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Measuring Student's Perception on Mathematics Learning using Fuzzy Conjoint Analysis

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HIGHLIGHTS

- Fuzzy Conjoint Analysis is used in measuring undergraduate mathematics management students' UiTM Perlis perception toward mathematics learning.
- Students show a good attitude in learning mathematics.
- Students strongly agreed that the lecturers had played their role very well.
- Students do not perceive mathematics positively.

ABSTRACT

Mathematics courses are widely applied in the overall sector because mathematics is not only about the calculation or formulation, but also helps in solving problems using mathematical modelling. Students need to have a good understanding of the theory of mathematics in order to produce the best results. In the world of digitization, subjects in science, technology, engineering and mathematics have become Malaysia's agenda in the preparation to compete globally. Empowering in these subjects enables the creation of innovators of the future, hence creating job opportunities in the digitization world. However, the academic institutions have been facing a critical problem in potential growth of achieving the mission and vision in enhancing the students' performance when it is related to the students' interest. This study focuses on students' perception toward mathematics learning among 60 undergraduate management mathematics major's students at UiTM Perlis using fuzzy set conjoint analysis. The attribute in each dimension is ranked according to the highest similarities values. The finding showed that students were rated neutral toward the preparation before class (student's attitude); strongly agree that the lecturers are knowledgeable and well prepared before class (lecturer's role); and rated neutral on female students are more qualified mathematician and their passion toward mathematics but strongly agreed that mathematics is difficult to understand in short period of time (student's perspective).

***Keywords**: Fuzzy conjoint analysis, attributes, perception.*

INTRODUCTION

Generally, most universities would like to offer their students a basic level of education and encourage other students to dive into mathematics learning as an elective for the students' course. Mathematics courses are widely applied in the overall sector because mathematics is not only about the calculation or formulation, but also sometimes helps in solving problems using mathematical modelling. Students need to have a good understanding of the theory of mathematics in order to produce the best results. From the research findings, through a various accepted approach, mathematics is described as a discipline that is full of meaningless rules and calculations. Serin and Incikabi (2017) defined mathematics as a fundamental tool which he tried to explain the importance of mathematics not only for solving a scientific problem but also in solving the issues that one faces in daily life.

Many factors can encourage or impact students' performance such as their attitudes, interest, perceptions, family background, and method of learning as educators. This research will go through certain aspects only. Attitude is not something new in the study of perception. Attitude can be described as internal matter to analyse or in showing the understanding of the certain matter. It can therefore be said that attitude is one of the major causes that influences students' perspective towards mathematics. As argued by Maria et al.(2012), attitudes can be described as more or less positive whereby a positive attitude towards mathematics education will enhance positive emotional disposition in relation to mathematics subjects. In fact, these will highly influence an individual's behaviour as it is likely to produce students with higher potential in mathematics performance. It is because they enjoy and explore knowledge on mathematics subjects with confidence and know how important mathematics learning is for their own future. Moreover, positive attitudes are very useful since it will influence willingness to learn and can benefit others such as students who will then help the institution to grow their performance as well as achieve their mission and vision.

In addition, students must show cooperation and have a strong relationship with the lecturer in the teaching and learning process. A lecturer's role also plays an important part in encouraging students' interest towards mathematics. Lecturers will try their best to educate their students by focusing on the implementation of the learning approach. On top of that, providing a conducive classroom ensures that students will be comfortable to study with an open mind and to be more focused during learning sessions. In order to improve students' understanding, lecturers normally take tremendous effort in preparing the teaching materials ahead of time to make sure the teaching process runs smoothly.

Unfortunately, students are likely to accept the perceptions from people who are likely to spread the negative vibes in the area. Research by Mutodi & Ngirande (2014) showed that students who have the best performance in mathematics are treated as "nerds". This makes students dislike mathematics and feel that this subject is reserved for the selected few. It also tends to increase the students' feeling of stress, anxiety and fear due to overthinking about their capabilities in mathematics learning.

