.970	76.547						
12	.664	1.845	78.392						
13	.588	1.634	80.026						
14	.564	1.566	81.592						
15	.534	1.484	83.076						
16	.511	1.420	84.496						
17	.473	1.313	85.809						
18	.449	1.248	87.057						

Figure 4.7. Total Variance Explained Before Factors Extraction

and the relative importance of data for the seven factors equalised. Taken together, the seven final factors explain 67.722 % of total variance. This is an acceptable percentage.

Scree Plot

The scree plot graphs the eigenvalue against the factor number. The scree plot in Figure 4.13 shows indicating the point of inflexion on the curve. The last drop occurs between the seventh and eighth components. The curve begins to tail off after three factors before a stable plateau is reached. The scree plot also suggested three. The researcher justifies retaining three factors that accounted for only 52.468 % of the total variance, but enhances the overview of the rotated

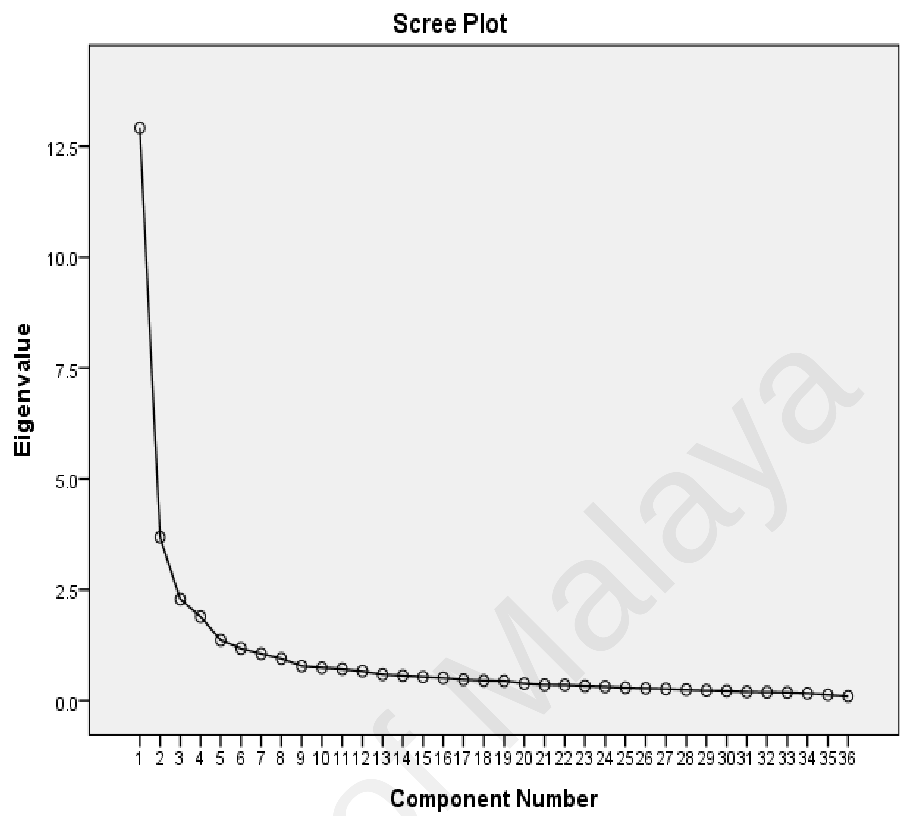

Figure 4.8. Scree plot

component matrix considerably. The factor analysis ensured that all items included were unidimensional.

Rotation

The interpretability of factors can be improved through the rotation. The rotation maximises the loading of each variable and one of the extracted factors while minimising the loading on all other factors. The rotation works through changing the absolute values of the variables while keeping the different values constant. The Varimax with Kaiser Normalisation rotation method was applied. The researcher attempts to relate the calculated factors to theoretical entities. In the principal-components analysis, rotation of the factor axes (dimensions) identified

Total Variance Explained									
Component	Initial Eigenvalues			Extraction Sums of Squared Loadings			Rotation Sums of Squared Loadings		
	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %
1	12.916	35.878	35.878	12.916	35.878	35.878	8.863	24.618	24.618
2	3.686	10.239	46.117	3.686	10.239	46.117	5.092	14.145	38.763
3	2.287	6.351	52.468	2.287	6.351	52.468	4.934	13.705	52.468
4	1.894	5.260	57.728						
5	1.364	3.789	61.517						
6	1.177	3.268	64.786						
7	1.057	2.936	67.722						

Figure 4.9. Total Variance Explained After Extraction

in the initial extraction of factors, in order to obtain simple and interpretable factors.

The 36 items were subjected to Exploratory Factor Analysis (EFA) to explore the factor structure of Mathematics Teachers Values Scale. Principal Component Analysis (PCA) with varimax rotation was conducted. To determine the number of factors, a priori theory about the number of factors, the absolute values of eigenvalues, scree test, parallel analysis, and the relative interpretability of rotated solutions criteria were applied. The inter-item correlation values were low to moderate. The Kaiser-Meyer-Olkin (*KMO)* was equal to .918 and Bartlett's Test of Sphericity [$\chi 2$ (630) = 5898.993; p < .001] was significant, indicating that the inter-item correlation matrix was suitable for factor analysis. There were seven eigenvalues greater than one that accounted for 67.722% of the total variance as in Figure 4.9 above. The visual inspection of scree test and the parallel analysis, the researcher retained three factors. Finally, PCA was conducted. Table 4.31 shows

Table 4. 31

The Eigenvalues (λ), Percentage of Variance, Factor Loadings for Each Item in Real Study

	Loadings		
Items	Factor 1	Factor 2	Factor 3
Q4	.833		
Q3	.828		
Q2	.826		
Q13	.798		
Q15	.787		
Q10	.742		
Q5	.739		
Q14	.716		
Q18	.671		
Q6	.654		
Q11	.640		
Q12	.623		
Q16	.607		
Q1	.600		
Q9	.576		
Q8	.562		
Q7	.542		
Q17	.512		
Q22		.752	
Q21		.706	
Q25		.685	
Q23		.640	
Q20		.627	
Q26		.625	
Q24		.605	
Q19		.417	
Q29			.704
Q27			.696
Q31			.633
Q30			.564
Q32			.563
Q28			.562
Q36			.495
Q33			.423
Q34			.414
Q35			.406
Eigenvalue	8.863	5.092	4.934
% of Variance	24.618	14.145	13.705

the eigenvalues (λ), the percentage of Variance Explained by Factors, and factor loading PCA. This analysis revealed that eighteen items Q4, Q3, Q2, Q13, Q15, Q10, Q5, Q14, Q18, Q6, Q11, Q12, Q16, Q1, Q9, Q8, Q7, and Q17, constituted the first factor, eight items Q22, Q21, Q25, Q23, Q20, Q26, Q24 and Q19, constituted the second factor, and ten items Q29, Q27, Q31, Q30, Q32, Q28, Q36, Q33, Q34 and Q35constituted the third factor. Items in factor one revolved around general education values, items in factor two revolved around mathematics education values and, items in factor three revolved around mathematics values. In terms of variance explained by each factor, general education values 8.863%, mathematics education values for 5.092 %, and mathematics values accounted for 4.934 %. The Cronbach alpha coefficients calculated for the general education values, mathematics education values and mathematics values were .910, .881and .843 respectively. Cronbach's alpha for the real study of the instrument was 0.944.

In the pilot study, the factorability of thirty-two items was examined. In the real study, the factorability of thirty-six items was examined. Six factors were extracted for the pilot study and seven factors were extracted for the real study which had eigenvalues more than 1. A positive loading will indicate a positive relationship with the factor, whereas one with a negative sign will suggest an inverse relationship. The researcher considers loadings greater than 0.6 to be very high, greater than 0.3 to be high, and less than 0.3 to be irrelevant and thus ignored. In the real study, the factor loadings are greater than 0.40. Principal components analysis with Varimax Rotation produces the dimension of differentiation was used in order to confirm the scale construct validity. Two statistical tests were used. The sample sufficiency index KMO by Kaiser-Meyer-Olkin, which compares the sizes of the observed correlation coefficients to the sizes of the partial correlation coefficients for the sum of analysis variables is .918, and it is reliable because it is greater than .70. The supposition test of sphericity by the Bartlett test to examine if the subscales of the scale are inter-independent shows 630 and Chi- Square = 5898.993. The control of sphericity (Bartlett's sign < 0.001) proved that the principal component analysis is meaningful. Consequently, the coefficients are not all zero, so that the second acceptance of factor analysis is satisfied. As such, both acceptances for the conduct of factor analysis are satisfied and the researcher can proceed to it.

The criterion of eigenvalue or characteristic root (eigenvalue) ≥ 1 was used for defining the number of the factors that were kept (Kaiser, 1960, Sharma, 1996). The instrument acceptance was based on two criteria: (a) each variable, in order to be included in the variable cluster of a factor, must load to it more than 0.5 and (b) less than 0.4 to the rest of the factors (Schene, et al., 1998). Moreover, each factor must have more than two variables. In addition, it was considered, on the basis of common variable Communalities**,** that the variables with high Communality (h2) imply great contribution to the factorial model (Hair et al., 2006). This was proven in the study. From the values of the common communality the researcher ascertain for each question that the majority of them have a value higher than 0.50 which represents the satisfactory quality of the measurements from the scale of 7 factors or components.

The coefficient of internal consistency (reliability) Cronbach's alpha is statistically significant and equals to 0.944 for the total number of questions in the real study. This is over 80%, which is an extra good value for the internal consequence of the conceptual construction of the investigated scale (Anastasiadou, 2010; Nouris, 2006). The refined thirty-six items were accepted as reliable in terms of internal consistency for the assessing of mathematics teachers 'values in teaching fractions. Correlation analyses are to assess both the strength and the direction of a linear relationship between two variables. This study explores whether teachers have responded to one question in the same way to another question.

Factor analysis is based on the correlation matrix of the variables involved. A correlation matrix gives the correlation coefficients between a single variable and every other variable in the investigation. The correlation coefficient between a variable and itself is always 1; hence the principal diagonal of the correlation matrix contains 1. The correlation coefficients above and below the principal diagonal are the same.

