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Application of Fuzzy Delphi Method in Developing Common Nouns and Proper Nouns Innovations

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Abstract

This study focuses on the creation and expert evaluation of a novel educational module aimed at improving students' grasp of common and proper nouns within vernacular school (SJK) textbooks. By integrating classroom learning with engaging, interactive tools, the module is designed to enhance students' understanding and application of noun concepts, thereby improving their writing accuracy. Employing the Fuzzy Delphi method, the study garnered insights from 20 Bahasa Malaysia (BM) experts through a comprehensive questionnaire. This questionnaire evaluated various aspects of the module, including its content, effectiveness, and the innovative use of KaNAK cards and Jenga games for learning. The unanimous consensus among experts, indicated by a threshold d value below 0.2, over 75% agreement, and a defuzzification (alpha-cut) above 0.5, validates the module's design and educational approach. This strong expert agreement highlights the module's potential to significantly enhance noun teaching and learning in BM. The findings suggest the need for further investigation into the module's application in classroom settings and its impact on student learning outcomes, pointing towards future research directions involving pilot studies to assess the module's effectiveness in practice.

Keywords: Innovation, Fuzzy Delphi, Evaluation, Common Noun, Proper Noun

Introduction

21st-century learning emphasizes creative and innovative teaching and learning techniques by focusing on students. Teachers with specific skills will nurture students' abilities, potential, skills and knowledge in various ways. A skilled educator can change students' perspectives on the subject and what they want to teach (Yahaya et al., 2019). According to Budhai and Taddei (2015), skills in the digital economy, known as PAK21, are essential for students to meet education needs and rapid change. The education system needs to undergo a paradigm shift so teachers can convey knowledge more fully and consistently to students. Applying PAK21 skills in an academic environment requires understanding and systemic action in education.

Every educator should be committed to educating competitive and thriving students in the 21st century. The PAK21 concept, introduced by the Malaysian Ministry of Education in 2015, emphasizes the 4C skills: skilled communicators, creators, critical thinkers, and collaborators. These skills prepare students to face the demands of an increasingly complex global society and rapidly developing technology.

Every educator is instructed to be motivated and committed to helping students achieve excellence in this digital age. The PAK21 concept, introduced by the Malaysian Ministry of Education in 2015 after an innovative test in 2014, has become the main focus of the country's education system. An educational approach that only focuses on the "3M" (Reading, Writing, and Numeracy), which was once considered the central core of education, is now regarded as inadequate in meeting the needs of the 21st century, which is increasingly complex and technologically evolving. Today's students need to be trained to be 4Cs: skilled communicators, creators, critical thinkers, and collaborators, to succeed in an increasingly complex and changing global society (Ng et al., 2020).

PAK21 is very important for teachers with high aspirations because it personally benefits educators. This is due to the ability of teachers skilled in this technology to integrate it into their curriculum. In particular, in an era where the use of technology is becoming more widespread in various professions, including education. Teachers who are creative in their teaching approach and skilled in technology are very much needed to meet the requirements of PAK21. An educational infrastructure that promotes relevant learning is more important than just using technology in every learning activity. In addition, the emphasis on PAK21 indirectly encourages improving school infrastructure, an essential aspect of learning. The education sector has undergone significant transformation in the 21st century. The implementation of PAK21 is believed to enable schools to improve their facilities and infrastructure and prepare a learning environment suitable for this era (Mailis, 2021).

Literature Review

A Study of 21st Century Learning

Iberahim et al. (2017) studied the influence of attitude, motivation and Malay language achievement of secondary school students in 21st-century learning. The applied elements are based on the needs of the technological age, such as communication skills, science and technology, thinking, interpersonal, intrapersonal, 3M skills and so on. Analyze the data descriptively by explaining the mean and standard deviation. The study's findings show that students' attitudes and motivations are positive towards learning the Malay language. One of the factors is that teachers use teaching methods that apply 21st-century skills. The study of Yusof et al. (2023) also stated that using the Malay Language Learning Kit (KPBM) can practice innovative teaching and practical learning. The study results show that the KPBM developed based on technology for international students learning the Malay language can increase their motivation and provide a positive attitude towards learning it.

