Modified Delphi Technique in Analysing Contents of Green Skills Module for Design and Technology Subject

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Abstract: The Green Skills Module (GS) is a teaching module of the Design and Technology (DT) subjects developed to introduce green skills and foster a positive attitude towards the environment. This article is intended to obtain the consensus of a panel of experts on the content analysis of the GS module. Modified Delphi Technique was used to analyse the contents of the GS Modules. Nine experts in the curriculum, Technical Vocational Education and Training (TVET), Environmental Education as well as DT excellent teachers were selected through the method of purposive sampling. The data were collected using a semi-structural interview method for the first round and questionnaires for the second round. Based on the findings, two elements, namely knowledge and practice of green skills included in the GS module, are analysed using IBM SPSS version 21 to get the value of 'Inter Quartile Range' (IQR) and the Wilcoxon Test. The findings show that all the items for practice have been agreed upon by the experts while two items of knowledge have been rejected. This study indicates that the application of Modified Delphi Technique can be a new alternative method in analysing programme content in the development of a module.

Keywords: Delphi technique, green skill, design and technology, environment

1. Introduction

Delphi Technique is not a new research method; it has been used scientifically to obtain the expert consent. Modified Delphi Technique is a branch of Delphi Techniques, which is one of the methods that can be applied to gain insights or information from experts in a particular field and foresee future events to seek consensus (McMillan, King, & Tully, 2016; Mohd Ridhuan, Saedah, Zaharah, Nurulrabihah & Ahmad Arifin Sapar, 2014; Saedah, 2013; Linestone & Turoff, 1975). It is also one of the techniques used to obtain a study framework and to build an instrument instrumen (Arasinah & Sariati, 2017; Irdayanti, Ramlee & Abdullah Yusoff, 2015b; Salwati & Zurida, 2010). Modified Delphi Technique is suitable for use in this study to obtain expert consent in analysing the contents of the Green Skill module in TVET

(Ahmad, Ros, Kamis, Abdullah, Abdullah, 2019; Alwi & Kamis, 2019; Bushra, Arasinah & Che Ghani, 2018; Arasinah & Sariati, 2017; Mohd Ridhuan et al., 2015; Irdayanti et al., 2015a).

Green skills are new skills to be included in TVET; teaching of green skills is one of the steps to educate primary school students to be more environmentally friendly. Hence, the integration of Green Skills in Design and Technology subject is essential as these skills are technical in nature, the values or the attitudes of which are required to support *green jobs* (Ahmad, Ros, Kamis, Abdullah, Abdullah & Makmor, 2019; Arasinah, Ramlee, Waliza, & Bushra Limuna, 2016; CEDEFOP, 2012; Pavlova, 2012). The learning modules used in schools must provide knowledge, awareness and most importantly, the green skills that can be acquired by primary school pupils who are inheritors of the world in the future (Arasinah, Amarumi, Bushra Limuna, Normah, Faizal Amin, 2017a; Arasinah, Ridzwan, Mohd Bekri, Faizal Amin, Normah & Haryanti, 2017b; Ramlee, 2015; Sharifah Zarina, 2014).

This article describes how the authors develop a Modified Delphi Technique application that involves an analysis phase to develop a module using the ADDIE Model, which encompasses Analysis, Design, Development, Implementation and Evaluation (Alwi & Kamis, 2019; Branch, 2014). However, this article only covers the first phase of analysis, which is the content of the module. In this article, we describe a phase that uses the Modified Delphi Technique to analyse the findings of the study. The aim of this study is to obtain experts' agreement in exploring the elements of knowledge and practices to be included in the GS Module. The elements of knowledge and practices are explored through this study. These elements are findings from the previous phase of study.

