



Clustering Analysis of Students' Culture and Behavior for University Choice Using Kohonen Self Organizing Map

KEYWORDS

University Choice, Kohonen SOM, Culture, Consumer Behaviour

Ronald

Business School, Universitas Pelita Harapan Surabaya
Jl. Jend. A. Yani 288, Surabaya 60234, Indonesia

Amelia

Business School, Universitas Pelita Harapan Surabaya
Jl. Jend. A. Yani 288, Surabaya 60234, Indonesia

ABSTRACT Higher Education has now become one of the essential needs for the public, considering that education is an asset. In addition, Higher Education is a significant domain for human resources development and knowledge development which are needed by the country (Polat, 2012). Therefore, it is important for colleges/universities to understand and meet the expectations of prospective students in order to increase their competitiveness. Study about students' selection process towards universities has become an interesting subject to discuss. Ming Sia (2013); Beceren (2010) in Polat (2012); Jian et al., (2010) suggests that a student's preference in selecting a university is determined by their parents or relatives suggestions. Conversely, Polat (2012) argues that students are more likely to choose their preferred university according to their own perspectives. Some previous research about this study encourages the authors to conduct further research about students' preference in selecting university to enroll. This study implements simple random sampling technique, conducted by distributing questionnaires to 690 private high school students in Surabaya, who were selected as the samples. The author applies Hofstede's theory (1980) about cultural dimensions and Irawan's theory (2008) about 10 characteristics of Indonesian consumers to determine high school students' behavior in selecting university to enroll. The data were processed using SOM (Self Organizing Map) clustering method. This study grouped students into four clusters: Individualistic Students (group 1), Unplanned Students (group 2), Family-Oriented Students (group 3), and Long-Term-Oriented Students (group 4).

I. Introduction

Higher Education is a service industry that is rapidly evolving and increasingly exposed as a global process (O'Neil & Palmer, 2004). Higher Education is a significant domain for human resources development and knowledge development which are needed by the country (Polat, 2012). In order to attract prospective students, it takes effort to understand and meet the needs and expectations of students (Nadiri et al., 2009).

The process of selecting university to enroll has become an interesting subject to discuss. Ming Sia (2013); Beceren (2010) in Polat (2012); Jian et al., (2010) suggests that students' decision in choosing a university is determined by their parents or relatives. Conversely, Polat (2012) argues that students are more likely to choose their preferred university according to their own perspectives. Prospective students by themselves look for information about their preferred universities. 77% of respondents participated on this research had gathered information before they decided to enroll to their preferred university and field of study. Research conducted by Polat (2012); Raponso and Alvers (2007) pointed out that prospective students by themselves decided to look for information and enroll to their preferred universities. Polat (2012) explained that prospective students were more considerable to the importance of their preferred universities that must meet their needs. This encourages the authors to conduct a further research about student's characteristic and behavior in selecting university to enroll.

Consumer behavior in doing a purchase always dynamically evolves (Schiffman and Kanuk, 2010). Every prospective student has his/her own characteristics (Ming Sia, 2013; Tan-Kuick & Ngee Ng, 2011; Jian et al., 2010; Kindle & Colby, 2008; Waarts & Everdingen, 2005). Universities must clearly understand those characteristics in order to specifically target or segment the students. This research about respondents' characteristics will be conducted by clustering prospective students' reasons or considerations in choosing university. Clustering will be conducted using SOM software (Self Organizing Map). Respondents (high school students) must answer 18 questions that will be tabulated and clustered into four groups mentioned earlier based on their preferences or reasons in choosing university. As result, this research will

figure out some groups or clusters of high school students' behavior in selecting university to enroll.

Culture refers to a unique identity that distinguishes an individual from another (Contiu et. at., 2012). Culture covers the diversity of region, city, state, and country, groups diverse in ethnics, organizations diverse in identity that has its own norms and values and results in diversity of attitudes or behaviors (Schradler and Self, 2003). Culture represents the "rules of the game" which is not written but understood by the whole member of organization (Schein, 1992).