Ahamad and Bakar (2023) used the fun learning approach by applying project-based Malay language learning, which is believed to involve students actively during the PdPc process. This learning is also supported by Tonge and Mahamod (2020), who believe that project-based learning can improve writing skills among students. Ahamad and Bakar (2023) have used a project based on acting and building a song as a step to present a given situation. Through this activity, students can work with group members to generate ideas for each situation (Ahamad, Bakar and Juhary, 2022). This improves language learning and successfully creates good interaction between friends, mastering good reading and writing. In line with 21st-century learning, student-centred learning, the mastery of Malay language skills, as emphasized in DSKP, can be achieved quickly and effectively. This study benefits educators in

diversifying teaching and learning methods that suit the students' environment so that students can actively engage in class.

Looking at students' acceptance of game-based learning, the study of Hushaini et al. (2022) proves that teaching materials that apply the latest technology significantly impact students. One of the ways to implement learning in the 21st century is through applying gamification that is in line with the current generation. This can be seen in the study of Ding et al. (2018), who created a game named gEchoLu that has successfully attracted students' attention to actively attending lectures. Furthermore, the study of Chee et al. (2020) found the same finding, which is that learning Chinese as a foreign language has been well received by students through an application called Smart Mandarin. Students enjoy learning a new language under the supervision of a facilitator. This study motivates every educator to model teaching by applying exciting technology so that students have a positive attitude towards the subjects being studied.

On the other hand, Mahat et al. (2021) studied the assessment implementation process in technology-based schools. The student-centred teaching and learning process emphasized in Pak-21 applies elements of communication, collaboration, critical thinking and creativity, as well as the application of moral values and ethics (Ministry of Education, 2017). However, the study results show that teachers use less technology-based teaching and focus more on conventional teaching. This is due to time constraints, and some teachers are also believed to need more skills to use technology. When examining students' wishes and interests, the study results show that students want teachers to use technology during the PdPc process because it can provide a clearer understanding of a subject being studied. As such, this study offers an opportunity for researchers to generate ideas to build an innovation that can be used in mastering capital letters and small letters in common and proper nouns.

Next, the study by Ahmad et al. (2019) found that 21st-century teaching and learning practices positively impact student development. Based on the eight dimensions emphasized in pak-21 learning, three dimensions can be applied successfully during the PdPc process at school. The most dominant skills teachers apply are problem-solving, communication, and critical thinking. The teacher's awareness of student-centred learning and the application of skills aimed at forming excellent and holistic people reflect the competence of the teachers and give importance to the development of the times. All educators should emulate the application of teaching and learning based on pak-21 to convey knowledge effectively and form holistic students.

Module / Game Based Studies

The study of Rasdi et al. (2021) is based on module development in learning. This study has used the ASSURE model to develop a teaching module in the form of a game named a game board (GB) and test the module's effectiveness in the teaching and learning method of number operations in early mathematics. The sample in this study involved four preschool children who were six years old and a nursery school teacher. This study was conducted for eight weeks and involved a combination method (mix method) in analyzing and testing the effectiveness of the modules produced. This game-based module involves three types of games, namely Game Goose, snakes and Ladders and Sliding Kids. These three games positively impacted the post-test conducted after exposure to the method of teaching and learning number operations. The study results have shown that children who have moderate mastery in number operations have managed to master number operations well through this

game activity. In addition, the children's involvement is also active throughout the teaching session; the children also interact positively with the Group members. This study has proven that teaching and learning patterns should be in line with the development of the current generation, and 21st-century skills should be applied so that the teaching and learning motive runs smoothly and achieves the goals of the content standards that have been set. This study encourages researchers to produce reference materials suitable for learning common nouns and proper nouns that can be used as support material by teachers and students.

