REVIEW OF INTERNATIONAL GEOGRAPHICAL EDUCATION

ISSN: 2146-0353 • © RIGEO • 11(4), WINTER, 2021

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Research Article

# Application of Fuzzy Delphi Method (FDM) for Supervision Process Construct for First Degree Supervision in Institute of Teacher Education (ITE) Malaysia

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## Abstract

Research supervision is an academic activity that are planned and executed to enhance learning and maximize learning experience in the first-degree level of Institute of Teacher Education (ITE) Malaysia. The study aims to identify and rank the elements in Supervision Process construct for The Synergistic Psycho-Social Model (SyPSM) based on expert consensus. The expert consists of 15 experts from all ITEs, and possess variety of expertise in research supervision for first degree level. In addition, the chosen expert equipped with 10 years of experience in their respective fields. The study utilizes Fuzzy Delphi Method (FDM) technique to analyse the data. The findings indicate that all 13 elements in Supervision Practice construct were accepted. These elements were accepted since the threshold (d) value is less than 0.2, the Fuzzy A score is > 0.5 and percentage of expert group consensus is more than 75%. In conclusion, the research has successfully identified elements for supervision process construct based on FDM analysis and "Ensure that the report on analysis result is the real result from conducted research" element is the priority to produce main framework of elements in developing The Synergistic Psycho-Social Model (SyPSM).

**Keywords**
Supervision process, Supervision, Fuzzy Delphi Method (FDM), Institute of Teacher Education (ITE)

**To cite this article:** Borhan, M, T, B.; Rahman, N, B, A.; Yusop, N, A, B, M.; Suhaimi, A, B.; Wan, X, N, A.; and Ahmad, Y, B. (2021) Application of Fuzzy Delphi Method (FDM) for Supervision Process Construct for First Degree Supervision in Institute of Teacher Education (ITE) Malaysia. *Review of International Geographical Education (RIGEO), 11(4), 764-774. doi:* 10.48047/rigeo.11.04.70

**Submitted:** 07-04-2021 • **Revised:** 15-04-2021 • **Accepted:** 25-05-2021

# Introduction

Institute of Teacher Education (ITE) Malaysia is a higher education institution under the purview of Ministry of Education that focuses on teacher training for Malaysia primary schools. There are 27 ITE campuses across country which offers more than 50 programmers. The Ministry of Education Malaysia raised the status of teacher training qualification at the Institutes of Teacher Education (ITE) from a diploma to a bachelor's degree in 2007, wherefore marked a significant role shift of teacher education training in IPG. This leads to a new responsibility for IPG lecturers i.e., supervising research of undergraduate level. Thus far, eight years after the graduation of IPG's first batch of Bachelor of Teaching degree, lecturers are still groping for appropriate supervision approaches that specifically suitable for the unique research supervision practices in IPG milieu; a type of supervision that aims to produce reflective practitioners. There is however, a scarcity of literature for characteristics of or effective ways of undergraduate research supervision for IPG lecturers to refer to (Grant, Heckney and Edgar, 2014). Hence, the current research proposes a new research supervision model, named as Synergistic Psycho-Social Model (SyPSM) that accommodates the synergistic elements of Lee's (2007) Conceptual Models of Research Supervision, psycho-social supervision and reflective practices supervision. The Fuzzy Delphi Method (FDM) is used to design the main components and elements through the agreement of a group of experts to verify, evaluate, reject and add every construct and element in the Synergistic Psycho-Social Model (SyPSM). These constructs are:

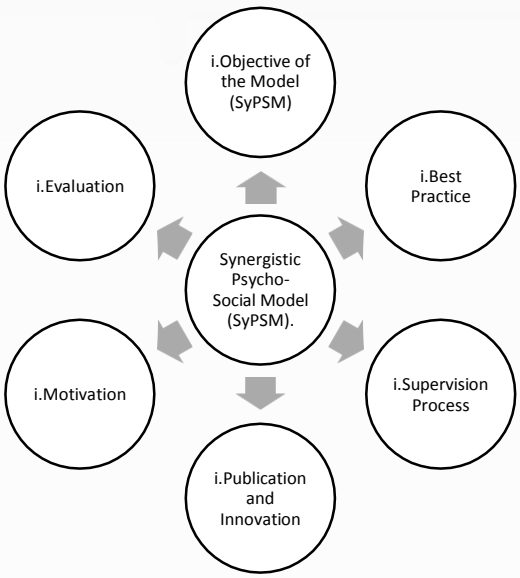



**Figure 1:** The Synergistic Psyco-Social Model (SyPSM) model that comprises six constructs.

However, this paper will only report on the findings of Supervision Process constructs (3rd constructs) which consists of 13 items. Hence the objective of this paper is to determine the element for Supervision Process construct and its rank in *The Synergistic Psycho-Social Model (SyPSM)* based on expert consensus using Fuzzy Delphi Method (FDM).

