PROCEEDINGS

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INTERNATIONAL SEMINAR ON MACHINE LEARNING OPTIMIZATION & DATA SCIENCE

Jakarta - Indonesia, 29 January 2022

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WELCOME SPEECH

To honorable,

- Dr. Domenico Santaniello, Associate Professor from University of Salerno ITALY
- Dr. Zilu Liang, Associate from Kyoto University of Advanced Science, JAPAN
- Director General of Higher Education, Research and Technology (Prof. Ir Nizam, M.sc, DIC, Ph.D., IPU, Asean Eng.),
- Head of Region 4 Higher Education Service Foundation and staff,
- Rector Krisnadwipayana University Education Staff,
- Researchers and Conference Attendees,

Assalamualaikum WR. WB. I hope you are safe and health today.

Firstly, let us say thank you to almighty God for his blessings and grace, we can gather in this room together or in this time by virtual, although under the condition of COVID-19 Pandemic, we are still be given strength, health, and chance to be capable of participating in the **2021 International Seminar on Machine Learning, Optimization, and Data Science** (***2021 ISMODE***).

At this moment, I am as a Dean of Krisnadwipayana University, I would like to welcome you to International Conference, I apologize that this conference was held virtually because the COVID-19 Pandemic has not ended yet. However, we must do this conference very well.

Nevertheless, we never give up on this situation, hopefully, the enthusiasm of the research can convey the best things to all participants and can be seen from the numbers of research articles sent to us.

We feel so proud and grateful good participation of researchers who have been willing to join their research results, for publishing in this International Conference, I would like to say thank you very much to the plenary speakers and IEEE Indonesia Section, who have believed and given strong support to this conference from the beginning.

I personally hope for the next year, when the COVID-19 will have ended, we could meet again warmly and join conferences from researchers.

Ladies and gentlemen, this is the end of my speech, I would like to sincerely apologize for any inconveniences during this meeting.

Thank you very much for your kind attention and Wassalamualaikum WR WB.
Thank you

Jakarta, 29 January 2022
Dean,

Dr. Harjono

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PREFACE

Analyzing data has a long history. Many terms have been widely used to describe this field of data analysis, including statistics, artificial intelligence, machine learning, and data analytics. This study is also known as data science. The most fundamental thing in this study are experiments, observations, and numerical simulations in all fields of science and business that use big data from terabytes of data, and in some cases, up to petabytes and above. This information analysis consists of datasets from various fields from knowledge on the earth's surface, social processes, information-based industries, and outer space. The knowledge that has a lot of data causes choices and considerations for calculations in exact theory to be ignored even though data science is a value approach with a fast way to get precise values.

The development of data science includes all data without exception so that data that was previously only stored in files and folders can now be used to dig up information. Data retrieval capabilities can include understanding data, processing data, extracting values, visualizing it, and communicating. These abilities are essential in the coming periods for professionals and ordinary people who can learn them. It is because there is a lot of data everywhere. Meanwhile, these critical properties will bring up ideas in data processing. Five main things make up big data: volume, velocity, variety, value, and veracity. The volume sector means that data is collected over time so that it becomes many from terabytes, petabytes, to exabytes. Many ideas arise when the computer can't process data, such as MapReduce, Hadoop, etc. The velocity sector causes data to be generated very quickly.

In contrast, the data variety sector has differences in its types, so selecting and comparing it requires carefulness and accuracy. Sector value data must have good considerations so that to be able to understand the data needs to be converted into a specific value. In the veracity sector, the data to be processed must be flawless and appropriate. However, data science can be done on small datasets. Otherwise, not everything done in big data will be referred to as data science. So there are things that overlap in the two terms. In real-world problems, it can be said that there is no definite provision of a data inference. What is unacceptable is when the data do not support the reported conclusions.

Given the many implementations and applications of this data processing, the 2021 International Seminar on Machine Learning, Optimization, and Data Science (2021 ISMODE) appears. We hope that this 2021 ISMODE will start to advance the exchange of ideas, concepts, and engineering in the data processing. Even though it is still in a COVID-19 pandemic, this activity must be in line with the development of existing technology so that it does not stagnate in efforts to develop knowledge.

