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Application of Fuzzy Delphi Techniques in The Construction of Affixes Innovation 21st Century Learning

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Abstract

The teaching of the 21st century is a very appropriate approach in line with the era of globalization in producing a new generation that is competent and skilled. In this regard, this article presents the elements of the Affixes innovation game based on 21st-century learning. This study is a quantitative study using the Fuzzy Delphi technique. The approach used to collect research data using a questionnaire instrument which is divided into four constructs consisting of 20 items. A total of 18 experts have been involved in the formation of elements such as the content of teaching and learning topics of Affixes applied according to 21st Century learning, learning outcomes. The applied 21st Century, the design of the Affixes Innovation Game that is appropriate in the 21st-century learning and the application of the 21st century learning used. As a result of the analysis through the Fuzzy Delphi method, no element in the Affixes Innovation Game was dropped through expert consensus. In the meantime, the expert panel has agreed on the items and elements set in the Affixes Innovation game with a threshold d value of less than 0.2, the expert agreement percentage exceeds 66.7% while the Defuzzication (alpha-cut) has exceeded 0.5. In conclusion, the Affixes Innovation game has been accepted and has a full expert consensus on the items and constructs that have been set.

Keywords: Teaching, Learning, 21st Century, Fuzzy Delphi, Innovation, Affixes

Introduction

In the effort to make 21st century learning a success, teachers play an important role. Therefore, pedagogical knowledge of 21st century learning skills and the interactive delivery of subject content play an important role in implementing 21st century learning. According to Goh and Blake (2015), teachers need to be prepared in the learning skills of the 21st Century, some changes need to be made in the education system such as the curriculum based on the Malaysian context, improve training and practice and develop training placements. In addition, to make these changes in the education system, improvements need to be made in these three contexts. The education system is experiencing holistic innovation and transformation, which involves changes to the education system, the quality of school

leadership, the quality of teachers, the development of students, and the strengthening of more efficient governance. Every educator needs to make a paradigm shift and streamline skills and knowledge to face the transformation of education in this century. Standardization of the quality of national education is dependent on a transformation that explores the link with knowledge and information (Bee, 2015). According to Ahmad (2018), transformation in education is an obligation because the success of economic transformation depends heavily on the success of a futuristic education plan. Furthermore, the School Transformation Programme (TS25) is one of the efforts of the Malaysian Ministry of Education in creating quality schools and improving student achievement in line with the current needs of our country's education while creating a fun learning environment supported by quality and visionary leadership, teachers who are highly aspirational and competent, and a cohesive community. TS25 also applies the best practices in the implementation of management and leadership, as well as pedagogy in Learning and Facilitation in line with the wishes contained in the Malaysian Education Development Plan (PPPM) 2013 - 2025.

Innovation in Learning

The study of the effectiveness of innovation in the form of a kit for increasing the mastery of affixes among Tamil National Type School Students by Narayanan and Subramaniam (2020), is a positive step in understanding the use of innovation that can help in education. The results of the study found that the innovative reward kit built into the learning of the Malay language becomes more interesting and interactive and increases the motivation of students to learn with more enthusiasm. This study also shows an increase in student achievement in terms of affixes. As a gap in this research, the researcher examines the motivation of students in the use of innovations, which will provide the factors that affect their learning. Researchers also consider involving aspects of motivation to understand research to understand the role of motivation and the impact of innovation on student achievement. The use of innovation in education is a good approach to make learning more interactive and interesting, especially in topics that require understanding such as affixes.

Next, a study conducted by Zaini (2020) entitled the use of the Telegram application in learning dialogue essay writing shows that the use of the Telegram application has a positive effect on student behavior and achievement in dialogue essay writing. In addition, the study of affix errors in student essays is a field of research that can provide an understanding of grammatical aspects that need attention in the field of education. The researcher also conducted an extended study that focused on affix errors in students' writing, which in turn could help teachers and researchers focus on Malay topics that need to be corrected.

