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Analysis of Internet Network Technology Online Training for Indonesian Navy Information Technology Employees Using Hierarchical Clustering

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Abstract

During the covid-19 pandemic, all institutions had a high dependency on information technology. Network strength is very important. Thus, an internet network technology course was conducted for information technology personnel of the Indonesian Navy. The training is conducted online. Studied learning success is associated with the initial data held, namely rank, gender, work experience in the field, previous education and learning activities, and age of participants. The data was clustered with the final test results to determine the clustering of training results and these factors. Based on the clustering it can be stated a good grouping of learning success in this pandemic period. From the 75 personnel data, we could made 5 clusters. Recommendation for internet network tools online training, especially in internet network technology, is that the participants of the course should have experience in internet and network, young and have good education level at least high school.

Keywords: *hierarchical cluster, online training, internet network technology*

Introduction

On 2 March 2020, the President of the Republic of Indonesia, Joko Widodo, officially announced Indonesian citizens who contracted the virus in Jakarta. Therefore, since then, the COVID-19 had entered Indonesia. To suppress the development of Covid-19 in Indonesia a work from home policy was issued (Mustajab et al., 2020). The Indonesian Navy as an important institution in Indonesia also implements a work from home policy for some of its employees by scheduling work from home.

The work from home system is in dire need of a good communication network in offices and government agencies. The personnel who are responsible for networking need to be given network training in order to better organize the network in the office. The previous research shown that in general, students of both public and private vocational high schools stated that online learning is not more interesting than ordinary learning, although most of them can understand the lessons taught and they were given an opportunity by their teachers to actively participate during the learning process (Mulyanti et al., 2020). This proves that training for skills in computer networking is possible to be done online. Within the Indonesian Navy, the need for network arrangement is also becoming increasingly urgent. Training for personnel serving in the field of networks throughout the Indonesian Navy in various regions in Indonesia is very important and has been carried out so that they can immediately play a role in supporting the performance of the Indonesian Navy online during the Covid 19 pandemic.

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Evaluation of training results for training participants is carried out. Referring to various studies on the success of education with clustering have been carried out (Sudhakar & Basariya, 2017), (Alaghbari, 2016),. The results of the clustering carried out can help map student performance in education and can be used to help improve the quality of education. Therefore, in this study, a clustering of the results of training for Indonesian Navy Information technology personnel was carried out with a record number of 76 people with recordable indicators, namely: age, gender, rank, and level of education as well as the length of service in the field of information technology before attending the training.

Based on this background, research questions can be formulated. The question is: how to analyze the results of online-based internet network technology training for Indonesian Navy IT personnel with the supporting variables: age, gender, rank, and level of education as well as the length of time served in the information technology field before participating in training.

Method

Data mining method consists of: data collecting, pre-processing, data transforming, data processing and analyzing (Witten et al., 2011), (Thankachan & Suchithra, 2017) and (Suharjo & Utama, 2021). This method can be explained as follows:

1. Data Collection. Collecting data from the form filling out prospective course students, attendance, and learning evaluation results. The form is filled out by the trainees when they start the training.
2. Pre-processing. The pre-processing is carried out by checking data and eliminating unnecessary data in the form of: data on place of birth date and data on work units.
3. Data Transformation. Data transformation is done by transforming text data into numbers of nominal and ordinal types. Nominal data is gender. The data was transformed from women to 0 and 1 for men. Ordinal data is the age with the age transformation of 20-30 years with numbers 1, <30 - 40 years with numbers 2 and <40 - 50 with numbers 3. The next transformation is the rank with 1 for enlisted men, 2 for non-commissioned officers and 3 for officers. The last transformation is Education level 1 for junior high school 2 for senior high school, and 3 for Bachelor and diploma.
4. Data processing with Hierarchy cluster. Data processing with hierarchical clustering was carried out using a dendogram. Hierarchical grouping combines data objects into clusters, the cluster becomes a larger cluster, and so on, creating a cluster hierarchy (Rani & Rohil, 2013). One of the most widely used techniques for grouping data is agglomerative clustering. Such algorithms have long been used in many different fields because their output is easy to interpret (Balcan & Gupta, 2014). The clustering steps using hierarchical are (Erman et al., 2015), (Wahyuni & Aryo Jatmiko, 2018), and (Widyawati et al., 2020) :
   a. Calculate Distance Matrix between data.
   b. Combine the two closest groups based on the defined proximity parameter.
   c. Update the Distance between data matrix to represent the closeness between the new group and the remaining groups.
   d. Repeat steps 2 and 3 until only one group remains.