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Machine-Learning Prediction of Informatics Students Interest to the MBKM Program: A Study Case in Universitas Pembangunan Jaya

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***Abstract*—This paper presents a prediction model of student interest to join in the MBKM (*Merdeka Belajar Kampus Merdeka*) program. The MBKM is a new learning program launched by the Indonesian ministry of Education and Culture to improve the quality and competency of the students. This program offers a freedom to the students in accomplishing their study. Since this is a new program, knowing the students interest is very important in preparation, implementation, and improvement of the program. The students interest can be known through a survey, but this is time consuming and expensive. While a survey is difficult to be done, a prediction would be an alternative solution to know the student interest. Machine learning is applied to predict the students interest by implementing support vector machine (SVM) as the learning algorithm. The machine learning is built using a dataset that was obtained through a survey to the students at the Department of Informatics, Universitas Pembangunan Jaya (UPJ). The result shows that the machine learning was able to predict the student interest with accuracy up to 89.29%.**

***Index Terms*—Machine learning, support vector machine (SVM), prediction, MBKM program.**

I. Introduction

It was reported that total unemployment in Indonesia was 9.77 million people in 2020 [1] and 9.10 million people in 2021 [2]. The high unemployment rate is a problem that must be solved by the government. This is not a simple problem where the solution needs involvement and cooperation of several departments (ministries). The ministry of Education and Culture is one of the involved departments in solving this problem. The ministry of Education and Culture has a responsible to make the education especially at the higher education institutions (HEIs) producing qualified graduates who meet national interests and increase national competitiveness [3].

The HEIs are the place where the students build hard and soft skills such that are ready to build a professional career after graduate. Unfortunately, many fresh graduates have difficulty to obtain proper jobs. This case is happen in many countries and caused by many factors, such as lack of competencies and experiences of the fresh graduate, and mismatch between the education and industries [4]–[6].

In order to minimize the unemployment rate, the Indonesian ministry of Education and Culture launched a new program known the MBKM program in February 2020. The MBKM is stand for *merdeka belajar-kampus merdeka* or freedom to learn - independent campus. This program offers a freedom to the students in completing their study program. The students are given opportunity for one semester (equivalent to 20 credits) or two semesters (equivalent to 40 credits) to take courses in other departments, other universities, or event more in industries. The MBKM program consists of eight activities: 1) internship in industries, 2) community service projects in villages, 3) teaching in school, 4) student exchanges, 5) conducting research, 6) conducting entrepreneurial activities, 7) independent project studies, and 8) join in the humanitarian program. The students are free to choose one of the activities. The MBKM program allows the HEIs to be more flexibility, independent, less bureaucratic, and innovative in producing higher qualified graduates [7]. The program gives more emphasizing to the educational outcome to produce more competitive graduates in the global job market.

As a new program, the MBKM raises positive and negative responses from the students [8]. Regardless to the responses, providing a good understanding about the program is very important such that the students make good and reasonable decision whether joining in the program or not. Several events to socialize the program have been conducted by the ministry as well as the universities. Not only the socialization, the ministry is also providing supports for implementing the program, such as policy, funding, and cooperation to industries or other ministries [3], [9]–[12].

In order to make a good preparation and implementation of the program, a knowing the students interest in participating the program is very important [12]–[14]. While the students interest is very high, the ministry and university have to make preparation to accommodate the students. The high interest will impact many students apply in the program. This has to be anticipated in the implementation, such as selection method, quota, funding, and evaluation method. However, if the students interest is low, it remains some questions, for examples: the students understanding to the program, supports and policies of the university to the program, and

the effectiveness of the socialization. Data of the studer interest can be obtained through a survey [3], [12], [15], [1(The survey might ask the students about the understandir socialization method, support and policy of the universi expected benefit and impact, and the interest to the MBK program. However, conducting this survey is time consumi and costly. As an alternative solution, the students interest c be predicted instead of obtained through a survey.

Several prediction methods are available and one of them prediction using a machine learning. The machine learning trained using a dataset to build an intelligence. The machi learning has a goal to program computers using example da or past experience to solve a given problem [17]. The fa growing of machine learning is supported by several factc such as the new learning algorithm and theory, online da availability, and low cost computation [18]. The machi learning has two main functions: classification and regressic where both are applicable in prediction.

