

The Development of an Instrument to Assess Primary School Mathematics Teachers' Values in Teaching Fractions

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Abstract: The purpose of this study was to develop and validate an instrument that could assess primary school mathematics teachers' values in teaching fractions. Mathematics education researchers and mathematics teachers had ignored values in mathematics education until recently. The critical issues are lack of instruments to assess teachers' values in teaching mathematics, lack of research on values in mathematics education and gap in teachers' knowledge of values in mathematics education. This developmental study used universal integrated approach theory to develop the instrument. Fractions were chosen because it is an important topic in mathematics. The respondents were primary school mathematics teachers in Kuala Lumpur. The items were generated through reviewing previous researches related to values in mathematics education using the ADDE model. The 96 items on general education values, mathematics education values and mathematics values were constructed. The researcher reduced it to 32 items before giving it to the focus group. Results were analysed based on focus group's feedback on readability, clarity, language compatibility, difficulty, relevance and representations. The items were refined again before giving to the experts. The experts' panel identified both bad items, good items and commented on the items. The experts' items evaluation determined content validity and face validity. The questionnaire was pretested with five mathematics teachers who are doctorate students. The items were refined again. The instrument will be pilot tested among two hundred primary school mathematics teachers. The feedback obtained from the pilot study will be used to refine the 32-item instrument. The reliability and validity of the instrument will be determined using Items Response Theory, Exploratory Factor Analysis (EFA) and Confirmatory Factor Analysis (CFA). The instrument titled; Values Assessment in Mathematics Education (VAME) will be re-evaluated by the expert panel for the last time. The instrument measures three constructs that are rated on a 5-point Likert scale, has a completion time of about 30 minutes. This instrument is useful for the ministry of education, curriculum developers, educators, text book writers, researchers and preservice teachers looking for appropriate outcomes through the implementation of explicit and implicit values in mathematics education. Further analysis of these items indicated that they could be improved by focusing future item development.

Key words: Values • Assessment • Fractions • Teaching

INTRODUCTION

The purpose of the study is to develop and validate an instrument for assessing primary school mathematics teachers' values in teaching fractions. Values in mathematics education are deep affective qualities which mathematics teaching fosters [1] and they are a

crucial component of the mathematics classroom affective environment. According to universal integrated approach, values are conceptions or beliefs of individuals concerning the importance of something which act as a general guides to their behaviour [2]. In the context of mathematics education values is a relatively new area of research interest. Bishop classifies values taught in

mathematics lessons into three different types by making them more specialized than that of Ernest [3]. These are general educational values, mathematical values and mathematics educational values [4]. Research has demonstrated that in the field of mathematics education; values do not receive enough attention [4, 5]. Values are generally taught implicitly rather than explicitly in mathematics [6]. Students encounter problems in recognising values when they do mathematics. Fractions tend to be one of the most difficult concepts for students to learn in primary school. Teachers found it difficult to discuss values in relation to Mathematics. Teachers chose to make explicit certain Mathematics or Mathematics education values or they showed them implicitly. It was easier for the teachers to think about and recognise the values they were teaching, rather than to implement new values Bishop [7].

Problem Statement: In this study, the critical issue chosen is the lack of instruments to measure teachers' values toward teaching fractions. There is a limited availability of instruments to measure values in mathematics education. The instruments now available are limited in scope. It concerned with cognitive and affective studies. In addition, it focussed on the general survey of mathematics education not on specific topics. This is due to the lack of interest by researchers in this area. There are a few instruments used to measure values in mathematics education in the area of perception or conception. In mathematics education, development of instruments had been done on perceptions of mathematics [8-10], attitudes and anxiety toward statistics, Mathematics Self Efficacy of students, mathematics Enhancement Teaching Efficacy and others.

Literature Review: Values are also crucial affective components of mathematics classroom environments [11]. There are only a few studies about values [12]. The Australian Values and Mathematics Project (VAMP) and The Taiwanese Values in Mathematics Teaching (VIMT) demonstrated that the role of values and their importance are situated and content-specific in mathematics education. The two 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 inservice teachers' values, which influence a person's choices and behaviours. 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. The quality of mathematics teaching would be improved if there were more understanding about values and their influences. According to Chin, *et al.* [13], the values portrayed by teachers in mathematics classrooms are linked to their pedagogical identities. Seah and Bishop [12], describe the values held by teachers as representing their cognition of affective variables such as beliefs and attitudes and the subsequent internalisation of these values into their respective cognitive personal system. Dede [14] investigated preservice mathematics teachers' values toward their mathematics teaching with regard to their grade level, gender and departments. Bishop [7] did a study on Teachers' Mathematical Values for Developing Mathematical Thinking in Classrooms: Theory, Research and Policy. Dede adopted a five point Likert type scale developed by Durmus and Bicak [15] to collect data.