Distance matrix can be count using Manhattan Distance or Euclidean Distance. Manhattan distance is $D = \sum_{i=1}^{n} |b_i - a_i|$. While, euclidean distance is

$$D(a, b) = \sqrt{\sum_{i=1}^{n} (b_i - a_i)^2}$$

Methods of agglomerative hierarchical grouping:

a. Single linkage: $d_{uv} = \min\{d_{uv}\}, d_{uv} \epsilon D$
b. Complete linkage: $d_{uv} = \max\{d_{uv}\}, d_{uv} \epsilon D$
c. Average linkage: $d_{uv} = \text{average}\{d_{uv}\}, d_{uv} \epsilon D$

5. Selection of the number of clusters. A dendogram with a large number of clusters was selected. The selection is made by comparing the number of members of a cluster, so that there should be no cluster with very few members.
6. Discussion. The characteristics of each cluster were discussed.

Graphically, research using hierarchical clusters is arranged in the form of a flow chart as follows:

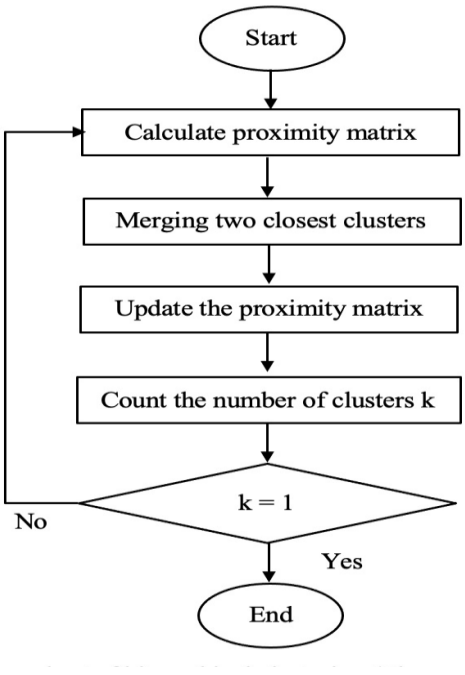

Figure 1. Flow chart of hierarchical clustering (Zhang et al., 2015)

Results

Data and Descriptive of data

The research data consisted of 74 online training participants. The participants are Indonesian Navy personnel who work in the IT field. Various data used in this study include age, gender, education, rank, and test results from theoretical and practical exams. Details can be presented as follows.

From table 1, we can describe the relationship between age with the results of the theoretical and practical tests, gender with the results of the theoretical and practical examinations, education with the results of the theoretical and practical examinations, rank with the results of the theoretical and practical examinations.

Table 1. The 74 of Research Data with Age, Gender, Education Level, Rank, and the result of theory and practice tests value

NO	Age	Gender	Education	Rank	Theory	Practice	NO	Age	Gender	Education	Rank	Theory	Practice
1	1	1	1	1	6	7	38	2	1	3	3	8	8
2	1	1	1	1	6	7	39	2	1	3	3	8	8
3	1	1	1	2	6	8	40	2	1	3	3	8	8
4	1	1	1	2	7	8	41	2	0	2	2	7	8
5	1	1	2	1	6	7	42	2	0	2	2	7	8
6	1	1	2	1	6	7	43	2	0	2	2	7	8
7	1	1	2	1	7	7	44	2	0	2	2	7	9
8	1	1	2	2	7	8	45	2	0	2	2	8	9
9	1	1	2	2	7	9	46	2	0	2	2	8	8
10	1	1	2	3	7	7	47	2	0	2	2	7	8
11	1	1	2	3	7	7	48	2	0	2	2	8	8
12	1	1	3	3	8	7	49	2	0	2	2	8	8
13	1	1	3	3	8	7	50	2	0	3	2	8	8
14	1	1	3	3	8	7	51	2	0	3	3	8	8
15	1	0	2	2	7	6	52	3	1	1	2	6	7
16	1	0	2	2	7	6	53	3	1	1	2	6	7
17	1	0	2	2	8	6	54	3	1	1	2	6	7
18	1	0	2	2	7	6	55	3	1	1	2	6	7
19	1	0	2	2	7	7	56	3	1	1	2	6	7
20	1	0	2	2	7	7	57	3	1	1	2	6	7
21	1	0	3	3	8	7	58	3	1	2	2	7	7
22	1	0	3	3	8	6	59	3	1	2	2	7	7
23	2	1	1	1	6	6	60	3	1	2	2	6	6
24	2	1	1	1	5	6	61	3	1	2	2	6	6
25	2	1	2	1	5	6	62	3	1	2	2	6	6
26	2	1	2	1	6	7	63	3	1	2	2	6	6
27	2	1	2	1	6	6	64	3	1	2	2	7	6
28	2	1	2	2	6	6	65	3	1	2	2	6	6
29	2	1	2	2	6	6	66	3	1	3	3	7	6
30	2	1	2	2	7	7	67	3	1	3	3	7	7
31	2	1	2	2	7	7	68	3	1	3	3	7	7
32	2	1	2	2	7	6	69	3	1	3	3	7	7
33	2	1	2	2	7	7	70	3	1	3	3	7	8
34	2	1	2	2	6	7	71	3	0	2	2	7	7
35	2	1	2	2	7	7	72	3	0	2	2	7	7
36	2	1	3	2	7	8	73	3	0	2	3	7	7
37	2	1	3	2	8	8	74	3	0	3	3	7	7