Several research works on applying machine learning prediction have been presented. Applying machine learni to predict customer purchase intention has been presented [19]. A study of applying machine learning to predict electi results was was presented in [20]. The machine learning w developed using dataset collected from Twitter. The stu resulted in a prediction model that was able to predict t election result with accuracy 94.2 % over the given baseline

This study presents a prediction of students interest to t MBKM program using machine learning. The goal is to obta a prediction model for the student interest with high accurac The machine learning is developed by applying the suppc vector machine (SVM) as the learning algorithm. The machi learning is trained using a dataset obtained through survey the students. Presentation of this paper is organized as follow Section I provides background and motivation of this stuc Section II discusses the machine learning and the survey f collecting the dataset. Section III presents the result of th study and discussing performance of the prediction model. Finally, conclusion of the work is presented in Section IV.

II. Methods

A. Support Vector Machine (SVM)

Machine learning is a part of artificial intelligence that grows very fast since the last two decades. The machine learning builds an intelligence through a learning process using a dataset. There are several algorithms that can be applied in the learning process of machine learning, and one of them is support vector machine (SVM). The SVM has been widely applied in real applications due to the performance efficiency, especially in classification problem.

Basically, the SVM is a binary linear classification technique as other techniques. However, the SVM promises that the classes separation is done using an optimal margin between the border line instances [21]. The optimal margin is the largest gap separating the border line instances. These border line instances are also known as the support vectors. The SVM is also known as the optimal margin classifier. The concept of

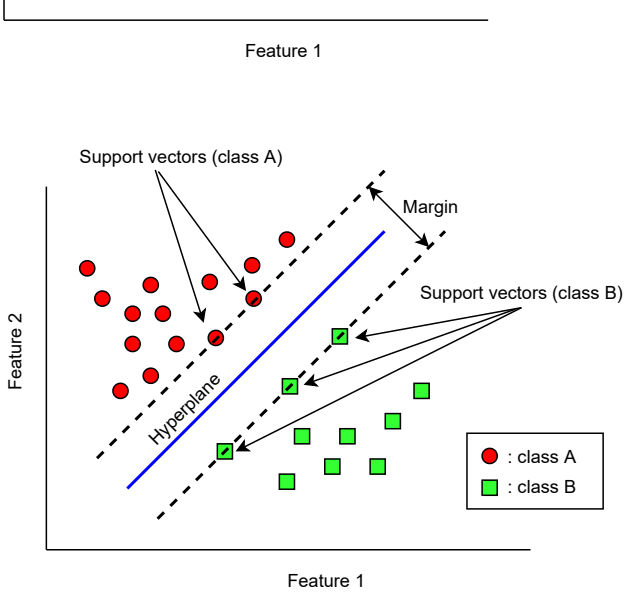


Fig. 1: An illustration of the SVM concept.

SVM is illustrated by the Figure 1. The figure shows a dataset that consists of two different classes: class A and class B. Both classes are separated by a solid line representing a hyperplane. The hyperplane is located at the middle of the dashed lines which is the border line. The support vectors are shown by the instants (data) at the border lines.

The SVM has an advantage of capability to classify non-linearly separable data. This capability is resulted by introducing Kernels into the SVM. The Kernels are mathematical functions that transform the data into a new higher dimensional space. Original space of the data is called as the input space, while the new higher dimensional space is known as the feature space. This transformation is to make the data to be linearly separable by a linear surface (hyperplane) in the feature space.

Mathematically, a Kernel is expressed by the following equation:

$$K(x_1, x_2) = \phi(x_1)^T \phi(x_2) \tag{1}$$

where x_1 and x_2 are two data points, ϕ is a mapping function, superscript T is a transpose operator, and K denotes Kernel. For input space has rich features, it is sufficient to utilize the identity function as the mapping function such that:

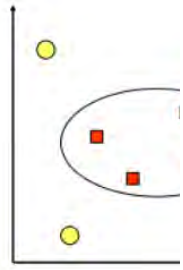
$$\phi(x) = x. \tag{2}$$

Substituting (2) into (1) results in:

$$K(x_1, x_2) = x_1^T x_2 \tag{3}$$

The (3) is known as the linear Kernel and the SVM applying the linear Kernel in known as the linear SVM. The linear SVM is very efficient to be applied in a problem high dimensional data. Accuracy of the linear SVM is close to the accuracy of non-linear SVM, but the linear SVM is much faster in training [22].

