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RESEARCH ARTICLE

Financial mismanagement: a fuzzy DEMATEL approach

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ABSTRACT - Financial mismanagement poses a significant challenge for many organizations involving people from all walks of life, including students. When students enrol to further their study at a university, it might be the first time they are solely responsible for their own finance, requiring them to manage their own expenses. They might have different issues and problems in managing their finances. Financial issues among students are normal, but they cannot be overlooked as they can affect their future. Therefore, identifying the criteria that contributed to the financial mismanagement among students is very crucial. A decision-making instrument which is Fuzzy Decision-Making Trial and Evaluation Laboratory (DEMATEL), was constructed in this study. It is focusing on the selection process to calculate, rank and identify the causes and effects that contribute to the students' financial mismanagement. Based on the analysis of six criteria, the finding shows that the criteria of spending behaviour hit the first place in the ranking order, followed by financial behaviour and financial independence. The causal diagram showed four criteria as the cause group, while two as the effect group.

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1. INTRODUCTION

Becoming a university student is one of the aspirations of many people especially among youngsters. People believe that higher education ensure higher rank in careers and the potential for a higher income. A new challenge someone will encounter at the university level involves effectively handling their own financial. Being full responsible towards one's own financial not only provide a new learning experience but also demands a set of financial management skills. Transitioning from dependence to independence requires learning financial mismanagement skills. Without proper oversight, students may make impulsive decisions and face a greater risk of financial mismanagement [1].

Mismanagement or mishandling is often described as a bad management of a situation or problem. Financial mismanagement refers to bad management of financial, improper administration and wrong use of cash. Financial mismanagement often happens among students. According to [2], students were not exposed to formal education in managing their finance before studying in a college. The findings reveal that only 17% learned the financial skills at school, 42% learned by observing from parents or relatives, while 37% are doing self-learning. Less exposure to financial educations may lead to poor managing level.

There were a number of researchers who have explored financial mismanagement issues in their studies. [3] who have investigated college students' attitudes towards financial management from gender view found that female students' performance in managing their financial is better compared to that of male students. Another study on the effectiveness and sufficiency of the financial education and financial tools was reported [4]. Many researchers have reported that a lack of financial skill and knowledge has caused students to have financial problems [3, 5]. Other than financial skill and knowledge, financial distress is one of the important domains in discussing financial mismanagement problems. The stress caused by financial situation is known as financial distress. Refer to [6], four main factors that lead to financial distress. This finding can be extended to analyse the factors that contribute to the financial mismanagement and its effects to the students. Furthermore, many studies reported that high percentage of students fail to manage their financial [7, 8]. Therefore, identifying the factors or criteria that contribute to the financial mismanagement among students is very essential to address the issue. On the contrary, ignorance about financial mismanagement can give a big impact to their life and well-being in the future.

Exploring the factors or criteria that contribute to the financial mismanagement involved the decision-making process. A complex problem can be efficiently solved using the right method. Among the existing decision-making methods, Decision-Making Trial and Evaluation Laboratory method (DEMATEL) has been used by many researchers in various fields [9-12]. This structural modelling approach can separate the cause group and effect group of the chosen criteria. In establishing the structural model, human judgment is usually presented in crisp values. However, crisp values are inadequate in many of the real-world problems. Thus, a more practical approach is to use linguistic assessment instead of numerical or crisp values in which most of the assessment criteria are evaluated using linguistic variables [13]. Therefore,

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this study aims to explore the criteria, specifically the cause and effect of financial mismanagement using Fuzzy DEMATEL approach.

2. METHODOLOGY

In this section, the methodology used is discussed in detail. Starting with the review of DEMATEL method, then the fuzzy set theory is presented. In the DEMATEL method, the initial and average direct relation matrices are first established and ended with determining the weight of criteria. Meanwhile, in the fuzzy set theory process, the fuzzy set data is converted to crips scale method.

2.1 DEMATEL method

A multi criteria decision-making method known as the Decision-Making Trial and Evaluation Laboratory (DEMATEL) was developed by Fontela and Gabus as cited between 1972 and 1976. The DEMATEL is a graph-theory-based technique which is extremely useful to visualize the structure of complex causal relations with diagraphs or matrices [14-17]. This practical method provides the relationship between criteria as well as the cause and effect that can be displayed in a graph. This method assumes a structure containing a set of factors or criteria, with pairwise relations that can be calculated. To reach the objective, this method can confirm the interdependence among the criteria/attributes and limit the relation that reflects the properties with a basic structure and advance trend. The framework and computational procedures are summarized in the following [11,18].

