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FUZZY DELPHI ANALYSIS IN DEVELOPING *MYFLIPPED* MODEL IN CULTIVATION OF MALAYSIA'S IR 4.0 GRADUATES LIFELONG LEARNING PROFILE

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ABSTRACT

This study is carried out to gain experts' consensus towards the lifelong learning profile and flipped element in MyFlipped model based on *Fuzzy Delphi* analysis. This study aims to gain experts' consensus towards the needs of flipped classroom element component in the main component of lifelong learning and the main ranking level for each construct of design and MyFlipped model. In this study, the *Fuzzy Delphi* method using 7 Likert Scale is used to collect 18 experts' response that consists of IPTA and IPG lecturers. The data obtained is analyses using triangular fuzzy number and the ranking for each variable is determined using 'defuzzification' process. The study findings show the response and experts' consensus about the elements in main component in MyFlipped model development is at a good level. The overall findings gained through experts' consensus is more than 75% Threshold value (d) <0.2 and -cut more than 0.5. Therefore, the element existence and main component in MyFlipped model can benefit the lifelong education to the higher education students (IPT) in challenging the 21st century learning. The implication of this study shows that the lifelong learning construct should be integrated in pedagogy in IPT.

Keywords: Flipped classroom**,** Fuzzy Delphi**,** Defuzzification **,** Lifelong Learning

INTRODUCTION

The rapid global development today makes the industries that focus towards artificial intelligence and the work environment that needs the high order thinking skills among the occupations that directly impacts the education sector (*World Economic Forum. The future of jobs report 2018: Insight Report - Centre for the New Economy and Society., 2018*). Changes in information and communication technology influence the teaching and learning method in the higher education. The flipped learning concept is a pedagogy method that replaces the normal lecturing session through the exploration of information (Siti Fatimah et al., 2019). The students can share the information obtained and discuss a problem through cooperation between

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friends outside class (Chen et al., 2014; Fauzi & Hussain, 2016).

However, flipped classroom in Malaysia or the West asserts the lifelong learning profile building. Lifelong Learning (LL) is a combination of continuous learning process where the individual's overall and mind encounters changing situations to produce an individual's continuous learning (Lai & Peng, 2020 & Joldersma & Crick, 2009). The LL policy is one of the Malaysian government initiatives of investment for the people. Continuous human resources development to maintain the main strategy ensures the workforce in Malaysia are able to compete globally (Crick, 2007). LL is the discourse to the education exercise to increase performance, work and knowledge, skills and education level of an individual (Crick, 2007 & Crick et al., 2004). Hence, these demands give new paradigm in lecturers' pedagogy technique. The role of lecturers is to stimulate change in students and design learning experience with knowledge so they can produce competent students in the globalization era.

The education system in Malaysia requires education workforce who have high resiliency in exploring and facing challenging education ecosystem to ensure maximum benefits obtained through flipped classroom learning. Based on Nicholls, (2000) 'teachers are true lifelong learners.' Therefore, lifelong learning elements and flipped classroom should be studied in line with various needs so the students will always renew their knowledge and skills in line with global demands.

Hence, two main constructs have been identified and used in MyFlipped model development, namely lifelong learning profile (LLP) construct and flipped classroom construct. Fuzzy Delphi Method (FDM) is an approach used in collecting data for a study based on a group of experts' consensus in an issue studied (Liu, 2013; Eshak & Zain, 2020 & Jamil et al., 2015). In this study, the determination of elements in lifelong learning profile construct and flipped classroom elements towards MyFlipped model development are based on the experts' consensus. FDM is a measurement method that is modified based on Delphi method introduced by (Kaufmann & M.M. Gupta, 1988). FDM is a combination between fuzzy numbering set and Delphi method (Jamil et al., 2015). This means that FDM is not a new approach because FDM is based on classic Delphi method where the respondents involved must be of the experts in certain fields suitable with the context of study.

This study uses FDM for element evaluation and main construct based on flipped learning approach in MyFlipped model. FDM's usage to achieve consensus from three categories of experts, namely education technology experts, flipped classroom experts and model development experts. The selection of these experts is to choose the best criterion in element selection and knowing the main factors that should be considered during the element selection in every main construct. Next, findings from the selection of elements in the construct are ensured to develop beneficial MyFlipped model for lifelong learning to the higher education students (IPT) in challenging ke 21st century learning. The implication of this study shows that

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lifelong learning construct aspect is integrated in IPT's pedagogy.

