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Development of Modeling System of Motivation and Critical Thinking Skill of Vocational Student

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Abstract. The industrial revolution 4.0 had a significant impact on Indonesia, so Indonesia must prepare for that impact. Preparation begins with the improvement of the quality of competence possessed by college graduates. Polytechnic is a vocational high school that aims to prepare graduates with certain field competencies so as to be able to work in the industrial world professionally. Learning methods relevant to the competence of these graduates are the learning model of Student Centered Learning (SCL) covering Problem, Project, and Inquiry Based Learning. The three models of learning require direct involvement of students in learning activities, where the atmosphere and conditions of the learning environment that resemble business and industry. One of the important factors affecting student involvement in learning activities is the factor that comes from within the student itself. This study aims to model the level of motivation and critical thinking skills of students to determine the learning model used. The modeling results with the Naive Bayes Classifier show an accuracy of 91.667% and 93.617%. The modeling results are used as a variable with the final class of the corresponding learning model. The final result is expected, the system is able to increase the motivation and critical thinking skills of the students for the implementation of the better learning process.

Keywords— ***student modeling, motivation modeling, critical thinking skills modeling, learning model, adaptive system***

1. Introduction

The Industrial Revolution 4.0 Relate has a significant impact on the Indonesian state so that Indonesia must prepare itself for this impact. The preparation starts from improving the quality of competencies possessed by university graduates. Polytechnic is a vocational high school that aims to prepare graduates with specific field competencies so that they are able to work in the business world and industry according to their expertise Mohamad Nasir (2018 stated that the competence of college graduates must be in accordance with the needs of industry so that the education model implemented by universities is the Model University-Industry Parthership.

Furthermore, in terms of the number of skilled workers in Indonesia, they still do not meet the required numbers. BPS data in 2015 shows the number of workers as many as 57 million people, while

the estimated need for skilled labor in 2030 is 113 million people. BPS noted that the open unemployment rate decreased in February 2017 by 5.33% compared to the same period in February 2016 of 5.50%. Data on open unemployment in 2017 according to the highest education completed showed the highest number of unemployed came from general high school / high school / high school graduates in the amount of 1,552,894. Similarly, Diploma graduates still show unemployment of 249,705 people. Even though SMK and Diploma graduates have been given certain field skills, so the mistakes that occur are in the process of the education system.

Based on these problems, the learning process in universities related to educators, students, and the learning environment must be improved. The learning process is carried out by choosing the right method according to the characteristics of students who will experience the learning process. Learning methods that are relevant to current graduate competencies are Student Centered Learning (SCL) learning models including Problem Based Learning, Project Based Learning, and Inquiry. The three learning models require student involvement directly in learning activities, where the atmosphere and conditions of the learning environment are set to resemble the business and industrial world. One important factor that influences student involvement in learning activities is a factor that comes from within the student itself. These factors are motivation and critical thinking skills [1], [2], [3], and [4].

Based on the needs of knowledge about the characteristics of students in the learning process to determine the right learning model, it requires information on motivation and critical thinking skills of students before the learning process. This study aims to create a system that can accommodate these needs, in the form of a system that can model the level of motivation and critical thinking skills of students to determine the learning model used. This system was built using the Naïve Bayes Classifier (NBC) algorithm which proved to have high accuracy but on the other hand had a fast execution time. Classification results will determine students' level of motivation and critical thinking skills. Based on the level of student classification produced by the system, it can be used as a basis for actions to be taken to determine the learning model used so as to increase students' motivation and critical thinking skills so that the learning process is maximized.

2. Related Work

2.1. Adaptive Learning

Adaptif Learning is the ability of the system to suit the needs of students. Basically every human being is a unique individual, meaning that each has different characteristics from one another [5]. Recognizing students as a whole is the ultimate goal of student modeling, this study aims to model two aspects of students: learning motivation [6] and critical thinking skills [7]. Both of these aspects will be modeled and rules will be developed that are able to provide learning models that are compatible with the characteristics of motivation and critical thinking skills / adaptive learning models.

2.2. Student Learning Motivation

Motivation is defined as a person's motivator or motive that aims to satisfy a goal. Motivation is seen as a chain of reactions that starts from the need, then the desire arises to satisfy it (achieve the goal), thus giving rise to psychological tension that will direct behavior to the goal (satisfaction) [8] [9] [10].