1.1   Green Skills

The Ministry of Education has conducted assessment of curriculum and curriculum related to Green Technology at pre-school, primary and secondary schools. The analysis results show that the integration of green topics is not comprehensive and needs to be updated according to the level of understanding (Laporan Kerjasama Pintar, KeTTHA, 2012). Therefore, it is necessary for TVET to play a role in providing knowledge of green skills in line with green technology, as industrial workers involved in the economic development are in various sectors such as tourism, energy resources and recycling of products (Arasinah, Amarumi, & Bushra, 2018; Arasinah et al., 2017a; UNEVOC, 2014). Green skills should be included in technical education so that graduates are well equipped with these skills before they join the workforce in the industry (Arasinah et al., 2016; Arasinah et al., 2017b; Ramlee, 2015; Pavlova, 2012).

Although the elements of Green skills are taught in the schools through the KPM teaching modules such as the utilisation of recycled materials, these elements are not widely put into practice. Green skills are an added aspect of DT subjects and need to be included in the school curriculum to produce competent students (Jasmi & Kamis, 2019; Arasinah et al., 2018; Arasinah et al., 2017a; Arasinah et al., 2016). The curriculum should provide a holistic approach so that pupils will grow up appreciating and conserving the environment (Teoh, 2016; Ramlee, 2015). Taylor, Quinn and Eames (2016) suggest that different approaches should be adopted because even though environmental education has long been implemented in schools, students are yet to develop good behaviours towards the environment.

The GS module is a step that aims to provide students with knowledge, practice, and positive attitudes towards conserving and preserving the environment. Pupils at the primary school level today will grow up in the next 10 to 20 years. Therefore, they should be informed early about the consequences of their activities that have a negative impact on life (Ramlee, 2015; Sharifah Zarina, 2014). Modules that contain significant amount of knowledge, skills and attitudes about green practices are well implemented through DT subjects; such efforts will nurture primary school children into environmentally friendly citizens (Huei, Rus, & Kamis, 2019; Arasinah, Che Ghani, Haryanti, Faizal Amin Nur, Paiman & Widihastuti, 2019; Alwi, Kamis & Ismail, 2018; Arasinah et al., 2017b; Arasinah et al., 2016).

The main objective of this article is to obtain the experts' consensus and confirmation for each round of questionnaire items using the Modified Delphi Technique. This is the analysis process of the GS module involving two items, which are knowledge and practice that will be included in the content.

2.   Methodology

The study was conducted using the Modified Delphi Technique aimed at obtaining the experts' agreement on the content of knowledge and practice to be included in the GS Module, and the evaluation was carried out based on the findings from the interviews. This article does not discuss the initial findings at the interview stage, but focuses only on the findings of the questionnaire using the Modified Delphi Technique analysis. The participants in the study consist of nine experts from the various fields as shown in Table 1.

**Table 1 - Panel of Experts in Modified Delphi Technique**

Number of Expert	Expert Profile	Institution	Expertise
1	Prof Madya (Senior Lecturer)	Sultan Idris Education University (UPSI)	Technical and Vocational Education

Table 1 - Panel of Experts in Modified Delphi Technique

Number of Expert	Expert Profile	Institution	Expertise
2	Dr (Senior Lecturer)	University Putra Malaysia (UPM)	Environmental Studies and Sustainability
1	Curriculum officer	Technical and Vocational Education Sector (DT Unit)	DT curriculum in primary school.
3	Officer	Ministry of Energy, Green Technology and Water (KeTTHA)	Green Technology and Green Skills
2	Design and Technology (DT) excellent teachers	Expert Teachers in RB subjects in primary schools	Primary school DT subject

The research instrument was a four-point Likert scale questionnaire set. Once data and information are obtained, the establishment of inventories for interview protocols in this Delphi technique was provided. This interview protocol had been reviewed and pilot-tested by a researcher on a Technical and Vocational lecturer and his own research supervisor to ensure usability of the questionnaire items. The steps are shown in Figure 1.