A geometrical illustration of the Kernel is shown in Figure 2. The figure shows a non-linearly separable data set in two-dimensional space on the left side. This two-dimensional space



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B. Survey

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C. Machine Lea

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shown in Figure

1. Importing li
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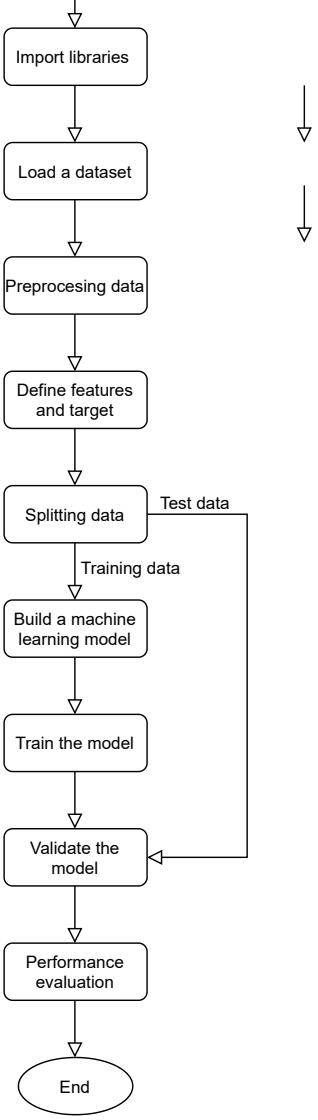
data that is very convenience in exploring, cleaning, and manipulating a dataset. Numpy or numerical Python is a library applied in numerical computation. scikit-learn is a library containing modules for building a machine learning.
2. Loading a dataset is to pull a dataset into the Python program. This dataset can be in csv file, txt file, or other data-type files.
3. Pre-processing data is to prepare the data such that properly applied in building a machine learning. The pre-processing data is done for examples by cleaning the data, removing incomplete data, and normalizing the data.



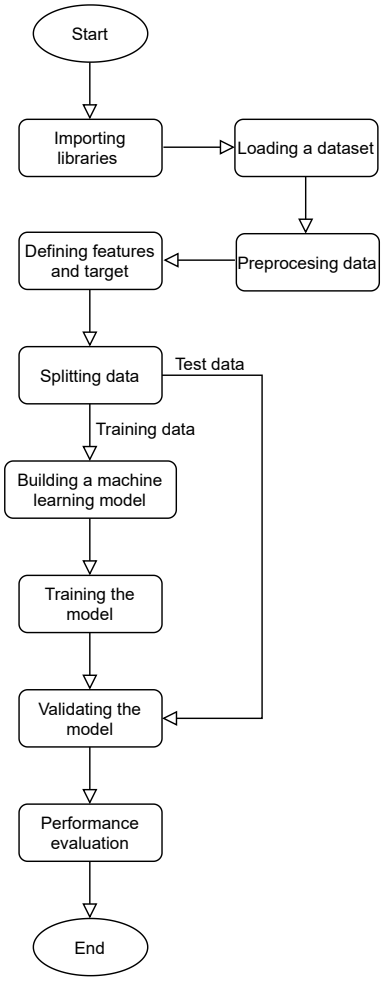


Fig. 3: A flow chart in building a machine learning.

4. Defining features and target are to select which columns data will be the features and target of the machine learning. The features are the input data for the machine learning, while the target is the reference data for the machine learning output. The machine learning is expected to result output that is approaching the target.
5. Splitting data is to divide the dataset into two subsets named the training data and the test data. The training data is applied in learning process of the machine learning, while the test data is applied to examined the the trained machine learning.
6. Building a machine learning is to create a machine learning model by applying modules of the scikit-learn. The built machine learning is applying SVM algorithm in this study.
7. Training the model is to build an intelligence on the machine learning model through a learning process. The learning process is carried out using training data, where the model is given the features data as input and trained to make a computation such that produces output close

to the target.

8. Validating the model is to test the trained model using the data test. The trained model receives the feature data as input and computes the output. The resulted output is compared to the target and the different of both is defined as an error.
9. Performance evaluation is to measure the performance of the built machine learning. There are several metrics in measuring the performance, where accuracy is the metric in this study.

III. Results

A. Survey Result as the Dataset

This study is only concerned to the students at Department of Informatics, Universitas Pembangunan Jaya. Therefore, the discussion is limited to the survey result of students in the department. The survey received answers from 138 students. The survey result show that 94 students (68%) are very interested, 39 students (28%) are moderate, and 5 students (4%) are not interested to the MBKM program.