The importance of conjoint analysis became popular in the field of mathematics because of its usage on measuring the reaction or predicting consumer preference given to various attributes of the product. However, the feedback or result that this study evaluates comes from people's judgments thus it is very subjective. Hence, it will differ in meanings because perception, opinions, and also satisfaction level are assessed by the customers' feelings. Having said that, there exists the development in describing the preferences of consumers by using Fuzzy set theory proposed by Zadeh (1965). The method was introduced to evaluate the perceptions regarding the consumers' reactions. The significance of this kind of method is that it will cover all the problems of uncertainty, the incomplete information and it can be processed with an undefined event which is stated by Abdullah & Osman (2011) . Linguistic rating basically on the

measurement of the Likert-scale. In terms of Likert-scale, which consists of "strongly not a priority", "not priority", "unsure", " priority", and "strongly a priority", shows the subjective preferences. This method has been implemented by added vector preference model which is known as combination function for evaluated the closely actual preference, so that it was called "fuzzy" and is supported by Abdullah et al. (2011), who states that the fuzzy conjoint concept is referring on fuzzy joint vector construct.

Fuzzy conjoint analysis method has been widely used in study to customer's preferences in selecting products, services, and perceptions. Tawil et. al (2011) used fuzzy conjoint analysis in the study of financial management faced by high-rise residential complexes in Kuala Lumpur and Selangor. The study focuses on the service charges, the amount paid by the owners and the level of the owners' satisfaction toward the services provided by the management. Baheri et.al (2010) in a case study of Iranian banks used fuzzy conjoint analysis to improve the market of credit cards in Iran. The aim of the study was to look for the best combination of attributes and level of credit card from the point of view of customers. Rasmani and Shahari (2007) used a fuzzy conjoint method with continuous fuzzy sets to evaluate job satisfaction of 45 academic staff in a university in Malaysia. The result shows that both discrete and fuzzy sets produce consistent results regardless of whether the fuzzy similarity measure was used.

There are many studies related to perceptions on mathematics. A study by Azimah et al. (2019) used fuzzy conjoint analysis to evaluate the students' perception of a game-based mathematics classroom among 83 undergraduate students of Faculty of Computer and Mathematical Sciences, Raub Campus. The study found that generally the students had a positive perception toward game-based mathematics classrooms. Study by R Osman et al (2019) on students' perception on the learning calculus at one government institution in Selangor showed that overall, students perceived positively in the learning calculus. The study used a fuzzy conjoint method based on triangular fuzzy numbers and used the fuzzy similarity measure based on distance, height, and area. Kathiresan et al. (2020) had conducted a study on perception of learning statistics among undergraduates from various non-mathematics/statistics orientations in a Malaysian public university. The finding found that students had highly negative perceptions on learning statistics. Students were often frustrated during the test as they admitted that statistics is difficult. Even though students were able to learn, they were unable to understand and were doubtful about the relevancy.

METHODOLOGY

The details of the use of the method Fuzzy Conjoint Analysis will be discussed as well as the data collected and analysed from this method to measure the perspectives on mathematics learning.

Survey on Students' Perceptions

A survey was constructed based on direct questionnaires that aim to investigate students' perception on mathematics learning. This study only focuses on several perceptions specifically, the students' attitude which consists of six attributes that is denoted by $(A_1 - A_6)$, lecture's role that also consists of six attributes represented as $(A_7 - A_{12})$ as well as student's perception symbolised as $(A_{13} - A_{17})$ which is made up of five attributes. The questionnaire was distributed randomly to Undergraduate Students of Management Mathematics (CS248) in UiTM Arau, Perlis whereby the total number of respondents comprises 60 students. It is interesting to study the mathematics major students' perception on mathematics learning as they are taking a lot of mathematics subjects ranging from algebra or statistics in which the concepts are related to each other. The lists of attributes for this survey are presented in Table 1 below.

