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Research Article

Content Validity Of Teacher Teaching Quality Measurement Using The Six Sigma Approach Based On The Fuzzy Delphi Method

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ABSTRACT

Teacher Teaching Quality Measurement using the Six Sigma approach (T²Qi-6σ) is a new teacher-teaching quality instrument. However, there is a need to evaluate each item for better accuracy and representativeness. Therefore, this study aims to test the content validity aspects of the T²Qi-6σ instrument using the Fuzzy Delphi Method (FDM) to ensure that the measurement instrument is suitable for use in education, especially in Malaysia. A total of 14 experts were selected through purposive sampling, consisting of nine professional and five field experts serving in Malaysia's public and private universities and the Ministry of Education. FDM was used to obtain agreement and consensus by 14 experts to assess the appropriateness of 200 items that had been constructed involving five constructs, namely (i) identify, (ii) measure, (iii) analyze, (iv) improve, and (v) control, using a seven-point Likert scale. The analysis results show that the threshold value (d), as many as 125 T²Qi-6σ items is equal to 0.2 or less than 0.2, while the percentage agreement value of the expert panel of T²Qi-6σ items ≥ 75 percent agrees. This shows that 125 T²Qi-6σ items have met all the requirements by FDM. The qualitative findings indicate that the T²Qi-6σ item is appropriate and relevant, yet it implies fostering the potential of this new instrument to be promoted for measuring teaching quality. It is suggested that the analysis of the pilot study using the Rasch Model so that the T²Qi-6σ items can be analyzed more deeply and produce quality items.

Keywords: *Teaching Quality, Six Sigma, Teachers, Content Validity, Fuzzy Delphi Method.*

1 Introduction

In today's globalized world, education holds great significance as the progress of a nation is contingent upon the strength of its education system (Kakingo & Lekule, 2021; Olutola et al., 2022). Furthermore, a robust education system is crucial to achieve rapid economic growth comparable to superpowers (Pal & Ghosh, 2022). Unfortunately, the field of education has been plagued by various challenges and issues that demand immediate attention and action (A.Arokiasamy & Krishnaswamy, 2021). In such a scenario, the quality of teaching by educators plays a critical role in bringing about high-quality education reform (Amirian et al., 2022; Jahongirovich, 2022). Hence, teachers must continually enhance their competence and quality to ensure the efficacy of their teaching (Blomeke et al., 2022).

However, the challenge of producing quality teachers is a global issue that has always concerned policymakers in every country (LeTendre & Wiseman, 2015). The issue of teacher teaching quality has been controversial because the future of a country depends heavily on its education system. As the global environment becomes increasingly challenging, each country will strive to ensure its citizens receive an excellent education (Blomeke et al., 2022). This shows that each country aims for its education system to be among the best in the world

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(Sandu & Sharma, 2020). Accordingly, the quality of teacher teaching should be taken seriously because, while the education system has become increasingly challenging, the teaching profession is also increasingly burdened with responsibilities (Maruli, 2014).

It has been suggested that continuous improvement is necessary to ensure that the quality of teacher teaching meets educational policymakers' standards (Sabtu et al., 2023). Taraza et al., (2023) academic institutions have introduced numerous models and approaches to maintain and enhance teaching quality. Among the popular improvement approaches, Six Sigma has been identified as an effective method (Abdulla & Kavilal, 2022; Wang, 2022). Six Sigma has been proven to improve teaching quality (Al Kuwaiti & Subbarayalu, 2015; Sunder, 2014; Yu & Ueng, 2012). So far, hover, Six Sigma approaches have mainly been implemented in higher education institutions and are not widely used at all levels of education, particularly in Malaysia (Sabtu & Matore, 2024).

2 Literature Review

2.1 Teacher Teaching Quality

When discussing student success strategies, the quality of teacher teaching is often the main focus (Martín-Pastor et al., 2023). Previous studies have reported the effectiveness of a teacher's teaching directly impacts student achievement (Almutairi & Shraid, 2021; Darling Hammond et al., 2017; Deti Rostini et al., 2022; Podungge et al., 2020). Essentially, a student's success is highly dependent on the efforts made by their teacher (Ruiz-Alfonso et al., 2021). Teachers must use creative and innovative teaching practices to spark students' interest in learning (Blomeke et al., 2022). Therefore, the education system must provide reliable and valid teaching evaluations to enhance the quality of education (Martín-Pastor et al., 2023).