The data resulted from the survey is applied as dataset to build a machine learning. The machine learning is to predict the students interest to MBKM program. However, not all of the questions in the survey are properly applicable in building a machine learning. Some questions have a potential to result in unbalance and incomplete data. Therefore, the dataset is composed using only 13 questions as listed in Table II in the Appendix. Since the answers are not numerical data, quantification is done to convert them into numerical values.

B. Machine Learning Prediction

A machine learning model is developed to predict students interest into the MBKM program. The model is built by implementing the SVM algorithm. The model is trained using a dataset resulted through a survey. This dataset consists of 138 rows and 13 columns of data. The rows represents the asked students, while the columns represents the questions. Table II shows the 13 questions and the answer choices in the survey. The question Q18 is the question that asks how the students interest to the MBKM program, while the other questions ask the students about understanding, preparation, and opinion to the MBKM program and the impact. Therefore, in developing this machine learning, the answers of question Q18 which is the actual interest defined as the prediction target, while the answers of other 12 questions are being the features data.

The dataset is randomly split into two sub-dataset, i.e. the training sub-dataset and the validation sub-dataset, with splitting ratio 80:20 percents, respectively. The training sub-dataset is applied in training the machine learning in order to build a prediction model. The validation sub-dataset is applied to examine the prediction model to make a prediction based on unknown data.

A machine learning model is developed using the SVM algorithm. The model is trained using the training sub-dataset that consists of 12 feature. The trained model is then tested to predict the student interest based on the features data of validation sub-dataset. Evaluation of the model is done by comparing the predicted interest and the actual interest. Based on the evaluation result, the developed model results in prediction accuracy of 82.1%. The model was developed using 12 features. It is interesting to observe how the features affects the prediction accuracy. Therefore, several models are developed using different features.

The second machine learning model is built and trained using 11 features by eliminating the feature data of Q1. The result show that the second machine learning model result in prediction accuracy of 85.71% which is better than the first machine learning model. Next, the third machine learning model is built and trained using 11 features by removing the Q3. The result shows that the third machine learning resulted in 85.71% prediction accuracy which is the same as the second model.

Similarly, other machine learning models are built using 11 features by eliminating different features as listed in Table I. Evaluation result of each models is presented as prediction accuracy in the table. The best accuracy using the eleven features were achieved by eliminating the feature of Q14, Q15, or Q15, where prediction accuracy of the machine learning reached 89.29%. On the other hand, removing the feature of Q13 resulted in the lowest prediction accuracy which is 75.0%, and followed by removing the feature of Q7 with prediction accuracy 78.57%. These results show that the questions Q7 and Q13 are the most critical questions for knowing the student interest.

IV. Conclusions

A machine-learning prediction of student interest to the MBKM program has been presented. Initially, data of the student interest was collected through a survey. The survey was conducted by giving questions about the MBKM program to the students at Department of Informatics in Universitas Pembangunan Jaya. The survey received answers from 138 students. The result shows the students interest to the MBKM program, where 68% students are very interested, 28% students are moderate, and 4% are not interested. The machine learning was developed by implementing the SVM algorithm and utilizing the survey data as a dataset. The dataset is split into 80% for training and 20% for testing. Simulation results showed that the machine learning was able to predict the student interest to he MBKM program with accuracy up 89.29%. Varying the applied features of dataset in building the machine learning resulted in different prediction accuracy. Removing the Q13 feature resulted in a significant reduction in the prediction accuracy. This indicates that the questions Q13 is the most critical question for knowing the students interest to the MBKM program.

This study presents a breakthrough in predicting the student interest to the MBKM program by applying machine learning. The prediction is done very quickly and might save the time and cost. Since this study uses only a small dataset, the further improvement of machine learning by applying a larger dataset should be a concern in further studies.