Hofstede perceives culture as a pattern of directed thoughts and feelings that figures out a "mental programming" which distinguishes a member of a group from another (Contiu et. al., 2012). Culture might identifies multiple levels from micro sub-cultures (family and organization) within a narrow scale to the supra cultures (country with an economic system, ethnicities, religion, etc., that relatively similar one another) on a large scale (Franke and Nadler, 2008). Therefore, to conclude, each country has diverse characteristics of culture and consumer behavior.

The authors use some criterion to determine the characteristics of high school students in selecting university according to Hofstede's (1980) theory of culture dimensions and Irawan's (2008) theory of 10 characteristics of Indonesian consumer. Hofstede's (1980) culture dimensions include: (1) uncertainty avoidance, for high school students who avoid uncertainty by selecting university with clear standards and regularities; (2) individualism-collectivism, for high school students who decide to select a university because of personal reason or environmental reason (family, relatives); (3) masculinity – femininity, for high school students who decide to choose university that supports his/her success or university that has a good social relation; (4) power distance, for high school students who decide to choose a university with a clear hierarchy; (5) long term orientation, for high school students who decide to choose a university with good quality or university that provides acceleration program- where students are able to finish their study earlier than usual. Other criterion, according to the 10 characteristics of Indonesian consumers (Irawan, 2008), include: (1) short-term-minded, for

those who choose university that ease their students to finish their studies, (2) unplanned-minded, for those who choose university without many considerations; (3) collectivism, for those who choose university because of some influences/suggestions from friends, family, or relatives; (4) technology-oriented, for those who choose modern university that comes up with advanced technology; (5) context-oriented, for those who choose a university with good curriculum standards; (6) abroad-minded, for those who choose an international college/university; (7) religious, for those who choose a university with holistic education; (8) prestige-minded, for those who choose a reputable university; (9) subculture, for those who are fanatic to a certain university; (10) social-responsibility, for those who choose a university that has a social-responsible program by providing scholarship.

The growth and development of private universities in Indonesia has been rapidly increasing year by year. APTSI (Asosiasi Perguruan Tinggi Swasta di Indonesia - Association of Private Universities in Indonesia) pointed out that private universities had dramatically increased for as much as 1,468 in a decade, from 1,293 in 1997, and there has been 2,761 private universities in 2007. There are five kinds of higher education institutions, namely: academy, institute, polytechnic, college, and university (Kopertis VII). The growth of the higher education institutions increases the competitiveness among private universities to attract prospective students. Instead, private universities must also compete with public universities. (Best University 2010, TEMPO 2010).

Table 1. Amount of Private and Public Universities in East Java and Surabaya

	Private University		
	East Java		Surabaya
	2000	2013	2013
Academy	32	85	14
Institute	16	13	5
Polytechnic	5	12	4
College	105	144	10
University	63	75	24

Source: APTISI (2000 and 2013) and Kampus Info (2013)

In 2013, based on APTISI, the amount of private higher-education institutions in Surabaya was 57; including 14 academies, 5 institutes, 4 polytechnics, 10 colleges, and 24 universities (APTISI 2013). There were 5 public higher-education institutions including 1 institute, 2 polytechnics, and 2 public universities (List of Public Campuses in East Java, 2013). Table 1 depicts the number of higher-education institutions in Surabaya that competed to get prospective students. The amount of private higher-education institutions in East Java has increased of 33% from 211 in 2000 to 329 in 2013. It means that competitiveness among institutions is tighter. So, problem that raises in this study: What are the characteristics of high school students in selecting higher education institution in Surabaya? This research will be conducted to know the characteristics of high school students in selecting university to enroll. Consumer behavior in doing a purchase always dynamically evolves. This research is conducted to give some characteristics decisions of consumer behavior based on Indonesian perspective. This research will result in a cluster of consumer behavior characteristics that will be grouped based on perspective similarities in selecting university. The reason of knowing students characteristics in selecting university is to make a market target segmentation and to analyze the competitors. This research has never been done before, and the authors hope it will give a new contribution about consumer behavior descriptions especially to the educational sectors.