Correlation matrix identifies the pattern of relationships. The inter-item correlation matrix indicates that all items correlate positively with the other items. In this study, the inter-item correlation matrix mean is .326 and variance .024. The significant values for variables do not exceed 0.05. Correlation Matrix Table presents the matrix of correlations between variables, it can be seen that there are most sets of correlations above 0.30, therefore the application of the factorial analysis on these variables is appropriate thus satisfying the requirement (Tabachnick & Fidell, 2001). The correlation coefficients are not greater than 0.9. Therefore multicollinearity is not a problem for these data. All questions correlate well, and none of the correlation coefficients is particularly large. So, eliminating items is not a necessity. Tabachnick and Fidell (2001) recommended inspecting the correlation matrix (often termed Factorability of R) for correlation coefficients over 0.30. It was categorised these loadings using another rule of thumb as±0.30=minimal, ±0.40=important, and ±.50=practically significant. In this case,

Table 4.32
Item Total Statistics Real Study

	Scale Mean if Item Deleted	Scale Variance if Item Deleted	Corrected Item-Total Correlation	Squared Multiple Correlation	Cronbach's Alpha if Item Deleted
Question 1	157.7320	154.558	.505	.	.945
Question 2	157.5000	154.934	.502	.	.943
Question 3	157.5600	154.119	.512	.	.943
Question 4	157.5320	154.796	.492	.	.943
Question 5	157.5200	154.829	.536	.	.943
Question 6	157.5800	154.606	.512	.	.943
Question 7	157.4560	155.831	.541	.	.943
Question 8	157.4880	154.604	.618	.	.942
Question 9	157.4720	155.600	.572	.	.943
Question 10	157.4880	153.753	.630	.	.942
Question 11	157.4160	156.019	.588	.	.943
Question 12	157.4680	154.925	.598	.	.943
Question 13	157.6720	152.117	.627	.	.942
Question 14	157.5080	153.255	.737	.	.942
Question 15	157.6560	152.162	.623	.	.942
Question 16	157.4920	155.681	.552	.	.943
Question 17	157.6080	154.721	.540	.	.943
Question 18	157.6400	152.159	.571	.	.943
Question 19	157.6360	156.200	.464	.	.944
Question 20	157.7560	152.563	.615	.	.942
Question 21	157.6320	155.141	.577	.	.943
Question 22	157.6400	155.227	.580	.	.943
Question 23	157.5720	155.169	.591	.	.943
Question 24	157.5840	154.131	.651	.	.942
Question 25	157.5920	155.118	.603	.	.943
Question 26	157.7200	152.042	.665	.	.942
Question 27	157.6800	151.704	.707	.	.942
Question 28	157.6480	153.016	.675	.	.942
Question 29	157.7400	151.543	.656	.	.942
Question 30	157.6960	153.642	.624	.	.942
Question 31	157.7920	152.326	.653	.	.942
Question 32	157.7320	153.530	.567	.	.943
Question 33	157.4160	158.838	.308	.	.945
Question 34	157.5600	157.749	.350	.	.944
Question 35	157.4480	159.847	.253	.	.945
Question 36	157.4480	158.337	.316	.	.945

alpha is above 0.8 and is in the region indicated by Kline (1999) indicates good reliability. Items need not be removed and that factor analysis was done again in the real study.

Table 4.32 shows Item-total Statistics. The column Scale Mean if Item Deleted shows the mean of the summated items that exceed 157. The column Scale Variance if Item Deleted shows the mean of the summated variance that exceeds 151. Corrected Item-Total Correlation shows the correlation of the item designated with the summated score for all other items. In Table 4.32 the summated score values should be at least.40. In this real study, items 1, 33, 34, 35 and 36 have scored less than 0.40. The column Alpha if Item Deleted represents the scale's Cronbach's alpha reliability coefficient for internal consistency if the individual item is removed from the scale. Item 35 has the lowest corrected item-total correlation of .253. Once item deleted the scale's Cronbach's alpha would be .945. Overall the Cronbach is more than 0.94 and that no need to remove items. This is a correlational index, so values can range from -1.00 to 1.00. Higher positive values for the item-total correlation indicate that the item is discriminating well.

Confirmatory Factor Analysis

Confirmatory Factor Analysis is based on theory. The planning of the analysis was controlled by the theoretical relationships among the observed and unobserved variables. Confirmatory Factor Analysis was applied to test the factor structure of each construct. Each construct was specified using a path diagram showing each latent variable loading to the overall construct and individual subscale. The CFA could assess the unidimensionality, validity and reliability of a latent construct. Confirmatory Factor Analysis fit is assessed using a number of criteria, namely chi-square statistic, the Comparative Fit Index (CFI), the

Table 4.33

Results of Confirmatory Factor Analysis for Mathematics Teaching Values Scale

Factor	Item	Loading	Estimate	S.E.	C.R.	P
General Education Values						
F1	Q 18	0.75	1.030	.101	10.183	***
F1	Q17	0.55	.737	.083	8.921	***
F1	Q16	0.78	.686	.072	9.558	***
F1	Q15	0.70	1.070	.093	11.504	***
F1	Q14	0.80	.876	.071	12.257	***
F1	Q13	0.70	1.106	.093	11.947	***
F1	Q 12	0.68	.721	.073	9.868	***
F1	Q 11	0.70	.627	.065	9.683	***
F1	Q 10	0.75	.873	.079	11.046	***
F1	Q 9	0.67	.650	.070	9.250	***
F1	Q 8	0.69	.708	.074	9.608	***
F1	Q 7	0.57	1.249	.256	4.874	***
F1	Q 6	0.67	1.819	.349	5.211	***
F1	Q 5	0.56	2.176	.389	5.590	***
F1	Q 4	0.60	2.785	.482	5.783	***
F1	Q 3	0.63	2.870	.497	5.775	***
F1	Q 2	0.62	2.749	.474	5.804	***
F1	Q 1	0.59	2.717	.503	5.400	***
Mathematics Education Values						
F2	Q26	0.71	1.004	.089	11.336	***
F2	Q20	0.61	.967	.091	10.635	***
F2	Q 25	0.79	1.444	.191	7.577	***
F2	Q 23	0.78	1.474	.194	7.598	***
F2	Q 24	0.78	1.487	.197	7.537	***
F2	Q 22	0.78	1.539	.200	7.700	***
F2	Q 21	0.73	1.468	.196	7.506	***
F2	Q19	0.70	1.000			
Mathematics Values						
F3	Q 31	0.82	1.000			
F3	Q 30	0.78	.859	.081	10.622	***
F3	Q 29	0.84	1.136	.093	12.185	***
F3	Q 28	0.78	.900	.080	11.292	***
F3	Q 27	0.75	1.055	.086	12.293	***
F3	Q 35	0.69	.430	.125	3.444	***
F3	Q 34	0.71	.643	.153	4.204	***
F3	Q 33	0.69	.572	.138	4.135	***
F3	Q 32	0.70	1.309	.204	6.416	***
F3	Q 36	0.63	1.000			

Goodness of Fit Index (GFI) and the Root Mean Square Error of Approximation (RMSEA). The factor loading for newly developed items should exceed 0.5 (Hulland, 1999). Higher factor loadings are better. According to Tabachnick and Fidell (2007), factor loadings above 0.71 are excellent, 0.63 very good, 0.55 good, 0.45 fair, and 0.32 poor.

Confirmatory factor analysis (CFA) was performed for MTVS Scale to confirm the three factor model emerged from EFA. Table 4.33 shows the *t*-values (CR), factor, loading, estimate, and regression estimates of the items and their respective subscales. Based on the analysis, factor 1 has excellent loadings for items GQ10 (0.75) and GQ14 (0.80), very good loadings for items GQ8 (0.69), GQ9 (0.67), GQ11 (0.70), GQ12 (0.68), GQ13 (0.70), GQ15 (0.70), good loadings for items GQ5 (0.56), GQ7 (0.57), GQ17 (0.55), GQ18 (0.59), GQ2 (0.62), GQ3(0.63), GQ4(0.60), GQ6 (0.67) and GQ1 (0.59). This factor 2 have excellent loadings for items EQ21 (0.73), EQ22 (0.78), EQ23 (0.78), EQ24 (0.78), and EQ25 (0.79), very good loadings for item EQ26 (0.71), EQ20 (0.61), EQ19 (0.70). This factor 3 has excellent loadings for items MQ27 (0.75), MQ28 (0.78), MQ29 (0.84), MQ30 (0.78), and MQ31 (0.82), very good loadings for item MQ32 (0.70), MQ33 (0.69), MQ34 (0.71), MQ35 (0.69), and MQ36 (0.63).

Fit statistics test how well the competing models fit the data. According to Mulaik (1987), a goodness-of-fit test evaluates the model in terms of the fixed parameters used to specify the model and acceptance or rejection of the model in terms of the over-identifying conditions in the model. The main absolute fit index is the model chi-square ($\chi 2$) that tests whether the model fits accurately in the study. The chi-square is a function of the differences between the observed covariances and the covariances implied by the model. The good of fit index measures the relative amount of variances and covariances jointly accounted for by the model (Joreskog & Sorbom, 1986).

Researchers use various goodness-of-fit indicators to assess a model fit (Kaplan, 2000; Bentler & Wu, 2002). However, there is no agreement among researchers which fitness indexes to use. Hair et al. (1995, 2010) and Holmes-Smith (2006) recommend the use of at least one fitness index from each category of model fit. There is three model fit categories namely Absolute Fit, Incremental Fit, and Parsimonious Fit shown in Figure 4.10.

Name of category	Name of index	Level of acceptance
1. Absolute fit	Chi-Square	P-value > 0.05. **Not** Applicable for large sample size (>200)
	RMSEA	RMSEA < 0.08
	GFI	GFI > 0.90
2. Incremental fit	AGFI	AGFI > 0.90
	CFI	CFI > 0.90
	TLI	TLI > 0.90
	NFI	NFI > 0.90
3. Parsimonious fit	**Chisq/df**	Chi-Square/ df < 3.0

Figure 4.10. Three Categories of Model Fit and their Level of Acceptance

GFI (goodness of fit index) values range from 0 (poor fit) to 1.0 (perfect fit). The values greater than 0.80 are considered an acceptable threshold Holmes-Smith & Coote, 2002). Values for AGFI (adjusted goodness of fit index) range between 0 and 1 and it is generally accepted that values of 0.90 or greater indicate well-fitting models. For RMSEA (root mean square error of approximation) with a range of 0.08 to 0.10 provides an acceptable fit (Hair et al., 2006) and values 0.05 to 0.08 indicate more desirable fit (Schumacker & Lomax, 2004). Brown (2006) recommends RMSEA close to 0.06 or less. The CFI (comparative fix index) ranges from 0 to 1 with higher values indicating better fit (Hair et al., 2006). Brown (2006) recommends CFI close to 0.95 or greater. The value of NNFI or Tucker-Lewis

Index (TLI) should be greater than 0.95 (Tucker & Lewis, 1973, Bagozzi, 2010). The normed fit index, NFI varies from 0 to 1, with 1 determines perfect fit. NFI should be greater than 0.90. NFI is a measure of comparison between the researcher's model and the null model. The chi-square to degrees of freedom ratio of 3 or 2 or less has been supported as a satisfactory level of fit for confirmatory factor models (Carmines & McIver, 1981). The PCLOSE (.000) of less than 0.05, the threshold of a good model fit, however, showed a good fit.

In this study, the results revealed that the three-factor model was correctly adjusted to the data $\chi 2$ = 306.878; p <. 01; χ^2/df = 1.587; Comparative fit index (*CFI*) = .912; Goodness of fit index (*GFI*) = .933, Adjusted goodness of fit index (*AGFI*) = .911, Root mean square error of approximation (RMSEA) = .036 and TLI (Tucker-Lewis fix index) = 0.985. Furthermore, all parameters were found to be significant which indicated that each item contributes significantly to the corresponding subscale.