Several researchers have reported that teacher teaching quality evaluation is used to assess the achievements of teachers and identify areas that need improvement (Almutairi & Shraid, 2021; Ansari et al., 2018). Surveys such as that showed that it is also crucial for assessing and improving quality in educational institutions (Jayamohan & Bhasi 2021). Recent research has suggested that teachers must continually evaluate and critique their teaching practices to enhance their skills (Amirian et al., 2022). Besides that, most countries have standards for evaluating the quality of teacher teaching to ensure a satisfactory level of teaching is established and maintained in educational institutions (AITSL, 2017; GOV.UK, 2021; NBPTS, 2016).

However, in practice, only some teacher evaluation systems enhance teacher competence and quality of education (Darling-Hammond et al., 2015; Gerritsen et al., 2016). Although responsible parties evaluate teacher teaching quality, the results are often the same. This is because the evaluation emphasizes the rating of teaching and learning (T&L) conducted by teachers rather than identifying weaknesses and developing more effective T&L. Callahan and Sadeghi (2015) suggests that in evaluating T&L, teachers should focus on measuring their strengths and weaknesses, identifying problems, and offering improvement strategies to enhance classroom teaching quality.

Furthermore, Bijlsma, Glas, and J.Visscher (2021) found that instruments that assess the quality of teacher teaching are limited, and there is no standard instrument for measuring teacher quality that can evaluate teacher quality worldwide. There are various opinions and contradictions in evaluating the quality of teacher teaching. The evaluation of teaching quality is not fully linked to teaching ability, and studies that assess the quality of teaching by teachers abroad focus more on evaluating the quality of teaching at Institutions of Higher Education (HEIs) (Ashwin, 2022; Ekawati et al., 2022; Wang, 2022).

2.2 Six Sigma Approach to Education

Six Sigma originated in the mid-1980s and was first developed by Motorola (LeMahieu et al., 2017; Mazumder, 2014; Pal & Ghosh, 2022). Its remarkable success at Motorola caught the attention of several other large corporations, including Allied Signal, Texas Instruments Defense Group, IBM, and Digital Electronics, who began using Six Sigma to enhance the quality and efficiency of their operations, thereby meeting the growing demands and expectations of their customers. Over time, Six Sigma continued to gain popularity and became a widely recognized methodology worldwide, mainly after General Electric earned a substantial profit in 1995 (Cronemyr, 2007; Stamatis, 2002).

Since the early 2000s, Six Sigma has also been applied in the education sector with excellent success (Abdulla & Kavilal, 2022; Cudney et al., 2014). A literature review has indicated that Six Sigma is an effective strategy for improving the quality of educational institutions (Cudney, Elrod, and Stanley 2014; Cudney et al. 2018). Moreover, according to Sabtu and Matore (2024), from 2012 to 2022, recent literature has demonstrated that Six Sigma, which was once mainly employed in profit-driven fields, is now being implemented in education.

The literature indicates that the Six Sigma approach in education primarily focuses on management, teaching and learning, and student development.

Several researchers have used Six Sigma to enhance various aspects of management (Biju and Nair 2017; LeMahieu, Nordstrum, and Cudney 2017; Sandu and Sharma 2020). For instance, a study conducted Abdulla and Kavilal (2022) in India revealed that the Six Sigma approach effectively identified the causes of defects in technical education. Additionally MacIel-Monteon et al. (2020), the Six Sigma approach has helped university management identify potential areas for improvement and improve the quality of management. The Six Sigma approach has also been applied to student development to improve academic achievement (Arafeh, 2016; Arafeh et al., 2021; Laux et al., 2017; M.Alkoot, 2019; Mazumder, 2014).