# Literature Review

Research supervision is a facilitative process requiring support and challenges (Pearson and Kayrooz, 2004). Evans et. al, (2017) posited supervision as the issue most demanding significant attention since supervision practises substantiate the achievement of certain learning objectives. Lee (2007) proposed five models of research supervision which constitute Functional supervision, Enculturalisation supervision, Critical thinking supervision, Emancipation supervision and Relationship development supervision. In functional supervision, the supervisor's task is related to project management e.g., setting/ agreeing the ground rules of supervision, expressing common expectations, timetabling meetings, negotiating resources, and giving feedback on early writing. Enculturalisation supervision provides some specific expertise but will also be a gatekeeper to learning resources, specialist opinions and networks. The supervisor would choose which gates to open, particularly in the early stages of the researcher's life. As the name suggests, critical thinking supervision addresses questions such as what is the underlying conceptual framework, what are the arguments for and against, what has been considered and what has been left out. Emancipation supervision views supervision

as a mentoring process (Pearson and Brew, 2002). It involves acknowledging that adults can move from being dependent to being self-directed, accumulate experiences and create a biography from which they can learn and can change. The expected movement is from needing to acquire knowledge and being subject centred to becoming more performance centred. Finally, in relationship development supervision, it involves emotional intelligences and flexibility that play a big part working with students towards successful supervision. There is some evidence that poor emotional intelligence, a mismatch in styles (such as when the student is still dependent but the supervision style is one of 'benign neglect') leads unsurprisingly to poor completion rates (Taylor and Beasley 2005).

# Methods/Methodology

## Research Approach and Design

The current study aims to develop and a newly proposed model for research supervision in the Institutes of Teacher Education (ITE), named as The Synergistic Psycho-Social Model (SyPSM). Design and development research approach (DDR) utilizes in this study includes a highly organized and systematic process in which it encompasses the process of designing, developing and evaluating a model that is produced (Richey & Klein, 2007). Hence, this study will be conducted in three main phases namely: need analysis phase, design and development phase and evaluation phase. Succinctly, need analysis will identify the need and urgency in developing a supervision model in ITE, design and development phase will deal with the construction of the construct and elements in supervision model and evaluation phase will involve statistical treatment (e.g: Rasch Model, Confirmatory Factor Analysis (CFA) or Nominal Group Test (NGT) to further validate the model. However, the following section detailing out the first two phases in DDR that are aligned with the focus and purpose of the paper.

## Research Phase

### Phase 1: Need Analysis

The first phase of data collection involves semi-structured interviews with selected expert from IPGs, Universities and Polytechnic and pre-service teachers majoring in science, art and language pursuing a Bachelor's Degree in Teaching at the Institutes of Teacher Education in Malaysia. The thematic analysis was implemented to validate the functionality of The Synergistic Psycho-Social Model (SyPSM) main component obtain from the literature review.

### Phase 2: Design and Development Phase

The Fuzzy Delphi Method (FDM) is used to design the main construct and elements through consensus of a group of experts to verify, evaluate, reject and add every component and element in the Synergistic Psycho-Social Model (SyPSM). These constructs are:

i. Objective of the model (SyPSM)
ii. Best practice
iii. Supervision process
iv. Publication and innovation
v. Motivation
vi. Evaluation

The synergistic supervision constructs are the amalgamation of all the six elements listed above. FDM method requires expert agreement. Hence, the FDM questionnaire is designed and administered on 15 experts who are senior lecturers in the Institutes of Teacher education, with the experience in supervision more than five (5) years. Several approaches are used in data dissemination and collection, namely through (1) Workshop Seminar by inviting involved experts; (2) Individual experts meeting; and (3) The distribution of questionnaire to an expert selected via Google Form. However, this paper only reports on the findings from the phase 2 of the supervision process element.

## Expert Respondent Profile

The research utilizes purposive sampling to obtain views of experts' consensus on the questionnaire. Haason, Keeney & Mckeena (2000) stated that purposive sampling is a suitable sampling technique in FDM. Total number of experts involved in this study is as in the Table 1. According to Adler & Ziglio (1996), number of experts between 10 and 15 are sufficient if the is homogeneity.