2.1.1 Establish the initial and average direct relation matrices

Respondents indicate the direct influence that criteria *i* exerts on the criteria *j* using the triangular fuzzy number (TFN). For *p* respondents and *n* criteria, *n* x *n* non-negative matrices, $\tilde{Z}^k$ (initial direct relation matrix) are computed with $1 \le k \le p$. Hence, $\tilde{Z}^1, \tilde{Z}^2, ..., \tilde{Z}^p$ are the resulting matrices for each respondent. The average direct related matrix is computed as follows.

$$\tilde{Z}^{(K)} = \frac{1}{p}\sum_{n=1}^{p}\tilde{Z}^{(n)} = \begin{bmatrix} 0 & \tilde{z}_{12}^{(k)} & \cdots & \tilde{z}_{1n}^{(k)} \\ \tilde{z}_{21}^{(k)} & 0 & \cdots & \tilde{z}_{2n}^{(k)} \\ \vdots & \vdots & \ddots & \vdots \\ \tilde{z}_{n1}^{(k)} & \tilde{z}_{n2}^{(k)} & \cdots & 0 \end{bmatrix} \qquad ;k = 1+2+\ldots+p \tag{1}$$

where $\tilde{z}_{21}^{(k)} = \left(l_{21}^{(k)}, m_{21}^{(k)}, u_{21}^{(k)}\right)$, and 0 on the diagonal elements.

2.1.2 Calculate the normalized direct relation matrices

The normalized direct relation matrix, *N* is obtained as follow:

$$\lambda = \frac{1}{\max\limits_{1 \le i \le n}\left(\sum\limits_{j=1}^{n} x_{ij}\right)} \tag{2}$$

$$N = \lambda X \tag{3}$$

2.1.3. Compute the total relation matrices

The total relation matrices, *T* can be calculated using the following formula, where *I* is the identity matrix.

$$T = N\left(I - N\right)^{-1} \tag{4}$$

2.1.4. Produce the causal diagram

To produce the causal diagram, the sums of the values of every column and row in the total relation matrix are required. D_i is the sum of the i^{th} row and R_j is the sum of the j^{th} column. The D_i and R_j values represent both the direct and indirect influences between criteria.

$$D_i = \sum_{i=1}^{n} t_{ij} \qquad i = 1, 2, ..., n \tag{5}$$

$$R_j = \sum_{j=1}^{n} t_{ij} \qquad j = 1, 2, ..., n \tag{6}$$

The variables ($D + R$) and ($D - R$) can be defined as impact and relation, respectively. The ($D + R$) indicates the total effect both given and received by the criteria *i* and is the impact. The ($D - R$) denotes the net effect that the criteria *i* contributes to the system and is called relation. The value represents the cause if positive values are obtained; and it

represents the effect if the values are negative. For the cause-and-effect diagram, different values are plotted on horizontal (*D*+*R*) and vertical (*D*-*R*) axis.

2.1.5. Determine the weights of criteria

According to [19], the weights are determined by using the following equation.

$$w_i = \sqrt{\left(D_i + R_i\right)^2 + \left(D_i - R_i\right)^2} \tag{7}$$

The value of w_i can be normalised as follows.

$$W_i = \frac{w_i}{\sum_{i=1}^{n} w_i} \tag{8}$$

2.2. Fuzzy set theory

Fuzzy set is a mathematical concept introduced by Zadeh in 1965 [20]. The idea that lies in this concept is the ability to express the amount of vagueness or ambiguity in human thinking and subjectivity in a comparatively exact manner [21]. The sense of uncertainty represents by fuzziness, however, is not the uncertainty of expectation; it is the uncertainty resulted from the imprecision of meaning of a concept expressed by a linguistic term in the natural language, such as the tall and old, and so forth [22]. Fuzzy numbers concept has been applied in many decision-making problems. The concept is developed from the fact that not all things in real life are being characterized in the forms of precise numbers. Fuzzy numbers are fuzzy sets in which certain restriction definitions have been applied. The most frequently used fuzzy numbers are triangular fuzzy numbers and trapezoidal fuzzy numbers. This fuzzy number is normally being associated with linguistic terms like “no influence”, “very low influence”, “low influence”, “high influence” and “very high influence” for the five scales value. Dealing with fuzzy numbers requires researchers to emphasize the way of converting the fuzzy numbers into crisp numbers for further analysis. Converting fuzzy data into crisp scale (CFCS) method is an established method that suggests the idea on determining the fuzzy maximum and minimum of the fuzzy range. Based on the membership function, the total score can be found out as weighted average. The following 4 steps are then conducted [23-24].