Table 1: The attributes of survey towards student's attitudes, lecturer's role and student's perspectives

	Attribute	Statement
Student's Attitudes	A_1	I am really happy if I can find the correct solution for a particular exercise.
	A_2	I always try my best to attend the mathematics class.
	A_3	I think that Mathematics subjects can help me a lot in future.
	A_4	I always prepare myself to study notes before the lecturer starts the lecture.
	A_5	I'm very glad to see that my result for mathematics is quite good compared to other subjects.
	A_6	Sometimes, I pretend to understand in front of lecturers but deep in my heart I only understand several parts.
Lecturer's Role	A_7	Lecturer is very knowledgeable and prepares herself/himself before starting the class.
	A_8	Lecturer is very punctual and strict with the class timetable.
	A_9	Lecturer is always opens the question-and-answer session.
	A_{10}	Lecturer always gives students an additional exercise.
	A_{11}	Lecturer always discusses quiz and test questions before the final examination starts.
	A_{12}	Lecturer usually will return all the test papers to students as a revision for the final examination.
Student's Perspectives	A_{13}	Mathematics subjects are difficult to understand in a short period.
	A_{14}	I am not able to get the higher marks since I am very weak in Mathematics.
	A_{15}	Female students are more qualified to become mathematicians.
	A_{16}	I always think about what the other people say, such as mathematics, one of the killer subjects.
	A_{17}	I do not think that mathematics is quite fun but I will try to get to love it and make it better for my own sake.

Likert Scale

In this study, fuzzy sets that were applied to represent linguistic term for the Likert Scale defined as L_k = {strongly disagree, disagree, neutral, agree, strongly agree}. Table 2 shows the fuzzy set for each L_k where $k = 1,2,3,4,5,$

Table 2: Fuzzy set for each linguistic term taken from Yahaya and Mohamad (2011)

Linguistic term	Rating	Fuzzy sets
Strongly Disagree	1	L1 = {1/1, 0.75/2, 0.5/3, 0/4, 0/5}
Disagree	2	L2 = {0.5/1, 1/2 , 0.75/3, 0.25/4, 0/5}
Neutral	3	L3 = {0/1, 0.5/2, 1/3, 0.5/4, 0/5}
Agree	4	L4 = {0/1, 0.25/2, 0.75/3, 1/4, 0.5/5}
Strongly Agree	5	L5 = {0/1, 0/2, 0.5/3, 0.75/4, 1/5}

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Fuzzy Conjoint Analysis

The conjoint model was developed by Turken & Willson (1994) by using a fuzzy set as an improved conjoint model which allows us to determine the degree of accuracy. A fuzzy set F refers to the hierarchy of all respondents towards the details of attributes. This method is suitable to be used as it gives the researcher a degree of consensus agreement of fuzziness and vagueness for each selected attribute only. The approximate degree of membership of each of element $y_j = 1,2, \dots l$ in the fuzzy set F represent A_m item that will be denoted as:

$$\mu_{F_i}(y_j, Am) = \sum_{i=1}^{n} W_i \bullet \mu_{L_i}(x_j, Am) \quad (1)$$

where:

- y_j and x_j represents as domain elements, j refer to the number of linguistic terms, which $j = 1,2, \dots ,5$
- A_m is a attributes used in the study with m refer to the number of attributes and stated as $m = 1,2,3 \dots d$ where $d = 6$ for student's attitude , $d = 6$ for lecture's roles and $d = 5$ for student's perception.
- W_i described the weight and calculated as:

$$W_i = \frac{wi}{\sum_{i=1}^{n} wi}, \quad (2)$$

  w_i is sum of particular rating that respondent gives for attributes A_m and $\sum_{i=1}^{n} wi$ sum of all rating for attributes A_m

- $\mu_{L_i}(x_j, Am)$ is the membership degree for element x_j for item A_m according to linguistic term $j = 1,2, \dots ,5$.
- n represent number of respondents