Analysis of Variance

The survey's demographic questions focused on the respondents' gender, age, and highest education level attained, race and teaching experience. These demographic characteristics are used in addressing the Research Question. Table 4.34 shows the results obtained for the impact of demographic factors on assessing teachers' values in mathematics education. Concerning the gender factor, the study involved 79 male (31.6 %) and 171 female (68.4 %) respondents. The respondents were predominantly female. The mean score for male respondents is 4.5 and mean score for female respondents is 4.6. The mean scores indicated that

Table 4.34
Analysis of Variance for Demographic Factors

	Sum of Squares	df	Mean Square	F	Sig.
Gender					
Between Groups	491.401	1	491.401	3.034	.083
Within Groups	40164.663	248	161.954		
Total	40656.064	249			
Age					
Between Groups	482.607	3	160.869	.985	.400
Within Groups	40173.457	246	163.307		
Total	40656.064	249			
Education					
Between Groups	94.488	2	47.244	.288	.750
Within Groups	40561.576	247	164.217		
Total	40656.064	249			
Experience					
Between Groups	1600.256	4	400.064	2.510	.043
Within Groups	39055.808	245	159.411		
Total	40656.064	249			
Race					
Between Groups	722.455	2	361.227	2.234	.109
Within Groups	39933.609	247	161.675		
Total	40656.064	249			

there are no gender differences in the assessment of values in mathematics education within the sample. In the responses to questionnaires, the male and female respondents indicated levels of agreement, and there was no question where all the males or females gave the same responses. All participants strongly agreed with related statements regarding their mathematical values. Based on one-way

ANOVA analysis, the Levene's test for gender was found as F (1, 248) = 0.017, p = .897 and F ratio (3.034) is not significant (p = .083) at the .05 alpha level. Thus, gender does not significantly influence the respondents' responses in assessing values.

Concerning the age factor, the respondents' age classified into four levels. The first level is 21 years old to 30 years old which has 35 respondents and the mean score is 4.5. The second level is 31 years old to 40 years old which has 154 respondents having a mean score of 4.5. The third level is 41 years old to 50 years old which has 53 respondents. The mean score is 4.6. The fourth level is 51 years old and above which has 8 respondents with a mean score 4.6. Based on ANOVA analysis, the Levene's test for age was found as F (3, 246) = 1.224, p = .302 and F ratio (0.985) is not significant (p = .400) at the .05 alpha level. Thus, age does not significantly influence the respondents' responses in values assessment.

Concerning the education factor, the level of education involved in the study is Diploma in Education, Bachelor of Education and Master in Education. This study comprises respondents of 15 Masters, 167 Bachelor degree and 68 Diploma holders. The mean score for a diploma in education is 4.6, the mean score for Bachelor in Education is 4.5 and the mean score for Masters in education is 4.4. All the three levels have a mean score of 4.4 and above. The mean scores indicated that there are no education differences in the assessment of values in Mathematics Education within the sample. Based on ANOVA analysis, the Levene's test for education was found as F (2,247) = 1.060, p = .348 and F ratio (0.288) is not significant (p = .750) at the .05 alpha level. Hence, the level of education does not significantly influence the respondents' responses in values assessment.

Concerning the factor of experience, the respondents' experience were divided into five levels. The first level of experience is from 1 to 4 years. The number of respondents is 22 with a mean score 4.6. The second level of experience is from 5 to 8 years. The number of respondents is 50 with a mean score 4.6. The third level of experience is from 9 to 12 years. The number of respondents is 78 with a mean score 4.6. The fourth level of experience is from 13 to 16 years. The number of respondents is 72 with a mean score 4.6. The fifth level of experience is 17 years and above. The number of respondents is 28 with a mean score 4.8. Based on ANOVA analysis, the Levene's test for experience was found F (4, 245) = 3.597, p = .007 and F ratio (2.510) is significant (p = .043) at the .05 alpha level. Thus, experience significantly influences the respondents' responses with regards to values in mathematics education assessment.

Concerning the race factor, the respondents' comprised of Malays, Chinese, and Indians. There were 181 respondents or 72.4 % Malays, 39 respondents or 15.6 % Chinese and 30 respondents or 12 % Indians. Based on ANOVA analysis, the Levene's test for race was found as F (2, 247) = 2.234, p = .021 and F ratio (2.234) is not significant (p = .109) at the .05 alpha level. Thus, the race does not significantly influence the respondents' responses in values assessment.

Based on analysis of variance (ANOVA), this study found that factors such as gender, age, levels of academic achievement, and race, did not significantly influence the teachers' responses on the scores. Teaching experience had an impact on the scores.

Reliability Analysis

The real study consists of 36 items made up of three constructs. The first construct is general education values. In the real study, 18 items were analysed under this sub-construct. This analysis discussed the items reliability and validity of the instrument after the real study.

Table 4.35
General education values

	Real study
Person mean	3.13
Person separation	2.16
Item separation	2.36
Cronbach's alpha	.91
Item Reliability	.85
Person reliability	.82
Standard deviation item	.35
Standard deviation person	1.42

Table 4.35 shows the real study summary statistics for the analysis of the 250 respondents on the eighteen items on general education values. The mean of the individual *person* measures is 3.13 (SE .53), and the *person* separation is 2.16 which is higher than the 0 calibrations of the item scale, the pre-set selection of the analysis. The standard deviation of the *person* measures is 1.42 logits, while the standard deviation for item measures is .35. The summary fit statistics for quality items and *persons* show satisfactory fit to the model. The *person* reliability is .82 the item reliability is .85 and The item separation is 2.36 The Cronbach alpha is .91, an excellent reliability assessment of teachers' general education values which is good instrument reliability in item-measuring teachers' general education values in mathematics education.

Table 4.36
Mathematics education values

	Real study
Person mean	3.31
Person separation	1.64
Item separation	2.08
Cronbach's alpha	.88
Item Reliability	.81
Person reliability	.73
Standard deviation item	.40
Standard deviation person	1.84

Table 4.36 shows the real study summary statistics for the analysis of the 250 respondents on the eight items mathematics education values, the *person* mean is 3.31 (SE .85) and the *person* separation is 1.64 which is higher than the 0 calibrations of the item scale, the pre-set option of the analysis. The standard deviation of the *person* measures is 1.84 logits, while the standard deviation for item measures is .40. The *person* reliability is .73, which is good. The assessment of teachers' mathematics education values has good reliability with Cronbach alpha .88. The item separation is 2.08. The Cronbach alpha for instrument reliability in item-measuring teachers' mathematics education values in mathematics education is .81.

Table 4.37 shows the real study summary statistics for the analysis of the 250 respondents on the ten items on mathematics values. The *person* mean is 3.14 (SE.68) and the *person* separation is 1.61which is higher than the 0 calibrations of the item scale, the pre-set selection of the analysis. The standard deviation of the *person* measures is 1.43 logits, while the standard deviation for item measures is.64. The *person* reliability is .72, which is acceptable. The Cronbach alpha is .84, a good reliability assessment of teachers' mathematics values. The item separation is 4.18 and the reliability is .95, which is a good instrument reliability in item-measuring teachers' mathematics values in mathematics education.

Table 4.37
Mathematics values

	Real study
Person mean	3.14
Person separation	1.61
Item separation	4.18
Cronbach's alpha	.84
Item Reliability	.95
Person reliability	.72
Standard deviation item	.64
Standard deviation person	1.43

Table 4.38 shows the overall summary statistics for reliability analysis for person and items for the real study consisting thirty-six items. Separation and reliability indices for items and persons were shown. Separation refers to the ability of an instrument to define a distinct hierarchy of items along the measured variable (Bond & Fox, 2007). It measures the spread of both person positions and item positions across the measured variable, providing an estimate of how well an instrument can differentiate persons or items on a measured variable (Bond & Fox, 2007). The item separation is 2.99 and person separation is 3.07.

Table 4.38
Reliability Analysis

	Real study
Person mean	3.08
Person separation	3.07
Item separation	2.99
Cronbach's alpha	.94
Item Reliability	.90
Person reliability	.90
Standard deviation item	.41
Standard deviation person	1.41
Number of respondents	250

According to (Duncan, Martin, Staudt, Yevich, and Logan (2003), the separation index is excellent. The *person* mean is 3.08 which is higher than the 0 calibrations of the item scale, which is the default option of the analysis. As the mean item measure is set to 0.0, a score of 3.08 implies that the items were easy to endorse. The standard deviation of the *person* measures is 1.41 logits indicates a greater spread in person variation than was observed in item measures as .41. The item reliability is .90 and person reliability is .90. According to (Duncan et al., 2003), the reliability is high and good. Higher values of separation signify greater spread of persons and items along the continuum, indicating increased variability between persons that is a number of distinct levels into which the sample of persons can be stratified and items that is the wider the range of the variable defined by the set of items, which yields higher reliability. Lower values of separation indicate redundancy in items and less variability of persons on the variable being measured, and therefore low reliability (Green & Frantom, 2002). The Cronbach alpha is .94 shows the instrument measures what is supposed to measure.

Principal Component Analysis

The principal components analysis residuals intention is to explain the variance. The factor in the residuals that explains the most variance is important. If the factor is at the "noise" level, then no shared the second dimension. If the factor is above the “noise” level, then it is the "second" dimension in the data.

For the real study, from Figure 4.11, the Rasch dimension explains 35.1% of the variance in the data which is good compared to the model 34.9%, which is >30% is considered a moderate measurement dimension. It is less than the minimum requirement of 40%. The instrument has fulfilled the requirement for unidimensionality of at least 20%. The unexplained variance in the first contrast is 9.2 %, the level of ‘noise’, which does not exceed the 15% limit. The ratio of 35.1% to 9.2 % is 4 to 1 which is supportive of good item unidimensionality (Linacre, 2006). The eigenvalue of the biggest residual dimension is 34.3, indicating it has the strength of almost 34 items. In other words, the contrast between the strongly

```
TABLE 24.0 REAL STUDY  SEPT 19.sav              ZOU836WS.TXT  Oct 10 22:36 2014
INPUT: 250 PERSON  36 ITEM  REPORTED: 250 PERSON  36 ITEM  5 CATS WINSTEPS 3.72.1
--------------------------------------------------------------------------------


     Table of STANDARDIZED RESIDUAL variance (in Eigenvalue units)
                                                -- Empirical --    Modeled
Total raw variance in observations     =       371.4 100.0%         100.0%
  Raw variance explained by measures   =       130.4  35.1%          34.9%
    Raw variance explained by persons  =        72.1  19.4%          19.3%
    Raw Variance explained by items    =        58.2  15.7%          15.6%
  Raw unexplained variance (total)     =       241.0  64.9% 100.0%   65.1%
    Unexplned variance in 1st contrast =        34.3   9.2%  14.2%
    Unexplned variance in 2nd contrast =        21.7   5.8%   9.0%
    Unexplned variance in 3rd contrast =        17.5   4.7%   7.3%
    Unexplned variance in 4th contrast =        13.6   3.7%   5.6%
    Unexplned variance in 5th contrast =        13.0   3.5%   5.4%
```

Figure 4.11. Principal Component Analysis

positively loading items and the strongly negatively loading items on the first factor in the residuals has the strength of about 34 items.