However, it is worth noting that more research on the Six Sigma approach to measure and evaluate the quality of teaching still needs to be done. Published articles on using Six Sigma to improve the quality of teaching have mainly focused on the professional development of lecturers in higher education institutions (Al Kuwaiti & Subbarayalu, 2015; Sunder, 2014; Vijay, 2013; Wang, 2022; Yu & Ueng, 2012). Therefore, there is a need for more research on the potential of Six Sigma to develop more effective, efficient, and sustainable strategies to improve the quality of teaching, particularly in school. The quality of teaching has become a global concern in education, and it is crucial to address this issue promptly, as it can significantly impact student development.

2.3 Content Validity

Validity generally means the ability to measure what is intended to be measured and is one of the important aspects of an instrument. According to DeVellis and Thorpe (2020), satisfactory validity is necessary for the psychometric characteristics of an instrument to be affected, even though the instrument has excellent reliability. The validation process will ensure the instrument has defensible, accurate, appropriate, meaningful, and valuable properties (Furr, 2021; Zamanzadeh et al., 2015). Therefore, the validation process must be done accurately to develop a valid instrument. Validity is generally divided into several categories with different purposes and goals: face, content, criterion, and construct (Taherdoost, 2016).

Content validity is the first thing in the validation process of an instrument, in addition to construct validity and criterion validity (Bond, Yan, and Heene 2021; DeVellis and Thorpe 2020). Content validity also refers to evaluating each item in the instrument and whether it suits it (Cohen, Schneider, and Tobin, 2022). The two main elements that focus on the content validity process are the appropriateness and representativeness of the items in measuring what the researcher wants to measure (Roebianto et al., 2023). At the same time, content validity is necessary for other aspects of construct validity (Koller et al., 2017). A test or scale that does not cover the content of the construct it intends to measure will not be related to other constructs or criteria in the way that would be expected for the respective construct. The accuracy of instruments heavily relies on content validity through expert judgment (Fernández-Gómez et al., 2020; Koller et al., 2017; Zamanzadeh et al., 2015). While high reliability is important, it alone cannot ensure the accuracy of measurements. Content validity enables precise measurements by assessing what needs to be evaluated in the study context (Furr, 2021).

Therefore, it is crucial to establish the content validity of an instrument assessing teachers' teaching quality using the Six Sigma approach (T^2Qi-6σ) designed to produce precise measurements. It is worth highlighting that validating a new instrument is crucial to guarantee the constructed items' accuracy, relevance, and measurability (Furr, 2021). According to Zamanzadeh et al., (2015), content validity refers to an instrument's ability to measure what we intend to measure accurately or the capacity to measure something that should be measured. Indeed, Bougie & Sekaran, (2020) suggests that content validity should be conducted to evaluate the items in the instrument and ensure that the measurement can be carried out accurately in the study's specific context. The expert panel's agreement and consensus will determine whether an item should be retained, refined, or eliminated to ensure its appropriateness to the measured construct (Finch and French 2019).

2.4 Fuzzy Delphi Method

The literature review results have indicated that content validity can be validated using the Fuzzy Delphi Method (FDM) (Karim et al., 2017). As demonstrated in prior studies, FDM has been recognized as a suitable and accepted method for obtaining expert approval in various fields (Hasim et al., 2023; Nor et al., 2022; Singh et al., 2021). FDM is a modified measurement method based on the Delphi method and combines the Fuzzy numbering set with the Delphi method (P.Galanis, 2018; Singh et al., 2021). FDM is not a new measurement method but an improved Delphi method (Yusoff et al., 2021). FDM has been agreed upon as a more effective measurement tool because it can solve problems with imprecision and uncertainty in a study field (de Hierro et al., 2021).

Compared to the Delphi method, FDM is seen as a more objective and systematic statistical analysis used to gain agreement and consensus from a panel of experts (Ciptono et al., 2019). Ishikawa et al., (1993) have also shown that FDM can deal with some of the ambiguity in finding Delphi panel consensus. According to Yusoff et al., (2021) FDM was developed to overcome the shortcomings of the Delphi method. The consensus of experts through the FDM method uses a quantitative approach. That is, the agreement of experts will be translated into empirical form (Hasim et al., 2023). This clearly shows that FDM can be a systematic measurement method for obtaining expert consensus to make a decision empirically, even through subjective evaluation.

