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Identification Of Higher Education Student's Entrepreneurial Motivation Using Fuzzy C-Means Algorithm

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Abstract- *The purpose of this research is to identify student entrepreneurial motivation in higher education using Fuzzy C-Means Algorithm. The entrepreneurial motivation was predicted based on the perception of the career attractiveness and feasibility level to start a business. The instrument uses a questionnaire consisting of two types of statements, fourteen statements of career attractiveness, and eleven statements of feasibility. This research used the Fuzzy C-Means algorithm to identify the entrepreneurial motivation into two categories, highly and lowlily motivated. Fuzzy C-Means algorithm is a data clustering method where each data into a cluster determined by the degree of membership. The Fuzzy C-Means algorithm is iterative and required ten iterations to converge onto a stable solution. The finding of this research is the Fuzzy C-Means algorithm able to identify higher education student's entrepreneurial motivation.* The number of students who low motivated is a very slight difference from students who high motivated. Entrepreneurial motivation is essential for students to open up opportunities to start a business in the future.

Keywords- Higher Education, Entrepreneurial Motivation, Fuzzy C-Means Algorithm

I. INTRODUCTION

In the world of education, especially higher education is currently strong enough to encourage the growth of the entrepreneurial climate. The education itself can be transformative if the teacher help their student know what the core of the learning is. This involves learning "how to negotiate and act upon our own purposes, values, feelings and meanings rather than those we have uncritically assimilated from others" (Mezirow, 2000). Developing more reliable beliefs, exploring and validating their fidelity, and making informed decisions are fundamental to the adult learning process (Taylor, 2017). It is transformative learning theory that explains this learning process of constructing and appropriating new and revised interpretations of the meaning of an experience in the world (Taylor, E. W., & Cranton, 2012). The future learning in Entrepreneurship is looking for the best way to make the students feel comfortable when they are learn. It can be beneficial for them in terms of achieving the learning outcomes (Ruggiero, 2014).

Bandura suggests that self-confidence in our abilities to successfully perform specific tasks comes from four key sources: mastery experiences (Rice et al., 2018), modeling (Day & Connor, 2017), social persuasión (Goodman-Delahunty & Howes, 2016), and judgments (Maras et al., 2019) of our own physiological states (Bandura et al., 2001). These mastery experiences, or simply put, "learning by doing," appear to be basic in determining our self-confidence to successfully perform future tasks that are perceived to be similar or related. Theory indicates that targeted education can play an important role in developing levels of entrepreneurial motivation (Wilson et al., 2007).

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Entrepreneurship will provide many opportunities in creating jobs and improving the quality of life of the community (Francoise et al., 2016). Various entrepreneurship training for students is more intensive because, according to research, there is only one way to develop entrepreneurial potential through education (Elina, 2015). Education is expected to foster entrepreneurial motivation among students because many people have the power to become entrepreneurs, but not everyone is motivated because they do not realize their potential (Kašperová et al., 2018). In fact, entrepreneurial motivation plays a role in overcoming obstacles to effective initial entrepreneurship (Alain Fayolle, 2013). And entrepreneurial motivation opens up opportunities to start a business (Santos et al., 2010). In some latest research, there are higher enrollment rates of males than females in entrepreneurship. Regarding attitudes towards participation in entrepreneurial educational programs, females demonstrate a stronger interest in acquiring knowledge, developing skills, facing career competition, and networking with local business, to a significantly higher degree than their male counterparts (Petridou et al., 2009). This study was interesting based on the gender perspective that females be more enthusiastic than males. In order to more fully capture the talents of women in new venture creation in the future, a vibrant "pipeline" of potential entrepreneurs is highly required. Along these lines, entrepreneurship guru David Birch, in a recent interview, advocates strongly for the increased use of mastery experiences in encouraging entrepreneurship, especially lengthy and meaningful apprenticeships, and argues that most entrepreneurship programs fall short in this área (Aronsson, 2004).

Researchers have studied various factors influencing entrepreneurial behavior while studying entrepreneurship (Alam et al., 2019). Sexton and Smilor (Sexton & Smilor, 1986) and Smilor and Kuhn (Smilor & Kuhn, 1986) in the 1980s were the preliminary studies of entrepreneurial motivation on theoretical and empirical perspectives. Soon after, research on personality traits of entrepreneurs takes the lead, and research on motivation could not attract researchers. The entrepreneurial motivation, according to some opinions and research, is influenced by personal achievement, independence, internal factors, and job security (Stefanovic et al., 2010). Other research says that: entrepreneurial motivation can be predicted based on perceptions of the level of career attractiveness and the level of feasibility to start a business. (Frazier, Barbara; Niehm, 2008). While indicators of entrepreneurial motivation are financial benefits, due to lack of work, the need for independence, living quality of life, and to achieve a higher social position (Mekonnin, 2015).