2.2.1 The converting fuzzy data into crisp scale (CFCS) method

Step 1: Normalization

$$x_{lj} = \frac{\left(l_{ij} - l_i^{\min}\right)}{\Delta_{\min}^{\max}} \tag{9}$$

$$x_{mj} = \frac{\left(m_{ij} - l_i^{\min}\right)}{\Delta_{\min}^{\max}} \tag{10}$$

$$x_{rj} = \frac{\left(r_{ij} - l_i^{\min}\right)}{\Delta_{\min}^{\max}} \tag{11}$$

$$\text{where } \Delta_{\min}^{\max} = \max r_{ij} - \min l_{ij} \tag{12}$$

Step 2: Compute the left and right normalized values

$$X_j^{ls} = \frac{x_{mj}}{(1 + x_{mj} - x_{lj})} \tag{13}$$

$$X_j^{rs} = \frac{x_{rj}}{(1 + x_{rj} - x_{lj})} \tag{14}$$

Step 3: Calculate total normalized crisp values

$$X_j^{crisp} = \frac{\left[x_j^{ls}(1 - x_j^{ls}) + x_j^{rs} \times x_j^{rs}\right]}{\left[1 - x_j^{ls} + x_j^{ls}\right]} \tag{15}$$

Step 4: Compute crisp value

$$f_{ij} = l_i^{\min} + x_j^{crisp} \Delta_{\min}^{\max} \tag{16}$$

3. RESULTS: THE IMPLEMENTATION OF FUZZY DEMATEL METHOD

The following stepwise procedures were implemented, combining the idea on fuzzy set and DEMATEL method. The study started with identifying the criteria and linguistic values, designing the questionnaire, and compiling the data obtained from respondents. Then, the DEMATEL method was applied, starting from constructing the primary matrix and average direct relation matrices until the visualization of a causal diagram.

Step 1: Determination of criteria and linguistic value

The factors of financial mismanagement were the criteria in this study. Table 1 shows the chosen criteria with their definition [6], meanwhile Table 2 shows the linguistic variables corresponding to the TFN.

Table 1. Financial mismanagement criteria

Criteria	C_n	Definition
Spending Behaviour	C_1	Spending money on something without thinking of the upcoming effect. According to [25], overspending has caused many young consumers to be overburdened with debts.
Financial Behaviour	C_2	Any human behaviour that is related to money management such as cash, credit or saving.
Lack of Financial Literacy	C_3	Any person who has low level of financial knowledge. Financial literacy is defined as the power or ability of a person to practice knowledge, skills and experience to decide effectively concerning the use and control of his/her finance to provide life-long financial security [26].
Financial Distress	C_4	Financial distress denotes the stress triggered by a financial condition from personal, family, and other financial situations. It was reported that the individuals who are under financial distress are often living paycheck to paycheck with too little or no extra money for any crisis. They also become lack of confidence about their ability to control personal finance, and are uncertain about their personal finance for retirement [27].
Financial Independence	C_5	Students' choices are obstructed by either their parting from parental support or their need to make their own decisions. Javine [28] found that independent students who come down with little to no support from their families were at a higher risk to suffer with loan debt.
Financial Status and Psychology	C_6	Past researchers reported that poor financial status may affect many aspects in life, including mental and physical health, academic performance, and even the competence to be employed after graduation. Literature showed that mental illness is strongly connected to unemployment, which in turns leads to poor financial status. This condition may cause bad effects on student's psychology.