Ali and Mahamod's (2016) study focuses on producing modules compatible with preschool PdP. The development and design of the study involved the Fuzzy Delphi approach from Richey and Klein. The objective of this study is tested in the first stage, which is to analyze the development needs of the module. The main focus of this study is on teaching and learning language skills among children in preschool, so the sample involved is ten preschool teachers. Due to time constraints, the study's findings show that teachers must practice play activities in their teaching and learning process. However, they agreed on the importance of student-centred teaching and learning and opened up space to develop modules that fit the needs of preschool children in improving language skills. The approach applied in this study serves as a guide for researchers to produce a systematic module. The researcher's study considered the Fuzzy Delphi approach in creating a module for letter mastery in common and proper nouns.

In addition, Raman et al. (2023) have studied the use of modules to master Malay language essays among level 2 students. This study aims to build a module that can be used as a guide in writing essays and test the module's effectiveness among students. The module is developed using the ADDIE Model. The study's findings show that this module obtains high expert agreement and is adopted because it is believed to improve student achievement during essay writing. The use of modules in Ping and Aik's study (2022) also stated that the illustrated modules produced for learning compound words positively impacted the construction of compound words when writing sentences. This shows that intervention methods from educators, such as diversifying teaching methods by looking at the needs of students, can lead to effective learning. This study gives researchers ideas on diversifying the content of modules specially built for students.

Next, the fun learning method, which is meant as a process of teaching while playing by Ching and Nordin (2021), positively impacts the learning of the Malay language. The game "Hidden Objects" strengthens the fourth-year students' understanding of learning to match numbers. This game is used as a learning aid that meets the learning needs of the 21st century; that is, students can learn anywhere without time control. This game got the attention of year four students, gave them fun, and even stimulated their motivation to learn number matching. This study provides the researcher with an idea to build a game that can raise the spirits of non-native speakers to master the essential components of the Malay language, namely common nouns and proper nouns, by understanding the concept of using capital letters and small letters.

Interactive games also attracted the attention of Zulfikri and Masnan (2022) in their study that examined the effectiveness of learning among children through innovation manipulated by the development of electronic technology. The game produced is a holographic prototype that can be accessed using a QR scanner, and the image will appear as a three-dimensional (3D) virtual reality. Through this innovation, children's involvement in learning Malay increased dramatically. Reading story books through interactive books stimulates children's

sensitivity in reading skills and reasoning knowledge for an extended period. The same findings are also seen in the study of Burhanuddin and Shapii (2020) and Tasripin and Bakar (2018), stating that interactive game activities are not only fun but can promote an effective learning process, that is, students can improve feedback skills, develop knowledge and attract students' attention. This study provides an opportunity for researchers to consider fun teaching methods for mastering letters in common nouns and proper nouns to stimulate students' interest and motivation in learning KNA and KNK more effectively.

Malay Language Proficiency Study

The study of language error analysis has also attracted the attention of many local researchers. Among the studies that can be seen are the studies of Mat and Shaid (2023), Razin and Subramanian (2019), Ahamad et al. (2020), and Ismail and Hamzah (2018), which focus on morphological errors, especially on the affix component. Non-native Malay speakers are found to need clarification and to gain knowledge in the correct use of affixes in writing. This study's findings attract researchers' attention to writing skills among SJKT students.

In addition, many studies examine orthographic errors, such as word usage, uppercase and lowercase letters, and spelling and punctuation errors. Asnola et al. (2022), Alizuddin and Arif (2021) and Nurhidayah and Prabawa (2016) studied spelling errors in the writing of students in primary school, students in secondary school and university students. The study's findings show that capital and minor letter errors, punctuation and spelling are very noticeable in their writing. Furthermore, Melai and Abidin (2020) also think that spelling mistakes are the main problem in language mastery by international students. The interference of their first language confuses the use of letters. Overall, the researcher found that the solution to the problem expressed received less attention from other researchers even though they knew that the fundamental aspects of the Malay language were still wavering among students. This study allows researchers to find ways to overcome the mistakes in using uppercase and lowercase letters among students.