Among the advantages of FDM that have been identified is that FDM can avoid boredom for researchers and expert groups by reducing the Delphi round (Singh et al., 2021). Through the reduction of this round, the use of fuzzy elements integrated into the Delphi technique can analyze the agreement of experts in just one round (Jamil et al., 2013). More interestingly, FDM has helped save time and cost in conducting questionnaires (de Hierro et al., 2021; Yusoff et al., 2021). The literature results found that FDM can avoid the dropout of data collected by the researcher against the expert (Bojadziew & Bojadziew, 2007; de Hierro et al., 2021). The appointed experts can give their full opinion to obtain completeness and consistency of information because the selection of experts is according to the criteria set (Jamil et al., 2013). Most importantly, FDM does not misinterpret the original opinion of the expert but provides a picture of the actual response of the evaluating expert (de Hierro et al., 2021). As a result, FDM is a helpful tool for researchers who want to gather comprehensive and reliable data.

3. Methodology

This section will elucidate the utilization of panel experts, instruments, and data analysis for content validity with FDM.

3.1 Panel Experts

When selecting experts for a study, it is important to consider their views and expertise in the field to ensure accuracy. According to Baker et al., (2006) the experts should have relevant qualifications and experience. For this study, the professional experts appointed are all doctors of philosophy with at least ten years of experience in their respective fields. For this study, the number of experts involved was determined using Jones & B.Twiss, (1978) the recommendation that FDM should be between 10 to 50 people. Adler & Ziglio, (1996) also supports this range, suggesting that 10 to 15 experts should be involved.

To ensure a comprehensive evaluation of the T^2Qi-6σ item review process, we assembled an expert panel through purposive sampling techniques based on their knowledge and experience. This panel consists of 14 individuals, nine professionals, and five field experts with expertise in validating the items. We considered a range of perspectives and views Rubio et al., (2003) and Jamil et al., (2019) while selecting criteria for content validity. The appointed experts possess a background or experience related to the study field.

Table 1: List of FDM Content Validity Review Experts

Expert	Field of Expertise	Position	University	Experience
1	Educational Measurement	Associate Professor	UPSI	27 years
2	Teaching & Learning	Associate Professor	UM	24 years
3	Teaching & Learning	Associate Professor	UMPSA	25 years
4	Educational Measurement	Dr.	UPSI	16 years
5	Measurement & Evaluation	Dr.	UPM	15 years
6	Curriculum & Teaching	Dr.	UPM	16 years
7	Teaching & Learning	Dr.	UNISZA	17 years
8	Teaching & Learning	Dr.	UNISZA	16 years
9	Teaching & Learning	Dr.	UNIMAS	12 years
10	Educational Measurement	Dr.	IAB	26 years
11	Educational Measurement	Dr.	IPG	21 years
12	Curriculum & Pedagogy	Dr.	IPGM	33 years
13	Teaching & Learning	Dr.	IAB	30 years
14	Teaching & Learning	Dr.	JN	32 years

Notes : *UPSI – Universiti Pendidikan Sultan Idris, UM - Universiti Malaya, Universiti Malaysia Pahang Al-Sultan Abdullah, UPM- Universiti Putra Malaysia, UNISZA- Universiti Sultan Zainal Abidin, UNIMAS - Universiti Malaysia Sarawak, IAB- Institut Aminuddin Baki, IPG- Institut Pendidikan Guru, IPGM- Institut Pendidikan Guru Malaysia, JN-Jemaah Nazir*

In this study, the professional experts appointed hold a doctorate, have over ten years of experience in the field, and are actively publishing. Of the nine professional experts appointed, they serve in public and private universities and remain active in their respective services. Meanwhile, the five field experts have specific skills or experience in the field under study and consist of lecturers at the Aminuddin Baki Institute (IAB) and the Institute Perguruan Guru (IPG), as well as officers at the Jemaah Nazir (JN). Table 1 shows a list of 14 Expert Content Validity Using FDM.

3.2 Instrument

A team of 14 experts utilized the Fuzzy Delphi technique to assess the content validity of all 200 T²Qi-6σ items. The experts evaluated each item using a set of seven Likert scales, as Jamil et al., (2019) recommended, for increased precision and accuracy of data. This thorough evaluation ensures the items' reliability before being distributed to respondents. The expert panel is only required to select one scale for each item based on Table 2 and may provide additional comments or suggestions for improvement in the note column provided. This comprehensive approach strengthens the content, language, and clarity of meaning for each item being assessed.