Use of Fuzzy Delphi Method

Eshak and Zain (2020) in a study on the development of the PEKASa Sexuality module using the Fuzzy Delphi method showed positive results in agreement and expert feedback about elements in the main components of the module. The whole study shows that the percentage that exceeds 75% and the low Threshold (d) value (<0.2), as well as the high α-cut (>0.5), indicate a good level of agreement in the selection of module elements. However, one item in the main component, Emotional and Social Health Management Activities, was rejected because it did not comply with the conditions of Triangular Fuzzy Numbers. This indicates that there is a disagreement with the element or that it needs adjustment to meet the specified conditions. Overall, this study provides a positive view on the development of PEKASa's

Sexuality module, and a rejection of the designated elements indicates the need for further research or an appropriate arrangement in the module. This study has provided information to the researcher regarding the conditions of acceptance of expert agreement and the rejection of items that do not meet the requirements of construction or innovation.

In addition, Ibrahim et al. (2020), the study showed that 'clear audio' got the highest ranking with a value of 0.897 in the Flipped Classroom design for students with special educational needs (SE). This shows that quality audio elements are very important in delivering learning materials to MBP. Although 'structured use of sentences' gets a lower value, audio is an important context in learning. This study also shows that a multimedia approach that involves quality audio and organised sentence-shaped messages is the main choice in MBP learning design. In conclusion, learning materials need to be carefully planned to meet the needs and abilities of MBP, especially the clear audio element, which is a very effective teaching and learning element. Through this study, the researcher can make a reference to the fact that the main element in a construction or innovation is determined by ranking in the Fuzzy Delphi method.

Methodology

Research Design

This study is a quantitative study that applies FDM to obtain expert agreement on the need for Affixes Innovation Game elements based on expert consensus. This method involves the use of fuzzy set theory, which has been integrated into the classic Delphi method, where the Likert scale chosen by the expert will be converted to a fuzzy scale by using fuzzy numbering, which consists of binary numbering terms (0,1). The integration of this fuzzy numbering will produce three values, namely the minimum value, the most reasonable value, and the maximum value that will be selected by the expert.

Research Instrument

This study uses a questionnaire as an instrument to obtain quantitative data regarding the elements of Affixes Innovation Game. This questionnaire has gone through the views and refinement of experts and has received language validity and content validity from field experts and curriculum experts. The use of questionnaires is to meet the criteria and conditions for the use of FDM, which involves the use of mathematical formulas to obtain expert agreement. The instrument used by the researcher is based on the needs of this study.

Table 1
Questionnaire for Experts

Level of Agreement	**Likert Scale**	**Fuzzy Scale**		
Extremely Strongly Agree	7	0.9	1	1
Strongly Agree	6	0.7	0.9	1
Agree	5	0.5	0.7	0.9
Moderately Agree	4	0.3	0.5	0.7
Disagree	3	0.1	0.3	0.5
Strongly Disagree	2	0	0.1	0.3
Extremely Strongly Disagree	1	0	0	0.1

The diagram shows that the higher the number on the scale, the more accurate the data obtained. In this study, the researcher has used a seven-point linguistic scale as shown.

Data Analysis Questionnaire

In summary, the conditions for reaching expert agreement are as follows:

Table 2
Conditions of Triangular Fuzzy Numbers and Defuzzification

Condition	Value
Threshold Value (d)	≤0.2
Expert Agreement Percentage	≥75%
α-cut value	≥0.5

In the process of building the Affixes Innovation Game, there are 18 experts who have been selected to confirm, evaluate and look in detail at the main components of this Affixes innovation. This is very important for verification and improvement, acceptance or rejection based on the agreement of experts group with experience.

Condition 1: Using Threshold Values, d.

According to Cheng and Lin (2002), if the threshold value exceeds 0.2 the item will be rejected or the second round only against experts who do not agree. The threshold value that exceeds the threshold value of 0.2 will be marked black (bold).

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

Figure 1. Defuzzication Process

Condition 2: Based on Traditional Delphi Method.

According to Chu and Hwang (2008), the Traditional Delphi Method states that expert group agreement needs to be more than 75% as a condition for accepting the item.

Condition 3: Based on α-cut Tang and Wu (2010)

The α-cut value is the middle or median value between Fuzzy numbers (0-1), so the α-cut value amounts to 0.5. The use of the α-cut value is used in the Fuzzy evaluation process. If the value of the fuzzy score (Amax) is more than 0.5, then the construct or item being measured is accepted by expert consensus. Whereas if it is less than 0.5, the construct or item in a study is rejected based on expert consensus.