Some studies examine orthographic errors, such as Tenggok and Shaid (2023), Kihob and Mahali (2020), Mahamod et al., (2021) and Zakaria and Abdullah (2014). Although these studies examine the errors of language analysis from the aspect of orthography, the discussion focuses on the mistakes of uppercase and lowercase letters and needs more attention. Uppercase and lowercase letter errors are only stated from the total number of mistakes made. No specific study carefully examines the mastery of uppercase and lowercase letters. The gap in this study allows the researcher to study the mastery of uppercase and lowercase letters in nouns.

Based on the discussion, the main focus of the researcher in this study is to examine the agreement of experts on the innovation kit built by the learning of pak-21 in the mastery of uppercase and lowercase letters in common nouns and proper nouns.

Methodology

The design of this study is a quantitative study that applies FDM to obtain expert agreement in the design of remuneration innovation based on expert consensus. This method involves the use of Fuzzy Set theory, which has been integrated into the classic Delphi method, i.e. the Likert scale chosen by the expert will be converted to a Fuzzy Scale by using fuzzy numbering consisting of binary numbering terms (0,1). The combination of this fuzzy numbering will

produce three values: the minimum value, the most reasonable value, and the maximum value that the expert will select.

Instruments

This study uses a questionnaire to gather quantitative data to create the Remuneration Innovation design. This survey has been subjected to expert review and revision and verified for language and content validity by curriculum and field experts. It uses questionnaires to fulfil the requirements and specifications for FDM, which includes utilising mathematical formulas to get expert approval. The requirements of this investigation determine the researcher's tool.

Table 1
Expert Questionaire Likert Scale

Level of suitability	Likert scale	Fuzzy scale		
Strongly disagree	1	0	0	0.1
Disagree	2	0	0.1	0.3
Somewhat disagree	3	0.1	0.3	0.5
Neither agree nor disagree	4	0.3	0.5	0.7
Somewhat agree	5	0.5	0.7	0.9
Agree	6	0.7	0.9	1
Totally agree	7	0.9	1	1

(Source: Jamil et al., 2014)

The table above shows a 7-point likert scale that has been used to get expert agreement on the innovation kit developed to help students master common nouns and proper nouns more effectively. According to Jamil et al., (2017), the higher the scale value, the more precise and accurate the data obtained. In summary, the conditions to reach expert agreement in fuzzy Delphi involve three conditions, as shown in the following table.

Table 2
Triangular Fuzzy Numbers and Defuzzification Process

Condition	Value
Threshold value (d)	d≤0.2
Percent of specialist deals	>75%
Fuzzy A score	≥0.5

In the design process of the KaNAK Innovation kit, 20 experts were selected to verify, evaluate, and look at the main components of this innovation in detail. This is very important for verification and improvement, as well as acceptance or rejection based on the agreement of a group of experts with experience.

Condition 1: Threshold value (d).

The first condition includes the value of Threshold value (d). In this case, the resulting Threshold (d) value must be less than or equal to a value of 0.2 to obtain expert group agreement. Accordingly, three decimal points are used. So, every item with a Threshold value (d) that does not reach a value of 0.3 and above will be translated as ACCEPTED based on

expert agreement. The following is the Threshold value (d) formula used to calculate expert agreement in this study.