From the explanation before, it can be concluded that entrepreneurial motivation is a motivating factor for entrepreneurship, it is also a driving force / drive within oneself that creates enthusiasm for the creation of an activity/job by looking at opportunities around, acting boldly in taking risks, carrying out innovative activities, and has a profit orientation. Someone who has high motivation will definitely work hard to be the best (Degeng, 2005). Therefore, this research aims to identify how much entrepreneurial motivation a university student has. This identification was solved by an artificial neural network approach-based cluster method. This method classifies a collection of data objects into one or more groups so that the data collected in a group has a high level of similarity.

The identification method used in this research is the Fuzzy C-Means Algorithm. Fuzzy C-Means (FCM) is a data identification method where each data into a cluster that is determined by the degree of membership. In the previous research, (Sasmita et al., 2012) conducted a cluster analysis of *Quickbird Satellite* imagery using Fuzzy C-Means

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(FCM) and Fuzzy C-Shell (FCS), it was concluded that FCM was better than FCS because FCM has more minimum objective values than FCS. While (Rohmatullah et al., 2020) compares K-Means dan FCM in classifying agricultural data, it was concluded that FCM was better than K-Means also. In this research, the FCM algorithm identifies higher education student's entrepreneurial motivation based on the career attractiveness and feasibility information from the questionnaire that has been distributed.

II. RESEARCH METHOD

This research is to determine the level of entrepreneurial motivation students of Faculty of Teacher Training and Education Darul Ulum Islamic University (Unisda) of Lamongan. The campus was chosen by researchers to be the subject of research because 1) Unisa is one of the favorite and largest universities in the city of Lamongan, so it is classified as qualified students. 2) The campus has a large number of classes, so sample selection can be more representative. Determination of the sample by purposive random sampling, assuming that the respondents taken could represent all students at the university. The subjects of this research are 140 respondents, divided into English and Indonesian Department. Each department is consisting of two classes that are morning and evening. In this research, the average of the male were 34 or 24% while the female was 106 or 76%, as shown in figure 1

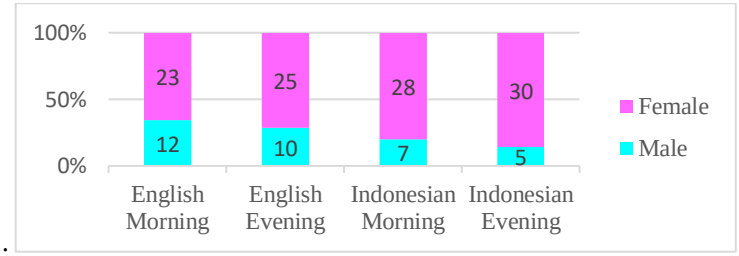

Figure 1. Research Subject

The instrument used a questionnaire to identify entrepreneurial motivation in this research. The questionnaire in this research used a questionnaire developed by Frazier, Barbara, Niehm, Linda S, in an article titled FCS Students' Attitudes and Intentions toward Entrepreneurial Careers. The indicator of entrepreneurial motivation is the perception of career attractiveness and feasibility to start a business consisting of 25 statements where 14 statements of career attractiveness and 11 statements of feasibility. The statements given five choices of answers SS (strongly agree), S (agree), R (doubtful), TS (disagree), STS (strongly disagree), and students will fill in by giving a cross (X) in the answer column. Score for each answer option when answering A = 5, B = 4, C = 3, D = 2, and E = 1. This entrepreneurial motivation questionnaire is appropriate for research data collection because it has been standardized and used by many researchers to classify student entrepreneurial motivation, and also, the instrument has been validated using SPSS 22.0 software.