In fact, the crisp rating of weight w_i is directly obtained by its respondents' rating for each attribute and each level of agreement. An overall fuzzy membership value should be in μ_{F_i} is the element of [0,1] as final output for fuzzy conjoint model (Turksen & Willson,1994)

Degree of Similarity

In this fuzzy conjoint analysis model, it is substantial to calculate the similarity because it is used to measure the total Euclidean distance that compares the fuzzy set F with the standard fuzzy set of L_k which $k=1,2,3,4,5$. The formula of similarity is:

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$$S(F, L_k) = \frac{1}{\left[1 + \sqrt{\sum_{j=1}^{5} \left(\mu_F(j, Am) - \mu_{Lk}(j)\right)^2}\right]} \quad (3)$$

Similarity degree S can determine the rank and it describes the preference of attributes. Therefore, the final output will determine the ranking of the attributes by selecting the maximum similarity which is denoted as S^{max} (Turksen & Willson , 1994).

Measurement Procedures

In this study, there are 17 attributes that need to be considered. The procedure for this method is detailed as follows:

Step 1: Collect the students' responses for each attribute A_m.
Step 2: Calculate weighted for each attribute W_i by using equation (2).
Step 3: Find the value of membership of each element in set F by using equation (1).
Step 4: Find similarity degree between two set which is set F and set L_k which k refer to linguistics term, $k = 1,2,3,4,5$ by using equation (3).
Step 5: Choose the highest similarity degree.
Step 6: Propose the rank for each group specifications.

FINDINGS AND DISCUSSIONS

The discussion on each attribute will be presented based on results using Excel software and split according to its categorization of attributes. This result includes students' perspective on three specific factors related to attributes, fuzzy output vector and degree of similarity. Table 3 shows the frequency of students' opinions for each attribute A_m.

Table 3 : Frequency of students' opinions related to student's perception attributes A_m.

	Attribute	L_1	L_2	L_3	L_4	L_5	Total
Student's Attitude	A_1	0	0	1	7	52	60
	A_2	0	1	6	11	42	60
	A_3	3	0	4	20	33	60
	A_4	0	11	28	11	10	60
	A_5	2	1	7	19	31	60
	A_6	0	1	11	21	27	60
Lecture's Roles	A_7	0	0	0	22	38	60
	A_8	1	0	3	28	28	60
	A_9	0	0	1	16	43	60
	A_{10}	0	0	3	23	34	60
	A_{11}	0	1	8	25	26	60
	A_{12}	0	1	12	17	30	60

Student's Perspective	A_{13}	0	6	12	18	24	60
	A_{14}	8	23	12	7	10	60
	A_{15}	9	9	25	9	8	60
	A_{16}	2	4	12	27	15	60
	A_{17}	3	19	19	11	8	60

The weight of each attribute A_m with respect to linguistic value k was calculated by using equation (2) is shown in Table 4.

Table 4: Weight of each attribute A_m relayed to linguistic values L_k, k = 1, 2,…,5.

	Attribute	L_1	L_2	L_3	L_4	L_5
Student's Attitude	A_1	0.0000	0.0000	0.0167	0.1167	0.8667
	A_2	0.0000	0.0167	0.1000	0.1833	0.7000
	A_3	0.0500	0.0000	0.0667	0.3333	0.5500
	A_4	0.0000	0.1833	0.4667	0.1833	0.1667
	A_5	0.0333	0.0167	0.1167	0.3167	0.5167
	A_6	0.0000	0.0167	0.1833	0.3500	0.4500
Lecture's Roles	A_7	0.0000	0.0000	0.0000	0.3667	0.6333
	A_8	0.0167	0.0000	0.0500	0.4667	0.4667
	A_9	0.0000	0.0000	0.0167	0.2667	0.7167
	A_{10}	0.0000	0.0000	0.0500	0.3833	0.5667
	A_{11}	0.0000	0.0167	0.1333	0.4167	0.4333
	A_{12}	0.0000	0.0167	0.2000	0.2833	0.5000
Student's Perspective	A_{13}	0.0000	0.1000	0.2000	0.3000	0.4000
	A_{14}	0.1333	0.3833	0.2000	0.1167	0.1667
	A_{15}	0.1500	0.1500	0.4167	0.1500	0.1333
	A_{16}	0.0333	0.0667	0.2000	0.4500	0.2500
	A_{17}	0.0500	0.3167	0.3167	0.1833	0.1333