After provided a letter to all the Modified Delphi experts and with their agreement to cooperated, the first round of Modified Delphi Technique began; the researchers proceed to conduct the semi-structured interviews with the experts to obtain the desired information (McMillan et al., 2016; Saedah, 2013; Linestone & Turoff, 1975). The data collected from the interviews was transcribed, coded to provide items for the module content inquiries. Once the module content questionnaire was completed, it was returned to the same experts to choose the content and the level of their consent. This was the second round of the Modified Delphi Technique.
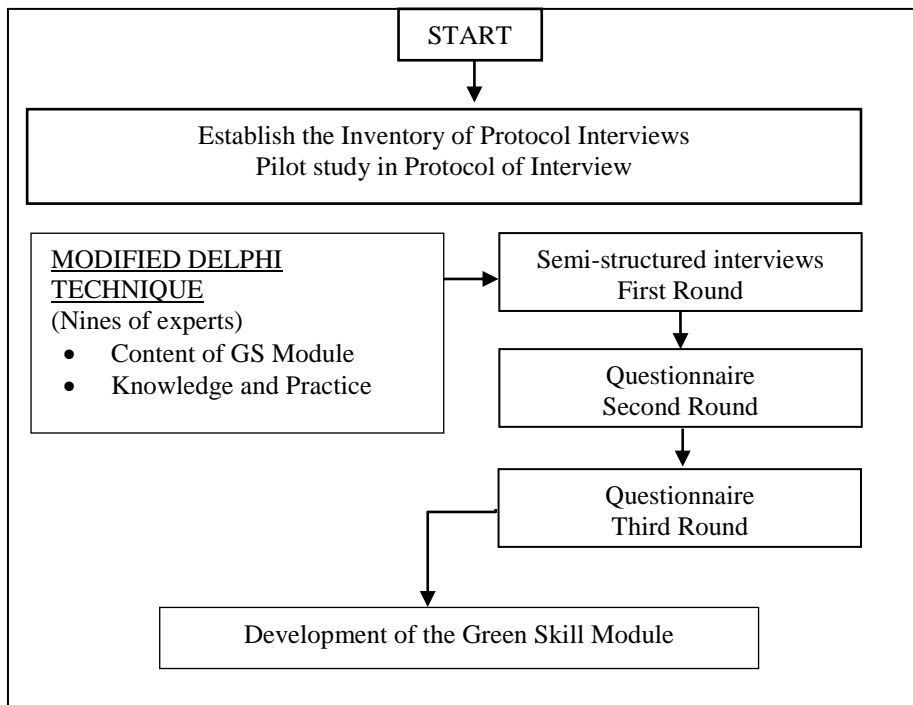
Fig.1- Analysis Stage based on Modified Delphi Technique

Some items were rejected if they had a low consensus level based on the calculations made. After that, the third round was conducted by resubmitted the content questionnaire based on the experts' approval levels. After all the experts had stated the level of consent based on the consensus value obtained, the round was closed and the expert agreement was obtained (Mahoney et al., 2017; Linestone & Turoff, 1975).The questionnaire was sent to the experts by hand or via email due to time factor.

In this study, the collection and analysis processes of the Modified Delphi Technique were carried out in three rounds. The first round was the initial process of getting constructs and items through a structured interview. In this study, the semi-structural interviews are used. There are two constructs identified: P-for knowledge items and A- for practice items. The second and subsequent rounds were carried out until a high level of agreement among the experts is

reached. When all the accurate data have been obtained, the *Inter Quartile Range*, IQR calculations were used to determine the relationship of each item with each expert to facilitate the interpretation of the consensus of each item. At this stage, the *Wilcoxon test* was conducted to find the value of Inter Quartile Range, or IQR in order to search for the consensus values among the Delphi experts.

1.1   Data Collection of Modified Delphi Techniques

The data were analysed using the Measure of Central tendency, which is the median, and Inter Quartile Range, IQR. There are two important aspects of Modified Delphi Techniques, the IQR and the process of obtaining IQR values. IQR is composed of Q1, Q2 and Q3 values and is usually shown in the form (Q3-Q1). Q1 represents the first quartile value and Q3 represents the third quartile value. The IQR was used to produce a Variable Scaling for the purpose of translating the linguistic variables to the Modified numbers. The level of consent or level of the Modified Scale is in the numbers 0, 1 and 2 (Peck & Devore, 2011). IQR 0 to 1 indicates a high agreement. The number of rounds in Delphi Techniques can be determined using the statistical analysis of the Wilcoxon signed-rank test (Norlidah & Saedah, 2010). The researchers have used IBM SPSS 21 to compare items in the first round with that of the second round. Only inner items that exist in the first round can be compared with the same items in the second round. Additional items in the second round are not included.