Study Objectives

Based on the problem statements stated above, the study conducted is based on the study objectives as follow:

a) To identify the elements in lifelong learning profile construct and flipped elements towards MyFlipped model development based on experts' consensus.

b) To identify the elements' positions in lifelong learning profile construct and flipped elements towards MyFlipped model development based on experts' consensus.

Research Questions

Based on the study objectives above, this study is conducted with the research questions as follow:

a) What are the elements in the lifelong learning profile construct and flipped elements towards MyFlipped model development based on experts' consensus.

b) How are the elements' positions in lifelong learning profile construct and flipped element towards MyFlipped model development based on experts' consensus.

METHOD

This study was conducted using Fuzzy Delphi method to obtain experts' consensus towards the construct – and elements developed for MyFlipped model (Cheng & Lin, 2002). Questionnaire was used as the study instrument to obtain the consensus of views among the selected experts to determine MyFlipped elements to cultivate Malaysia's IR4.0 graduates' lifelong learning profile.

The Fuzzy Delphi method suggested by Lai and Peng, (2020) pictured as follows:
The purpose of this method was to answer the research question above. To answer the questions, a few methods were designed to fulfill the needs of this study.

Step 1: Expert K was invited to determine the importance of evaluation criteria towards the variable that will be measured using the linguistics variable as in Table 1.

$$i = 1, \ldots, m, j = 1, \ldots, n, k = 1, \ldots, K.$$

Step 2: Change all the linguistics variables into triangular fuzzy number as suggested in Table 1. Assume the fuzzy number is a variable for each criterion for expert k and

$$\tilde{r}_{ij} = \frac{1}{K}[\tilde{r}_{ij}^{1} \oplus \tilde{r}_{ij}^{2} \oplus \cdots \oplus \tilde{r}_{ij}^{K}] \qquad \tilde{r}_{ij}^{k}$$

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Table 1: **Linguistics variables**

Linguistics variables	Likert Scale	Fuzzy Scale
Extremely disagree	1	(0.0, 0.0, 0.1)
Strongly disagree	2	(0.0, 0.1, 0.3)
Disagree	3	(0.1, 0.3, 0.5)
Simply agree	4	(0.3, 0.5, 0.7)
Agree	5	(0.5, 0.7, 0.9)
Strongly agree	6	(0.7, 0.9, 1.0)
Extremely agree	7	(0.9, 1.0, 1.0)

Source: Saedah Siraj *et al*., 2021

Step 3: For each expert, use the vertex method to count the distance between $\tilde{r}_{ij}$ and $\tilde{r}_{ij}^{k}$;

The distance for two fuzzy numbers and calculated using the formula

$$d\left(\tilde{m},\tilde{n}\right)=\sqrt{\frac{1}{3}\left[(m_1-n_1)^2+(m_2-n_2)^2+(m_3-n_3)^2\right]}.$$

Step 4: According to [14], if the distance between the average and expert's evaluation data was less than threshold value, (dm,n) < 0.2, then all experts were assumed to achieve consensus to each item in the construct. Each construct will also be counted its value and if the experts' consensus was more than 75%, the construct achieved the experts' consensus (Chu & Hwang, 2008) and next to step 5. If the result was different, the second round of Fuzzy Delphi Method (FDM) needed to be done.

Step 5: Aggregate fuzzy evaluation with:

$$\tilde{A}=\begin{bmatrix}\tilde{A}_1\\ \tilde{A}_2\\ \vdots\\ \tilde{A}_m\end{bmatrix} \quad \text{where } \tilde{A}_i=\tilde{r}_{i1}\otimes\tilde{w}_1\oplus\tilde{r}_{i2}\otimes\tilde{w}_2\oplus\cdots\oplus\tilde{r}_{in}\otimes\tilde{w}_n,$$

$$i=1,\cdots,m$$

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Step 6: For each alternative, fuzzy evaluation was defuzzification using the formula:

$$a_i = \frac{1}{4}(a_{i1} + 2a_{i2} + a_{i3}).$$

The ranking choice alternatives could be determined using the value a_i.