**Table 1:**
List of experts involved in FDM technique.

| Expert No. | Highest qualification | Experience |
|---|---|---|
| P1 | PhD | Less than 10 years |
| P2 | PhD | More than 20 years |
| P3 | PhD | 15-19 years |
| P4 | PhD | More than 20 years |
| P5 | PhD | More than 20 years |
| P6 | Masters | More than 20 years |
| P7 | Masters | 15-19 years |
| P8 | Masters | More than 20 years |
| P9 | PhD | More than 20 years |
| P10 | PhD | 15-19 years |
| P11 | PhD | More than 20 years |
| P12 | PhD | More than 20 years |
| P13 | PhD | More than 20 years |
| P14 | PhD | More than 20 years |
| P15 | PhD | More than 20 years |

## Research Instrument

A set of expert questionnaires is constructed using 7-point Likert scale. 7-point Likert scale is selected since the higher the number of scales, the higher number of reliability and accuracy of the data (Rashidah, Saedah dan Zaharah, 2018). As depicted in Table 2, the 7-point Likert Scale is uses to replace the Fuzzy value. Respondent consists of senior lecturers in Institute of Teacher Education (ITE) were invited to use the 7-point Likert scale (1=Exteremely disagree, 2=Highly disagree, 3=Disagree, 4=Fairly agree, 6=Highly agree, 7=Extremely disagree) to indicate expert consensus towards all elements.

**Table 2:**
Likert Scale, Linguistic Variable and Fuzzy Scale

| Likert Scale | Linguistic variables | Fuzzy Scale |
|---|---|---|
| 1 | Extremely disagree | (0.0, 0.0. 0.1) |
| 2 | Highly disagree | (0.0, 0.1. 0.3) |
| 3 | Disagree | (0.1, 0.3. 0.5) |
| 4 | Fairly agree | (0.3, 0.5. 0.7) |
| 5 | Agree | (0.5, 0.7. 0.9) |
| 6 | Highly agree | (0.7, 0.9. 1.0) |
| 7 | Extremely agree | (0.9, 1.0. 1.0) |

**Source:** (Chang, Hsu & Chang, 2011)

## Steps To Carry Out Research Using FDM Technique

There are 7 steps in implementing research using FDM as follows:

**Selection Of Experts**

The study the involved a total of 15 experts that have been selected using purposive sampling method. According to Siti Farhah Aziz and Saedah Siraj (2015), a person who has more than 10 years of work experience and is consistent in the same field is eligible to become an expert. The selection of these experts is very important to ensure that the selected experts are able to provide the right views in the context of the study conducted.

**Creating A Questionnaire for Expert**

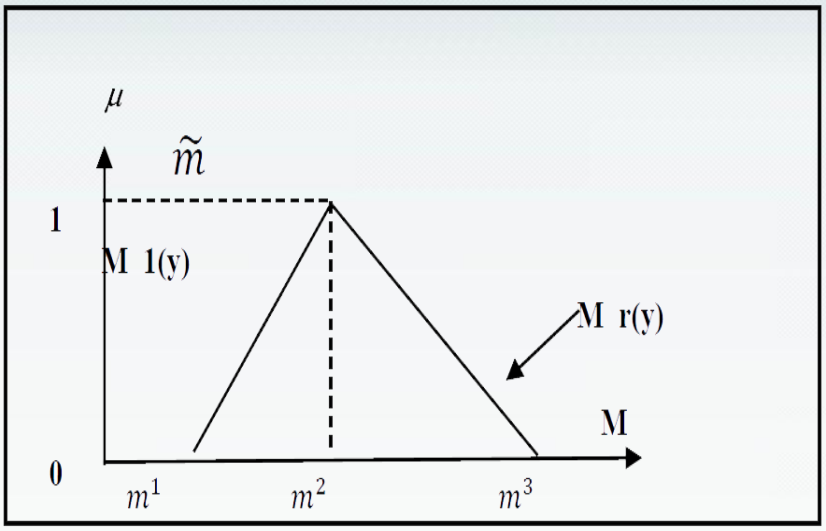
Construction of a questionnaire can be done through several methods, namely interviews and literature review. According to Powell (2003), Delphi method is a very flexible method to obtain expert agreement. This is because the first round of Delphi was held to identify an issue with expert interviews. However, for identifying and obtaining an issue can be done through open-ended questions or utilizing existing questionnaire in the literature.

**Distribute The Questionnaire**

The questionnaire was distributed by making appointment with the expert via their respective Institute of Teacher Education administration.