Table 2. Fuzzy linguistic scale

Linguistic terms	Influence score	Triangular fuzzy number
Very high influence	4	(0.75, 1.00, 1.00)
High influence	3	(0.50, 0.75, 1.00)
Low influence	2	(0.25, 0.50, 0.75)
Very low influence	1	(0.00, 0.25, 0.50)
No influence	0	(0.00, 0.00, 0.25)

Step 2: Design the questionnaire

The data were collected using questionnaire. The questionnaire comprises section A (demographic) and section B (criteria in financial mismanagement). The questionnaire was distributed via online medium to a group of final year students. Respondents were required to respond by rating the six criteria from 0-4. The explanation or definition was attached in the questionnaire to help respondents understand the meaning for each criterion.

Step 3: Construct initial and average direct relation matrix

The following average direct relation matrix recorded the analysed data from 42 respondents that represent 42% of the population.

Table 3. Average direct relation matrix

	C_1	C_2	C_3	C_4	C_5	C_6
C_1	0	(0.51, 0.75, 0.94)	(0.49, 0.74, 0.94)	(0.38, 0.62, 0.82)	(0.51, 0.76, 0.93)	(0.43, 0.68, 0.89)
C_2	(0.43, 0.68, 0.89)	0	(0.43, 0.67, 0.87)	(0.39, 0.64, 0.85)	(0.46, 0.71, 0.89)	(0.43, 0.67, 0.88)
C_3	(0.49, 0.74, 0.89)	(0.43, 0.68, 0.86)	0	(0.41, 0.66, 0.84)	(0.44, 0.69, 0.89)	(0.44, 0.69, 0.88)
C_4	(0.51, 0.76, 0.92)	(0.50, 0.74, 0.92)	(0.47, 0.72, 0.90)	0	(0.49, 0.74, 0.93)	(0.48, 0.73, 0.92)
C_5	(0.46, 0.70, 0.89)	(0.46, 0.71, 0.91)	(0.39, 0.63, 0.83)	(0.43, 0.67, 0.88)	0	(0.46, 0.71, 0.91)
C_6	(0.49, 0.73, 0.89)	(0.48, 0.72, 0.89)	(0.39, 0.64, 0.83)	(0.39, 0.64, 0.83)	(0.45, 0.70, 0.90)	0

Step 4: Defuzzification using CFCS method

The triangular fuzzy number was converted to crisp value by implementing CFCS method using equation (9)-(16).

Table 4. Crisp value

	C_1	C_2	C_3	C_4	C_5	C_6
C_1	0	0.67	0.66	0.58	0.67	0.62
C_2	0.63	0	0.63	0.60	0.65	0.63
C_3	0.66	0.62	0	0.60	0.63	0.63
C_4	0.64	0.63	0.61	0	0.63	0.62
C_5	0.64	0.65	0.59	0.62	0	0.65
C_6	0.66	0.65	0.60	0.60	0.64	0

Step 5: Compute a fuzzy total relation matrix

Table 5. Total direct relation matrix

	C_1	C_2	C_3	C_4	C_5	C_6
C_1	-0.5801	-0.1780	-0.1670	-0.1868	-0.1780	-0.1880
C_2	-0.1869	-0.5727	-0.1719	-0.1728	-0.1790	-0.1780
C_3	-0.1757	-0.1899	-0.5581	-0.1732	-0.1860	-0.1790
C_4	-0.1821	-0.1850	-0.1782	-0.5469	-0.1850	-0.1810
C_5	-0.1844	-0.1796	-0.1880	-0.1664	-0.5740	-0.1720
C_6	-0.1771	-0.1796	-0.1841	-0.1742	-0.1830	-0.5660

Step 6: Calculate the impact and relation criteria

The value of (D + R) and (D - R) were calculated to produce the impact and relation criteria. The sum of n row of the matrix denoted as $\tilde{D}_i$ shows the sums of the impacts the n criterion has affected other criteria, while the sum of n row of the matrix denoted as $\tilde{R}_i$.