The data of the age with theory and practice from all participants in the training, can be shown in Table 2.

Table 2. Age with Theory and Practice

Age	Theory	Practice	Average
Young	7.045	7.000	7.023
Middle	7.033	7.367	7.200
High	6.522	6.739	6.630

Based on table 2, it can be concluded that the highest score was achieved in the training participants with the middle level, then young and finally high. This is consistent with the fact that skills are greatly influenced by experience in the same field. With a sufficient age, experience in the IT field for training participants is quite good. But if he is old then his skills will also decline.

Table 3. Gender to Theory and Practice

Gender	Theory	practice	average
Man	7.391	7.348	7.370
Woman	6.654	6.942	6.798

Based on table 3, it can be concluded that the highest score was achieved in the training participants with the gender is man. This is consistent with the fact that skills in IT practice still are greatly influenced by gender and in this case is man.

Table 4. Education to Theory and Practice

Education	Theory	Practice	average
Junior High School	6.000	7.000	6.500
Senior High School	6.795	6.977	6.886
Bachelor	7.632	7.316	7.474

Based on table 4, it can be concluded that the highest score was achieved in the training participants with the education is bachelor, followed by Senior High School and Junior High School. That fact is consistent with the fact that skills in IT practice still are greatly influenced by level of education.

Table 5. Rank to Theory and Practice

Education	Theory	Practice	Average
Enlisted	5.900	6.600	6.250
non-commissioned Officer	6.851	7.128	6.989
Officers	7.500	7.167	7.333

Based on table 5, it can be concluded that the highest score was achieved in the training participants with the rank. The fist officers, followed by non-commissioned officers and enlisted. This is consistent with the fact that skills in IT practice still are greatly influenced by level of intellectual and education. Because almost all personnel with higher rank have greater education level and intellectual level than the lower ones.

Clustering for all Factors

Clustering was done using the agglomeration method in hierarchical clustering. The results of clustering using this hierarchical method are presented as dendogram in Figure 2, as follows.