The next step is to calculate the membership degree for a fuzzy set of students' responses by using equation (1) to each linguistic value, k = 1,2,..,5. Table 5 shows the membership degree of each element of fuzzy set F corresponding to the linguistic value of k=1 (L_1 ; Strongly Disagree).

Table 5: Membership degree of each element of fuzzy set F corresponding to linguistic value L_1 for each attribute Ai

	Attribute	L_1	L_2	L_3	L_4	L_5
Student's Attitude	A_1	0.0000	0.0000	0.0083	0.0000	0.0000
	A_2	0.0000	0.0125	0.0500	0.0000	0.0000
	A_3	0.0500	0.0000	0.0333	0.0000	0.0000
	A_4	0.0000	0.1375	0.2333	0.0000	0.0000
	A_5	0.0333	0.0125	0.0583	0.0000	0.0000
	A_6	0.0000	0.0125	0.0917	0.0000	0.0000
Lecture's Roles	A_7	0.0000	0.0000	0.0000	0.0000	0.0000
	A_8	0.0167	0.0000	0.0250	0.0000	0.0000
	A_9	0.0000	0.0000	0.0083	0.0000	0.0000
	A_{10}	0.0000	0.0000	0.0250	0.0000	0.0000
	A_{11}	0.0000	0.0125	0.0667	0.0000	0.0000

	A_{12}	0.0000	0.0125	0.1000	0.0000	0.0000
Student's Perspective	A_{13}	0.0000	0.0750	0.1000	0.0000	0.0000
	A_{14}	0.1333	0.2875	0.1000	0.0000	0.0000
	A_{15}	0.1500	0.1125	0.2083	0.0000	0.0000
	A_{16}	0.0333	0.0500	0.1000	0.0000	0.0000
	A_{17}	0.0500	0.2375	0.1583	0.0000	0.0000

Student's Attitude

Based on table 6, for attributes related to students' attitude, the preparation on studying notes before class begin (F_4) had the highest maximum similarity value of 0.5599 with rated neutral. That means students are unsure that they are prepared before lecture. Students are strongly agreed in all the other attributes in especially in trying their best to attend mathematics class (F_2), followed by the awareness of the importance of mathematics (F_3), satisfy with their mathematics result, and happiness if they can solve mathematics problem (F_4) with maximum similarity degree of 0.5503, 0.5498, 0.5460, and 0.5447 respectively. Students also strongly agreed to the attribute that students sometimes pretend to understand in front of the lecturer but in fact they only understand part of it (F_6) with the least maximum similarity degree of 0.5433. Overall, students have shown a relatively good attitude in learning mathematics.

Table 6 : Similarity degree between fuzzy set *F* and linguistic variables, *L* for Students' Attitude

Fuzzy set	L_1	L_2	L_3	L_4	L_5	S^{max}	$L(S^{max})$	Rank
F_1	0.4268	0.4242	0.4570	0.4588	0.5447	0.5447	L5	5
F_2	0.4308	0.4330	0.4753	0.4767	0.5503	0.5503	L5	2
F_3	0.4353	0.4310	0.4739	0.4942	0.5498	0.5498	L5	3
F_4	0.4540	0.4860	0.5599	0.4948	0.4835	0.5599	L3	1
F_5	0.4360	0.4363	0.4838	0.4970	0.5460	0.5460	L5	4
F_6	0.4333	0.4401	0.4982	0.5086	0.5433	0.5433	L5	6

Lecturer's Roles

Table 7 showed the rank of the attributes related to lecturers' role. The result showed that students strongly agree in all aspects of the lecturer's role. The measurement showed that the lecturer is very knowledgeable and prepared before class (F_7) has the highest similarities degree value of 0.5615. It is followed by the attribute that lectures always open question and answer sessions (F_9) with 0.5586, give additional exercises (F_{10}), punctuality and strict class timetable (F_8). The result also showed the attribute lecturer usually returns all test papers (F_{12}) and always discusses quiz and test questions before final examination (F_{11}) rank 5 and 6 respectively.