Table 6. Value of impact and relation criteria

	$\tilde{D}$	$\tilde{R}$	$\tilde{D}+\tilde{R}$	$\tilde{D}-\tilde{R}$
C_1	-1.4782	-1.4863	-2.9645	0.0080
C_2	-1.4612	-1.4848	-2.9460	0.0236
C_3	-1.4615	-1.4473	-2.9088	-0.0142
C_4	-1.4584	-1.4203	-2.8787	-0.0380
C_5	-1.4641	-1.4847	-2.9487	0.0206
C_6	-1.4643	-1.4643	-2.9286	0.0000

Step 7: Determination of fuzzy weight of the criteria

Table 7. Weight of the criteria

Criteria	Weight, w_i	Normalize weight, W_i
C_1	2.9645	0.1687
C_2	2.9461	0.1677
C_3	2.9088	0.1655
C_4	2.8789	0.1638
C_5	2.9488	0.1678
C_6	2.9286	0.1666

Step 8: Construct the causal diagram

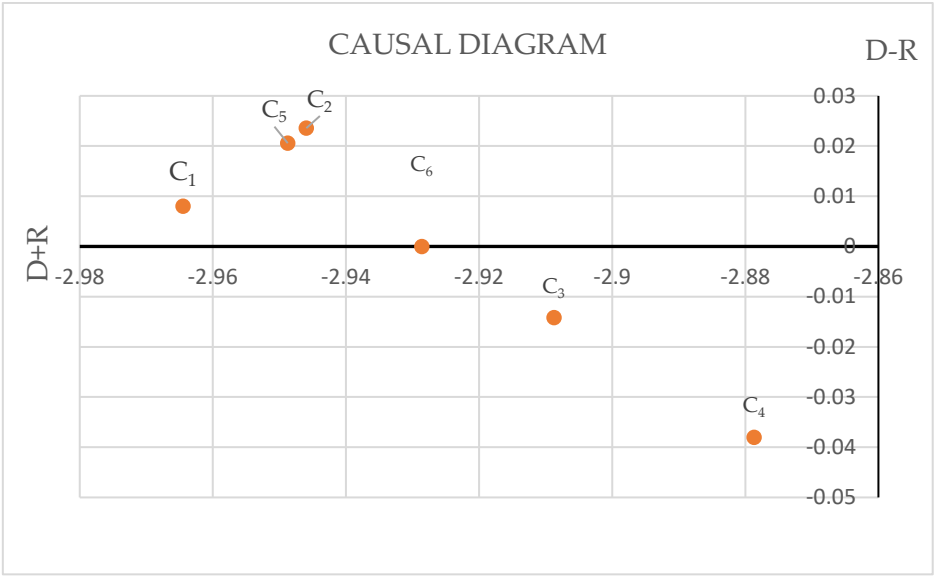

Figure 1. Causal diagram of financial mismanagement

4. DISCUSSIONS

This study was conducted to explore the criteria that contributed to the financial mismanagement among university students using Fuzzy DEMATEL method. Since there have been lack of studies focusing on criteria that lead to the financial mismanagement using fuzzy approach, this study is very significant to be conducted. There is also a necessity to know the cause and effect of this problem, which can help university students to find ways to manage their financial well. The implementation of Fuzzy DEMATEL produced the ranking order for the selected criteria of financial mismanagement and suggested the cause-and-effect group for the criteria. Table 8 summarizes the criteria, weightage and the ranking order, and Figure 2 groups the selected criteria into cause-and-effect groups.

Table 8. Weight and rank of criteria

C_n	Criteria	Weightage, W_i	Rank
C_1	Spending Behaviour	0.1687	1
C_2	Financial Behaviour	0.1676	3
C_3	Lack of Financial Literacy	0.1655	5
C_4	Financial Distress	0.1638	6
C_5	Financial Independence	0.1678	2
C_6	Financial Status and Psychology	0.1666	4