CONDITIONS FOR FUZZY DELPHI METHOD APPROACH (FDM)

Triangular Fuzzy Numbers

1. Threshold Value (d) < 0.2

Condition 1 involved threshold value (d). To measure experts' group consensus, threshold value (d) produced must be smaller or same with the value 0.2. In this study context, three decimal points are used. Therefore, each item that consists threshold value (d) that does not achieve value 0.3 and above will be translated as accepted based on the experts' consensus. The determination of threshold value (d) is based on the formula as follows:

2. Experts' Consensus Percentage >75%

Condition 2 involved the percentage of experts group consensus. This condition is based on the traditional delphi method approach where the percentage value is determined based on total items which consists threshold value (d) that do not achieve value 0.2 and above. This means that each item that has threshold value (d) equals or less than 0.2 will be accepted and changed to the percentage value based on traditional delphi method.

Defuzzification Value

1. Fuzzy (A) Score ≥ value α – cut = 0.5

For condition 3, fuzzy score value determination (A) was based on the value - cut which was 0.5. If fuzzy score value (A) was less than 0.5, the item measured was deducted based on the experts group consensus. If the value equals with 0.5 and above, it will be accepted based on the experts group consensus. Next, the process to determine the item's position and priority can be done where the highest fuzzy (A) was assumed to be at the first position. The determination of Fuzzy (A) score value was based on the formula: A = (1/3)*(m1 + m2 + m3).

According to Adler & Ziglio, (1996) the number of experts suitable for Delphi method is between 10 to 15 if there is a high uniformity level among the experts. While H & B.L,(n.d.) suggests that 10 to 50 experts. In this study, the researcher will choose 18 experts. The sample used in this study were lecturers from the universities and teachers' education institutes. The rationale of choosing the sample is because of the skills and knowledge they have in pedagogy and technology aspects.

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Table 2: **Numbers of experts by field**

Field	Number of experts
IPTA lecturers	13
IPG lecturers	5

The experts who are chosen to do the construct evaluation for this model were based on the criteria as follow:

1) The experts must have at least a bachelor degree in their respective fields.
2) The experts have at least five years of expertise in pedagogy or education technology.
3) The experts must have at least 10 years of experience in their respective fields.

RESULTS AND DISCUSSION

Table 3 shows the threshold value *(dm,n)* for each item based on experts and threshold total percentage value for experts' group consensus towards pedagogy construct. Overall, based on the experts' consensus percentage all items were agreed by the experts.

Table 3: **Each item's threshold value *(dm,n)* and experts' group consensus percentage value for Flipped Classroom element construct.**

Item / Element	*Fuzzy Numbers Triangular Conditions*		*Defuzzification Process Condition*				Experts' Consensus	Accepted Elements	*Ranking*
	Threshold Value, d	Experts' Group Consensus Percentage	m1	m2	m3	Fuzzy Score *(A)*			
1	0.068	100%	0.833	0.967	1.000	0.933	Accepted	0.933	1
2	0.104	89%	0.778	0.928	0.989	0.898	Accepted	0.898	4
3	0.102	83%	0.733	0.900	0.983	0.872	Accepted	0.872	7
4	0.086	94%	0.822	0.956	0.994	0.924	Accepted	0.924	2

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5	0.139	83%	0.756	0.906	0.972	0.878	Accepted	0.878	6
6	0.084	94%	0.767	0.928	0.994	0.896	Accepted	0.896	5
7	0.106	89%	0.789	0.933	0.989	0.904	Accepted	0.904	3

Table 4 shows defuzzification score value for Flipped Classroom. Based on defuzzification score value, shows the ranking for each item that need to be prioritize by each lecturer in conducting Flipped Classroom process.

Table 4*:* **Flipped Classroom elements domain defuzzification score**

Item	*Flipped Classroom elements*	*Defuzzification value*	Ranking
1	Considering Taxonomy Bloom where the students focus on the higher cognitive process (application, analysis, evaluates and creates) in class with the teacher's guidance.	0.933	1
2	Considering the student-centred learning environment to support lifelong learning.	0.898	4
3	Considering the place where learning objectives can be achieved.	0.872	7
4	The educator combines various FL elements based on student-centred activities in teaching.	0.924	2
5	Considering the opportunity given to the students to gain exposure on basic concept before class.	0.878	6
6	Considering mechanism preparation such as pre-exercise to evaluate students' understanding.	0.896	5
7	Considering meaningful learning such as students are exposed to new material outside the classroom through lecturing video.	0.904	3

Table 4 showed the results from defuzzification score values for each Flipped Classroom element is seen given acceptable value. Therefore, all items can be used in the model development process in cultivation of Malaysia's IR4.0 graduates lifelong learning profile.