1.2   Delphi Analysis Modified

As a step of incorporating environmental skills into DT subjects in primary schools, the views or information from the experts in the relevant fields should be obtained so that the objective of developing this Green Skills module was achieved. Based on the definition and concept of the Modified Delphi Technique, the researcher has selected this method to obtain the experts' consent in determining the elements that should be included in the design of the teaching module of Green skills in DT subjects for primary schools. The justification of selecting Delphi Techniques is that it was an efficient tool for conducting future research (Arasinah & Sariati, 2017; Irdayanti et al., 2015a; Salwati & Zurida, 2010).

3.   Findings

3.1   First round

The first analysis is based on the structured interview questions to the experts that have been identified. There are two elements outlined for the construction of the Green Skills module, namely knowledge and practice. Under the element of knowledge, seven items have been identified while the practice element has six items. Items of knowledge and practice that have been obtained based on the first round interview are listed in Table 2 below.

Table 2 - List of Items of Knowledge and Practice Obtained in The First Round

Item	Knowledge
P1	Solid Waste Management
P2	3R Concept (*Reduce, Reuse and Recycle)*
P3	Compost Fertiliser
P4	Low Carbon Product
P5	Alternative Energy
P6	Biodiversity
P7	Degradation of polymer plastic

Item	Practice
A1	Separation at Source
A2	Using wasted materials to produce a project
A3	Reuse reusable items
A4	Save on the use of non-renewable energy sources or use alternative energy
A5	Doing activities that can reduce the release of carbon gases into the air
A6	Composing the fertiliser

The findings of the questionnaire from the first round have been compiled according to the Likert Scale 4: (4) strongly agree, (3) agree, (2) agree and (1) strongly disagree. The items are based on the expert consent and content elements that are to be included in the green skills module.

3.2   Second Round

In the second round, the data were analyzed using Modified Delphi Technique, the median, and the quartile ranges. Based on the median for each item, the statements have been arranged according to the specified category. The researchers had used the Wilcoxon (sign-ranked test) test to check the consistency level between the expert views in round 1 and round 2. Wilcoxon values indicated with Z and the statistics are tested at values of 0 to -1.99. When the value of Z was within that range (insert the range), it indicates that the experts were consistent in giving the consent (Mahoney et al., 2017; Norlidah & Saedah, 2010). This shows that no significant changes have been made to the items of 1st and 2nd rounds. On the other hand, if the tailed value is -2.00 and above, this indicates that the experts are inconsistent in giving their consent in the 1st and 2nd rounds. This means that there is a significant change in the experts' approval in round 1 and round 2. Items tested by Wilcoxon method are merely those in round 1 and round 2. The new items proposed by the experts in round 1 are not tested for Wilcoxon value.

Table 3 - *Wilcoxon Test* Results for Knowledge

Item (Knowledge)	(%)	med	mod	Inter Quartile Range	Expert consensus value	Z	There is a significant difference between expert answers in rounds 1 and 2
Solid Waste Management	100	4.00	4	0	High	0.00	Yes
3R Concept (*Reduce, Reuse and Recycle)*	100	4.00	4	0	High	0.00	Yes
Compost Fertiliser	100	4.00	4	0	High	0.00	Yes
Low Carbon Product	100	4.00	4	0	High	0.00	Yes
Alternative Energy	100	4.00	4	0	High	0.00	Yes
Biodiversity	78	1.67	1	1.5	Low	-2.4	No
Degradation of polymer plastic	67	2.00	1	3	Low	-2.25	No