Table 2.1 Indicator of Measurement of Learning Motivation Researched

No.	Indicator	Information
1.	Work hard	Trying to complete the task with the best results
2.	To be responsible	Able to take responsibility for yourself and determine the future
3.	Requires feedback	Requires regular feedback on progress and achievements
4.	Worries will fail	Tend to choose a task with moderate degrees of difficulty that makes it possible to succeed

5.	The desire to excel	Innovative and creative by looking for opportunities and using opportunities to show their potential
6.	like the challenge	Happy for competitive activities

Characteristics of students' learning motivation in achieving maximum learning outcomes are expressed by [11] namely: (1) working hard; (2) hope for success; (3) concerns will fail; and (4) competition. Based on the understanding and characteristics of learning motivation that has been described, the indicators that will be used in measuring students' learning motivation are shown in Table 2.1.

2.3. Student Critical Thinking Ability

Thinking involves doubting activities and ensuring, designing, calculating, measuring, evaluating, comparing, grouping, distinguishing, linking, interpreting, seeing multiple possibilities, making analysis and synthesis reasoning or drawing conclusions from existing premises, weighing, and deciding. According to [12] thinking is a cognitive process that is directed to ultimately produce behavior from solving a problem.

Based on an understanding of thinking, critical thinking skills must be developed in the learning process to prepare vocational graduates who are able to solve problems critically as technology develops. Critical thinking component [13], including: 1) Interpretation, which includes categorizing, decoding, clarifying meaning, giving a simple explanation; 2) Analysis, which includes examining ideas, and analyzing arguments, building basic skills to identify; 3) Inferensi, which includes questioning claims, thinking of alternatives, drawing conclusions, solving problems, making decisions; 4) Inference, which includes questioning claims, thinking of alternatives, drawing conclusions, solving problems, making decisions; 4) Self-regulation, which includes self-correction, self-examination to manage the next strategy.

Based on the components of critical thinking skills, in this study using indicators of the measurement of critical thinking skills shown in Table 2.1.

Table 2.1 Indicators for Measurement of Thinking Skills Researched

Sub Variables	Indicator
Critical thinking	• Provide a simple explanation • Build basic skills • Summing up • Provide further explanation • Manage strategies / tactics

2.4. State of The Art

The application of learning methods to computer science students must consider the three components of the learning process namely student learning styles, motivation during the learning process and efficiency in education [14]. Based on the research, it is natural that there are many studies related to motivation and thinking ability.

Research [15] developed a learning model to generate students' initial motivation to complete projects in the form of teamwork. The study of learning motivation was also carried out by Chin Kai-Yin, Lee Ko-Fong, Chen Yen-Lin (2015). Research [16] develops a prediction system that can increase student motivation to try to learn. Research [17] developed a system to predict vocational student achievement based on hi motivation.

The development of critical and creative thinking can be developed during the learning process especially for vocational education because the existing technology continues to develop. Research [18] [19] [20] [21] [22] [23] [24] that IT industry students need the development of creative ideas in software

development design. The ability approach that must be possessed by IT students is the ability to solve abstract problems and logical thinking.

Naïve Bayes modeling techniques are also used by [25] to develop a prediction system for student placement in a particular field of focus. In addition to determining student placement, the naïve Bayes algorithm is also used by [26] in determining the level of knowledge of vocational students, the naïve Bayes technique shows better accuracy results than other data mining techniques such as regression, decision tree, and neural network. [27] [28] [29] [30].

From the above research it can be concluded that learning motivation and critical thinking ability are important components of students. This study aims to develop an adaptive system for computer engineering students in universities, using the corresponding learning model based on the results of motivation modeling and critical thinking skills.

3. Research Method

This research carries out several stages, each stage is a part that is complementary and continuous to each other. The research methodology involves several steps as shown in Figure 3.1.

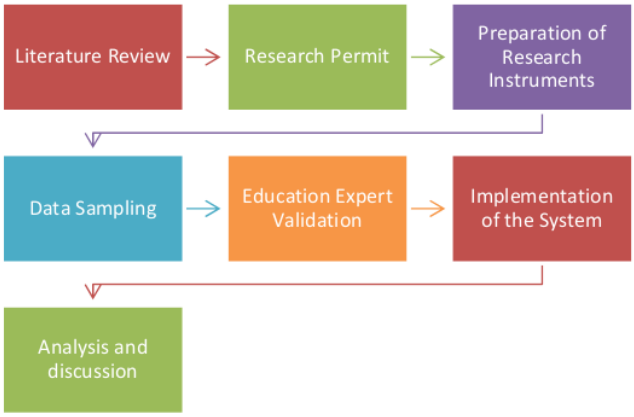

Figure 3.1 Research Methods

Based on the research method shown in Figure 3.1, the description of the activities in each stage is explained in Table 3.1 along with the assignments of each member of the research team.