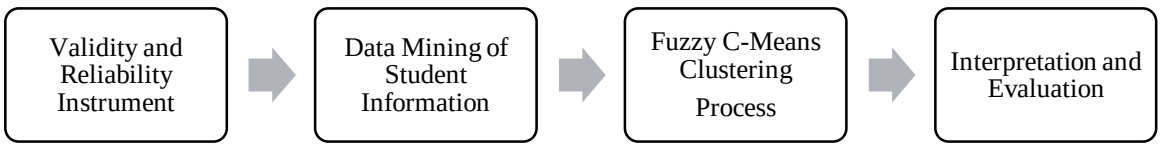

Figure 2. The workflow of Identification Students Entrepreneurial Motivation in Higher Education

The score of entrepreneurial motivation then analyzed using the Fuzzy C-Means (FCM) algorithm based neural network approach. Fuzzy C-Means (FCM) algorithm classified students into 2 clusters who have high and low entrepreneurial motivation. Clustering is the process of grouping a collection of data objects into one or more groups so that the data collected in a group has a high level of similarity. Clustering is a process of data processing that has several applications. The purpose of clustering is to identify a group of data from a population of data to produce the properties of the data itself (Han et al., 2012). This research used the Fuzzy C-Means clustering method. Fuzzy C- Means (FCM) is a data clustering method where each data enters a cluster that is determined by the degree of membership. This method was invented by (Bezdek et al., 1984). This method can also cluster data that has dimension sizes into a number of different clusters. This research used Matlab Software to run the Fuzzy C-Means (FCM) algorithm.

The optimization of FCM is minimizing an objective function in the equation.

$$J_m = \sum_{i=1}^{D}\sum_{j=1}^{N} \mu_{ij}^{m} \left\| x_i - c_j \right\|^2 \tag{1}$$

Where: D is the number of data

N is the number of cluster center point

m is fuzzy partition matrix exponent to manage fuzzy degree, with $m > 1$

x_i is the i[th] data

c_j is the j[th] cluster point

μ_{ij} is the membership degree from x_i on the jt[h] cluster center point

For every $x_i, i = 1, 2, ..., D$, the number of values the membership function for all clusters is one, as in the equation (4).

$$\mu = \begin{bmatrix} \mu_{11} & \mu_{12} & \cdots & \mu_{1N} \\ \mu_{21} & \mu_{22} & \cdots & \mu_{2N} \\ \vdots & \vdots & \vdots & \vdots \\ \mu_{D1} & \mu_{D1} & \cdots & \mu_{DN} \end{bmatrix} \tag{2}$$

$$\mu_{ij} \square U(0,1), \quad i = 1, 2, ..., D, \quad j = 1, 2, ..., N \tag{3}$$

$$\sum_{j=1}^{N} \mu_{ij} = 1, \quad i = 1, 2, ..., D \tag{4}$$

The FCM algorithm can be designed as follows (Han et al., 2012) :

1. Initialize the membership degree value of the cluster center μ_{ij}, as in the equation (3) and equation (4) randomly.
2. Calculate the cluster center point as in the equation (5) with $m = 2$. The cluster center point is calculated by finding the average of all points in a cluster by weighting the membership degree in the cluster.

$$c_j = \frac{\sum_{i=1}^{D} \mu_{ij}^{m} x_i}{\sum_{i=1}^{D} \mu_{ij}^{m}}, \; j = 1, 2, ..., N \tag{5}$$

3. Update values of membership degree value of cluster center μ_{ij} as in the equation (6)

$$\mu_{ij} = \frac{1}{\sum_{k=1}^{N}\left(\frac{\left\|x_i - c_j\right\|}{\left\|x_i - c_k\right\|}\right)^{\frac{2}{m-1}}} \qquad (6)$$

$$i = 1,2,...,D \quad j = 1,2,...,N$$

4. Calculate the objective function J_m using equation (1).
5. Repeat steps 2-4. The termination rule can be a maximum iteration or the smallest error value reached.

III. RESULT AND DISCUSSION

Identification of higher education student's entrepreneurial motivation starts from measuring the validity and reliability of the instrument test. The results of the validity test with the product-moment correlation coefficient appear that the entrepreneurial motivation instruments in the career attractiveness and feasibility section. The validity of the instrument is determined by looking at the correlation coefficient column. If the score is less than 0.4, then the item is categorized as invalid. Based on the validation results in table 1, that each has an item-total correlation value greater than 0,4 both in training and main data. So, all items are categorized as valid and can be used as a measurement of career attractiveness and feasibility students in higher education.

