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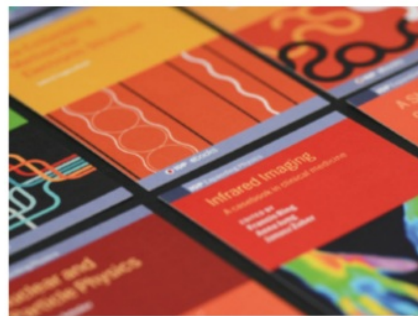
Developing Automatic Student Motivation Modeling System

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Abstract. Achievement motivation is one of the internal factors in encouraging a person to perform the best activity in achieving its goals. The importance of achievement motivation must be possessed as an incentive to compete so that the person will always strive to achieve success and avoid failure. Based on this, the system is developed to determine the achievement motivation of students, so that students can do self-reflection in improving achievement motivation. The test results of the system using Naïve Bayes Classifier showed an average rate of accuracy of 91,667% in assessing student achievement motivation. By modeling the students 'motivation generated by the system, students' achievement motivation level can be known. This class of motivation will be used to determine appropriate counseling decisions, and ultimately is expected to improve student achievement motivation.

Keywords: machine learning, NBC, student motivation modeling

1. Introduction

The purpose of vocational education in higher education of diploma degree is to prepared graduates to specific field skills and ready to work in business and industry. Characteristic of vocational education is the environment of learning process which the student are directly involved in the learning process according with the industry and business world. [1] conclude that the learning process in higher education demands direct student involvement in learning activities, where the atmosphere and condition of the learning environment are set up to resemble the business and industry. Actually, the implementation learning process in the vocational education need innovative learning methods and have to improve student learning motivation. [2] conclude that there are three components in the learning process that are student learning style, motivation during the learning process, and educational efficiency. Between the three components of learning process, motivation during the learning process has the most important position as [3] said that in vocational education be important to monitor the student motivation that influence in their achievement because in learning process the vocational student must have motivation as people work.

Motivation become one of the important factors affecting student involvement in learning activities because this factor comes from within the student itself. Finally, it is important to know the student motivation level before determine and using the true method in the learning process. [3] use the data mining to predicting student achievement based on the student motivation. The result showed that achievement motivation significance to influence the student achievement. Therefore, achievement

motivation become high priority to improve in learning process. The monitor of learning process also must be kept running by evaluating to kept the motivation still high during learning process [5]. By keeping this achievement motivation high, then the student will have a good life skill in order to be able to compete and survive in the good work of the industrial and business world, given the increasingly tight business development and the increasingly tight occupation.

Based on the importance of empowerment of achievement motivation in learning vocational education, then the required level of motivation achievement of students before the learning process. This study aims to developing system that is able to accommodate these needs, a system that can model the level of student motivation to achieve. This using the Naïve Bayes Classifier (NBC) algorithm that proved to have high accuracy but on the other hand has a fast time of execution. As supervise learning, the study uses K-Means as a clustering algorithm, which is further validated by education experts.

Finally, the level of student achievement motivation generated by the system then it can be used as the basis of actions that will be done to improve the level of achievement motivation of students to the implementation of the learning process to the optimum. Actions can be done in the form of counseling and method innovation in the learning process.

2. Related Work
Motivation is one of importance student characteristic that must improve during learning process [2]. This is one of any part of education psychology, such as [4] develop system is called QR-Based U-Learning Material Production System. The aim of this research is improving student motivation using this system to create authentic learning experience. The result show that this system effective to improve student motivation because student participant becomes high in the learning environment. Similarly, [5] implements learning model by using the learning 4 work model for vocational student showed that student motivation increase in the beginning learning process. This model simulate about finished project by student team and the result showed that project is finished well.

Based on that study conclude that its importance to know how the student motivation to get the best student achievement. [3] predicted the student motivation using NBC Technique and the result showed that the most significant motivation variable is student achievement motivation. Furthermore, [6] use NBC for predicting the factor which influence student performance and the result of using this modeling method is affective show another significant external factor in student performance beside the motivation factor.

So, the aims of this paper is developing automatic student motivation modeling system using Naïve Bayes Classifier algorithm. This system using digital validate questioner to modeling student motivation with that algorithm. NBC algorithm have good accuracy and decreasing number of iteration [7], [8], [9], and [10] based on these result study, also this algorithm usually use to complete the educational case

3. Methods
This study uses several stages that showed in Figure 1. The first stage is literature review to determine state of the art of study research and references for developing the instrument test of achievement motivation. The next stage is developing instrument test according to the needs of achievement motivation modelling. The instrument development in 15 item number and use three indicator achievement motivation, there are work hard, responsibility, feedback needed, and feeling worried about failure. The instrument developing process through the validity test and reliability test using SPSS. Validity test using Pearson Correlation test where the result of each instrument item is significant shown from the 2-tailed significant value is less than 0,05 and reliability test using Alpha Croanbach Scale where the result concluded that the instrument is reliable shown from Alpha Croanbach Value more than 0,700 [11] and [12].
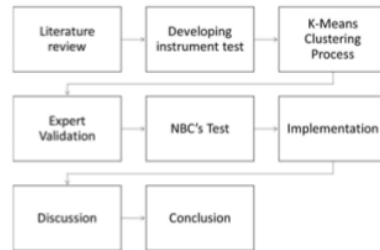
Figure 1. Research Stage

The next stage after developing instrument test is K-Means Clustering Process to determine the class. K-Means Clustering calculate the each data to another data. The application in this study use three class cluster that is cluster_0, cluster_1 and cluster_2. The result of clustering should validate by expert so it will identified become three class based on the cluster there are high motivated, middle motivated, and low motivated. This validation expert result will be used as a knowledge based for NBC algorithm. NBCs test is stage to test the accuracy of NBC performance for student achievement motivation modeling. This test using data form data test and data trainer (Informatics Engineering student of State Polytechnic of Jember) and resulted the accuracy value of NBC based on research data. Data trainer counts are 51 and data test counts are 192. The implementation will give the result of system accuracy. The last stage is discuss and conclusion. Actually, this research will be evaluated based on the conclusion.

