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Conceptual of the Fuzzy Delphi Technique in the Design and Development phase of Health Education Assessment Module for the implementation of Classroom Assessment

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A B S T R A C T

Researchers have identified that there is a significantly less assessment module for Health Education subject to assess lower primary students in classroom assessment. This burdens teachers who teach Health Education to assess the knowledge of lower primary students. To save teachers time and to reduce the workload of teachers who teach Health Education subjects for lower primary students, researchers have developed a Health Education assessment module that can be used by teachers to perform classroom assessment. To design and develop the module the researcher has used the fuzzy Delphi method where it is a technique to determine the expert agreement on the construct and the item constructed. Researchers have developed two questionnaires, namely FDM 1 questionnaire to determine the constructs to design the module and FDM 2 questionnaire to determine the items for module development. researchers have obtained consensus for the constructs and items of the module from 20 experts from various fields. As the result, all the constructs and items have been complied with Fuzzy Delphi conditions such as Threehold (d) value lesser than <0.2, consensus percentage exceed more than > 75% and Aplha cut value exceed > 0.5. These results have shown that all constructs and items of health education assessment modules are acceptable and applicable to designing and developing such modules.

Keywords: Assessment module, Health Education, Fuzzy Delphi, Classroom Assessment

1. Introduction

The Fuzzy Delphi technique was introduced by Murray, Pipino and Gigch in 1985 and developed by Kaufman and Gupta (1998). According to Mohd Ridhuan.,et al (2013), the technique is a combination of Fuzzy Set Theory and Delphi method. This shows that this method is not a new method but an improved instrument. The use of the Fuzzy Delphi method reduces the round and with this the researcher can save time for this research. Not only that but this method can avoid the problem of boredom of experts to answer the questionnaire. This method is accepted and used by many researchers (Hsu & Sanford, (2007).There are two step sequences in the Fuzzy Delphi technique in this phase. The first step is that the researcher has designed a questionnaire

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instrument to obtain expert consensus for the main constructs that need to be in the module and the second step is to develop the assessment module by obtaining expert consensus for the items contained in the module. Researchers used literature review and findings of needs analysis phase to design the main constructs of the module while document analysis such as annual lesson plan (RPT), curriculum and assessment standard documents (DSKP) to form module development items. However, the constructs and items have been used as questionnaires to obtain expert consensus. The questionnaire was answered by 20 experts. This process aims to get anconsensus on the constructs and items that will be included in the module to be designed and developed later.

2. Method

2.1 Sampling

The most important thing in the Fuzzy Delphi technique is the selection of experts as the study sample. There are various definitions given to experts. Linstone & Turoff (1975), explain that experts are informative individuals such as Goodman (1987**),** who define experts as individuals who are informed about issues and interested in research issues. Weirsma and Jurs (2009), on the other hand, define experts as people who have specialized knowledge and skills, can identify problems in their area of expertise and can provide suggestions to overcome those problems. In addition, Donohoe & Needham (2009), explain that experts are individuals who have a level of experience or knowledge that distinguishes experts from new people in a field. Sample selection for this phase is done using purposive sampling method. The working experience of each sample was taken into account and it was found that all samples had worked for more than 5 years in their field. Based on the argument put forward by Berliner (2004), he clearly put forward his opinion, that a person who has served between 5 to ten years can be categorized as an expert. The experts who been selected for this phase all have more than 10 years of experience in their field. According to Clayton (1997), if the study sample is hetorogenous then the appropriate number of samples is between 5 to 10 people if the sample from various fields and categories of expertise, while Gordon (1994), recommends between 10 to 35 samples. For this phase researcher choose 20 experts that work in different field of education.

2.2 Instrument

Okali and Pawlowski (2004), stated that the items and elements of a study can be formed through literature review that is related to the scope of the study but according to Skulmowski, Hartman &Krahn (2007), elements, constructs and items for a questionnaire can be formed based on researchers' experience, pilot study, and literature review while Ridhwan et al., (2013) stated that the questionnaire for Fuzzy Delphi study can be formed through expert interviews, study highlights and focus group methods. Therefore, researchers have used literature highlights and findings of the needs analysis phase to design constructs (FDM 1) questionnaire while document analysis such as annual plans (RPT), curriculum and assessment standard documents (DSKP) and Health Education textbooks to develop module items (FDM 2) questionnaire.

2.3 Instrument Reliability

Reliability refers to the stability and consistency of a survey instrument or questionnaire that transcends time to an idea (Marican, 2005).The reliability of this phase of the Fuzzy Delphi questionnaire depends on the expertise of the panel involved in this phase of the study. The reliability of the data obtained from the questionnaire for the Fuzzy Delphi technique depends on the expertise of the selected panels (Alijah BintiUjang, 2016).