Table 1. The Validity Test of Entrepreneurial Motivation Instrument on Career Attractiveness

Career Attractiveness					Feasibility				
	Training Data		Main Data			Training Data		Main Data	
Point	Correlation Coefficient	Explanation	Correlation Coefficient	Explanation	Point	Correlation Coefficient	Explanation	Correlation Coefficient	Explanation
A1	0.924	Valid	0.914	Valid	B15	0.596	Valid	0.653	Valid
A2	0.944	Valid	0.920	Valid	B16	0.855	Valid	0.896	Valid
A3	0.925	Valid	0.877	Valid	B17	0.611	Valid	0.717	Valid
A4	0.916	Valid	0.907	Valid	B18	0.437	Valid	0.512	Valid
A5	0.945	Valid	0.929	Valid	B19	0.725	Valid	0.759	Valid
A6	0.944	Valid	0.919	Valid	B20	0.815	Valid	0.778	Valid
A7	0.857	Valid	0.905	Valid	B21	0.773	Valid	0.782	Valid
A8	0.490	Valid	0.487	Valid	B22	0.706	Valid	0.700	Valid
A9	0.446	Valid	0.611	Valid	B23	0.906	Valid	0.869	Valid
A10	0.868	Valid	0.878	Valid	B24	0.877	Valid	0.888	Valid
A11	0.893	Valid	0.908	Valid	B25	0.855	Valid	0.898	Valid
A12	0.803	Valid	0.869	Valid					
A13	0.866	Valid	0.884	Valid					

A14	0.837	Valid	0.890	Valid

The reliability of each instrument was carried out by the Alpha Cronbach method both in the first step in the testing data and in the second step in the main data. Based on table 2 below, overall, the results of the calculation of the reliability of both the first step in the testing data and the second step of the main data have a Cronbach Alpha coefficient greater than 0.80 both in training and main data so that it can be concluded that the research instrument is in the very high-reliability category and can be used as a measurement of career attractiveness and feasibility students in higher education.

Table 2. The Reliability Test of Entrepreneurial Motivation Instrument

Entrepreneurial Motivation Instrument	Training Data		Main Data	
	Total point	Reability	Total point	Reliability
Career Attractiveness	14	0.968	14	0.972
Feasibility	11	0.924	11	0.932

Then, the instrument is used to measure career attractiveness and feasibility on research subjects, including students in the English and Indonesian department, both morning and evening classes. Figure 3 is a description of the questionnaire data based on average scores. It is known that the students of evening classes at the Indonesian department have the highest career attractiveness score, while the student of morning classes at the English department has the highest feasibility business score.

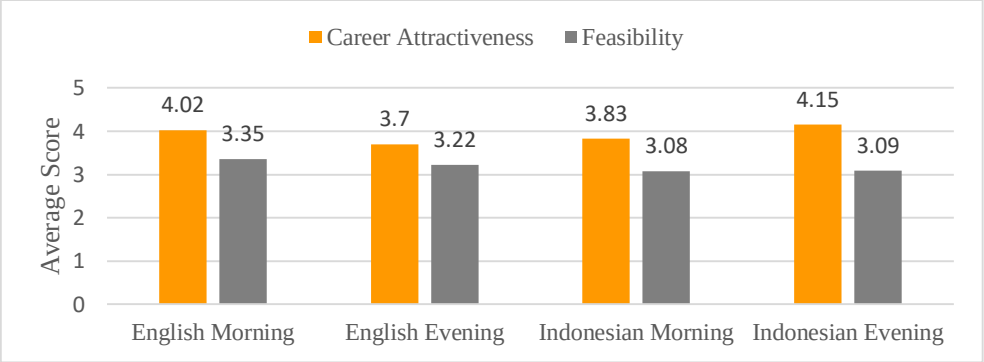

Figure 3. Descriptive data of Career Attractiveness and Feasibility

The results of the identification process of entrepreneurial motivation in the English department by the FCM algorithm are shown in figures 4a and 4b, respectively. Figure 4a is the optimization process of the FCM algorithm. In the optimization process, the sum of the objective functions converges to the minimum objective value. At maximum iteration, the value of the objective function is 1.996×10^3. Figure 4b is the result of clustering with two clusters with the sign '+' being the center of the cluster.