Table 2: Level of agreement and fuzzy scale for 7-point

Scale	Linguistic variables	*Fuzzy Scale*
1	Strongly Disagree	(0.0,0.0,0.1)
2	Very Disagree	(0.0,0.1,0.3)
3	Disagree	(0.1,0.3,0.5)
4	Moderately agree	(0.3,0.5,0.7)
5	Agree	(0.5,0.7,0.9)
6	Very agree	(0.7,0.9,1.0)
7	Strongly agree	(0.9,1.0,1.0)

3.3 Data Collection

Brinkman, (2009) suggests that data collection methods can vary depending on the preferences and needs of experts. This study employs both face-to-face and online approaches. Initially, experts were contacted via email to explain the study's purpose and procedures and obtain their consent to serve as content validity experts. Once an expert agrees to participate, they receive an online expert validity review form T²Qi-6σ and an operational definition of each construct. For this study, a group of eleven experts conducted a review of the T²Qi-6σ items online. In addition, three experts conducted a face-to-face question-and-answer session to better understand the constructed T²Qi-6σ items. This approach was taken to ensure a comprehensive review of the questionnaire by both online and in-person methods.

4. Findings and Discussion

The content validity of T²Qi-6σ items is determined using two methods, namely Triangular Fuzzy Numbers and Defuzzification Process. The acceptance of the construct and each T²Qi-6σ item is based on three conditions agreed upon by 14 experts. Conditions 1 and 2 are tied in the Triangular Fuzzy Numbers section. Condition 3 involves the Defuzzification process to determine constructs or items' score value and position or priority (ranking).

4.1 Triangular Fuzzy Number

The first step involves assigning fuzzy triangle numbers, which are determined by calculating the average value of a fuzzy number. This includes the minimum value (m_1), the most reasonable value (m_2), and the maximum value (m_3) (de Hierro et al., 2021; Nor et al., 2022). In the content validity check form, a panel of 14 appointed experts selected their preferred value on a Likert scale, and these results were then translated into the corresponding m_1, m_2, and m_3 values using the selected fuzzy scale. Once the information has been gathered from all 14 experts, the Likert scale is converted into a fuzzy scale. The threshold value (d) is then calculated by determining the distance between two fuzzy numbers, m (m_1, m_2, and m_3) and n (n_1, n_2, and n_3), using a specific formula below,

$$d\,(m,n) = \sqrt{\frac{1}{3}(\,m_1 - n_1\,)^2 + (\,m_2 - n_1\,)^2 + (\,m_3 - n_3\,)^2} \text{ .... (1)}$$

Once the value was obtained, a threshold value (d-construct) was calculated by using the formula below:

$$\text{(d-construct)} = \frac{\sum \text{average Threshold Value (d)for each item}}{\text{Total Experts x Total Item in Constructs}} \text{ .... (2)}$$

Two conditions need to be met in this first step. Namely, the primary condition that needs to be completed is that this value is based on the distance between the average and expert evaluation data, which must be ≤ 0.2 to show that an expert agreement has been reached [20]. The results of the consensus analysis of 14 evaluation experts show the threshold value, (d), of 125 T^2Qi-6σ items is equal to 0.2 or less than 0.2, taking into account three decimal points. In the second condition, the percentage value of the expert panel's agreement must be ≥ 75 percent agree. A total of 125 T^2Qi-6σ items met the expert panel's consensus percentage value. This means that the T^2Qi-6σ item has met both conditions and does not need to repeat the Fuzzy Delphi method to reach the set value. So, by showing that these two conditions have been met, continue with the second method, the fuzzy score (defuzzification process).