II. Research Methodology

The authors apply exploratory method on this research, that is to explore various kinds of attributes that affect students'

decision of choosing university. The authors pick 690 private-high school students in Surabaya as a countable population, with simple random sampling as the method. Questionnaires were distributed to students who were chosen as samples. The authors uses several criterion from Hofstede's (1980) theory about culture dimensions and Irawan's (2008) theory about 10 characters of Indonesian consumers, as follows, to determine students' characteristics in choosing preferred university.

1. I prefer to choose university with clear regularities.
2. I prefer to choose university based on my own decision/preference.
3. I prefer to choose university based on my parents' considerations.
4. I prefer to choose university which is able to support my success in the future.
5. I prefer to choose university with a good collectivism.
6. I prefer to choose university where students can have a close relationship with lecturers/staff.
7. I prefer to choose university with a good quality.
8. I prefer to choose university that provides acceleration program.
9. I prefer to choose university which is reputable and outstanding.
10. I prefer to choose university based on my friends' suggestions.
11. I prefer to choose university based on my considerations.
12. I prefer to choose university which is modern.
13. I prefer to choose university that provides a good curriculum.
14. I prefer to choose university that provides international standard.
15. I prefer to choose university that provides a good holistic education.
16. I prefer to choose university that can ease their students to graduate.
17. I prefer to choose university with a good reputation.
18. I prefer to choose university that provides scholarship.

The data of high school students' characteristics in choosing university were collected by distributing questionnaires that contain the eighteen items mentioned above. The authors choose students from private high schools in Surabaya as samples by two considerations:

- a. 12th grade students from private high schools, since they already have a perspective towards preferred universities.
- b. Students who plan to continue their study in university.

First of all, data collected from questionnaires that were distributed to the participants will be further processed using SOM (Self Organizing Map). SOM is software that is used to cluster or to group the data based its characteristics. A cluster consists of a group of similar vectors. SOM will result in a "topologic map" of the data. Data that has resemblance(s)/similarity to the others will have a small gap/ close distance and otherwise. SOM is the application of neutral network that uses multi-input and multi-output (Setiawan, 2004).

SOM is used to group the data based on their characteristics. Two-dimensions SOM method is applied on this research. Input layer will be a linear and output layer will be presented as a two-dimension matrix. Each unit of two-dimension matrix will be completely connected to all existing inputs (Setiawan, 2004).

The principles of algorithm with SOM topologic method will be described in 7 steps as follows:

Step 1: Neuron of input layer (input neuron), with amount of i is labelled as $x_1, x_2, x_3, \dots, x_i$ and neuron of output layer (output neuron), with amount of $j \times 1$ is labelled as $y_{11}, y_{12}, y_{13}, \dots, y_j$. Connection weight between input neuron and output

neuron is labelled as W_{ij} (three dimensions).

Step 2: Initiate connection weight between input neuron and output neuron (W_{ij}) with random number between 0 and 1.

Step 3: Repeat step 4 to step 7 until it is convergent (change in weight is relatively small/ smaller than tolerance range) or cycle (step 4 to 7 must be done as much as the given amount).

Step 4: Choose one of x input vectors randomly (real-random number between 0 and 1) that will be clustered and input to input neuron.

Step 5: Measure the gap between input vectors and connection weight d_{jl} for each output neuron by using the following formulation:

$$d_{jl} = \sum_{i=1}^n (w_{ijl} - x_i)^2$$

Step 6: Find the index of $b = j, c = l$ where d_{jl} is at the minimum; output neuron bc is called as the best matching unit.