Table 3.1 Description of Activities, Activity Outputs, and Team Tasks

No	Description of activities	Activity Output	Team Task
1.	Literature Review: The main function of this stage is to see the research position. By knowing the position of the research, it is used as a basis to determine the novelty of the research	State of the art and indicators of variables that will be the object of research	Nanik Anita Mukhlisoh, S.ST., MT, Bety Etikasari, S.Pd., M.Pd., and Khafidurrohman A., M.Eng.
2.	Permission to place data sampling	Research permit	Nanik Anita Mukhlisoh, S.ST., MT
3.	Preparation of research instruments: The instrument used in this study is a questionnaire that has been changed according to the needs of student achievement motivation modeling. This instrument is tested for validation and reliability, this is to convince the	Motivation questionnaire instruments and critical thinking skills	Bety Etikasari, S.Pd., M.Pd.

	study that each item from the questionnaire is valid/usable		
4	Data sampling: The population in this study were students of Information Technology Department, with sampling using random sampling technique	Research data	Chairperson, members and students
5	Validation from education experts: Experts in this process were asked to identify three SCL models that matched the characteristics of motivation (low, medium, high) and critical thinking skills (low, medium, high) which resulted in knowledge based decision making	Knowledge Base final decision making system	Bety Etikasari, S.Pd., M.Pd.
6	Implementation of a motivation modeling system and critical thinking ability with naïve Bayes classifier: The research data was analyzed using the Weka application by drawing conclusions on the relevant learning models used according to those submitted by the Expert. The system will calculate the class probability value that is close to the data entered by the user/user.	Results of data testing calculations	Khafidurrohman Agustianto, S.Pd., M.Eng.
7	Analysis and discussion of the level of modeling accuracy: This stage of analysis is used to determine the level of accuracy generated by the system/output from the system. The type of proof used is ground truth, which is comparing the results of system research with the results of expert judgment.	Value of classification accuracy for modeling systems with the Naïve Bayes algorithm	Nanik Anita Mukhlisoh, S.ST., MT dan Bety Etikasari, S.Pd., M.Pd.

4. Result and Discussion

Implementation from this modeling system are divided into two user in this application system, the student and the 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 [31] 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 [32] 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.

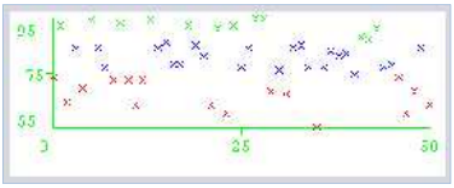

Figure 1. Clustering Knowledge Base Achievement Motivation

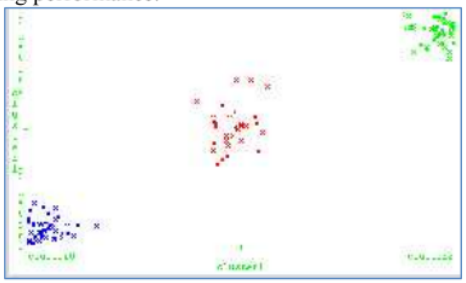

Figure 2. Classification Result 10 Fold

The created KB is used 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 accuracy of algorithm for the research case/data. In the implementation of NBC, system produces a value (*prior x likehood*) shown by Equation 1, 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.

$$p(A|B) = \frac{p(B|A) \times p(A)}{p(B)} \quad (1)$$

In this research, system identification critical thinking skill student using questioner shown by Table 2. This system identification student's critical thinking, this research defined 3 level, low, medium, and high. Based on system level result, having known the level of critical thinking skills and creative students, teachers can be improving the learning process. Innovation of suggested learning methods is a learning method that uses a constructivism approach such as Problem-Based Learning (PBL).