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

Condition 2: Percent of specialist deals

Percent of specialist deals ≥ 75%

The second condition in FDM is the percentage of expert group agreement for each item and the entire construct calculated using the traditional Delphi method. According to Chu and Hwang (2008), the rate of specialist agreements must exceed 75%. The percentage of expert group agreement is also essential to show expert agreement because if the expert deal for an item or construct is less than 75%, then the item does not get approval from the specialist group and needs to go through a second round or the item needs to be discarded. 75% is chosen based on the number of experts who agree that it is 2/3 of the total number of experts.
Condition 3: Fuzzy A score

Fuzzy score (A) ≥ α - cut value = 0.5

Based on Tang and Wu (2010), the α-cut value is the median value between fuzzy numbers (0-1), which is 0.5. In the defuzzification process, if the average fuzzy number score value exceeds 0.5, then the evaluated construct or item will be accepted based on expert agreement. On the other hand, if the value of the average of the fuzzy number is less than 0.5, then the construct or item measured is rejected based on expert agreement. Next, this process also shows the position and acceptance of the highest item. If the fuzzy score (A) value is the highest, then the item or construct will be in the first position. The calculation and determination of fuzzy evaluation in this study use the formula below A_{max} = 1/3*(m1, m2, m3) to obtain the average fuzzy number (Jamil et al., 2017).

Research Findings and Discussion

Table 3
Panel of Experts

Demography		Frequency N=20	Percentage (%)
Gender	Male	7	35
	Female	13	65
Race	Malay	6	30
	Chinese	3	15
	Indian	11	55
Work field	SISC+	1	5
	Head of Malay Committee	6	30
	Language teacher	13	65
Experience	1-5 years	0	0
	6-10 years	5	25
	11-15 years	9	45
	15 years and above	6	30

Table 3 shows the demographic information of the experts providing feedback on the innovations produced. A total of 20 experts were involved in this study's design and development phase. Of the 20 experts, 7 are male expert teachers, while 13 are female. The expert teachers involved in this study are Indians, a total of 11, 55%; 6 Malay expert teachers (30%); and 3 Chinese expert teachers (15%). Next, regarding employment, an expert consists of SISC+ officers (5%), heads of the Malay language committee involved in a total of 6 people and Malay language teachers, in a total of 13 people, respectively, showing 30% and 65%. Expert teachers with experience between 11-15 years show a large number of nine people, while expert teachers with experience between 6-10 years and 15 years and above comprise 25% and 30%, respectively.

Table 4
Content of Module

No	Item / Elemen	Condition in Triangular Fuzzy Number			
		Threshold value (d)	Percent of specialist deal (100%)	Fuzzy score (A)	Ranking
1	Module content is organized and focused on topics.	0.111	100.0%	0.887	4
2	A clear introduction of common noun and proper noun.	0.087	95.0%	0.903	3
3	The module is suitable for use as a reference book for common nouns and proper nouns.	0.107	100.0%	0.863	6
4	Explanations in the form of graphics, illustrations and pictures motivate students.	0.070	100.00%	0.932	1
5	Exercises are provided for each component to reinforce reinforcement.	0.096	100.00%	0.853	7
6	Exercises are provided for each component to strengthen the understanding of common nouns and proper noun.	0.076	100.00%	0.922	2
7	The module meets the needs of the user.	0.093	100.00%	0.872	5

Table 5
The Concept of Common Noun and Proper Noun

No	Item / Elemen	Condition in Triangular Fuzzy Number			
		Threshold value (d)	Percent of specialist deal (100%)	Fuzzy score (A)	Ranking
1	Common noun and proper noun components based on Learning Standards (SP).	0.076	100.0%	0.917	1
2	The concept of common noun is clear and acceptable.	0.101	100.0%	0.900	4
3	The concept of proper noun is clear and acceptable.	0.076	100.0%	0.912	3
4	The concepts given are easy to understand.	0.076	100.00%	0.912	3
5	The concepts of common noun and proper noun can be quickly remembered with the support of mnemonic techniques.	0.089	95.00%	0.913	2