4. Result and Discussion

Implementation from this modeling system are divided into two user in this application system, the student and the teacher. The student do the achievement motivation questionnaire, next the system will process the data from student and show the result for teacher. The teacher can use this resulted of achievement motivation student and determine to create the learning environment or student treatment for the student. Based on [13] need to create a model and evaluation in the learning process to control the motivation student. The result of this study shown that the motivation student improve during the learning process during the learning process. Same study [14] conclude that learning method, student discipline, and motivation had correlation with the student achievement. Based on this study, implementation of modeling achievement motivation will help the teacher to improve the learning performance.

Result from this research describe as follow: (1) K-Means clustering resulted three class of classifier; (2) Expert validation give three categories from K-Means clustering result; and (3) NBC test shown accuracy. K-Means classifier shown the result three class from data trainer, there are cluster_0 as blue color mark, cluster_1 as red color mark, and cluster_2 as green color mark. The classifier result shown by Figure 2. Data trainer for classifier is 70 totally student respondent. The classifier result from this K-Means is used as Knowledge Base for this system. The study of [15], [16], and [10] use the K-Means for clustering and this algorithm suitable in several case such as industry and education analysis.

The class from clustering result validate by the expert and categories each class from K-Means result in three categories, there are high motivated, middle motivated, and low motivated shown by Figure 2 that validate by expert. The clustering result by the expert shown by three color mark that the red as the low motivated, the blue as the middle motivated, and the green as the high motivated.

The created KB is used as rule for Naïve Bayes Classifier algorithm. Then, NBC algorithm is testing by Weka application [17]. Weka is a collection of machine learning algorithms for data mining tasks, resulted judgment accuration algorithm for the research case/data. In the implementation of NBC, system produces a value ($prior\ x\ likehood$), the value is used as a determinant of posterior value. The resulted test shown accuracy 91,667% with error rate 8,3%.

The visualization of classification result shown by Figure 3. The classification result showed that data have a good classification in three class.
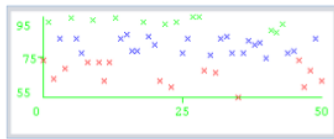

Figure 2. Clustering Knowledge Base Achievement Motivation
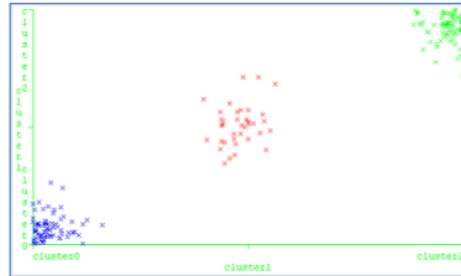

Figure 3. Classification Result 10 Fold

The error visualization from the test shown in Figure 4. Error occurred in data with green color mark, blue color mark, and red color mark. The most error data happened is low motivated that presented by red color mark in the graph. But, from the error value rate 8,3%, its concluded that this study effective to give the illustration of student motivation for teacher. Likely, the study based on [10] and [9] concluded that NBC algorithm have good accuracy using 10 fold technique.
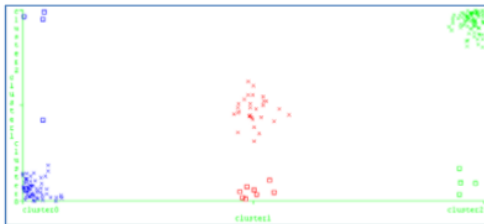

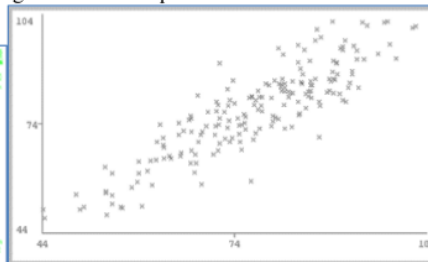**Figure 4.** Error visualization of data test

Figure 5. Visualization of data test

Figure 5 show the visualization from data test. The data shown good separate on appropriate. The value separate from (44-104) coordinate that it is presented from low motivated to middle motivated until high motivated. This is true according of KB, so the modeling system using Naïve Bayes Algorithm have an advantages because the results of analysis are easy to interpret except the high accuracy, so this algorithm often used to prediction purpose [18].

5 Conclusion

Achievement motivation is one of the dominant factor that influence the successful learning process, so it is importance to know how the student achievement motivation. By know the student achievement motivation, model of learning process in the learning environment can be set easily. This research develop a system with digital questioner to measure the student achievement motivation and categories the student in three categories achievement motivation that are high motivated, middle motivated, or low motivated. The system develop using the Naïve Bayes Classifier (NBC) that shown the result of accuracy 91,667% with ten times test using technique 10 fold.

Based on the accuracy result of this test concluded that the research can be used, because based on the error rate generated in the test of 8,33%. This result study can be used by the teacher to determine the learning model and student treatment in order to improve the student achievement by increasing the

student achievement motivation. This system not give a decision about learning path, but only show the categories of student achievement motivation.

6. Acknowledgment

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