4.2 Defuzzification Process Based

The second step, or the third condition, is the Defuzzification process to see the score value to determine each item's T^2Qi-6σ position or ranking priority. This Defuzzification process also aims to see whether an item T^2Qi-6σ is accepted or rejected based on expert consensus by comparing the Average Fuzzy Number score (Average Response) with the α-Cut value (α-Cut Value >0.5). In other words, the α-Cut defuzzification value should exceed 0.5 so an item will be accepted because it shows expert consensus to accept it (Bodjanova, 2005). A specific formula is;

$$A_{max} = \frac{1}{3} * (m_1 + m_2 + m_3) \text{ .... } (3)$$

Below are some practical examples of FDM analysis for five items under each construct of Six Sigma: (i) Define, (ii) Measure, (iii) Analyze, (iv) Improve, and (v) Control. Table 3 contains 25 items T^2Qi-6σ that are part of the 125 items agreed upon by the experts who evaluated them.

Table 3: FDM Analysis for five items for each construct of DMAIC

Construct	Item	Terms of Triangular Fuzzy Numbers		Terms of Defuzzification Process				Expert consensus	Item received	Ranking
		Threshold Value (d)	Expert Group Consensus	m_1	m_2	m_3	Fuzzy Score (A)			
Define	12	0.037	100%	0.871	0.986	1.000	0.952	ACCEPTED	0.952	1
	30	0.051	100%	0.857	0.979	1.000	0.945	ACCEPTED	0.945	2
	34	0.051	100%	0.857	0.979	1.000	0.945	ACCEPTED	0.945	2
	23	0.062	100%	0.843	0.971	1.000	0.938	ACCEPTED	0.938	4
	29	0.062	100%	0.843	0.971	1.000	0.938	ACCEPTED	0.938	4
Measure	28	0.051	100%	0.857	0.979	1.000	0.945	ACCEPTED	0.945	1
	15	0.062	100%	0.843	0.971	1.000	0.938	ACCEPTED	0.938	2
	16	0.062	100%	0.843	0.971	1.000	0.938	ACCEPTED	0.938	2
	22	0.062	100%	0.843	0.971	1.000	0.938	ACCEPTED	0.938	2
	27	0.078	93%	0.843	0.964	0.993	0.993	ACCEPTED	0.993	5
Analyze	29	0.037	100%	0.871	0.986	1.000	0.952	ACCEPTED	0.952	1
	11	0.051	100%	0.857	0.979	1.000	0.945	ACCEPTED	0.945	2
	19	0.062	100%	0.843	0.971	1.000	0.938	ACCEPTED	0.938	3
	31	0.062	100%	0.843	0.971	1.000	0.938	ACCEPTED	0.938	3
	38	0.062	100%	0.843	0.971	1.000	0.938	ACCEPTED	0.938	3
Improve	25	0.037	100%	0.871	0.986	1.000	0.952	ACCEPTED	0.952	1
	34	0.051	100%	0.857	0.979	1.000	0.945	ACCEPTED	0.945	2
	27	0.062	100%	0.843	0.971	1.000	0.938	ACCEPTED	0.938	3
	24	0.070	100%	0.829	0.964	1.000	0.931	ACCEPTED	0.931	4
	37	0.070	100%	0.829	0.964	1.000	0.931	ACCEPTED	0.931	4
Control	15	0.051	100%	0.857	0.979	1.000	0.945	ACCEPTED	0.945	1
	14	0.062	100%	0.843	0.971	1.000	0.938	ACCEPTED	0.938	2
	11	0.087	93%	0.829	0.957	0.993	0.926	ACCEPTED	0.926	3
	7	0.095	93%	0.800	0.943	0.993	0.912	ACCEPTED	0.912	4
	17	0.115	86%	0.786	0.929	0.986	0.900	ACCEPTED	0.900	5

Overall, these results indicate that this study has shown that the quality and robustness in the verification process of T^2Qi-6σ instrument items through FDM has been done carefully. The purpose of the current study was to determine whether FDM has detailed the content validity of the T^2Qi-6σ instrument by analyzing 200 items quantitatively through the consensus and agreement of 14 expert panels appointed to ensure that the items represent the constructed content. The variation of the detailed feedback from the 14 expert panels for a total of 200 items is apparent and detailed, and this shows that the expert panel has done a comprehensive content validity review process.