3. Analysis

Yu-Lung Hsu et al., (2010), have suggested several steps to analyze consensus data using the Fuzzy Delphi method. According to Ramlan Mustapha (2018), there are seven steps to analyze data. The first step is the selection of experts. Number of experts to determine the preferences, needs and importance of variables measured using linguistic variables. The number of experts is also determined according to the objectives of the study set by the researcher. The next step is to determine the linguistic variables based on the Triangular Fuzzy number.

This process involves the process of converting all linguistic variables into the numbering of Fuzzy triangles (Triangular Fuzzy numbers). This measure also involves the conversion of linguistic variables with the addition of Fuzzy numbers (Hsieh, Lu & Tzeng 2004; Chang, Hsu & Chang 2011). Triangular Fuzzy numbers represent the values of m1, m2 and m3 and are written as (m1, m2, m3). The value of m1 represents the minimum value, the value of m2 represents the reasonable value while the value of m3 represents the maximum value. While Triangular Fuzzy number is used to produce Fuzzy scale for the purpose of translating linguistic variables to Fuzzy numbers. The number of levels for the Fuzzy scale is an odd number.

The third step is the distance determination process to identify the value of Threshold "d". The threshold value is very important in the process of identifying the level of agreement between experts (Thomaidis, Nikitakos& Dounias, 2006). According to Chang et al., (2011), the distances for each fuzzy number m = (m1, m2, m3) and n = (n1, n2, n3) are calculated using the formula:

$$d(m, n) = \sqrt{(1/3 [(m1-n1)^2 + (m2-n2)^2 + (m3-n3)^2])}.$$

The threshold value is very important in determining the agreement between the experts. Expert agreement is considered to be achieved if the threshold value is less than or equal to 0.2 (<0.2) (Cheng & Lin, 2002) while the overall agreement should exceed 75% of the deal for each item, otherwise a second round should be implemented (Chang, Hsu & Chang, 2011; Chen & Lin, 2002).

The fourth step is to determine the percentage of group agreement. The percentage of group agreements must exceed 75%. The overall percentage of agreement should exceed 75% (> 75%) of the agreement for each item, otherwise the item or construct should be discarded or a second round should be implemented (Chang, Hsu & Chang 2011; Chen & Lin, 2002). If the overall percentage reaches the percentage value as set, then it is considered to have reached the consensus of the expert group (Chu & Hwang, 2008; Murry& Hammons, 1995).

The next step is to identify the alpha aggregate level of Fuzzy assessment. Once an expert agreement is obtained by adding a fuzzy number for each item (Ridhuan et al., 2013). The calculation and determination of fuzzy values is by using the formula Amax = (1) / 4 (m1 + m2 + m3). The sixth step is the phase of the defuzzification process. Defuzzification is the process of providing information about the level of importance of a variable (MohdRidhuan et al., 2013). There are three formulas that can be applied, namely:

$$A = 1/3 * (m1 + m2 + m3)$$
$$A = 1/4 * (m1 + 2m2 + m3)$$
$$A = 1/6 * (m1 + 4m2 + m3)$$

The value taken into account is the α-cut value which is the median value of "0" and "1", where α-cut = (0 + 1) 2 = 0.5. The use of α-cut values can be used in the process of defuzzification (MohdRidhuan et al., 2013). If the resulting A value is less than the α-cut value = 0.5, the item will be rejected. A α-cut value of less than 0.5 indicates an expert agreement rejecting the item and vice versa exceeding 0.5 indicates an expert agreement on the item (Tang & Wu, 2010; Bodjanova, 2006). Based on these steps the researcher will find out whether the items need to be rejected or accepted. Constructs and Items received are taken into account in designing the development of the module. The value of defuzzification indicates the ranking of the proposed items.

The final step is the process of determining the position (ranking). Position determination is based on the value of defuzzification based on the competence of the expert with the highest value determined by the most important position (Fortemps&Roubens 1996). Muhamad Ridhuan Tony (2014), also uses the value of defuzzification to determine the consensus of expert agreement. The positioning process is determined through the formula ai (Cheng, Hsu & Chang, 2011). Once the data was obtained, data analysis was performed. All levels and steps of this analysis were analyzed using Microsoft Office Excel software to analyze Fuzzy Delphi data. The Health Education assessment module was designed and developed by researchers using Fuzzy Delphi data analysis in this phase.

4. Discussion and Conclusion

The researcher has carefully explained all Fuzzy Delphi technique and how it's been used in this research. Researchers have design and develop a quality assessment module for Health Education which can be used in classroom assessment by using Fuzzy Delphi technique. The steps found in the Fuzzy Delphi technique are very suitable for design and developing any module or models. Researchers can conclude that a very high-quality module can be developed if every step found in the Fuzzy Delphi technique are adequately followed. Researchers who will venture into the field of research can use the Fuzzy Delphi technique if they want to design and develop a quality module. Hope future researchers will develop more modules for elective subjects such as Physical Education and Health Education for upper primary students and elementary school students with this kind effective technique.

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