0.0	0.1	0.2	0.3	0.4	**0.5**	0.6	0.7	0.8	0.9	1.0

α-cut = 0.5
Figure 2. Position of α-cut Value in Fuzzy Numbering

Analysis and Result

Table 3

Experts Demoghraphic Information

Item	Demographic information	Frequency	Percentage
Field of work	Director of MoE	1	5.5
	SIC+ BM	1	5.5
	IPG BM Lecturer	1	5.5
	BM Committee Chairman	3	16.7
	BM teacher	12	66.7
Experience	Less than 5 years	0	0
	5 - 10 years	4	22.2
	10 - 15 years	8	44.4
	15 years and above	6	33.3

The selected experts are from the field of Malay and have more than 5 years of experience. According to Grant and Davis (1997), experts are usually measured using criteria such as conferences, professional committee members, authors and at least 5 years of experience in academia or industry in a field. This statement is supported by Gambatese et al (2008) who state that experts are also identified through the demonstration of expert knowledge and are recognized by the profession community based on their expertise in the publications and disciplines involved. Moreover, the expert group also needs to be made up of experts in various fields who have broad skills regarding the research problem under study (George & Pramod, 2014).

Table 4

Content Findings of Affixes Innovation Games Based on the Fuzzy Delphi Method

Item acceptance conditions:

1) Threshold value ≤ 0.2
2) Expert Group Agreement Percentage ≥ 75.0%
3) All alpha -Cut values for each item exceed α= 0.5

Items in the content of the Affixes Innovation Game have received expert approval and expert agreement. The set items have been arranged based on the ranking (ranking) according to priority, the 'innovation game objective based on 21st century learning' got the first position in the consensus of experts. In conclusion, the items in this content have met the conditions and received approval from the expert panel with good value.

Table 5
21st Century Learning Outcomes Affixes Innovation Games

No	Items/Elements	Terms of Triangular Fuzzy Numbers			Ranking
		Threshold value, d	Percentage of Experts Group Consensus, %	Fuzzy Score (A)	
1	Affixes Innovation Games provide fun in learning.	0.016	100.0%	0.961	1
2	The Affixes Innovation game attracts students to learn Malay Language subject.	0.094	100.0%	0.867	5
3	TheAffixes Innovation game motivates students to learn the Affixes Topic.	0.075	100.0%	0.922	2
4	The acrostic technique in the Affixes Innovation Game makes student easier to master Affixes Topic.	0.068	100.00%	0.900	4
5	Affixes Innovation Game increase the mastery of Affixes topic quickly.	0.106	88.89%	0.909	3

Item Acceptance Conditions
1) Threshold value ≤ 0.2
2) Expert Group Agreement Percentage ≥ 75.0%
3) All alpha -Cut values for each item exceed α= 0.5
The items in the learning outcomes of the Affixes Innovation Game have received expert approval and expert agreement. The listed items have been arranged based on the ranking according to priority, 'Affixes Innovation Game provides fun in learning' is the item that got the first position in the consensus of experts. Strictly, all items of learning outcomes have been agreed upon by experts and meet the conditions that have been set.

Through this phase, a set of questionnaires was distributed to experts who had been selected by a total of 18 people. Each item has been selected and identified based on previous studies

and literature highlights that have been reviewed by previous researchers. Each item is also referenced based on DSKP and textbooks used by SJK students. As a result of the analysis through the Fuzzy Delphi method, no element of 21st century Affixes Innovation was dropped through expert consensus. In addition, the expert panel has agreed on the items and elements set in the Affixes Innovation game with a threshold d value of less than 0.2, the percentage of expert agreement exceeds 75.0% while the defuzzication (alpha-cut) has exceeded 0.5. In conclusion, the Affixes Innovation game has been accepted and has a full expert consensus on the items and constructs that have been set.

Conclusion

This study aims to design and build innovations that can be used by the programme to strengthen the topic of affixes in the Malay language. Before the Affixes innovation game is built, an analysis of the main elements and components based on 21st century learning is carried out first for the items that need to be applied in the Affixes innovation game. The information from this study will be used as one of the concrete inputs to design an Affixes innovation game based on 21st century learning. In addition, after obtaining expert consensus on defining constructs and elements, innovation prototypes can be developed as a basis. According to Mustapha and Darusalam (2018), the Fuzzy Delphi Method is an effective method in obtaining expert agreement or consensus on a topic or study.

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