**Convert The Linguistic Variables**

This process converts all scales of linguistic variables to the numbering of Fuzzy triangles (Triangular Fuzzy Numbers). The Fuzzy Triangle number is represented by the values $m1$, $m2$, and $m3$. The value of $m1$ represents the minimum value (smallest value), the value of $m2$ represents the most reasonable value and the value of $m3$ is related to the maximum value (maximum value). Next is the Triangular Fuzzy Number used to produce a Fuzzy scale that uses a Likert scale for the purpose of translating linguistic variables into Fuzzy numbers. The number of levels for the Fuzzy scale is in odd numbers. The higher the Fuzzy scale, the more accurate the data obtained. Figure 1 shows a graph of the mean triangle against the Triangular value of the three values in the Triangular Fuzzy Number.




**Source:** (Habibah @ Artini Ramlie et al., 2014)

**Figure 2:** Triangle mean graph vs triangular.

Figure 2 shows a graph of the mean triangle against Triangular with $m1$ = minimum value, $m2$ = intermediate value, and $m3$ = maximum value. The data obtained from Likert scale were analyzed using Microsoft Excel program. All data is converted into Triangular Fuzzy Number. The seven-point Fuzzy scale was used in this study.

**Analyse The Data**

Data analysis is based on the numbering of Fuzzy triangles (Triangular Fuzzy Numbers) which aims to obtain the value of Threshold (d). According to Thomaidis, Nikitakos & Dounias (2006) the process of identifying the value of Threshold (d) is very important to get a level of agreement among experts. For the purpose of obtaining an expert consensus for each item, the first condition to be complied is the Threshold value (d) should not more than or equal to 0.2, then it is considered that the expert consensus has been reached (Cheng & Lin, 2002).

**Determine Expert Consensus Percentage**

While the second condition to determine the value of the percentage of expert consensus that is the overall agreement (group consensus) should exceed 75.0% agreement for each item, otherwise the second round will be implemented again (Chu & Hwang, 2008).

**Data Analysis Using Average of Fuzzy Numbers @ Average Response (Defuzzification Process)**

This analysis process is aimed at obtaining Fuzzy (A) score values. The third condition that must be complied with, to obtain a Fuzzy (A) score value, must be greater than or equal to the median value (α-cut value) which is 0.5 (Tang & Wu, 2010; Bodjanova, 2006). This indicates that the element is accepted by the expert consensus. The value of Fuzzy score (A) can also be used as a determinant of the position and priority of an element according to the expert agreement view. The formula involved in getting the Fuzzy (A) score is as follows:

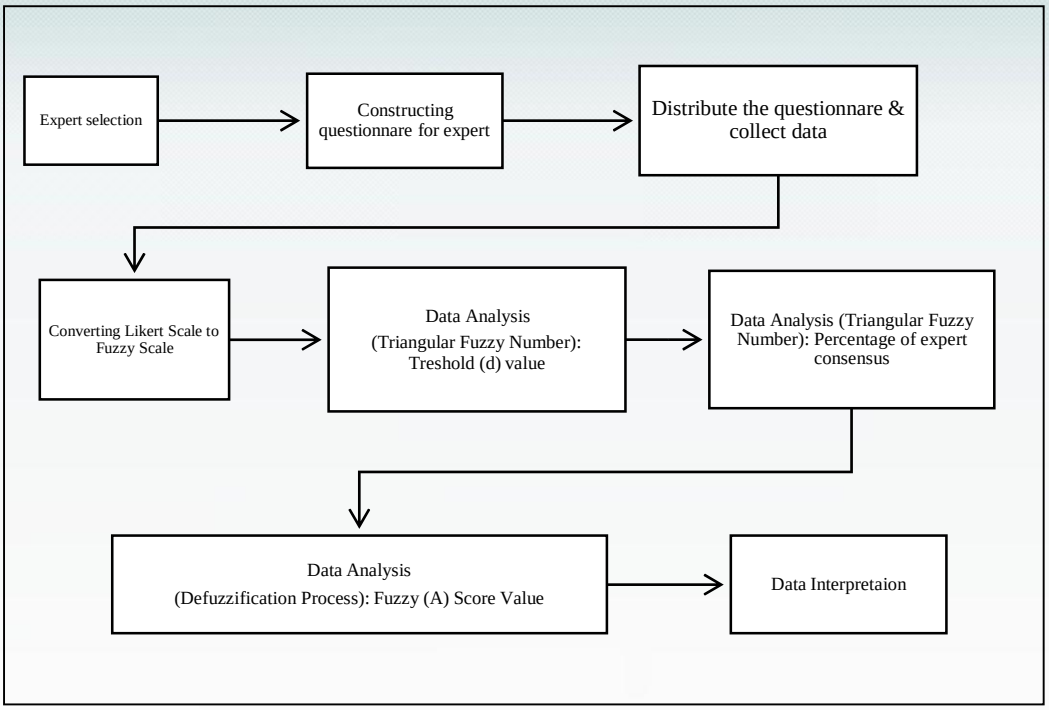
i. A = (13/) * $m1$ + $m2$ + $m3$), or;
ii. A = (14/) * $m1$ + 2$m2$ + $m3$), or;
iii. A = (16/) * $m1$ + 4$m2$ + $m3$).