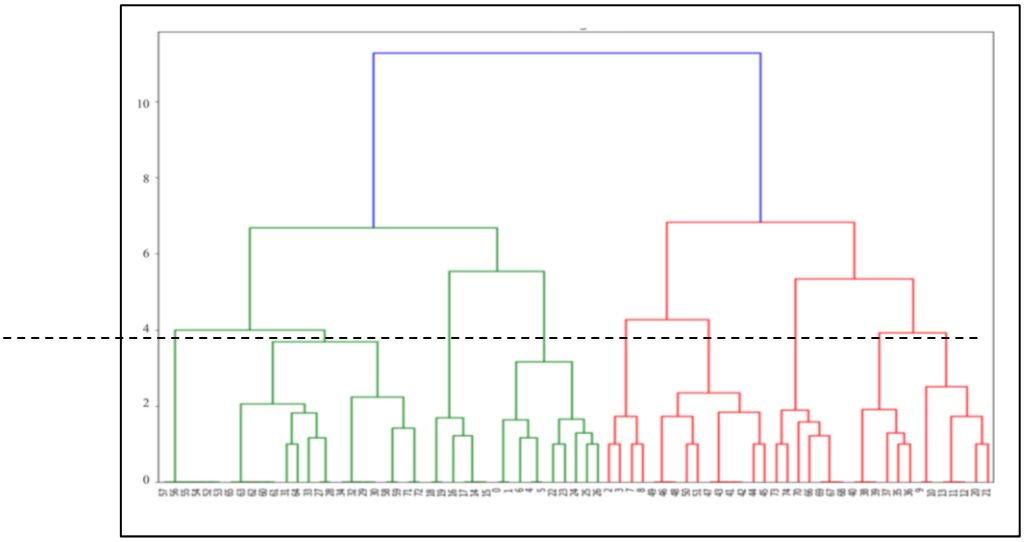

Figure 2. Dendograms of data research

Furthermore, from the dendogram that has been compiled, you can choose the number of clusters that will be used for data grouping. This study used 5 clusters. The results of grouping are presented in table 6 as follows.

Table 6. Data and Its Hierarchical Clustering

Data Number	Cluster
9, 10, 11, 12, 13, 20, 21, 35, 36, 37, 38, 39, 40, 66, 67, 68, 69, 70, 73, 74	0
27, 28, 29, 30, 31, 32, 33, 34, 52, 53, 54, 55, 56, 57, 58, 59, 60, 61, 62, 63, 64, 65, 71, 72	1
2, 3, 7, 8, 41, 42, 43, 44, 45, 56, 47, 48, 49, 50, 51	2
0, 1, 4, 5, 6, 22, 23, 24, 25, 26	3
14, 15, 16, 17, 18, 19	4

Based on the results of the clustering, the characteristics of each cluster can be explained on age, gender, education, rank and the results of theoretical and practical competency tests, as follows:

Table 7. Characteristics of Every Cluster

Cluster	Percentage	Characteristics
0	26,7%	Young people, male or female, non-commissioned officers and officers with a high school-graduate education, and get best grades
1	32%	Medium age and above, male, non-commissioned officer or officer and have experience in IT and get good grades
2	20%	Medium age, mostly women, high school education, have experience in IT and get good grades
3	13,3%	young men Junior high school education, enlisted or non-commissioned officers and get enough grades
4	8%	Young people, women, high school education, non-commissioned officers, get enough grades

An important note from the clustering results is that the highest is 32% with the characteristics: medium age and above, male, non-commissioned officer or officer and have experience in IT and get good grades. Furthermore, 26.7% with the characteristics of young people, male or female, non-commissioned officers and officers with a high school-graduate education, and get best grades. The third is 20% with characteristics are medium age, mostly women, high school education, have experience in IT and get good grades. The fourth is 13.3% with characteristics are young men, Junior high school education, enlisted or non-commissioned officers and get enough grades. Finally, a number of 8% with characteristics are young people, women, high school education, non-commissioned officers, get enough grades.

Discussion

The results showed that the best results were obtained in the group with the characteristic: young people, non-commissioned officers and officers with a high school-graduate education. The lowest results were in young men, junior high school education, enlisted or non-commissioned officers and women, high school education, non-commissioned officers. This is in accordance with the characteristics of IT network technology which is suitable for the younger and more educated generation. As for the older generation or the generation with lower education, this technology has not yet been mastered properly. This is in accordance with research conducted by (Rastati, 2018). In this study, the level of education also affects the ability to learn using online methods. This is in accordance with research by (Basargekar & Singhavi, 2017). In the study, the mastery of internet technology in the younger generation with a higher level of education because they were born in the era of the internet has developed. Meanwhile, in the older generation and the generation with a lower level of education, mastery of internet technology has not been fully achieved because they were born during the transition period of internet technology development. Thus, online education is suitable for the younger generation while the older generation requires higher training and adjustment.

Conclusion

Based on the results of hierarchical clustering calculations, it can be concluded that the data can be grouped into 5 clusters, with cluster 0 of 20 data or 26.7%, cluster 1 of 24 data or 32%, cluster 2 of 15 data or 20%, cluster 3 of 10 data or 13.3% and cluster 4 with 6 data or 8%. Based on the results of the characteristics of the data, it is recommended that the best training for women with sufficient age and work experience in the network field. High school education will produce the best score. Meanwhile, it is also recommended that at a young and moderate age, non-commissioned officers and Officers with high school and undergraduate education will get good grades. Value will be in the lowest position if trained in enlisted and non-commissioned officers with junior high or high school education and young people do not have experience in networking.

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