Table 6
Evaluation of card KaNAK

No	Item / Elemen	Condition in Triangular Fuzzy Number			
		Threshold value (d)	Percent of specialist deal (100%)	Fuzzy score (A)	Ranking
1	Card KaNAK innovation is interesting.	0.076	80.0%	0.922	5
2	Card KaNAK innovation helps students to remember the concepts of common noun and proper noun.	0.070	80.0%	0.932	2
3	Card KaNAK innovations help students to master the nouns.	0.057	80.0%	0.942	1
4	Card KaNAK innovation boosts student motivation towards learning Malay language.	0.073	80.00%	0.927	3
5	The card KaNAK innovation is easy to use as a reference for noun concepts.	0.073	80.00%	0.927	3

Table 7
Evaluation of Jenga KaNAK

No	Item / Elemen	Condition in Triangular Fuzzy Number			
		Threshold value (d)	Percent of specialist deal (100%)	Fuzzy score (A)	Ranking
1	Jenga KaNAK improves grammar skills.	0.076	100.0%	0.922	1
2	Jenga KaNAK meets cognitive skills in language learning.	0.076	100.0%	0.922	2
3	Jenga KaNAK activities encourage students to think critically and creatively.	0.072	100.0%	0.888	5
4	An activity that can contribute to the successful PdPc process.	0.076	100.00%	0.922	2
5	An activity that can improve students' performance in Malay.	0.070	100.00%	0.902	4

Condition
1) *Threshold* value (d) ≤ 0.2
2) Percent specialist deals ≥ 75%
3) All defuzzification values for each item exceed the α-cut=0.5 value

All the items given for the content of the letters in the nouns module, the concept of common nouns and proper nouns, card KaNAK evaluation, and Jenga KaNAK evaluation achieved an excellent percentage of expert agreement and were agreed by all experts. Items that achieve a high defuzzication value are arranged according to priority (ranking), as shown in Tables 4,

5, 6 and 7. All items for noun innovation have met the three conditions set in the fuzzy calculation.

The action to evaluate the innovation of module, card KaNAK and Jenga KaNAK is to get the opinion of certified experts and the effectiveness of innovation during implementation among students. This assessment can improve the quality of innovation and can provide benefits to all parties who apply innovation in the teaching and learning process. This coincides with the study of Effendi et al. (2017) and Pukdeewut et al. (2013), who argue that the main step in the construction of instruments, models or modules is to evaluate and measure the validity of the content of the development so that the researcher can achieve the set objectives. Accordingly, all innovation developments in this study have sought expert consensus. All constructs for this study have received high expert agreement and are accepted by experts. This proves that the development of modules and innovations based on the concept of fun education can positively impact the PdPc process and help students improve vocabulary mastery, which is also one of the factors highlighted by the teachers in the first objective. This finding aligns with the views of Mustapa and Miskon (2022) and Mohd and Ahmad (2005). Applying strategies and methods together with auxiliary materials in the PdPc process can build up-to-date teaching, more planned and systematic pedagogy, and teaching practices in addition to attracting students' interest by focusing on the teacher's instruction. Any views and suggestions from experts in this process have been considered as a step to produce modules and innovations that meet users' needs and facilitate the use process.

Conclusion

The study results show the evaluation of noun innovation items using the Delphi Method. Through this phase, questionnaires were distributed to 20 selected experts. The questionnaire was divided into four constructs of between 7 and 5 items. Each item has been selected and identified based on previous studies and literature highlights that earlier researchers have reviewed. As a result of the analysis through the Fuzzy Delphi method, every element in noun innovation was kept a secret through expert consensus. In addition, the expert panel has agreed on the items and elements set in noun innovation with a threshold d value of less than 0.2; the percentage of the specialist agreement exceeds 75.0%, while the defuzzification (alpha-cut) has exceeded 0.5. In conclusion, the noun innovation was accepted, and complete expert consensus was gained on the items and constructs set. According to Mustapha and Darussalam (2018), the Fuzzy Delphi Method is more effective for studies that use expert opinions and save time, shortening decision-making time and making it easy to get expert opinions. Experts are formulated as trusted sources based on knowledge to evaluate and make decisions about an issue transparently, accurately and fairly, according to the status and rules of the specialization of a field.

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