Step 7: For each W_{ijl} , renew connection weight by using the following formulation:

$$w_{ijl}(t+1) = w_{ijl}(t) + g(t) h_{jbc}(t)(x_i(t) - w_{ijl}(t))$$

$g(t)$ refers to an adaptive scalar function, ranged $0 \leq g(t) \leq 1$; the greater its value ($g(t)$), the faster connection weight adapts; in other words, input vector has a great influence to the change of connection weight. Output value of $g(t)$ function keeps changing overtime and getting closer to 0, so that the weight changing is getting smaller and input vectors are well-mapped. Declining linear function $g(t)$ is frequently used, as follows:

$$g(t) = g(0)(1-t/T)$$

$g(0)$ is the first adaptive scalar function (beginning), whereas t is the current iteration and T is the whole iteration applied. The following graph illustrates the equation:

$h_{ib}(t)$ refers to a neighboring function, ranged $0 \leq h_{ib}(t) \leq 1$. Purpose of this function is to affect weight change

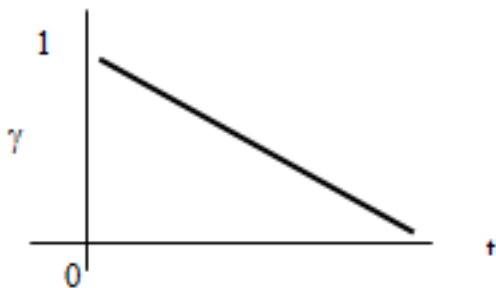


Fig. 1. Graph of $\gamma(t)$ function

proportionally from the best-matching neuron to the other neighboring neurons. The wider the gap between output neurons, the smaller the change will be. Output value of $h_{ib}(t)$ function keeps changing overtime and getting closer to 0. It means that the effect of weight changing is getting narrower overtime and therefore eventually only best matching will be

affected.

Function of gap measure on two-dimensions SOM applies Pythagoras formulation. Gap measure function becomes:

$$h_{jbc}(t) = \exp(-r_{ij}^2 + r_{bc}^2) / s(t)^2$$

r_{ij} refers to a neuron output position of i , and r_{bc} refers to s best matching neuron position. $s(t)$ refers to a wide/broad neighboring controller, ranged between 1 to 4. The position here can be one dimension or two dimensions, in accordance to the output layer dimension.

When $s(t) = 1$, the weight change will be broad/extensive to the existing neighbors. However, when $s(t) = 4$, the weight change will only affect the best matching unit.

The existing functions, $g(t)$ and $s(t)$, will always be changing, depend on the total iterations applied. This change is directed to bring neurons to a stable/ convergent position. It means that the longer it takes, the smaller it changes. Somehow a stable position can be reached before iteration ends (Setiawan, 2004).

Further process is conducted by applying measurement model of structural equation analysis technique, using Amos 20 software. Measurement model or confirmatory factor analysis is used to confirm whether the indicator variables that were used can confirm the construction (Ferdinand, 2002), also to point out the most important indicator in choosing university.

III. Result

Based on data tabulation using Self Organizing Map, we find that students' characteristics in selecting university can be grouped into four clusters (group 1 to 4).

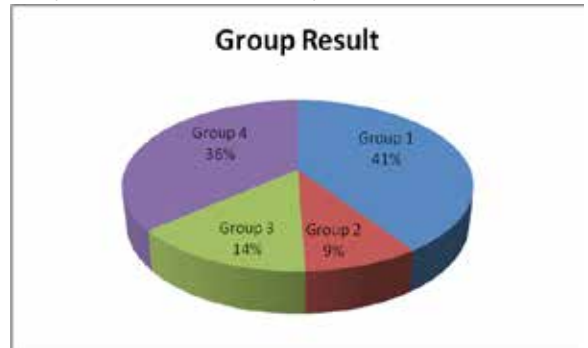


Fig. 2. Group Result

The data tabulation (Group All) shows that each indicator used is able to explain the preference in choosing university: the value of standardized regression weight is greater than 0.4 and CR is greater than 2. Based on the data tabulation, the most important indicator underlying university preference is its popularity among people. Another indicator is selecting university based on friends' suggestions; it means that students' characteristics are based on what's trending among people. Another indicator is selecting university that provides good quality. Another indicator is selecting university that provides acceleration program/ shorter period of study, and the other indicator is selecting university that provides international standards/ curriculum. The next data tabulation is given in Table 2.