Table 7 : Similarity degree between fuzzy set *F* and linguistic variables, *L* for Lecturers' Role

Fuzzy set	L_1	L_2	L_3	L_4	L_5	S^{max}	$L(S^{max})$	Rank
F_7	0.4262	0.4245	0.4625	0.4927	0.5615	0.5615	L5	1

F_8	0.4301	0.4293	0.4748	0.5096	0.5499	0.5499	L5	4
F_9	0.4268	0.4252	0.4624	0.4810	0.5586	0.5586	L5	2
F_{10}	0.4279	0.4283	0.4724	0.5003	0.5580	0.5580	L5	3
F_{11}	0.4318	0.4369	0.4906	0.5127	0.5444	0.5444	L5	6
F_{12}	0.4338	0.4408	0.4987	0.5004	0.5447	0.5447	L5	5

Students' Perspective

Table 8 showed the attribute related to the student's perspective. The attribute that female students are more qualified to become mathematicians (F15) had the highest similarity value of 0.5442 at the level neutral. This indicates that female students are not sure of their capability in mathematics even though the majority of mathematics management students' are female. Secondly, students are not sure that mathematics is fun but are forcing themselves to love it (F17). Students strongly agreed that mathematics is difficult to understand in a short period (F13) with a score 0.5285, rank 3. Students agreed that what other people said such as mathematics is a killer subject (F16) has influenced their perspective (rank 4). Lastly, students were rated neutral with the lowest score of 0.5091on attribute, unable to get good grades since they are very weak in mathematics (F14). Apparently, students' perspectives toward mathematics are not positive even for mathematics related major students.

Table 8 : Similarity degree between fuzzy set *F* and linguistic variables, *L* for Student's Perspective

Fuzzy set	L_1	L_2	L_3	L_4	L_5	S^{max}	$L(S^{max})$	Rank
F_{13}	0.4403	0.4536	0.5045	0.5012	0.5285	0.5285	L5	3
F_{14}	0.4853	0.5029	0.5091	0.4637	0.4679	0.5091	L3	5
F_{15}	0.4758	0.4837	0.5442	0.4829	0.4729	0.5442	L3	1
F_{16}	0.4427	0.4508	0.5086	0.5192	0.5142	0.5192	L4	4
F_{17}	0.4690	0.5004	0.5358	0.4829	0.4728	0.5358	L3	2

CONCLUSION AND RECOMMENDATIONS

Fuzzy conjoint analysis is used to measure students' perceptions towards mathematics learning. Respondents from undergraduate students of Management Mathematics UiTM Perlis had stated their beliefs and were then evaluated to determine the perceptions towards mathematics learning. The Likert Scale shows the preference level of agreement. The similarity between fuzzy set *F* and linguistic variables on mathematics learning displayed the overall outcome. As a result, regarding the attitude, preparations before the lectures showed the highest similarity degree at the level of "neutral". The remaining of the attributes recorded that they were strongly agreed upon. This concludes that students showed a positive attitude in learning mathematics.

Next, for the role of lecturers, it shows a positive perception as the result implied that students strongly agreed on all attributes. All attributes related to lecturers' role corresponded to positive perceptions and this indicates that lecturers did very well in performing their jobs. Lecturers are knowledgeable and prepare before starting the class with the highest ranking.