Item Fit and Item Misfit

Figure 4.11 shows the number of items based on the Infit MNSQ and outfit MNSQ statistics. The analysis shows that Infit MNSQ and outfit MNSQ value of all items and respondents that were measured. In this real study too, the researcher used the total mean square infit and outfit mean square in the range proposed by Bond & Fox (2007). The analysis showed that mean square infit is 0.59 to 2.15 and outfit mean square value of the item is 0.53 to 2.18 for all constructs. As shown in Figure 4.12, Infit MNSQ items were Q1, Q3, and Q18 and outfit MNSQ, items were Q1, Q4, Q6, Q33, Q34, Q35, and Q36, should be improved or dropped because has exceeded the range suggested by Bond & Fox. A total of 29 item are found to be fit and seven items could be improved. This indicates that intervention must be done to check on the problems or weaknesses of the items.

```
TABLE 10.1 REAL STUDY  RASCH SEP.sav             ZOU100WS.TXT  Dec 17 11:53 2015
INPUT: 250 PERSON  36 ITEM  REPORTED: 250 PERSON  36 ITEM  5 CATS WINSTEPS 3.72.1
--------------------------------------------------------------------------------
PERSON: REAL SEP.: 2.78  REL.: .89 ... ITEM: REAL SEP.: 3.05  REL.: .90

         ITEM STATISTICS:  MISFIT ORDER

-------------------------------------------------------------------------------------------
|ENTRY   TOTAL  TOTAL           MODEL|   INFIT  |  OUTFIT  |PT-MEASURE |EXACT MATCH|      |
|NUMBER  SCORE  COUNT  MEASURE  S.E. |MNSQ  ZSTD|MNSQ  ZSTD|CORR.  EXP.| OBS%  EXP%| ITEM |
|------------------------------------+----------+----------+-----------+-----------+------|
|    36   1163    250    -.66    .14|1.32   2.9|2.18   4.7|A .33   .49| 67.1  73.7| MQ36 |
|     1   1089    250     .60    .12|2.15   8.2|2.17   7.4|B .42   .59| 54.2  66.5| GQ1  |
|    34   1132    250    -.07    .13|1.33   2.9|1.93   5.0|C .37   .54| 60.8  70.3| MQ34 |
|    33   1171    250    -.83    .15|1.19   1.8|1.90   3.5|D .33   .47| 66.7  75.0| MQ33 |
|     6   1127    250     .01    .13|1.24   2.2|1.88   4.9|E .48   .55| 65.8  70.0| GQ6  |
|    35   1160    250    -.60    .14|1.28   2.5|1.77   3.4|F .31   .50| 61.7  73.2| MQ35 |
|     4   1139    250    -.20    .13|1.39   3.4|1.48   2.7|G .48   .53| 67.1  70.9| GQ4  |
|    18   1112    250     .26    .13|1.42   3.5|1.32   2.2|H .54   .57| 64.2  68.4| GQ18 |
|     3   1132    250    -.07    .13|1.41   3.5|1.24   1.6|I .51   .54| 63.8  70.3| GQ3  |
|     2   1147    250    -.35    .14|1.34   3.0|1.20   1.2|J .49   .52| 69.6  71.6| GQ2  |
|     5   1142    250    -.25    .14|1.12   1.2|1.17   1.1|K .51   .53| 69.2  71.1| GQ5  |
|    15   1108    250     .32    .12|1.08    .8|1.06    .5|L .59   .57| 66.3  68.2| GQ15 |
|    13   1104    250     .38    .12|1.05    .5| .97   -.2|M .61   .58| 68.3  67.7| GQ13 |
|    17   1120    250     .13    .13|1.02    .2|1.01    .1|N .54   .56| 71.3  69.2| GQ17 |
|    32   1089    250     .60    .12| .99   -.1| .95   -.4|O .60   .59| 68.8  66.5| MQ32 |
|    10   1150    250    -.40    .14| .95   -.4| .79  -1.2|P .58   .52| 73.8  72.1| GQ10 |
|     7   1158    250    -.56    .14| .94   -.5| .92   -.4|Q .52   .50| 75.8  73.0| GQ7  |
|     8   1150    250    -.40    .14| .82  -1.8| .92   -.4|R .57   .52| 74.2  72.1| GQ8  |
|    20   1083    250     .69    .12| .92   -.7| .88  -1.0|r .62   .60| 66.3  66.0| EQ20 |
|    29   1087    250     .63    .12| .92   -.7| .87  -1.1|q .65   .59| 61.7  66.4| MQ29 |
|    16   1149    250    -.38    .14| .88  -1.2| .88   -.7|p .54   .52| 76.7  72.0| GQ16 |
|    12   1155    250    -.50    .14| .87  -1.2| .80  -1.1|o .56   .51| 74.2  72.7| GQ12 |
|     9   1154    250    -.48    .14| .84  -1.6| .81  -1.1|n .54   .51| 72.9  72.6| GQ9  |
|    19   1117    250     .18    .13| .79  -2.1| .80  -1.5|m .57   .56| 72.1  69.0| EQ19 |
|    11   1168    250    -.77    .15| .75  -2.6| .78  -1.1|l .54   .48| 78.8  74.4| GQ11 |
|    25   1124    250     .06    .13| .69  -3.3| .78  -1.6|k .61   .55| 75.8  69.6| EQ25 |
|    22   1112    250     .26    .13| .72  -2.9| .78  -1.7|j .61   .57| 73.3  68.4| EQ22 |
|    31   1074    250     .81    .12| .76  -2.4| .76  -2.3|i .66   .60| 66.3  65.4| MQ31 |
|    30   1098    250     .47    .12| .75  -2.5| .74  -2.3|h .64   .58| 70.8  67.3| MQ30 |
|    21   1114    250     .22    .13| .75  -2.5| .73  -2.2|g .60   .57| 74.2  68.6| EQ21 |
|    23   1129    250    -.02    .13| .75  -2.6| .67  -2.5|f .60   .55| 75.8  70.1| EQ23 |
|    27   1102    250     .41    .12| .75  -2.6| .70  -2.6|e .68   .58| 77.1  67.6| MQ27 |
|    26   1095    250     .52    .12| .71  -3.0| .65  -3.2|d .68   .59| 74.2  67.1| EQ26 |
|    28   1110    250     .29    .13| .70  -3.1| .66  -2.9|c .67   .57| 76.7  68.3| MQ28 |
|    24   1126    250     .03    .13| .68  -3.4| .63  -2.9|b .64   .55| 79.6  69.8| EQ24 |
|    14   1145    250    -.31    .14| .59  -4.6| .53  -3.5|a .67   .52| 84.2  71.5| GQ14 |
|------------------------------------+----------+----------+-----------+-----------+------|
| MEAN  1126.0  250.0     .00    .13|1.00   -.3|1.06    .0|           | 70.5  69.9|      |
| S.D.    26.3     .0     .45    .01| .31   2.7| .46   2.6|           |  6.1   2.5|      |
-------------------------------------------------------------------------------------------

‡TABLE 10.3 REAL STUDY  RASCH SEP.sav             ZOU100WS.TXT  Dec 17 11:53 2015
INPUT: 250 PERSON  36 ITEM  REPORTED: 250 PERSON  36 ITEM  5 CATS WINSTEPS 3.72.1
--------------------------------------------------------------------------------
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Figure 4.12. Misfit Order

Point measure correlation

A value less than .15 indicates a potentially misfitting item. From Figure 4.08, none of the Point Measure values shows 0. The acceptable value for the Point Measure shall be in between 0.4 < x < 0.8. Items MQ36, MQ33, MQ 34, and MQ 35 have point measure value less than the accepted value 0.4. This probably means that the respondent is behaving the opposite way. The assessment always results with the highest score and these sometimes cannot represent the actual data. The acceptable value for the Outfit Mean Square (MNSQ), y-value must be in the range of 0.5 < y < 1.5. From the Figure 4.08, it shows that items MQ36, GQ1, MQ33, MQ34, GQ 6 and MQ35 are having MNSQ, not in the fit range. The Outfit z-standard (ZSTD) and the value must also be within the range of $-2 < z < 2$ or further check were needed. From the analysis, items MQ36, GQ1, MQ33, MQ 34, MQ 35 GQ04, EQ19, EQ26, MQ27, MQ 31, MQ 30, EQ21, EQ23, EQ27, MQ28, EQ24 and GQ14 having ZSTD values outside the fit range.

Rating Scale

Figure 4.13 provides a broad view of how the categories presented on the scale were selected. The observed count and observed percentage of counts of the rating scale categories provide information about the level of agreement of respondents for all thirty-six items. In this real study, a total number of responses for the observed count should be 9000. No missing counts. The respondents answered category 1 (strongly disagree) and category 2 (disagree), category 3 (undecided), category 4 (agree) and category 5 (strongly agree). Eight counts or zero % was in category 1, thirty-seven counts or almost zero % was in category 2, four hundred and twenty-nine counts or 5 % was in category 3, three thousand four hundred and seventy-seven counts or 39 % was in category 4 and five thousand and forty-nine counts or 56 % was in category 5. Therefore, 95 % of the counts were in category 4 and 5. Almost zero percent or eight of the counts used category 1 and almost zero percent or 37 of the counts used category 2. This focuses on the overall agreement or disagreement with the trait of interest that is assessing teachers' values in teaching mathematics.The observed average shows respondent's scoring pattern. The pattern increases in one direction from 2.26 logits to 3.88. It shows normal responses. The structure calibration is the dominant strength of Rasch model. In examining the 5 response options (1= strongly disagree, 2= disagree, 3= undecided, 4= agree and 5= strongly agree), the researcher observed a monotonic progression from one step calibration to the next,

```
TABLE 3.2 REAL STUDY  SEPT 19.sav              ZOU607WS.TXT  Jul  3 22:44 2015
INPUT: 250 PERSON  36 ITEM  REPORTED: 250 PERSON  36 ITEM  5 CATS WINSTEPS 3.72.1
--------------------------------------------------------------------------------


SUMMARY OF CATEGORY STRUCTURE.  Model="R"
-------------------------------------------------------------------
|CATEGORY   OBSERVED|OBSVD SAMPLE|INFIT OUTFIT||STRUCTURE|CATEGORY|
|LABEL SCORE COUNT %|AVRGE EXPECT|  MNSQ  MNSQ||CALIBRATN| MEASURE|
|-------------------+------------+------------++---------+--------|
|  1   1       8   0|  2.26   .36|  1.65  3.28||  NONE   |( -2.64)| 1
|  2   2      37   0|  1.58*  .79|  1.37  1.71||    -.96 |  -1.44 | 2
|  3   3     429   5|  1.30* 1.35|   .97  1.08||   -1.40 |   -.50 | 3
|  4   4    3477  39|  2.23  2.26|   .97  1.04||    -.33 |   1.26 | 4
|  5   5    5049  56|  3.88  3.86|   .94   .96||    2.69 |(  3.82)| 5
-------------------------------------------------------------------
OBSERVED AVERAGE is mean of measures in category. It is not a parameter estimate.