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Table 3 showed the Flipped Classroom elements which was considering Taxonomy Bloom; the students focused on higher cognitive process (application, analysis, evaluates and creates) in class with the teacher's guidance was at the first place with defuzzification score value of 0.933. Followed by the fourth item which the teacher combined all the various of FL elements based on student-centred activities in teaching at the second place. While the seventh item namely considering meaningful learning such as the students were exposed to new material outside the classroom through lecturing video that has defuzzification score value of 0.904 was at the third place. The second item namely considering student-centred learning environment to support lifelong learning had 0.924 score value was at the fourth place. Followed by the sixth item which was considering the mechanism preparation such as pre-exercise to evaluate students' understanding with 0.896 defuzzification score value was at the fifth place. Next was the fifth item which was considering the opportunity given to the students to gain exposure to the basic concept before class was at the sixth place with 0.878 score. Likewise with the third item namely considering the place where learning objectives can be achieved that had defuzzification score value of 0.872 was at the seventh place.

Table 5 shows the threshold value (*dm,n*) for each item based on experts and threshold overall percentage value for experts' group consensus towards lifelong profile construct. Overall based on the experts' consensus showed that all the items were agreeable by the experts.

Table 5: **Threshold value (*dm,n*) of each item and experts' group consensus percentage value for lifelong learning profile elements construct.**

Item / Element	***Fuzzy Numbers Triangular Conditions***		***Fuzzy Process Conditions***				**Experts' Consensus**	**Acceptable element**	***Ranking***
	Threshold value, d	**Experts' Group Consensus Percentage**	**m1**	**m2**	**m3**	**Skor *Fuzzy (A)* *Fuzzy score (A)***			
1	0.089	94%	0.811	0.950	0.994	0.919	Accepted	0.919	5
2	0.073	100%	0.822	0.961	1.000	0.928	Accepted	0.928	2
3	0.109	94%	0.800	0.939	0.983	0.907	Accepted	0.907	6

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4	0.086	94%	0.822	0.956	0.994	0.924	Accepted	0.924	3
5	0.080	94%	0.833	0.961	0.994	0.930	Accepted	0.930	1
6	0.078	94%	0.756	0.922	0.994	0.891	Accepted	0.891	7
7	0.086	94%	0.822	0.956	0.994	0.924	Accepted	0.924	3

Table 6 shows defuzzification score value for lifelong learning. Based on the defuzzification score value showed the ranking for each item that needs to be prioritized by every lecturer in conducting lifelong learning process.

Table 6: **Lifelong learning element domain defuzzification score**

Item	Lifelong Learning Elements	*Defuzzification value*	Ranking
1	Changing and learning can continuously improve the students	0.919	5
2	Critical curiosity among the students help them, striving to understand the learning	0.928	2
3	Meaning making enables the students to connect the existing knowledge to build new knowledge.	0.907	6
4	Creativity can help the students to build various new ideas during learning.	0.924	3
5	Strategic awareness is used by the students to decide the learning aims to be achieved.	0.930	1
6	Learning relationships aid the students to build “fun learning” when they can share information or ideas with other people.	0.891	7
7	Resilience is a criterion in building the students’ self-endurance.	0.924	3

Table 6 showed the results from defuzzification score value for each lifelong learning element are seen giving the agreeable values. Therefore, it was found that all items can be used in the model development process of cultivation Malaysia’s IR4.0 graduates lifelong learning profile. Table 6 showed the strategic awareness element used by the students to determine learning goals to be achieved with defuzzification score value of 0.930 was at the first place. Followed by the second item namely critical curiosity among the students that helped them, striving to understand a learning was at the second place. While items fourth and seventh namely creativity could help the students build various new ideas during learning and resilience was a criterion

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needed in building the students' endurance had the defuzzification score value of 0.924 were at the third place. The first item which was changing and learning could continuously improve the students had the 0.919 score value was at the fifth place. This is followed by the third item meaning making which enabled the students connecting the existing knowledge to build new knowledge with defuzzification score value of 0.907 was at the sixth place. While the sixth item namely the learning relationships aided the students to build "fun learning" when they could share information or ideas with other people was at the sixth place with 0.891 score.