On students' perception, the existence of neutral on three out of five attributes, agreed and strongly agreed on the other two showed that students do not have positive perception in mathematics. This contradicts people's expectations as they are mathematics related majors. Students do not find mathematics as a fun subject but they force themselves to love it anyway because they cannot escape the subject. Students agreed that mathematics is a difficult subject and strongly agreed that what people around said about mathematics being a killer subject had an influence in their perception toward mathematics.

This study has not included the size of limitations for respondents. This study cannot be considered as sufficient to effectively generate the outcomes since it only involved management mathematics degree UiTM Perlis. Therefore, a larger number of respondents are needed for a more accurate conclusion of overall or average students' perception towards mathematics learning. For the past two years the Covid - 19 pandemic has led to unprecedented challenges in all aspects of human well-being including education. School closures due to the pandemic had significantly disrupted the education system. Students are unable to attend classes and meet friends as they used to. These factors will affect students emotionally and also their learning perception during the pandemic.

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CONFLICT OF INTEREST DISCLOSURE

All authors declare that they have no conflicts of interest to disclose.

REFERENCES

Abdullah, Md.Tap & A, Wong (2011). Fuzzy Set Conjoint Model in Describing Students' Perceptions on Computer Algebra System Learning Environment. *International Journal of Computer Science. Issues,* 8(2), 92-97.

Baheri, E., Dalvand,M.R., Ansarinejad, A., & Miri-Nargesi, S. (2011). A Fuzzy Conjoint Analysis Approach for Evaluating Credit Card Services: A Case Study of Iranian Bank. *African Journal of Business Management,* 5(7), 2753-2765.https://doi.org/10.5897/AJBM10.1104.

Kathiresan.G,, Nur Raidah. S., and Ahmad Fauzi.M.A. (2020). Malaysian Undergraduates' Perceptions of Learning Statistics: Study on Attitudes Toward Statistics Using Fuzzy Conjoint Analysis. *ASM Science Journal,*13. https://doi.org/10.32802/asmcj.2020.sm26(2.15).

Maria de, L.M, Vera. M, & Francisco. P. (2012). Child Development Research. Attitudes towards Mathematics: Effects of Individual, Motivational, and Social Support Factor, from https://doi.org/10.1155/2012/876028.

.

Mutodi. P & Ngirande. H. (2014). The Influence of Students' Perceptions on Mathematics Performance. A Case of a Selected High School in South Africa. *Mediterranean Journal of Social Sciences MCSER Publishing, Rome-Italy,* 5(3).

R. Osman, N. Ramli, Z. Badarudin, H. Ayub and S.N.FAsri. (2019).Fuzzy Conjoint Method to Analyse Students' Perception on the Learning Calculus. *Journal of Physics: Conference Series. ICoAIMS 2019.*

Rasmani, K.A., and Shahari, N.A., Job Satisfaction Evaluation Using Fuzzy Approach. *Proceedings of Third International Conference on Natural Computation, 2007,Hainan, China.*

S. Azimah, S. Fairuz, H. Nur Fatihah, Z.A Syazwani, D. Anisah, M. Mazura (2019). Evaluation Of Students' Perceptions of Game-Based Mathematics Classroom Using Fuzzy Conjoint Analysis, *GADING Journal for 2019cience and Technology*, 2(2).

Serin, M.K. & Incikabi. S. (2017). Undergraduate Students' Perceptions of the Mathematics Courses Included in the Primary School Teacher Education Program. *European Journal of Educational Research,* 6(4), 541 – 552.

Turksen, I.B., and Willson, I.A., Fuzzy Set Preference Model for Consumer Choice. (1994). *Fuzzy Sets and Systems. 1994,* 68, 253-353.

Yahaya & Mohamad. (2011). Designing Software Usability Measurement Using Fuzzy Set Conjoint Model. *International Conference on Computer Communication and Management Proc. of CSIT ,* 5.

Zadeh, L.A. (1965) *Fuzzy Set, Information and Control*, 338 - 353.