----------------------------------------------------------------------------------------------------
|CATEGORY    STRUCTURE    |  SCORE-TO-MEASURE   | 50% CUM.| COHERENCE        |ESTIM| OBSERVED-EXPECTED |
| LABEL    MEASURE   S.E. | AT CAT. ----ZONE----|PROBABLTY| M->C C->M  RMSR  |DISCR|RESIDUAL DIFFERENCE|
|-------------------------+---------------------+---------+------------------+-----+-------------------|
|   1      NONE           |( -2.64) -INF   -2.06|         |   0%   0% 3.3109|     |  -1.1%        -.1 | 1
|   2        -.96     .36 |  -1.44  -2.06   -.97|   -1.65 |   0%   0% 2.1091|  .11|   -.6%        -.2 | 2
|   3       -1.40     .15 |   -.50   -.97    .15|   -1.06 |  49%   7% 1.0351|  .80|   -.3%       -1.3 | 3
|   4        -.33     .05 |   1.26    .15   2.81|    -.07 |  62%  72%  .4322|  .98|   -.1%       -2.1 | 4
|   5        2.69     .03 |(  3.82)  2.81  +INF |    2.73 |  78%  76%  .4135| 1.05|    .1%        3.8 | 5
----------------------------------------------------------------------------------------------------
M->C = Does Measure imply Category?
C->M = Does Category imply Measure?
```

Figure 4.13. Rating Scale

which is desirable; however, the steps are very small between #2 and #3 (-.96 to -1.40).

In Rasch modelling, coherence statistics are examined to infer the empirical relationship between ratings and measures and measures and ratings. Coherence statistics are presented as the percentage of ratings that are in the same category as the model-based expected ratings that is observations imply measures and the percentage of model-based expected ratings that are consistent with the actual ratings that measure imply observations. Linacre (2004) indicates 40% or higher as an empirically useful level of coherence for inference of measures-to-ratings and ratings-to-measures with otherwise satisfactory data sets. In this study, *Strongly Disagree* category and *Disagree* category did not meet the criteria, showed zero. The others, category 3, category 4 and category 5 showed 49%, 62% and 78% respectively, that is greater than 40%. In the real study, Strongly Disagree failed to receive the recommended number of ten responses in categorical options (Linacre, 2004). Modifications of the categories could be done.

A Rasch variable map, also known as an Item-Person map or Wright map, is a WINSTEPS output tool that allows researchers to assess the validity of their instrument with regards to the definition of the construct the instrument purports to measure. Validity issues that can be examined using a variable map include the theoretically based definition of the construct according to the map, item coverage that is the range of items addressing the construct, including identifying redundancy or gaps and the linear progression of items along the construct's continuum (Liu, 2010). A Rasch variable map provides a graphic representation of the distribution of items and persons along a common scale (Bond & Fox, 2007; Drouin, Horner, & Sondergeld, 2012). The common unit of measure for the scale is the logit, which is a log odds transformation of the probability of correctly answering an item (Bond & Fox, 2007, Drouin et al., 2012).

The distribution of items is on the right side of the map, the distribution of persons on the left. Items are arranged by difficulty; items that are easiest to endorse or agree with are towards the bottom of the scale, items that are more difficult to endorse or agree with are towards the top. Persons are arranged by the level they demonstrate the construct being measured; those having low levels of the construct are towards the bottom of the scale; those having higher levels of the construct towards the top. Items that are at the same logit measure as a person have a 50% probability of being endorsed by that person (Drouin et al., 2012).

```
‡TABLE 1.2 REAL STUDY  SEPT 19.sav              ZOU154WS.TXT  Dec  9 14:27 2014
INPUT: 250 PERSON  36 ITEM  REPORTED: 250 PERSON  36 ITEM  5 CATS WINSTEPS 3.72.1
--------------------------------------------------------------------------------