Hence, the flipped approach was one of the teaching and learning methods used widely in teaching world now (Lo & Hew, 2017). Among the model used in higher education pedagogy is flipped classroom. Flipped classroom is a transformative pedagogy to handle various problems faced by the traditional classes. To fulfill the current needs, flipped classroom element was introduced in pedagogy at the school level and higher education.. According Siti Fatimah et al., (2019) and Bates & Ludwig, (2020) explained the flipped classroom concept as a form of pedagogy which replaced the normal lecture through information exploration process from the materials provided by the educator outside the classroom. Other than that, flipped classroom concept is also explained as knowledge seeking process by the students themselves outside the classroom. The students can share the information obtained and discuss a problem through cooperation with their friends in the classroom (Reidsema et al., 2017). The process occurred during flipped classroom practice is believed able to encourage the problem-solving learning, collaboration learning among the students and promotes self-learning style, interactive, just-in-time teaching and combination of various information resources (Bond, 2020 & Persky & McLaughlin, 2017).

The lecturers' active participation will increase the students' motivation and participation towards the flipped element so it becomes better. However, the use of mobile device should consider current technology features so its usage that involves content access aspect and locality learning at a different time can be benefitted. Internet connection disruption and device's features can also cause the students to not in focus during learning session. Therefore, LMS can be practiced as one way to handle internet disruption (Estrada Villa et al., 2021).

For the LLP element as suggested by Joldersma & Crick, (2009), there were seven elements created. These seven elements include changing and learning, critical curiosity, meaning making, resilient and perseverance, creativity, learning relationships and strategic awareness. These seven elements created learning power, a synergy in learning ecosystem. Their view is that the students who have lifelong learning profile is an asset to create a learning society that is able to adapt drastic transformations or changes. The seven dimensions were suggested able to produce skilled workforce towards industry revolution 4.0 (Shahroom & Hussin, 2018).

From the analysis done, the lifelong learning profile element which was at the first place was a strategic awareness, used by the students to set the learning goals to be achieved with the

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defuzzification score value of 0.930. This statement was in line with the guideline suggestion claimed in the 21st century educators' characters (Kementerian Pendidikan Malaysia, 2018) to become the agent of changes towards School Transformation 2025, TS 2025.

All of the seven lifelong learner profile elements obtained threshold value of less than 0.2 received the experts' consensus to be accepted (Cheng & Lin, 2002). Defuzzification value for all elements were also more than -cut which was 0.5. Majority of the items received defuzzification value of 0.9 and above which were critical curiosity, creativity, resilience and perseverance, changes and learning and meaning making. The lecturers' profiles involved these elements are seen critical in creating learning society that able to adapt drastic transformations or changes (Joldersma & Crick, 2009).

One element in the lifelong learner profile which was at 0.8 defuzzification value was learning relationships. It means that the ability to learn with others, from others and by themselves. They are competent in managing the balance between socialization and privacy in studies. They are neither too independent nor too dependent on others. They appreciate other people's presence in the knowledge gaining process (Crick et al., 2004).

CONCLUSION

In conclusion, each element for the Lifelong Learning Profile and flipped classroom construct were accepted based on the experts' consensus and the item priority has been obtained through Fuzzy Delphi analysis. Student-centred learning environment to support lifelong learning is important in this model. The focus on cognitive process is higher in executing learning based on flipped learning. Meaningful learning concept is more exposed to the flipped element and the students' preparedness started at home. Various learning activities can give high impact value to the effectiveness of learning. It pictured flipped classroom learning environment that combined with Lifelong Learning profile element. Lecturers and students created two different layers that tied them in one synergy namely lecturers' wisdom as the learning designer and the students' profile as lifelong learner. This model becomes the resource of inductive, flexible to be adapted in a secluded learning ecology with unique and different challenges for each learning institutes ecosystems. This suits the MOE's intention in producing competent individuals and to fulfill IR4.0 aspiration.

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