Table 2. Results of Factor Analysis (Factor Loadings)

		Standardized Loading Data				
	All	Rank	Group 1	Group 2	Group 3	Group 4
x1	0,444	16	0,566	-0,019	0,347	0,265
x2	0,538	8	0,512	0,023	0,611	0,261

x3	0,474	15	0,395	0,011	0,7	0,201
x4	0,498	11	0,394	-0,025	0,389	0,091
x5	0,481	14	0,509	-0,031	-0,113	-0,195
x6	0,559	7	0,544	-0,036	-0,016	-0,141
x7	0,642	3	0,607	-0,019	-0,05	0,269
x8	0,621	4	0,598	0,005	-0,382	0,325
x9	0,686	1	0,634	0,01	-0,602	0,725
x10	0,659	2	0,536	-0,023	-0,466	0,485
x11	0,405	18	0,239	-0,009	-0,023	0,172
x12	0,482	13	0,266	-0,041	-0,233	0,205
x13	0,503	9	0,384	-0,016	-0,224	0,167
x14	0,602	5	0,505	-0,007	-0,102	0,26
x15	0,58	6	0,508	-0,029	-0,042	0,288
x16	0,503	10	0,318	-0,039	-0,147	0,059
x17	0,492	12	0,155	0,011	0,112	0,212
x18	0,432	17	0,17	-0,047	0,119	0,083

Source: Output Amos 20

Based on Table 2, the most prominent indicator of the first group of students is to choose university which is well-known or prominent among people, university which has a good quality, university that offers acceleration program- where students can finish their study earlier, university that provides clear regularities, and last but not least is to choose university that provides a close relationship between students and lecturers/staff. Students' characteristics are clearly reflected by the eighteen indicators. Based on the list of indicators mentioned, this cluster is more likely to represent a group of students who are independent- not dependent to their parents' decisions- and have a strong willingness to learn. Therefore, this cluster is included as a group of individualism students.

The second group of students gives an interesting finding to this research. Based on the eighteen indicators mentioned, nothing meets the reasons to explain students' characteristics in choosing university. This finding reflects that this second group consists of students who have another considerations beyond the all indicators mentioned above. This means that further exploration is necessary- instead of culture dimensions analysis and consumer behavior. Therefore, further research is necessary to determine students' characteristics of the second group; which is included as the unplanned students.

The third group figures out that the most prominent indicator/reason in choosing university is based on parents' con-

siderations. This group of students reflects that there is a strong influence from parents who direct their children while choosing university. Another indicator is to choose university based on their own considerations, which also means that parents give some recommendations/suggestions about what university to choose and then make a decision. Another reason is to choose a university that supports future career success. This means that there is a greater influence from parents, since parents will suggest or encourage their children to choose a university that will support their future career. Another indicator is to choose university that has a clear regularity, so that parents will not be worry about their children since there is a clear regularity applied. Other interesting finding from the third group is that there are some indicators which make students uninterested in a certain University, one of those indicator is choosing university which is well-known among people. The reason is because of parents' dominant influence in determining their children's choice/ preference to a certain university. Other less dominant reason is because of their friends suggestions. This third group of students reflects that friends' influences are not as dominant as parents' influences. Therefore, this third group is included as family-oriented students.

The fourth group of students figures out a characteristic of choosing a university by its popularity/reputability; this group of students are more likely to choose a university which is well-known among people. Another reason is to choose university based on friends' recommendation, and the other reason is to choose a university which provides acceleration program so that students can complete their study earlier. This means that students in this group are more likely to choose a certain university because they want to build a stronger and wider network relationship by following their friends' suggestions. Interesting finding on this research, students are less likely to choose university which provides a close relationship between students and lecturers/staff, means that it is not the main consideration in choosing university. This fourth group of students is included as long term-oriented students.