           PERSON - MAP - ITEM
               <more>|<rare>
    7          .####  +
                      |
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           .#######   |
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    6                T+
                      |
                ###   |
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                      |
                 ##   |
    5                 +
              .####   |
               .###   |
                     S|
               ####   |
            .######   |
    4           .##   +
                .##   |
             .#####   |
              .####   |
              #####   |
             .#####   |
    3       ####### M+
                 ##   |
                ###   |
           .#######   |
              #####   |
             .#####   |
    2         #####   +
               .###   |
              .#### S|
                .##   |
            .######   |
              #####   |
    1         .####   +
                    . |T MQ31
                    . |  EQ20    GQ1     MQ29    MQ32
                    . |S EQ26    MQ30
                      |  GQ13    GQ15    MQ27    MQ28
                    . T|  EQ19    EQ21    EQ22    GQ17    GQ18
    0               . +M EQ23    EQ24    EQ25    GQ3     GQ6     MQ34
                      |  GQ4
                      |  GQ10    GQ14    GQ16    GQ2     GQ5     GQ8
                      |S GQ12    GQ7     GQ9
                      |  MQ35    MQ36
                      |T GQ11    MQ33
   -1                 +
               <less>|<frequ>
EACH "#" IS 2. EACH "." IS 1.
```

Figure 4.14. Variable Map

Items below a person's level of the construct have a greater probability of being endorsed, while items above a person's level of the construct have a lower probability of being endorsed (Bond & Fox, 2007; Drouin et al., 2012).

The variable map, Figure 4.14 reveals substantial gaps in the continuum represented by the scale. While *person* ability spans nearly 6 logits, items span 2 logits. A significant number of them can be considered high implementers and are not well-targeted by the scale, as revealed by a significant gap in the coverage of the construct at the upper end of the scale where there are people but no items. The variable map reveals considerable redundancy in the items making up the scale. A review of the variable map for iteration revealed several groups of items to be redundant in endorsability. Review of the actual items found several pairs of items to be similar in content as well as endorsability, targeting some of the items for removal. For example, six items measure values assessment at the difficulty level corresponding to a logit value of 0 (the mean of the scale). Five of the six items could be eliminated, and the scale would still accurately measure values assessment of teachers with implementation levels at the mean of the scale. Furthermore, 20 of the 36 items in the scale (87%) measure implementation at difficulty levels between 0 and -1 logits. The scale would be significantly improved by deleting many of these redundant items and adding items that discriminate more effectively along more points on the scale.

Rasch Analysis Summary

This study uses Rasch Model analysis to evaluate 36 items used in the real study. The items were identified according to theory and evaluated according to the Rasch Measurement Model using Winsteps software. It is a psychometric study to test the validity and reliability of the questionnaires to develop the instrument. Based on the results of the Rasch analysis measurement; item reliability was 0.94 > 0.50, item separation was 3.82 > 2.0, for the pilot study and item reliability was 0.90 > 0.50, item separation was 2.99 > 2.0 for the real study. Item separation refers to all participants are able to answer all level difficulty of items. That means the participants can be separated based on those constructs that are measured. The criterion for the usefulness of an instrument is exceeding its item separation (Linacre, 2007). A higher value of separation means greater spared of items and *persons* along a continuum. Lower values of separation indicate redundancy in items and less variability of persons on the trait. Item reliability refers to the consistency of item placement along the pathway if these items were given to another sample of the same size that behaved the same way. While *person* reliability refers to the consistency of *person* ordering that could be accepted if this sample of *persons* were given a parallel set of items measuring the same construct. The criteria for accepting reliability Rasch Model is exceeding 0.50 (Linacre, 2007; Bond & Fox, 2007).

For analysing construct validity, item polarity and dimensionality analyses were conducted. All values of Point Measure (PTMEA) correlation is positive for both the pilot study and real study. This indicates that all the items generally measure all the constructs. Item polarity or point measure correlation is the early detection of construct validity (Bond & Fox, 2007).

Results of the dimensionality analysis show that the value of raw variance as explained by measure is more than 40% and 30 % for the pilot study and real study respectively. The value of unexplained variance in the first contrast is less than 15% for the real study. This shows that there is no sub-dimension that exists under the values dimension. Dimensionality aspects are important for determining the instrument was measured in one direction and one dimension (Linacre, 2003; Bond & Fox, 2007). Dimensionality aspect is one of the conditions in the analysis using the Rasch Model. This is to ensure content validity and construct validity of the instrument (Wu & Adams, 2007).

Analysis of the study showed the reliability of 250 respondents with 36 items in the real study for these constructs was high to assess the values of teachers and presenting a strong acceptable level.

Summary

This chapter analysed the data for the pilot study and real study. The instrument was developed to assess primary school mathematics teachers' values in teaching fractions. The construct, sub-constructs, dimensions and value indicators of the instrument were constructed based on the universal integrated perspective. The content validity of the instrument was verified through focus group analysis and experts' panel feedback for readability, clarity, language compatibility, difficulty, relevance, and representations and on both bad items, good items and modifications based on the pre-determined criteria. A pilot study was carried out on 150 national type primary school mathematics teachers. Rasch model analysis evaluated the psychometric properties of the items and assessed the appropriateness of this instrument. Specifically, the analyses examined fit statistics for both persons and items, response scale structure, unidimensionality, item invariance, and reliability. The factor analysis identified Cronbach's alpha to determine internal consistency as an indicator for the reliability of the instrument. It also indicated how well the items were correlated with each other.

The researcher assumed that the instrument was developed not based on a specific theory and proceed to carry out the Principal Components Analysis. Specifically, principle components analysis using Varimax rotation showed that 36-items emerged as separate factors.The loadings were all high and positive indicating that the three sub-constructs were contributing strongly to the study thus showing the compatibility of results to the theory based results. The results indirectly support the instrument constructed based on universal integrated perspective. Descriptive statistical analysis showed the data were fit for factor analysis, item-total correlations, standardised factor loadings, difficulty indices, skewness and normality. The findings of this study indicated that the scales utilised were reliable through exploratory factor analysis, confirmatory factor analysis, ANOVA and Rasch model analysis.

The internal consistency for the sub-constructs of this study was determined through factor analysis and Rasch analysis. To validate the developed constructs, the instrument was tested with a confirmatory factor analysis (CFA) in which each measurement item was loaded on its prior constructs, and the constructs were correlated in the analysis. The 36 statements were used to collect responses and observe results of CFA. The CFA was employed to test if the relationship between observed variables and their underlying latent construct exists. The CFA results showing fitness indexes and factor loading for every item together with its R2 are presented. For confirmatory factor analysis, unidimensionality is achieved when all measuring items have acceptable factor loadings for the respective latent construct. In order to ensure unidimensionality of a measurement model, any item with a low factor loading should be deleted. When a confirmatory analysis fails to fit the observed factor structure with the theoretical structure, the researcher can evaluate ways to improve the model by exploring which parameters might be freed that had been fixed and which might be fixed that had been freed. The computer packages can be utilised to change parameters one at a time in order to determine what changes offer the greatest amount of improvement in the fit of the model.

CHAPTER 5: DISCUSSIONS, CONCLUSIONS, AND IMPLICATIONS

Introduction

This chapter describes research summary, the summary of results, discussions, conclusions, implications to theory and educational practice, implications to further studies and ends with concluding remarks. The research summary discusses the purpose, background, significance, design, procedures, selection of subjects**,** data analysis and statistical considerations of the study. The summary of results discusses the results obtained in the study as described in Chapter Four based on the problem statement, research questions and the main research results. The discussions describe the analysis, synthesis, interpretation, and explanation of results based on the research questions. The conclusion describes the research results and research findings, identifies the similarities and differences of the research results and past studies. The implications of theory discuss the importance of the study based on the theory of foreground and the theory of background. The implications for educational practice discusses the improvement of current educational practices based on the research results and new understanding applications to develop values in mathematics education. The implications for further studies focus on a future study that is relevant to be carried out to improve the results and solve the critical problems of the present study and find a suitable replication study based on the research results.

Summary of the Study

This study had three main objectives. The first aim was to find out the dimensions of the mathematics teachers' values in teaching Fractions. The second aim was to find out the psychometric properties of the mathematics teachers' values Scale. The third aim was to find out the relations between mathematics teachers' values in teaching Fractions and age, gender, race, educational level and teaching experience. This study developed an instrument, the Mathematics Teachers Values Scale (MTVS) designed to assess primary school mathematics teachers' values in teaching fractions. In addition, the researcher validated the instrument. The assessment development and validation were conducted by building and supporting arguments for the use of assessment in values development. In the five phases of the research, the study first developed a test blueprint defining the target domains and then developed the assessment from existing instruments and literature. Numerous sources of evidence were evaluated with regard to the credibility of the inferences laid out from previous studies. Values in mathematics education are categorised as general education values, mathematics education values and mathematics values. Fraction is a topic in mathematics where teachers have difficulty in teaching and students have difficulty in understanding and learning (Empson & Levi, 2011). After an extensive review of the existing research and instruments attributed to the measurement of values and other affective domain, it was determined that a new instrument had to be developed. Traditional items as found on the review of literature were too specific and did not allow for equal weight along each of the three constructs as proposed by Bishop and Nik Azis.

The universal integrated perspective guided this study. In developing the MTVS, it was necessary to address the following research questions:

1. What are the dimensions of the mathematics teachers' values scale (MTVS) involving teaching Fractions?
2. What are the psychometric properties of the mathematics teachers' values scale involving teaching Fractions?

3. Do the mathematics teachers' values involved in teaching Fractions differ by age, gender, race, education and experience?

Summary of Research Results

This section summarised the results of the study. They are as follows:

1. Under the analysis phase, the vast literature review provided an opportunity to examine the instruments developed on various aspects of values in mathematics education and other affective domain. The items used to measure values are largely inconsistent across studies. According to Bishop (1996) and universal integrated perspective (Nik Aziz, 2013), the construct values has three major sub constructs. The first is general education values which deal with norms and manners of a particular society or educational institute. The dimensions are basic values, core values, main values and expanded values. The second sub-construct is mathematics education values which deal with values developed through school mathematics curriculum, mathematics text book, mathematics syllabus, and mathematics classroom practices. The dimensions are teaching values and learning values. The third sub-construct is mathematics values which deal with mathematics values development in a culture or civilisation. The dimensions are ideological values, sentimental values and sociological values. All the three sub-constructs have their dimensions and respective values indicators.

Existing literature reviews gave a good overview of the research that has been undertaken so that the relevance of the present study can be determined. The bibliographic references from the literature were accessed to find other sources regarding the study.

In the analysis phase, the subject field and the target group were determined to develop the instrument. The subject field valued in Mathematics education and the target group was primary school mathematics teachers. The analysis phase provided information pertaining to preferred design elements relating to the development of the instrument and the content of the items. The results from the analysis phase set the pace for implementing the next three phases, design, development, and evaluation. The analysis phase output becomes the input to the design phase.

2. In the design phase, the researcher designed the instrument to assess teachers' perceptions on values in mathematics education. The five-point Likert scale was appropriate for the study. The respondents from the focus group created the design guidelines and helped with the design and content for the items. The items were arranged in order according to the constructs. The respondents seemed to understand the items, the scale development, questionnaire format, and the instructions. The goal was to produce items that the respondents immediately and accurately comprehend. Formative evaluation took place in parallel with instrument development. The researcher evaluated the items and their feedback was taken into account during instrument design and development. Summative evaluation took place after the instrument has been developed. In this study, formative evaluation was used during the design phase when items were being created, while summative evaluation was used once the instrument fully developed. In the design phase, the content was formed and the indicators were determined, thus the general framework of the design was developed.

3. In the development phase, the results obtained from the pilot study helped the researcher refine the instrument. From the responses, the researcher identified the quality of the items and the scale as a whole. The readability, clarity of the items, understanding of the terms, difficulty of the items, representations of the items towards the sub-constructs, precision and compactness of the items presentation, the uniqueness that no overlapping of ideas, comprehensiveness, suitability, clear instructions, time allocation to answer the questionnaires, upgrading and addition of the items and fulfils the social responsibility. The researcher reviewed and validated the instrument. The items have a face and content validity. The format of the items and the questionnaire were improved and refined for the real study. The real study results were discussed in Chapter four whereby the instrument was shown to be valid and reliable.

4. The implementation phase involved the pilot study, reviewing the instructions and items, preparation of relevant items, assessment of respondents, collecting feedback from respondents and conducting a formative and summative evaluation to refine the items for the real study.

5. The evaluation phase consists of formative and summative evaluation and management of data. In the pilot study, the researcher did item analysis that involved evaluation on item performance determining the mean, variance, standard deviation, missing values, skewness, kurtosis and total item correlations. This analysis was used to remove unsuitable items from the instrument or refine the items. Based on the real study results, the researcher determined alpha coefficient, measurement standard error, and various group confirmation analysis at the item level, determined group differences, and validity analysis on self-differential construct and convergent