TABLE I: Machine Learning Prediction Results

No.	Number of Features	Applied Features	Eliminated Feature	Prediction Accuracy
1	12	Q1, Q3, Q5, Q7, Q8, Q9, Q10, Q11, Q13, Q14, Q15, Q17	-	82.1 %
2	11	Q3, Q5, Q7, Q8, Q9, Q10, Q11, Q13, Q14, Q15, Q17	Q1	85.71 %
3	11	Q1, Q5, Q7, Q8, Q9, Q10, Q11, Q13, Q14, Q15, Q17	Q3	85.71 %
4	11	Q1, Q3, Q7, Q8, Q9, Q10, Q11, Q13, Q14, Q15, Q17	Q5	85.71 %
5	11	Q1, Q3, Q5, Q8, Q9, Q10, Q11, Q13, Q14, Q15, Q17	Q7	78.57 %
6	11	Q1, Q3, Q5, Q8, Q9, Q10, Q11, Q13, Q14, Q15, Q17	Q8	85.71 %
7	11	Q1, Q3, Q5, Q7, Q8, Q10, Q11, Q13, Q14, Q15, Q17	Q9	85.71 %
8	11	Q1, Q3, Q5, Q7, Q8, Q9, Q11, Q13, Q14, Q15, Q17	Q10	82.14 %
9	11	Q1, Q3, Q5, Q7, Q8, Q9, Q10, Q13, Q14, Q15, Q17	Q11	85.71 %
10	11	Q1, Q3, Q5, Q7, Q8, Q9, Q10, Q11, Q14, Q15, Q17	Q13	75.0 %
11	11	Q1, Q3, Q5, Q7, Q8, Q9, Q10, Q11, Q13, Q15, Q17	Q14	89.29 %
12	11	Q1, Q3, Q5, Q7, Q8, Q9, Q10, Q11, Q13, Q14, Q17	Q15	89.29 %
13	11	Q1, Q3, Q5, Q7, Q8, Q9, Q10, Q11, Q13, Q14, Q15	Q17	89.29 %

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APPENDIX

The Table II shows the questions and optional answers in the survey and the answer quantification. The questions and optional answers in the survey were originally given in Indonesian and translated into English as presented in the table.

TABLE II: The questions and optional answers in the survey.

Question code	Questions	Answer choices	Quantified answer
Q1	How well do you know about the MBKM policy?	a) Knowing the overall policy. b) Knowing most of the contents of the policy. c) Knowing a little. d) Don't know at all.	3 2 1 0
Q3	Where did you get the information about the MBKM policy?	a) Ministry of Education and Culture online channel (website or social media). b) Offline/online socialization activities organized by the Ministry of Education and Culture. c) University online channel (website or social media). d) Offline/online socialization activities organized by universities. e) Community communication channels (e.g.: alumni community or lecturer community). f) Mass media. g) Others:	1 2 3 4 5 6 7
Q5	Does your study program have any previous programs that match the form of the Independent Learning-Independent Campus (MBKM) activity?	a) Yes b) No	1 0
Q7	Do curriculum documents, guidelines and operational procedures for participating in MBKM activities already exist in your study program?	a) Yes b) No c) I do not know.	2 1 0
Q8	Have you prepared yourself to be a part of MBKM activities?	a) Yes b) No c) Not interested	2 1 0
Q9	In your opinion, will learning activities outside the study program have implications during the study period?	a) The study period becomes longer. b) Stay on time. c) I do not know.	2 1 0
Q10	In your opinion, will off-campus learning activities provide additional competencies such as skills in solving complex real problems, analytical skills, professional ethics, etc.?	a) Yes b) May be c) I do not know.	2 1 0
Q11	In your opinion, studying in another study program will broaden your perspective and provide the additional competencies needed?	a) Yes b) May be c) I do not know.	2 1 0
Q13	In your opinion, how useful are you if you take part in MBKM activities in developing competence/skills to prepare for work after graduation?	a) Very useful b) Quite useful c) Less Useful d) Useless	3 2 1 0
Q14	In your opinion, how much of an increase in soft-skills did you get after you took part in MBKM activities in developing competence/skills to prepare you for work after graduation?	a) No improvement at all. b) There is improvement but not good. c) There is a pretty good improvement. d) There is improvement well. e) There is an improvement very well.	0 1 2 3 4
Q15	In your opinion, how important are MBKM activities to prepare for the post-campus period?	a) Very important b) Important c) Quite important d) Not too important e) Not important	4 3 2 1 0
Q17	In your opinion, do MBKM activities for higher education meet the needs of future graduates?	a) Very suitable b) Suitable c) Not suitable	2 1 0
Q18	How are you interested in the MBKM program held by the Directorate General of Higher Education, Research, and Technology?	a) Very interested b) Moderate c) Not interested	2 1 0

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Work Unit	: Informatics

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Destination	: Online
	■ In Town □ Out of Town □ Overseas
Day / Date	: Saturday - Sunday / January 29 - 30, 2022
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