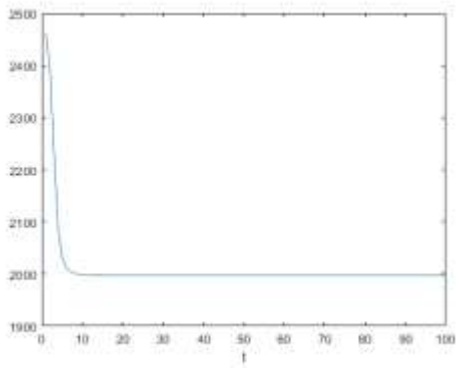

Figure 4a. Optimization Process of Eng. Department

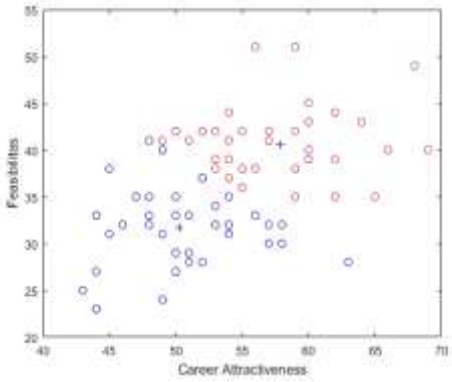

Figure 4b. The cluster of English Department

The results of the identification process of entrepreneurial motivation in the Indonesian department by the FCM algorithm are shown in figures 5a and figure 5b, respectively. Figure 5a is the optimization process of the FCM algorithm. In the optimization process, the sum of the objective functions converges to the minimum objective value. At maximum iteration, the value of the objective function is 2.022 x 10^3. Figure 5b is the result of clustering with two clusters with the sign '+' being the center of the cluster. When compared to the optimum value of the objective functions between the English and Indonesian department clusters. It is known that the English department is better than the Indonesian department in the clustering process because the optimum value of the English department objective function 1.996 x 10^3 is smaller than the optimum value of the Indonesian department objective function 2.022 x 10^3.

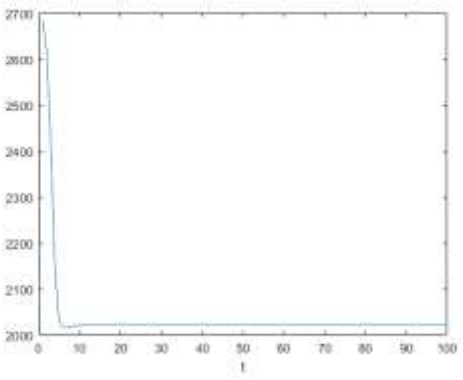

Figure 5a. Optimization Process of Ind. Department

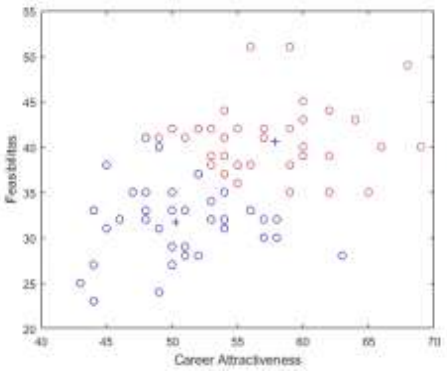

Figure 5b. The cluster of Indonesian Department

Based on figure 4b and figure 5b above, the red color indicates the category of high entrepreneurial motivation, while the blue color indicates the category of low entrepreneurial motivation. The students whose high entrepreneurial motivation tends to have a higher combined value (career attractiveness + feasibility) than students who low entrepreneurial motivation. Some respondents have identical values so that the analysis results are not visible because they coincide.

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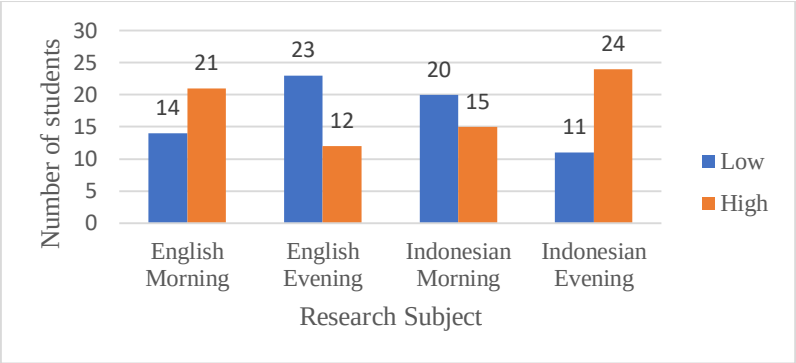

Figure 6. Identifying Entrepreneurship Motivation

Figure 6 shows the result of identification entrepreneurship motivation based on analysis FCM by Matlab software. The Fuzzy C-Means algorithm is iterative and required ten iterations to converge onto a stable solution. The student in English morning class has similar patterns with an Indonesian evening class, and English evening class has similar patterns with Indonesian morning class. Overall, student entrepreneurial motivation 51% high motivated and 49% low motivated. Based on the results of this study, higher education institutions must focus more on developing entrepreneurship and innovation centers to motivate students and increase their employment opportunities.

IV. CONCLUSION

Higher education student's entrepreneurial motivation was identified in this research by using the FCM algorithm. The result identified each data that is determined by the degree of membership to enters a cluster. It was found that the FCM algorithm positively aided in identifying student's entrepreneurial motivation based on career attractiveness and feasibility information. For further research, it can be developed using data with more dimensions.

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