construct. Confirmation analysis at item level involved individual item correlation in values scale with the three subscales. Two criteria were used in the analysis. Firstly, items correlate with total subscale that was corrected at a higher level compared with correlation another subscale. Secondly, items correlate with total subscale that was corrected at level .45 or more. Items that did not fulfil the two criteria should be removed.

6. The study's data was analysed using Rasch analysis, factor analysis, confirmatory factor analysis and ANOVA. The responses analysed through Rasch model and factor analysis showed the degree of validity and reliability of the instrument. The instrument has content validity and constructs validity. The Rasch Measurement analysed items for item polarity, item fit, and unidimensionality. The principal components analysis of residuals provided empirical support for item validity and unidimensionality. Both the pilot study and real study provided strong demonstrations of reliability as indicated by Cronbach's alpha procedure scores. The pilot test and real study reliability coefficients were 0.949 and .944 respectively indicating high internal consistency. Basically, a coefficient of .80 or higher is sufficient. It can be concluded that this instrument has adequate evidence to support the reliability and stability of the instrument. The findings from this study also provided evidence for construct validity. With regards to content validity, the real study items received high ratings from experts' panel with respect to difficulty, readability, clarity, relevancy, content representations and language compatibility. Overall, experts' ratings showed more variability on items created to reflect strong support. The respondents' reliability index of .90 is a good value for the expected

consistency on the logit scale for the answers on different sets of items that measure the same construct.

The summary fit statistics for quality items and *persons* show satisfactory fit to the model. Factor analysis measures internal consistency (reliability) of the test items called Cronbach's Alpha. The Cronbach alpha for this instrument is excellent for all the three constructs in values in mathematics education. The items used to assess the teacher's values were reliable and produced low measurement error resulting in high person and item reliability and separation. The statistics generated by Rasch analysis estimate the degree of items suitability which measures latent variables, confirming the item-fit of the instrument are within an acceptable range.

Confirmatory factor analysis tested the consistency of the construct with the researcher's understanding of the nature of that construct and determined how well the model fits the data.

7. The findings showed that reliability and separation indices revealed adequate reliability. The 5-point response scale showed promising results with respect to reliability and separation. Three of the five rating scales were functional because the scales monotonically progressed along the linear relationship. Findings indicated that respondents were not in favour of choosing category 1 and 2. The probability curves show how probable is the observation of each category for measures relative to the item measure. Categories which emerged as peaks correspond to proper Rasch-Andrich thresholds. The persons' responses generally conformed to the expectations of the Rasch model. No doubt, many of the items had adequate fit statistics, there are some items used in this data collection may not have a clear meaning to respondents. One example is the misfitting item belief in God in the pilot study. This item does not

load heavily on either subscale identified in this analysis. Removing the item did not change the fit statistics of the items to the extent that would warrant deleting it on that basis. The item was revised to form four new items in the real study. The researchers used Rasch analysis to create and evaluate questionnaire instruments has been demonstrated. The findings suggest that the teachers responded well.

8. The findings showed that factor analysis identified dimensions and assessed the construct validity of the instrument and not a means for data reduction. The factorability of the thirty-six items examined, revealed that five items 1, 33, 34, 35 and 36 correlated less than 0.40 as compared to others suggesting reasonable factorability. The Kaiser-Meyer-Olkin measure of sampling adequacy was .918 above the commonly recommended value of .6, and Bartlett's test of sphericity was highly significant ($\chi 2$ (630) = 5898.993, $p < .001$). The communalities were all above .45 confirming that each item shared some common variance with other items. The factor analysis was deemed to be suitable for all thirty-six items. Varimax rotation factor analysis provided an index for understanding factor loading. Varimax rotation maximised the variance of the squared loadings for each factor that encouraged the detection of factors each of which is related to few variables and discouraged the detection of factors influencing all variables. Factor loadings that exceeded .30 or .40 were considered to be meaningful. Initial eigen values indicated that the first seven factors explained 35.9%, 10.2%, and 6.4 %, 5.3 %, 3.8%, 3.3% and 2.9% of the variance respectively. The other factors had eigen values just over one. The seven factor solution explained about 68 % of the variance, was preferred because of: (a) its previous theoretical support; (b) the 'levelling off' of eigen values on the scree plot after three factors; and (c) the insufficient number of primary loadings and difficulty

of interpreting subsequent factors. Cronbach Alphas determined the internal reliability of each of the instrument used in this study. Pearson correlation matrix determined the strength of relationships among composite factors, and determine the relationship between respondents' answers and the latent construct.

9. The findings showed the high correlation among the items, with good Cronbach alpha. The inter item correlation indicated that all items correlate positively with other items. Corrected Item-Total Correlation column displays the corrected point biserial correlation. Items were not deleted to improve the alpha. The items appeared to be worthy of retention. All items have correlated well with the total scale. The items show Cronbach alpha more than 0.94.

10. The findings from confirmatory factor analysis showed that the results revealed the three-factor model presents the data $\chi 2 = 306.878$; $p <. 01$; $\chi^2/\mathrm{df} = 1.587$; Comparative fit index (*CFI*) = .912; Goodness of fit index (*GFI*) = .933, Adjusted goodness of fit index (*AGFI*) = .911, Root mean square error of approximation (RMSEA) = .036 and Tucker-Lewis fix index *(TLI)* = 0.985. Furthermore, all parameters were found to be significant which indicated that each item contributes significantly to the corresponding subscale. All measurement items were loaded on their expected constructs verifying the goodness of fit indices. Therefore, the researcher retained all items in the instrument.

Discussions

The research questions were based on the five phases of instrument design and item development used in this study. The answers to the research questions are summarised as follows:

The first research question was based on the analysis phase. What are the dimensions of the Mathematics Teachers' Values Scale (MTVS) in teaching Fractions?

The preliminary selection of the dimensions was based on the literature review presented in Chapter Two. Two methods were chosen to generate the item pool. First, the deductive method was used. The deductive method reviews existing literature and currently available instruments as a basis to generate items. Multiple disciplines were explored and synthesised to determine the dimensions of the instrument. The researcher reviewed currently available instruments used to assess values, beliefs, attitudes, and teachers' efficacy towards mathematics education. While reviewing, indicators were identified. From this information, numerous items were generated and reviewed by the researcher to verify the content validity. Initially, three theories emerged as relevant and possible dimensions for the instrument. The researcher chose universal integrated perspective since it is a faith based theory. The second phase of step two was to use the inductive method to generate items. The researcher approached the focus group and experts' panel to refine the selected items.

The researcher analysed six studies and their characteristics were analysed based on theory and instrument format, sub-constructs, dimensions and number of items of the studies. The researcher chose Nik Azis's study to guide in the development of the instrument. Once the theoretical concepts were identified, the sub-constructs, dimensions and indicators were identified. This provided a sound framework as the basis to draft items for the scale. The initial version of 96 items created based on the three sub-constructs, nine dimensions and thirty-two indicators. The value indicator for basic values is a belief in God. The value indicators for core values are good personality, courage or bravery, wisdom and fairness. The value indicators for main values are discipline, cooperation, accountability and innovation. Values involving knowledge of *ilm*, the success of perseverance, the importance of quality, the virtue of precision and the power of integrity are the value indicators for expanded values. The above value indicators are for sub-construct general education values. Under sub-construct mathematics education values, the value indicators for teaching values are theoretic values (pure mathematics), utilitarian values (applied mathematics), functional values (constructive mathematics) and appreciation values (transformation mathematics). The value indicators for sub-construct mathematics values are ideological values, sentimental values and sociology values. This provided a good framework as the basis to draft items for the scale. A pool of items was gathered to sample systematically all content that is potentially relevant to the target construct.

Two items for each indicator removed. It was reduced to 32 items before giving to the focus group. The first set of fourteen items measured general education values, the next eight items measured mathematics education values and, the following ten items measured mathematics values for the developed instrument. After the refinement of items, the instrument was reviewed by nineteen experts. The refined 32 items from the experts' panel were administered to the 150 pilot study respondents. Based on the results, the 32 items were refined again with the experts' panel. The basic value items were added from one item refined to four items making the total 36 items for the real study based on the pilot study respondents' suggestions. The first set of 18 items measured general education values, the next eight items measured mathematics education values and, the following ten items measured mathematics values for the final developed instrument. The face validity and content validity of the questionnaire were verified through the literature review, focus group interview, experts' panel review, pilot study and the real study. The analysis provided the researcher with information about the characteristics of the respondents in choosing the five Likert scale categories. The combination of content and face validity procedures along with the panellists' suggestions assisted in refining the original measure of the instrument. The researcher reviewed the items several more times and made minor revisions to the wording of items to make certain that each satisfactorily targeted its dimension. The results from the exploratory factor analysis, confirmatory analysis, and ANOVA and Rasch Model analysis produced factors that were relatively consistent with the proposed dimensions.

The researcher analysed the list of items again to ensure that the following criteria were met.

1. A representative number of cognitive and affective (Mueller, 1986)
2. Items were not factual statements (DeVellis, 2003; Pett, Lackey & Sullivan, 2003)
3. Obvious and obscure items were deleted (Netermeyer, Bearden, & Sharma, 2003;
4. Adequate redundancy (DeVellis, 2003; Netermeyer, Bearden, & Sharma, 2003)
5. No double barreled items (DeVellis, 2003; Netermeyer, Bearden, & Sharma, 2003;
6. 4. Items were at the desired readability level (DeVellis, 2003; Netermeyer, Bearden, & Sharma, 2003; Pett, Lackey & Sullivan, 2003)
7. Items were clearly worded, unambiguous, and concise (DeVellis, 2003).

8. Items were grammatically correct (DeVellis, 2003; Pett, Lackey & Sullivan, 2003).
9. Items were in the proper tense (Pett, Lackey & Sullivan, 2003).

The researcher considered words, types of statements, and responding options, to be included in the instrument. Items related directly to the survey questionnaire objectives and phrased in such a way that all respondents interpreted similarly. All are positive items. The respondents understood the language and answered quickly and accurately on a five-point Likert scale. The final instrument made up of three value sub-constructs, nine value dimensions and 36 value indicators or items answered by 250 respondents.

The second research question, “What are the psychometric properties of the Mathematics Teachers’ Values Scale in teaching Fractions?”

This research question answered by presenting the process of analysing the validation study data in order to create the most appropriate and parsimonious version of the MTVS, which relates directly to the instrument’s psychometric properties. The results from the pilot study supported the content validity of the MTVS. Based on the feedback from the focus group involved in the pilot study, the MTVS does have face validity related to assessing values as a measure that can be easily read and understood by the teachers. Items were rewritten and given to the experts’ panel. Expert reviews suggested that the items appropriately represent relevant values in mathematics education specified to measure the target domain.

The principal components analysis (PCA) computed by SPSS. The PCA grouped similar items into domains or components. Based on the visual inspection of scree test and the parallel analysis the researcher retained three factors. Items in factor one revolved around general education values, items in factor two revolved around mathematics education values and, items in factor three revolved around mathematics values. In terms of variance explained by each factor, general education values 8.863%, mathematics education values for 5.092 %, and mathematics values accounted for 4.934 %. The Cronbach alpha coefficients calculated for the general education values, mathematics education values and mathematics values were .910, .881and .843 respectively. Cronbach's alpha for the real study of the instrument was 0.944. For these data, none of the items here would affect reliability if they were deleted. The data in this real study shows negative scores, show no clustering and scores spread out. Therefore, it is positively skewed (right-tailed). The inter-item correlation matrix indicates that all items correlate positively with the other items. In this study, the inter-item correlation matrix mean is .326 and variance .024. The significant values for variables did not exceed 0.05. All questions correlate well. So, eliminating items is not a necessity. All the communalities indicate 50% or more of the variance in each variable is explained by the components.

Since the survey items loaded into logical domains, construct validity was established and content validity was further confirmed. Internal consistency was established for the reliability of the survey instrument. The internal consistency reflects the stability or consistency of the instrument (Warner, 2008). The Cronbach's alpha was 0.94 which was very good and provides evidence that the scale was stable. The results of the content validity, construct validity, and internal reliability assessments indicate that the instrument shows promise as a measure to assess values.

Confirmatory factor analysis (CFA) showed the relationships between the continuous latent variables and observed variables. In this study, CFA evaluated the instrument's internal structure and provided information about the scale's internal consistency. CFA provided three important sets of results namely parameter estimates, fit indices, and, potentially, modification indices for the researcher to modify if necessary. Based on the findings, the fit statistics indicated an acceptable model. In this study, the results revealed that the three-factor model was correctly adjusted to the data $\chi2$ = 306.878; p <. 01; χ^2/df = 1.587; Comparative fit index (*CFI*) = .912; Goodness of fit index (*GFI*) = .933, Adjusted goodness of fit index (*AGFI*) = .911, Root mean square error of approximation (RMSEA) = .036 and TLI (Tucker-Lewis fix index) = 0.985. Furthermore, all parameters were found to be significant which indicated that each item contributes significantly to the corresponding subscale.

CFA offers researchers power and flexibility in evaluating the dimensionality of their scales, the reliability of their scales, and, ultimately, the validity of their scales. Unidimensionality was achieved since all measuring items have acceptable factor loadings for the respective latent construct. Factor loadings reflected the degree to which each item is linked to a factor. An item's factor loading in this study reflected the degree to which differences in participants' responses to the item arise from differences among their levels of the underlying psychological construct being assessed by that item. The factor loading for items was greater than 0.61 which is acceptable. The main focus of the study is the development of an instrument. One aspect of the evaluation of an instrument is to consider whether the model fits the conceptual framework of the study. CFA was the instrument used to determine the model fitting. In this study, it was found that the model that has been developed does fit the conceptual framework as shown by the results of confirmatory factor analysis. This process assisted in providing further evidence for strong construct validation.