α-cut value = median value for '0' and '1', i.e., α-cut = (0 + 1) / 2 = 0.5. If the resulting A value is less than the α-cut value = 0.5, the item will be rejected because it does not indicate an expert agreement. According to Bojdanova (2006) and Tang & Wu (2010), the α-cut value should exceed 0.5. It is supported by who stated that the α-cut value should exceed 0.5. Table 3 shows an example of a fuzzy (A) score value conducted using the defuzzification process analysis based on the Fuzzy Delphi (FDM) method approach.

**Table 3:**
Example of Fuzzy Score Value (A)

| **Item/Element** | **Defuzzification Process** | | | | **Ranking** |
|---|---|---|---|---|---|
| | **m1** | **m2** | **m3** | **Fuzzy (A) Score** | |
| Ensure that the report on analysis result is the real result from conducted research. | 0.833 | 0.967 | 1.000 | 0.933 | 1 |
| Ensure that the empirical data is interpreted academically without any fact manipulation | 0.820 | 0.960 | 1.000 | 0.927 | 2 |
| Ensure that the reading of literature is complete and systematic | 0.820 | 0.960 | 1.000 | 0.927 | 2 |

In Table 3, the ranking process was determined by selecting elements based on the value of defuzzification process based on expert consensus with the element with the highest value determined the most important position (Fortemps & Roubens, 1996). Figure 3 summarise the procedure:




**Source:** (Mohd Ridhuan Mohd Jamil, 2016)

**Figure 3:** Overall procedures of FDM

## Result and Discussion

The results precise with discussion and be clear in presenting the data. It may be supported and presented by the graphs, figures and tables. The discussion can either be a part of the Results section or a separate section of its own.

### Research Result

There are 13 items to represent research supervision process element for the Synergistic Psycho-Social Model (SyPSM). Table 4 presents findings for analysis using Triangular Fuzzy Numbers. The first condition for Triangular Fuzzy Number is *Treshold* (d) < 0.2. All items associated with research supervision process constructs comply with the first condition and the (d) value and the (d) is ranging from 0.068 to 0.162. The second condition of Triangular Fuzzy Number is percentage of expert consensus that must exceed 75%. Across the 13 items the expert consensus percentage is ranging between 93.33% to 100.00%. Therefore, all items comply with the second condition. The next condition is Defuzzification process condition that the score of Fuzzy (A) > a-cut = 0.5. Based on the process of Defuzzification, the Fuzzy score (A) is ranging from 0.851 until 0.933. Finding from FDM technique also obtain the ranking of item in the research supervision process construct for the Synergistic Psycho-Social Model (SyPSM). *"Ensure that the report on analysis result is the real result from conducted research"* item is in the first place, followed by *"Ensure that the empirical data is interpreted academically without any fact manipulation", "Ensure that the reading of literature is complete and systematic",* and *"Ensure that research objective is understands and internalize by pre-service teachers"* are in the second place. The fifth place is occupied *by "Guide pre-service teachers in developing theoretical and conceptual research framework"*. Ranking number six are occupied by four items as following *"Guide pre-service teachers in preparing report based on the schedule so that the progress could be evaluate more frequently.", "Support on the resources and references used", "Introduce pre-service teachers to Scholarly Networks" and "Encourage pre-service teachers to explore latest issues".* The rest of the four items were also accepted and total number of items accepted for research supervision process construct are 13 items. This is also to conclude that all items are valid to represent Supervision Process construct.