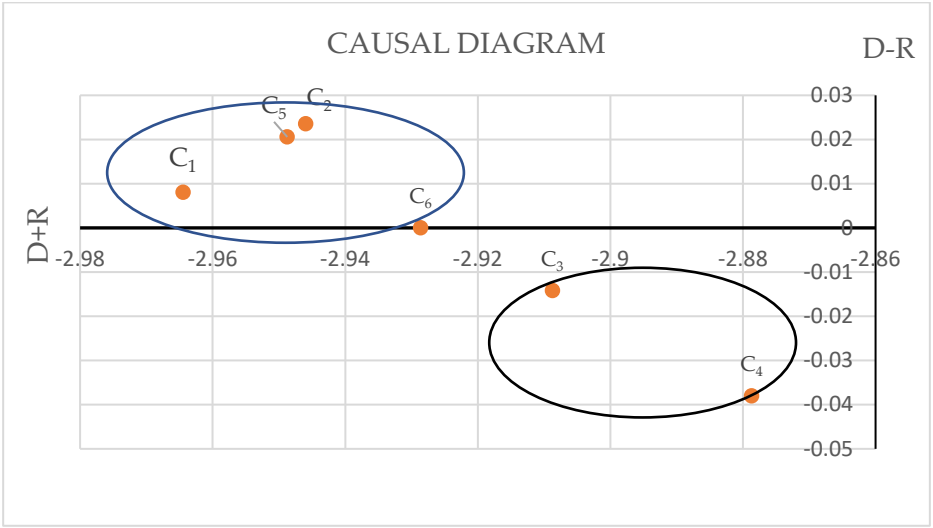

Figure 2. Cause and effect group in causal diagram

Table 8 shows the ranking for each criterion. By implementing the Fuzzy DEMATEL method, the result shows that the criteria that influenced students the most was spending behavior (C_1) with the weightage of 0.1687. Spending behavior is a learned behavior often transmitted by parents and other influential individuals. Students need to plan wisely and be more careful before they do their purchase. [8] reported that the uncontrolled spending behavior among young consumers may occur because of the rapid growth and changes of current technology. They have the tendency to buy more to keep up with the recent technological trend and materialize their high desire to obtain the latest electronic gadget. Financial independence (C_5) was ranked at the second place with the weightage of 0.1678. [2] said that financial independence often leads to thoughtless decision-making and puts students at a higher risk of developing compulsive buying. Financial independence turned out to be second place of importance because it affected the overall financial status of students. In fact, good independence will contribute a lot to students' monetary management.

Next, financial behavior (C_2) was ranked in third place with a weight value of 0.1676. Lack of discipline in planning and being prone to overspending are part of bad financial behavior. Compulsive buying tendencies, which are the lack of ability to control impulsive spending and irrational purchasing decisions, is more abundant among college students than in the general population. This is because students nowadays are exposed to online payment and some of them are novice users of debit or credit cards [2]. Therefore, students need to be more exposed to financial education to improve their financial behavior. Financial status and psychology (C_6) were at the fourth ranking with the weightage of 0.1666. Past literature presented that poor financial status has affected mental and physical health, academic performance, and even their competence to be employed after graduation [29].

Lack of financial literacy (C_3) was placed at the fifth rank with the weightage of 0.1655. A low level of financial literacy is the inability to effectively manage money due to unhealthy financial ways of thinking. It was influenced by other factors that contribute to financial mismanagement. Lastly, financial distress (C_4) was at the last ranking (0.1638) contributing to financial mismanagement among students. Students should practice how to manage their finances well to avoid becoming distressed. Financial distress may arise from other criteria in this research since it is in the effect group. Financial distress is a subjective incident; if two persons with the same level of earnings and economic resources are compared, they may have different level of perceived financial distress and financial well-being [30].

Figure 2 shows the criteria of financial mismanagement in the cause-and-effect group. The classification of criteria into cause or effect group depends on the value of $\left(\tilde{D}-\tilde{R}\right)$. The positive value of $\left(\tilde{D}-\tilde{R}\right)$ shows that the variable was a cause, while the negative value of that indicates the effect variable. The cause group consists of four criteria which were spending behavior (C_1), financial behavior (C_2), financial independence (C_5) and financial status and psychology (C_6). These criteria were plotted in $\left(\tilde{D}+\tilde{R}\right)$ negatively in the Casual Diagram which means that they are cause factors of perceived risks. Meanwhile, the effect group consists of two criteria which were lack of financial literacy (C_3) and financial distress (C_4). The finding shows that, for every reason in financial mismanagement among students, it may lead to financial distress and is the reason for students' lack of financial literacy. Similarly, the effect group was plotted in $\left(\tilde{D}+\tilde{R}\right)$ negative so it was called as effect criteria of perceived risks.

5. CONCLUSIONS

The spending behaviour tends to become the most significant criterion related to financial mismanagement among university students. Therefore, the students need to pay extra attention to the knowledge and skill in controlling as well as upgrading their spending behaviour. Bad management of financial leads to poor financial status, thus, affects the individual well-being. It is hoped that the findings will benefit students by focusing on the criteria that leads to financial mismanagement. Future study might consider more criteria and different approaches that may offer more comprehensive result.

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