IV. Conclusion, Research Limitation and Extension

The authors noted some limitations within this research. This research did not examine the moderating variables and samples were only limited in Surabaya. There are some other related issues that need to be reconsidered to maintain and improve students' interests and preferences towards university. The authors did not consider other issues such as socio – demographics factors in accordance to students' preference towards university choices. It is also necessary for the further researcher to add more samples in order generalize the data result. The moderating variables can also be used to strengthen the research. The authors expect that in the future there will be further research about this study that will cover all limitations.

REFERENCE

- Daftar Nama Kampus Negeri di Jawa Timur. (2013). http://www.kampus-info.com/2011/08/daftar-nama-nama-kampus-negeri-di-jawa_5962.html
- | | Franke, George and Nadler, Scott. (2008). Culture, economic development, and national ethical attitudes". *Journal of Business Research*, 61, pp. 254–264. | Franke, George R., & Nadler, S. Scott. (2008). Culture, economic development, and national ethical attitudes. *Journal of Business Research*, 61, 254-264. | | Hofstede, G. (1980). *Culture's consequences: international differences in work-related values*. Beverly Hills, CA: Sage Publications. | | Irawan, Handi. (2008). *10 Karakter Unik Konsumen Indonesia*, Publishing One, Jakarta. | | Jian, Hua-Li., Frode Eika Sandnes, Yo-Ping Huang, & Yueh-Min Huang. (2010). Cultural factors influencing Eastern and Western engineering students' choice of university. *European Journal of Engineering Education*, 35(2), 147 – 160. | Kindle, Peter A. & Ira Colby. (2008). School Selection Preferences of Public and Private University MSW Students: A Retrospective Study. *Journal of Social Work Education*, 44(3), 97 – 113. | | Ming Sia, Joseph Kee. (2013). University Choice: Implications for Marketing and Positioning. *Education*, 3(1), 7 – 14. | | Nadiiri, Halil., Jay Kandampully, and Kashif Hussain. 2009. Students' Perceptions of Service Quality in Higher Education, *Total Quality Management*, Vol. 20, No. 5, 523-535. | O'Neill, M. and Palmer, A. 2004. Importance-performance analysis: a useful tool for directing continuous improvement in higher education, *Quality Assurance in Education*, Vol. 12, no. 1: 39-52. | | Polat, Soner. (2012). The factors that students consider in university and department selection: A qualitative and quantitative study of Kocaeli University, Faculty of Education students. *Procedia Social and Behavioral Sciences*, 47, 2140-2145. | | Raposo, Maria & Helena Alves. (2007). A model of university choice: an exploratory approach. *Linking Research, Policy and Practice*. 1- 18. | | Schein, E. H. (1992). *Organizational Culture and Leadership* (2nd ed.). San Francisco: Jossey-Bass. | Schiffman., G. L & Kanuk, L.L. (2010). "Consumer Behavior". 10th Edition. Prentice Hall, One Lake Street, Upper Saddle River, New Jersey. | | Schraeder, M. and Self, R. D. (2003). Enhancing the Success of Mergers and Acquisitions an Organizational Culture Perspective. *Management Decision*, 41/5, 511-522. | | Setiawan, Kuswara. (2004). Paradigma Sistem Cerdas: Artificial Intelligence, 73-100. | | Tan-Kuick, Ching Li Gwendoline. & Keith Yong Ngee Ng. (2011). The Mediating Effects of Peer and Parental Encouragement on Student's Choice of a Nursing Education. *Journal of Applied Business and Management Studies*, 2(1), 1 – 10. | | Waarts, Eric., & Everdingen, Yvonne Van. (2005). The Influence of National Culture on the Adoption Status of Innovations: An Empirical Study of Firms Across Europe. *European Management Journal*, 23(6), 601-610. doi:10.1016/j.emj.2005.10.007. |