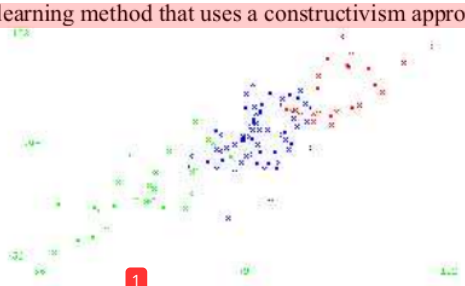

Figure 3. Data Test Visualizations

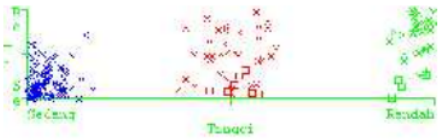

Figure 4. NBC Classification Result

In Figure 3, it appears that the data is spread evenly, marked by the distribution of data with the color label green, blue, and red. The result of the use of NBC classification algorithm shown by Figure 4 shows that average accuracy with ten times test using technique 10 fold is 93.617%.

5. Conclusion

The modeling results with the Naive Bayes Classifier show an accuracy of 91.667% (motivation) and 93.617% (critical). This high accuracy value indicates that the system is able to give a precise picture of the condition of motivation and the ability to think critically of students, so that with these results the results of the reading of the system can be used as a basis for determining the learning / treatment model suitable for each student. The type of treatment or learning model that is used to respond to the condition of students is left to the teacher, this system adheres to a blended learning system, where the research places the teacher side by side with the system.

The final result is expected, the system is able to increase the motivation and critical thinking skills of the students for the implementation of the better learning process. The better the learning process is expected to improve the quality of vocational education, this means that graduates or outcomes of vocational education will be better.

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References

[1] Y. Riyani, "Faktor-faktor yang Mempengaruhi Prestasi Belajar Mahasiswa," *J. EKSOS*, vol. 8, no. 1, pp. 19–25, 2012.
[2] A. Kamaei and M. Weisani, "the Relationship Between Achievement Motivation , Critical Thinking and Creative Thinking With," *Indian J. Fundam. Applik lied Life Sci.*, vol. 3, no. 4, pp. 121–127, 2013.
[3] P. Li, "The Relationship between Motivation and Achievement," vol. 2, no. 1, p. 123, 2009.
[4] B. Etikasari and H. Suswanto, "The Relationships of Student Critical and Creative Thinking Skills towards Capability of Installation Skill Local Area Network Competence of Vocational Student Computer and Network Engineering Program," vol. 030038, 2016.
[5] K. Agustianto, A. E. Permanasari, S. S. Kusumawardani, and I. Hidayah, "Design adaptive learning system using metacognitive strategy path for learning in classroom and intelligent tutoring systems," in *AIP Conference Proceedings*, 2016, vol. 1755.
[6] P. Destarianto, B. Etikasari, and K. Agustianto, "Developing Automatic Student Motivation Modeling System," *J. Phys. Conf. Ser.*, vol. 953, no. 1, 2018.
[7] W. K. Dewanto, K. Agustianto, and B. E. Sari, "Developing thinking skill system for modelling creative thinking and critical thinking of vocational high school student," *J. Phys. Conf. Ser.*, vol. 953, no. 1, 2018.
[8] S. Irmalia and Anggraini, "Motivasi Belajar dan Faktor-Faktor yang Berpengaruh: Sebuah Kajian Pada Interaksi Pembelajaran Mahasiswa," *Prem. Educ.*, vol. 1, no. 02, pp. 100–109, 2016.
[9] A. Sri, "Aplikasi Teori Hierarki Kebutuhan Maslow Dalam Meningkatkan Motivasi Belajar Mahasiswa," *J. Online Unika Widya Mandala Madiun*, vol. 01, no. 01, p. 82, 2010.
[10] Schunk, *Motivasi dalam Pendidikan Teori, Penelitian, dan Aplikasi*. Jakarta: Indeks, 2012.
[11] Sujarwo, "Motivasi Berprestasi sebagai Salah Satu Perhatian dalam Memilih Strategi Pembelajaran," 2008.
[12] E. M. Mursidik, N. Samsiyah, and H. E. Rudyanto, "Kemampuan berpikir kreatif dalam memecahkan masalah matematika open-ended ditinjau dari tingkat kemampuan matematika pada siswa sekolah dasar," *J. Pedagog.*, vol. 4, no. 1, pp. 23–33, 2015.
[13] Desmita, *Psikologi Perkembangan Peserta Didik*. Bandung: Remaja Rosdakarya, 2010.
[14] O. Debdi, M. Paredes-Velasco, and J. A. Velazquez-Iturbide, "Influence of Pedagogic Approaches and Learning Styles on Motivation and Educational Efficiency of Computer Science Students," *Rev. Iberoam. Tecnol. del Aprendiz.*, vol. 11, no. 3, pp. 213–218, 2016.
[15] D. Fonseca, X. Canaleta, and A. Climent, "Evaluación de la usabilidad y la satisfacción del estudiante de formación profesional en función de su motivación inicial."
[16] P. Khongchai and P. Songmuang, "Implement of salary prediction system to improve student motivation using data mining technique," *2016 11th Int. Conf. Knowledge, Inf. Creat. Support Syst.*, pp. 1–6, 2016.
[17] J. N. Purwaningsih and Y. Suwarno, "Predicting students achievement based on motivation in vocational school using data mining approach," *2016 4th Int. Conf. Inf. Commun. Technol.*, vol. 4, no. c, pp. 1–5, 2016.
[18] B. L. Shoop, "Developing Critical Thinking, Creativity and Innovation Skills," *Proc. SPIE - Int. Soc. Opt. Eng.*, vol. 9289, pp. 928904–928904, 2014.
[19] J. W. Chang, T.-I. Wang, M.-C. Lee, C.-Y. Su, and P.-C. Chang, "Impact of Using Creative Thinking Skills and Open Data on Programming Design in a Computer-Supported Collaborative Learning Environment," *2016 IEEE 16th Int. Conf. Adv. Learn. Technol.*, pp. 396–400, 2016.
[20] L. Y. Tokman and R. Yamacli, "Web (technologies and tools) for architectural thinking skills of architecture students," *Proc. 2009 4th Int. Conf. Internet Web Appl. Serv. ICIW 2009*, pp. 643–644, 2009.
[21] L. N. S. P. Goteti and G. V. Madhuri, "Assessing soft and higher order thinking skills among