The content validity of 200 T^2Qi-6σ items was conducted by expert judgment analysis for only one round according to the recommendations of the Fuzzy Delphi Technique. Three conditions are used to accept each item of the T^2Qi-6σ instrument agreed by the expert: whether the item is accepted or dropped. The results of FDM analysis, the threshold value (d), and the percentage of expert agreement meet the requirements, showing the stability and robustness of the T²Qi-6σ instrument. Condition 3 is the Defuzzification process to see the score value to determine the position or ranking of the item is also taken into account to see whether the T²Qi-6σ instrument item is accepted or rejected based on expert agreement by comparing the Average of Fuzzy Number (Average Response) score value with the α value -cut (> 0.5).

This research has one important part, the qualitative section. This is fundamental to obtaining the expert's comments regarding the items for improvement. The results show that the T²Qi-6σ instrument based on five constructs, namely identify, measure, analyze, improve, and control, is essential and appropriate to enhance the quality of teacher teaching in Malaysia. The result confirmed that all 125 items of the T²Qi-6σ instrument had potential and were suitable for this study. A total of 75 items have been dropped because they do not meet the requirements of FDM (Table 4). The reasons for dropping the items are biased factors, repetition of the same item's meaning, vague reasons that items are written in general, and some items are double-barrel. Overall, comments and feedback on the instrument are only focused on sentence structure and repetition of items. No significant errors, such as unrelated constructed items or inappropriate constructs, were identified in this study.

Table 4: The Summary of All Three Pre-requisites Post Fuzzy Delphi Analysis

Construct	The Number of Original Items	The Number of Dropped Items	Dropped Items	Number of Items After Fuzzy
Define	40	15	3, 4, 7, 8, 16, 17, 18, 19, 24, 25, 26, 33, 35, 36, 37, 40	25
Measure	40	15	3,7,9, 11, 17, 19, 21, 25, 29, 30, 32, 34, 35, 37, 38	25
Analyze	40	15	1, 3, 6, 9, 13, 16, 17, 21, 23, 24, 26, 32, 35, 36, 39	25
Improve	40	15	1, 2, 6, 8, 9, 10, 17, 18, 19, 20, 21, 26, 29, 36, 38	25
Control	40	15	4, 6, 8, 9, 13, 19, 22, 25, 26, 27, 34, 35, 36, 37,40	25
Total	**200**	**75**		**125**

5. Conclusion

The main goal of this study is to determine the validity of the content and see the suitability of the T²Qi-6σ instrument to be used in the education system in Malaysia. Based on expert consensus, the FDM has provided solid empirical evidence verifying the T²Qi-6σ instrument's validity. The findings of this study prove that the T²Qi-6σ instrument is suitable for measuring teachers' teaching quality using the Six Sigma approach in the context of education in Malaysia. Based on the findings, the researcher believes this T²Qi-6σ instrument has great potential to be valid and reliable in detecting the strengths and weaknesses of teachers' teaching quality with Six Sigma to improve and improve educational excellence. Decisions to retain, improve, or drop items in the T²Qi-6σ instrument can be made confidently and clearly once the FDM analysis is done. It shows that all the constructs from the literature review, document review, and semi-structured interviews are confirmed as indicators to implement the evaluation and measurement of teacher teaching quality. An implication is that the items can be used as a teacher's self and peer assessment to measure their teaching quality.

6. Future Implications And Limitations

The research findings have several significant implications. The research conducted has yielded valuable insights that can greatly impact future endeavors. One of this study's most significant practical implications is that the selected items can be a viable alternative for self-evaluation and peer evaluation sessions. These items can be used to measure teaching quality and identify areas for improvement effectively. This information can prove extremely valuable for educators and institutions striving to enhance their teaching standards and improve the overall learning experience for the students. Besides, implementing Six Sigma based on the culture and context of Malaysian government schools provides an opportunity for scholars to explore and develop the potential of Six Sigma through more effective strategies in different institutional contexts. This study's major limitation is finding professional experts on measurement, especially in the Six Sigma research context. One thing that future researchers can do is to find experts abroad. Besides, this can get different perspectives other than local experts. Further study is suggested that all 125 items T²Qi-6σ that have been refined will undergo a pilot study by teachers using the Rasch Measurement Model. It is exciting to use Rasch analysis to examine the validity and reliability of the T²Qi-6σ instrument more profoundly and to be able to review, document review, and semi-structured interviews as indicators to implement the evaluation and measurement of teacher teaching quality.

7. Conflict of Interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

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