Table 4 - *Wilcoxon Test* Results for Practice

Item (Practice)	(%)	med	mod	Inter Quartile Range	Expert consensus value	Z	There is a significant difference between expert answers in rounds 1 and 2
Separation at Source	100	4	4	0	High	0.00	Yes
Using wasted materials to produce a project	100	4	4	0	High	-1.14	Yes
Reuse reusable items	100	4	4	0	High	0.00	Yes
Save on the use of non-renewable energy sources or use alternative energy	100	4	4	0	High	0.00	Yes
Doing activities that can reduce the release of carbon gases into the air	100	4	4	0	High	0.00	Yes
Composing the fertiliser	100	4	4	0	High	0.00	Yes
Separation at Source	100	4	4	0	High	0.00	Yes

Table 3 and Table 4 above shows the range of quartile values from 0.0 to 1.0 (high consensus) for all items tested except for two items of knowledge, which are Biodiversity and Plastic Degradation. While the Wilcoxon test reading value was between (-0.000) and (-1.14), there is no significant difference between the expert answers in rounds 1 and 2 for all the items except two items of knowledge, namely Biodiversity and Plastic Degradation. The *Wilcoxon test* reading values for Biodiversity items were (-2.40) and (-2.25) for Degradable Plastic items. This showed a significant difference between the expert answers in round 1 and 2 for Biodiversity and Plastic Degradation Knowledge items; this item does not have the consensus of the experts, and the low consensus values cause these two items to be rejected.

4. Findings and Discussions

The Modified Delphi Technique is an effective way of exploring the consent and consensus of specialists, especially in introducing something new like green skills (Arasinah & Sariati, 2017; Irdayanti et al., 2015a; Salwati & Zurida, 2010). This technique can be used in analysing content of the development of a module because the results analysis can determine the level of consensus and agreement by the experts in a particular field. (Mohd Ridhuan et al., 2014; Norlidah & Saedah, 2010). In addition to using Measure of Central tendency in analysing data in the Modified Delphi Technique, the Wilcoxon test (Norlidah & Saedah, 2010) and Rasch Analysis (Mahoney et al. (2017) can be used as an alternative to find the value of Z, the consensus value of the experts.

The findings of this study are consistent with those of Jasmi and Kamis (2019) ; Arasinah et al., (2018); Arasinah et al., (2017a); Arasinah et al., (2017b); Arasinah et al., (2016); Ramlee (2015); Sharifah Zarina (2014); CEDEFOP (2012); Pavlova (2012); the learning modules need to incorporate elements of knowledge, awareness, sustainability skills so that students can acquire technical skills, values and attitudes pertaining to conserving the environment for future generations. In terms of the content of the GS Module, the findings have listed five items of knowledge from the original seven items. The knowledge elements included in the GS module are Solid Waste Management, 3R Reduce, Reuse and Recycle, Compost Fertiliser, Low Carbon Products and Alternative Energy. The results of this study are in line with the study of Norlidah and Saedah, (2010) which also excludes two items of the 15 items obtained in Round 1; the results are also similar to those of Moheney et al., (2017), which listed only the top five elements after experiencing three rounds of expert approvals. Irdayanti et al., (2015b) also abolished two of the five items found in one of their study constructs.

The list of practices of the GS Module include the separation of solid waste, using recyclable materials or 3R, saving the use of energy sources, providing compost fertilizer and reducing the activity that can release carbon dioxide gas into the air. In this instance, no items are omitted as all of them have been approved by all the experts. This also occurs with the study of Irdayanti et al. (2015b), which includes all the items in their research construct as all the items obtain high consensus value.

5. Conclusion

This Modified Delphi Technique is an appropriate method for finding consensus or consensus among the experts in assessing or obtaining the consent, especially of something new in any field, and in this study, the TVET and module development. The researchers also consider all comments and suggestions of the experts for refinement and improvement purposes. The findings show that from the original seven knowledge items, two items are rejected, leaving only five items to be included in the GS module; meanwhile, all six items of the green skills practice are included in the module. As a result, the developed GS module has three major sub-modules and six units based on three categories, namely Waste, Energy and Water. Please list all the items that will be include in the GS module and how these items would benefit the curriculum in general and TVET students specifically.

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