students using a rubric and progressive reflection," *Proc. 2013 IEEE Int. Conf. MOOC, Innov. Technol. Educ. MITE 2013*, pp. 332–334, 2013.

[22] H. Li, J. Liu, X. Yang, J. Xiao, and G. Yang, "An Empirical Study on Developing Higher-Order Thinking Skills of Primary Students with E-Schoolbag," *2016 Int. Symp. Educ. Technol.*, vol. 1, pp. 44–49, 2016.

[23] S. Huang, K. H. Muci-Kuchler, M. D. Bedillion, M. D. Ellingsen, and C. M. Degen, "Systems thinking skills of undergraduate engineering students," pp. 1–5, 2015.

[24] Z. Deng, W. Huang, R. Dong, and P. Wen, "Exploration of ability development of engineering and computational thinking skills in software engineering majors," *Proc. 2009 4th Int. Conf. Comput. Sci. Educ. ICCSE 2009*, pp. 1665–1668, 2009.

[25] P. Guleria and M. Sood, "Predicting Student Placements Using Bayesian Classification," *Third Int. Conf. Image Infonnation Process. Predict.*, pp. 109–112, 2015.

[26] Z. Liu, "Cox's proportional hazards model with Lp penalty for biomarker identification and survival prediction," *Proc. - 6th Int. Conf. Mach. Learn. Appl. ICMLA 2007*, pp. 624–628, 2007.

[27] T. Mahboob, S. Irfan, and A. Karamat, "A machine learning approach for student assessment in E-learning using Quinlan's C4.5, Naive Bayes and Random Forest algorithms," *Proc. 2016 19th Int. Multi-Topic Conf. INMIC 2016*, 2017.

[28] K. Maharani, T. B. Adji, N. A. Setiawan, and I. Hidayah, "Comparison Analysis of Data Mining Methodology and Student Performance Improvement Influence Factors in Small Data Set," pp. 169–174, 2015.

[29] T. Devasia, Vinushree T P, and V. Hegde, "Prediction of students performance using Educational Data Mining," *2016 Int. Conf. Data Min. Adv. Comput.*, pp. 91–95, 2016.

[30] D. Oreški, M. Konecki, and L. Milić, "Estimating profile of successful IT student: Data mining approach," *2017 40th Int. Conv. Inf. Commun. Technol. Electron. Microelectron. MIPRO 2017 - Proc.*, pp. 723–727, 2017.

[31] A. Kawano and E. Isogai, "A Model and Evaluation Method of Learning Motivation in the Education and Training of Professional Engineers," *2016 IEEE Int. Conf. Teaching, Assessment, Learn. Eng.*, no. December, pp. 311–318, 2016.

[32] F. A. Gunawan, "Fuzzy-Mamdani Inference System in Predicting the Corelation Between Learning Method , Discipline and Motivation with Student ' s Achievement," pp. 1–6, 2016.

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