Research Questions

- What specific items in the survey instrument that can be developed to assess primary school mathematics teachers' values in teaching fractions?
- What is the validity and reliability of the survey instrument developed to assess primary school mathematics teachers' values in teaching fractions?

Methodology: This study was based on a developmental design The ADDE (Analysis, Design, Develop and Evaluation) model was used. This study encompasses four phases as shown in table 1.

The items were generated through reviewing previous researches related to values in mathematics education using the ADDE model. Both newly created and existing items were placed in a common pool. The 96 items on general education values, mathematics education values and mathematics values were constructed. The researcher reduced it to 32 items before giving it to the focus group.

Data Analysis: A teacher's focus group was used to review the initial items. The six mathematics teachers answered the questionnaires and commented. Items with mean 3.5 and above were considered for the survey. The poor items were deleted and the others refined.

Table 1: *ADDE Model to Develop Scales to Measure Values*

Level	Phase	Main focus	Activity	Process
Identification	Analyses	A. Problem identification B.Theory formation	1. Determining problem through literature review.	Qualitative
			2. Formation of research purpose and research questions.	
			3. Theoretical framework explanation to develop scales.	
			4. Values construct definition and values sub construct explanation.	
Generate	Design	Scale design	5. Scale development	Qualitative/ Quantitative
			6. Determining scale questionnaire format	
			7. Generate items pool	
			8. Develop formula for scale scores.	
			9. Instructions for respondents	
Generate	Development	Precision	10. Focus group to evaluate, critic items pool and questionnaires.	Qualitative/ Quantitative
			11. Check and correct items pool and questionnaires based on focus group feedback.	
			12. Expert panel to evaluate items pool and questionnaires.	
			13. Check and refine items, questionnaires based on experts' panel.	
Confirmation	Evaluation	Validity and Reliability	14. Selecting sample from population for pilot study.	Quantitative
			15. Determine validity and reliability.	

The teachers provided valuable face and content validity of the instrument. The refined questionnaires were sent to one hundred experts who are professors and lecturers from the Education faculty of universities in peninsula Malaysia. Experts from the field of Mathematics, English, BahasaMelayu, Statistics and Measurement responded with comments and suggestions. All the items were above the mean 3.5. The thirty-two items were refined based on the experts' feedback. The questionnaires were given to five current post graduates cum mathematics teachers to answer. They commented that a few items were pupils oriented and not teachers. The questionnaires were refined again before the pilot study. The teachers, experts and provided valuable face and content validity of the instrument.

RESULTS AND DISCUSSION

The study was organized in four phases using both qualitative and quantitative methods to gather validity and reliability evidence of the instrument. The thirty-two items are ready for pilot study. The researcher will administer the questionnaires to two hundred primary school mathematics teachers in Kuala Lumpur. Statistical analyses will be performed on the obtained results using the Item Response Theory, Exploratory Factor Analysis (EFA) and Confirmatory Factor Analysis (CFA).

CONCLUSIONS

The contribution of the study will be twofold: it provided an instrument by which values are assessed and

it generated data to answer the research questions. Previous research on values in mathematics education has largely focused on general education values, mathematics education values and mathematics values. The current study extends the literature on values in mathematics education in assessing values in teaching one particular topic that is fractions, through a new developed instrument. This study could be significant to lecturers, education curriculum centres, teachers and textbook writers. The instrument could be used in research to enhance positive thinking towards values. The text book writers would be more careful in forming different types of questions based on the available mathematical values. The new instrument has the potential to illustrate how the Ministry of Education could assess values 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 could proceed to investigate in detail the relationship between teachers' engagement and learning outcome. 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 would offer teachers and lecturers the correct strategies for developing values in teaching fractions in particular and mathematics education as a whole. The lecturers would be able to try on their pre service teachers to improve the instrument. They could revise the mathematical values or the content of what is taught. The curriculum developers would be able to improve on the

previous curriculum. Values based school reform would renew the curriculum and development of pedagogy. The Ministry of education could use values based approaches to strengthen teaching and learning values implicitly and explicitly.

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