This was a significant indicator for future applications of Mathematics Teachers' Values Scale.

In Rasch analysis, reliability considered from the perspective of items as well as the perspective of persons. The *person* separation measures in Rasch analysis indicated how well the questionnaire succeeded in spreading out respondents' assessing ability. The resulting *person* reliability is analogous to Cronbach's alpha reliability. The reliability and separation indices from Rasch analysis revealed adequate reliability. Rasch model and factor analysis had proven the degree of reliability on the developed instrument.

Separation indices for persons and items indicate an excellent degree of variability between persons and items that are 3.07 and 2.99 respectively. High separation yields higher reliability and the reliability for both persons (.90) and items (.90) of the MTVS is excellent (Duncan et al., 2003). Item separation index indicates the MTVS to cover a broad range of item difficulty along the construct continuum making it appropriate for measuring values. The MTVS meets the Rasch specifications for unidimensionality. All items exhibited positive point-biserial correlation coefficients indicating them to be contributing to the measure. There were no misfitting items. The level of reliability for each question was presented in chapter Four.

The third research question, "Do the mathematics teachers' values in teaching Fractions differ by age, gender, race, the level of education and teaching experience?

A one-way analysis of variance was conducted to explore the impact of gender, age, levels of academic achievement, teaching experience and race on values in mathematics education. The results indicated that the variances for the populations in gender, age, levels of academic achievement, teaching experience and race were assumed to be approximately equal. Results show that the test for homogeneity of variances was not significant for all the factors. The Levene's test for gender was found as F (1, 248) = 0.017, p = .897 and F ratio (3.034) is not significant (p = .083) at the .05 alpha level. The Levene's test for race was found as F (2, 247) = 3.902, p = .021 and F ratio (2.234) is not significant (p = .109) at the .05 alpha level. The Levene's test for age was found as F (3, 246) = 1.224, p = .302 and F ratio (0.985) is not significant (p = .400) at the .05 alpha level. The Levene's test for education was found as F (2,247) = 1.060, p = .348 and F ratio (0.288) is not significant (p = .750) at the .05 alpha level. The Levene's test for experience was found F (4, 245) = 3.597, p = .007 and F ratio (2.510) is significant (p = .043) at the .05 alpha level. The Levene's test for race was found as F (2, 247) = 2.234, and F ratio (2.234) is not significant (p = .109) at the .05 alpha level. These results indicated that the homogeneity of variances assumption was met in all the factors test. The ANOVA has a p-value more than 0.05, for all the above factors except for teaching experience. Hence, the impact of factors on values in mathematics education are not significantly different except for the teaching experience. This investigation indicated that teacher's teaching experience has an effect on the values of mathematics teachers. These results revealed that it is important to consider the teaching experience differences when studying values in mathematics education.

Conclusions

There were five major conclusions for this study. They cover the formation and nature of instrument and factors affecting responses.

1. This study produced a valid and reliable perceptual instrument to assess primary school mathematics teachers' values in teaching fractions. The instrument demonstrated good content validity, construct validity, and internal consistency.

Content validity was determined by focus group and experts' panel where focus group evaluated the level of the item of readability, clarity, understanding, difficulty, representations, simplicity and compactness, uniqueness, comprehensive, suitability, time allocation, item bias, and items improvements, while experts' panel verified the items based on content relevancy, representations, comparability, clarity, readability, and improvements. Factor analysis and Rasch analysis determined construct validity. The internal consistency of the items was determined by Cronbach's alpha coefficient as 0.94, while the Rasch analysis person separation index was 3.07.

The findings of this study are compatible in terms of content validity and construct validity, formatting of items, data collection and data analysis with the values questionnaire used by Dede (2010). However, it is incompatible in terms of nature of items, where this study focussed on positively worded items, while Dede's instrument focussed on positive and negative worded items concerning mathematics education values construct.

2. The instrument was constructed based on universal integrated perspective and contained three components, namely general education values consisting four

dimensions, fourteen values indicators and eighteen items; mathematics education values consisting two dimensions, eight values indicators and eighteen items; and mathematics values consisting three dimensions, ten values indicators and ten items. This instrument was in the form of a self-report questionnaire consisting of thirty-six items displayed on a five-point Likert scale which produced ordinal data and it showed good reliability.

Inter item correlations showed good reliability and Rasch analysis revealed that the sub-construct general education values have Cronbach alpha .89; the sub-construct mathematics education values have Cronbach alpha .83, and the sub-construct mathematics values have Cronbach alpha .91. The combined Cronbach alpha value is 0.94 indicating good reliability.

The construct and the sub-constructs of this instrument are compatible with Nik Azis (2014) instruments but differed from Bishop's (1986) instrument. The instrument in this study was based on universal integrated perspective, while Bishop's instrument was based on sociocultural approach. Furthermore, Bishop's instrument had three values dimensions and six mathematics values indicators, while the instrument in this study contained 36 items assessing primary school's teachers' values in teaching fractions using ordinal data, answered on a five-point Likert scale. Also, Bishop's instrument contained 57 items assessing teachers' values using ranking order on teaching as a whole.

3. The findings of this study indicated that the responses of teachers on the values instrument have no major impact by gender, age, levels of academic achievement, race and teaching experience the respondents.

Based on analysis of variance (ANOVA), this study found that factors such as gender, age, levels of academic achievement, and race, did not influence the teachers' responses on the scores. The teaching experience showed a significant difference in the scores. This verifies that experienced teachers do respect and understand the values in mathematics education. Scale depends on the level of teaching experience with the method. This indicates that teachers are cautious in forming an opinion about a new teaching approach involving values in mathematics education. The fact that values in mathematics education, as a novel idea depends upon teachers' background knowledge has important implications for practice. Therefore, teaching experience plays a vital role in wanting to impart values in a mathematics classroom. They are more likely to hold a positive attitude towards a teaching strategy they have had the opportunity of teaching for a long time. However, the researcher found out personally during the real study that a large number of respondents had never heard of values in mathematics education prior to answering the questionnaire. The results indicated that the homogeneity of variances assumption was met in all the factors tested, with *p*-value more than 0.05.

The findings of this study are compatible in terms of demographic factors with Zerpa's (2007) study, where analysis on teachers' academic background has no differences in conceptual knowledge and values. Further, in Luttrell, (2010) and Dede (2011) studies, the level of experience and gender did not have a difference in the findings on their values. However, the findings of this study were incompatible with the findings of Dede (2011) where the teaching experience has a difference in the Turkish and German mathematics teachers' values. In addition, the study was done by Keng and Yang (1993), age and gender of Taiwanese consumers have differences in the responses on values such as security and respect. Furthermore, the findings by Lascu, Manrai and Manrai (1996) revealed that age and not gender has a difference in Poland respondents' instrumental values.

4. This instrument developed in this study was found to be reliable in assessing primary school mathematics teachers' values in teaching fractions. The mathematics values in the instrument constructed contained ten items of which four items involved ideological values, three items on sentimental values, and three items on sociological values.

This study found that overall 94% of the respondents chose category 4 and category 5, to the ten perception statements involving fractions on mathematics values construct. This indicates that majority of the respondents acknowledged to the survey items. Rasch analysis indicated high person and item reliability and showed the consistency of person responses and items coherence with a mean-square fit statistic of 1.0, which indicated perfect fit of items for the instrument. Based on the factor analysis, the overall mean and Cronbach alpha for mathematics values construct were 4.472 and .843 respectively and this indicated a good reliability.

The findings of this study are compatible with mathematics values in Bishop's (1986) instrument and Nik Azis's instrument (2014). Also, the findings of this study are compatible in terms of content validity and construct validity, formatting of items, data collection and data analysis to the instrument with the mathematics and mathematics educational values scale used by Durmu and Bıçak (2008). However, it is incompatible in terms of nature of items where this study focussed on mathematics teachers' perceptions on values while Durmu and Bıçak instrument focussed on values about teachers' conceptions and beliefs about mathematics and mathematics teaching from the perspectives of positivism and constructivism. Furthermore, there are studies that did not assess relevant dimensions of mathematics values and are incompatible with the findings of this study. Among them are Luttrell's (2011) mathematics values inventory that surveys students' beliefs in areas such as interest, general utility, achievement, and personal cost, Dede's (2005) instrument which assessed students' mathematics education values towards function concept, and Chin and Lin (2000) instrument that assessed mathematics education values on students' knowledge, abilities, intellect and personality.

5. The findings for confirmatory factor analysis of this study showed that the model fits the data. The researcher did not do the model modification and retesting in this study since the analysis is acceptable. Variables were not added or deleted. Therefore all thirty-six initial indicators and latent variable were retained.

Theoretical Implications

The developed instrument has a specific structure and format, uses a set of specific terms. If some of these terms are modified accordingly, this instrument may be used to measure values of teaching fractions from other respondents such as preschool and secondary school teachers. In addition, if relevant modifications are made on values indicators, this instrument can be used to assess primary school teachers' values in teaching other school subjects such as Science and Physical Education. For example, the word mathematics may be replaced with Science and Physical Education in all the items.

The conceptual framework for this study was formulated based on the universal integrated perspective. This conceptual framework help researchers in collecting, analysing and interpreting data in a comprehensive way. This study indicated that some improvements may be made to the conceptual framework by modifying relevant value items and indicators. For example, fractional knowledge and fractional applications may be modified into operations and problem solving involving fractions.

Implications for Educational Practice

The results of this study suggest several implications for mathematics education practices. Firstly, this instrument was developed to assess primary school mathematics teachers' values in teaching fractions. The findings of this study identified specific perceptions of teachers on general education values, mathematics education values and mathematics values. The instrument may be used by education lecturers at the faculty of education and teacher training institutes in helping them to be aware of their values in the teaching of fractions.

Secondly, the findings of the study show that factors such as age, gender, the level of education, experience and race did not influence the scores of the respondents on values in teaching fractions. These findings may be used by curriculum developers and text book writers to produce better quality mathematics curriculum and text books that convey values. This is in line with the emphasis on values development as stated in the National Education Blue Print.

Thirdly, the items on mathematics values involve ideological, sentimental, and sociological views towards the teaching of fractions. The findings of the study show specific inclinations of primary school mathematics teachers towards a different approach in teaching fractions. This instrument may be used in helping other primary mathematics teachers to identify their own ideological, sentimental, and sociological views concerning values in teaching fractions. This may, in turn, bring awareness to teachers to teach values in the mathematics classroom.

Implications for Further Studies

This study developed an instrument to assess primary school mathematics teachers' values in teaching fractions. All the research respondents were from primary schools in Kuala Lumpur. Firstly, further studies may be done on research respondents from secondary schools and pre-service teachers. They are from the different demographic background, may give different information and views on perceptions of values in teaching fractions. Different findings may be obtained to show different values influences on the teaching of fractions in the secondary school mathematics classroom and teacher training institutes.

Secondly, this study was done on a sample consisting 250 primary school mathematics teachers, considered to be small in determining the validity and reliability of the constructed instrument. Thus a bigger sample consisting 1000 sample respondents or more may be needed to verify the validity and reliability of the instrument. This sample was taken from one location. By involving a sample involving respondents from other areas outside Kuala Lumpur where different richer information will be available that may shed light on the influence of demographic factors on the findings.

Thirdly, the instrument did not focus on constructing the profiling of primary school mathematics teachers values on teaching fractions. Further study may be done to build up profiling of teachers on general education values, mathematics education values and mathematics values to obtain information for developing programmes to improve on personal development of teachers.

Fourthly, this instrument was constructed to assess primary school mathematics teachers' values on one topic Fractions. Primary school Mathematics syllabus contain topics on Numbers and Operations, Geometry and Measurement, Relationship and Algebra, Statistics and Probability. Further study on assessing values may be done on one another topic from the syllabus. The findings may be compared with the previous study to gather more information.

Concluding Remarks

This study focused on the development of an instrument to assess primary school mathematics teachers' values in teaching fractions. This instrument also assessed perceptions of teachers towards values in mathematics education. This instrument filled the gap left by previous researchers that there is lacking instrument to assess values. The results of this study contributed to the existing knowledge of values in mathematics education thus providing empirical data for the literature that may be of value to the researchers. This study used universal integrated perspective as a background theory for the developing this instrument. This theory helped in the formation of the conceptual framework and laid the theoretical foundation for the study. The application of the theory was necessary to develop the instrument including initial construction of the items and the content validation process. Additionally, the focus group interviews, experts' panel feedback and decisions about choosing items related to the factor structure within sub-constructs were guided by this theory. This is a faith-based theory that was not used by many researchers for a study on a similar topic. The results of the content validity, construct validity, and internal reliability assessments indicated that the instrument shows promise as a measure to assess primary school mathematics teachers' values involved in teaching fractions.

According to the researcher, we did not need to develop separate religious textbooks for mathematics; many excellent secular textbooks present the mathematical content. We rather focus on supplementing those books with materials that would help students see mathematics from a faith perspective.

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