**Table 4:**
Result Table According to FDM Technique

| | | Triangular Fuzzy Numbers | | Defuzzification Process | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| **No** | **Item / Element** | **Threshold, d Value** | **Expert consensus percentage, %** | **m1** | **m2** | **m3** | **Fuzzy (A) Score** | **Expert Consensus** | **ACCEPTED element** | **Ranking** |
| 1 | To conduct discussion by proposing new ideas to pre-service teachers | 0.135 | 93.3% | 0.767 | 0.913 | 0.973 | 0.884 | ACCEPTED | 0.884 | 11 |
| 2 | Encourage pre-service teachers to explore latest issues | 0.093 | 93.3% | 0.807 | 0.947 | 0.993 | 0.916 | ACCEPTED | 0.916 | 6 |
| 3 | To ensure approvement from EPRD is gathered before implementing any research | 0.162 | 86.7% | 0.753 | 0.900 | 0.960 | 0.871 | ACCEPTED | 0.871 | 12 |
| 4 | Introduce pre-service teachers to *Scholarly Networks* | 0.093 | 93.33% | 0.807 | 0.947 | 0.993 | 0.916 | ACCEPTED | 0.916 | 6 |
| 5 | Assists pre-service teachers in choosing research topics | 0.149 | 93.33% | 0.713 | 0.880 | 0.960 | 0.851 | ACCEPTED | 0.851 | 13 |
| 6 | Ensure that research objective is understands and internalize by pre-service teachers | 0.073 | 100.00% | 0.820 | 0.960 | 1.000 | 0.927 | ACCEPTED | 0.927 | 2 |
| 7 | Guide pre-service teachers in developing theoretical and conceptual research framework | 0.076 | 100.00% | 0.807 | 0.953 | 1.000 | 0.920 | ACCEPTED | 0.920 | 5 |
| 8 | Ensure that the reading of literature is complete and systematic | 0.073 | 100.00% | 0.820 | 0.960 | 1.000 | 0.927 | ACCEPTED | 0.927 | 2 |
| 9 | Assists pre-service teachers in determining research methodology | 0.094 | 93.33% | 0.793 | 0.940 | 0.993 | 0.909 | ACCEPTED | 0.909 | 10 |
| 10 | Ensure that the empirical data is interpreted academically without any fact manipulation | 0.073 | 100.00% | 0.820 | 0.960 | 1.000 | 0.927 | ACCEPTED | 0.927 | 2 |
| 11 | Ensure that the report on analysis result is the real result from conducted research. | 0.068 | 100.00% | 0.833 | 0.967 | 1.000 | 0.933 | ACCEPTED | 0.933 | 1 |
| 12 | Support on the resources and references used | 0.093 | 93.33% | 0.807 | 0.947 | 0.993 | 0.916 | ACCEPTED | 0.916 | 6 |
| 13 | Guide pre-service teachers in preparing report based on the schedule so that the progress could be evaluate more frequently. | 0.093 | 93.33% | 0.807 | 0.947 | 0.993 | 0.916 | ACCEPTED | 0.916 | 6 |

## Discussion And Conclusion

Based on the analysis using the FDM, the research supervision construct for the Synergistic Psycho-Social Model (SyPSM) was formed. The analysis result of the expert consensus indicated that the consensus value is a good level. Succinctly, FDM can be utilized to obtain expert consensus and expert act as respondent based on quantitative method. Therefore, the research is able to answer the inquiry of the study whereby the analysis result
suggests that there is expert consensus in the main construct (the research supervision process construct), element or item in the construct (which consist of the 13 items) and the item ranking. Based on the research finding *"Ensure that the report on analysis result is the real result from conducted research.", "Ensure that the empirical data is interpreted academically without any fact manipulation"* and *"Ensure that the reading of literature is complete and systematic"* are the dominant elements in supervision process construct that influence supervision in ITE. In sum, the research has successfully identified suitable element for supervision process construct in the developing the synergistic psycho-social model (SyPSM) research supervision model in the ITE. The research indicates that the analysis of the finding is derived from the empirical data. In addition, the supervisor also priorities that the research objectives must be fully understand by the pre-service teachers and the literature are complete and systematic. Therefore, it is pertinent for student to be competent in conducting empirical research to obtain valid data and supported with the extensive and systematic reading of the literature. This will eventually assist the understanding the objectives and as consequent, they would be able to answer research objectives accordingly.

## Acknowledgements

Financial support for this study was provided by a grant from Malaysian of Higher Education (MOHE) Fundamental Research Grant Scheme (FRGS) (FRGS/1/2019/SSI09/IPGM/02/5) entitled the Synergistic Psycho-Social Model (SyPSM): Designing and Developing a New Model for Research Supervision in The Institute of Teacher Education (ITE).

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