

CLASSIFICATION OF STUDENTS BASED ON QUALITY OF LIFE AND ACADEMIC PERFORMANCE BY USING SUPPORT VECTOR MACHINE

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Abstract

Most studies done in the past on factors affecting academic performance did not touch on quality of life factor. Also, most studies only used correlation and regression analysis. Not many studies used classification analysis. Hence, this study aimed to classify students based on quality of life and academic performance. Students' quality of life was measured by using WHOQOL-BREF questionnaire which consists of five quality of life domains namely physical health, psychological health, social relationship, environment and overall quality of life whereas the academic performances were represented by cumulative grade point average (CGPA). The selected sample for this study was 60 Universiti Teknologi MARA (UiTM) Perlis students from Bachelor of Science (Hons.) Management Mathematics program. This study applied support vector machine (SVM) method for classifying the students. The results for each quality of life domain showed that students with both low and high academic performance were classified into high academic performance class. The same result was obtained when all domains were combined. All models showed high accuracy which implied that the classification made by SVM were strongly correct. The findings of this study demonstrated that quality of life plays an important role in students' academic performance.

Keywords: *quality of life, academic performance, support vector machine.*

Article history:- Received: 7 August 2017; Accepted: 05 February 2018; Published: 11 May 2018

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Introduction

Academic performance is a measurement of students' overall success. There are many studies conducted on factors affecting academic performance. Nevertheless, there are limited studies that investigate the relationship between quality of life and academic performance. Thomas et al. (2017) conducted a study to examine the effects of emotional intelligence, cognitive test anxiety and coping strategies towards academic performance. They found that emotional intelligence had positive relation with academic performance while cognitive test anxiety and emotion-focused coping strategy had negative relation with academic performance. Ng et al. (2015) studied the reciprocal relations between life satisfaction and academic performance and found that there was a positive reciprocal causal relation between the two variables. From the results of their study, they implied that high level of life satisfaction resulted in good academic performance and vice versa. Rosli et al. (2012) examined the relationship between self-esteem and academic performance. They also examined the relationship between stress and academic performance. Their result showed that students with higher self-esteem perform better in academic. Their result also showed that there was a weak positive correlation between stress and academic performance. Ahrberg et al. (2012) examined the relationship between stress, sleep quality and academic performance. Their findings indicated that stress, sleep quality correlated with academic performance with low sleep quality and high stress level resulted in low academic performance. Sivertsen et al. (2015) assessed the association between delayed sleep phase and academic performance. They proved that delayed

sleep phase was associated with academic performance in a way that students with delayed sleep phase performed poorly in academic. Hamaideh and Hamdan-Mansour (2014) conducted a study to determine the psychological, cognitive and personal factors that best predict academic performance. The psychological factors that they considered were self-esteem, motivation, life satisfaction, student-faculty interaction, stress, anxiety, and depression. The cognitive factors were previous academic achievement while personal factors were age and gender. They found that self-esteem, motivation and life satisfaction are significantly and positively correlated with academic performance while depression is negatively correlated with academic performance. Lin et al. (2017) studied the associations of mental toughness with academic performance and found that mental toughness and academic performance were correlated with each other. Mahmud (2014) studied the correlation of students' oral communication proficiency and academic performance. The result of her study implied that oral communication skills correlated with academic performance, that is, students with better oral communication skills have better academic performance. Unni et al. (2015) conducted a remarkable study to measure overall quality of life of pharmacy students and compare quality of life of students from different academic settings; specifically students from public and private schools, and determine the factors that contribute to students' quality of life. However, their study did not at all focus on the effect of quality of life on academic performance. Hence, it remains a question as to whether or not quality of life affects students' academic performance.

According to World Health Organization (WHO), quality of life is an individual's perception of his or her position in life in the context of the culture and value systems in which he or she lives and in relation to his or her goals, expectations, standards and concerns. Based on this definition, it can be said that the association of quality of life with academic performance is worth examining.

Despite the relevant and overwhelming results obtained in the past where positive factors such as emotional intelligence, motivation and self-esteem affect academic performance positively and negative factors such as stress, depression and anxiety affect academic performance negatively, there also exist unexpected and twisted results. For example, Malik et al. (2013) who investigated the relationship between life satisfaction and academic performance found no relationship between the two. Hamaideh and Hamdan-Mansour (2014) revealed in their study that stress as well as anxiety did not correlate with academic performance. In 2016, So and Park conducted a study to determine health behaviors that affect academic performance. It was expected to find that smoking and alcohol consumption behavior were associated with low academic performance but it was surprising to find that physical activity had negative relationship with academic performance. Furthermore, Maher et al. (2016) examined the relationship between physical activity, sedentary behavior and academic performance and found that academic performance was largely unrelated to physical activity. The varied and inconsistent results shown in the literature bring about the need for a continuous study on factors affecting academic performance.

In addition, studies done in the past on factors affecting academic performance mostly used correlation and regression analysis (Thomas et al., 2017, Albert and Dahling, 2016, Lin et al., 2017, Anderson and Good, 2017, Rosli et al., 2012). There are limited studies that used classification analysis (Goga et al., 2015). In fact, there are no studies that applied classification analysis on quality of life and academic performance. Therefore, this study aims to classify students based on quality of life and academic performance. This study is believed to give insight to both students and educators on the importance and the role of quality of life towards academic performance.

Methods

Sample

The sample selected for this study was Universiti Teknologi MARA (UiTM) Perlis students from Bachelor of Science (Hons.) Management Mathematics program. The sample consisted of 60 students which was made up by 55 female students and 5 male students.

Measures

The variables of interest under study are quality of life and academic performance. Quality of life was measured by using a questionnaire called WHOQOL-BREF questionnaire. The questionnaire was introduced by World Health Organization (WHO). It consists of 26 items and measures five domains of quality of life namely physical health, psychological health, social relationship, environment and overall quality of life. There are 7 items of physical health, 6 items of psychological health, 3 items of social relationship, 2 items of environment and 2 items of overall quality of health. Each item in the questionnaire has certain response options with five-point Likert scale. The Cronbach's alpha for WHOQOL-BREF used in this study was 0.87.

Academic performance was measured by using cumulative grade point average (CGPA) and was expressed in binary form namely low and high. CGPAs of 2.99 and below were set as low academic performance while CGPAs of 3.00 and above were set as high academic performance.

Support Vector Machine (SVM)

Classification is the action or process of classifying things according to similar qualities or characteristics. In statistics and machine learning, one of the popular classification methods is support vector machine (SVM). SVM is a binary classification method introduced by Vapnik (1995) based on the structured risk minimization principle that seeks to minimize an upper bound of the generalization error. Classification using SVM are formulated as quadratic programming problems which can be solved by using many optimization algorithms. The basic idea behind SVM is to find an optimal hyperplane that separate data points into two classes. A plane is bad if it passes too close to the points. The goal is to find the plane passing as far as possible from all points. Therefore, the operation of SVM algorithm is based on finding the hyperplane that gives the largest minimum distance to the training data points.

SVM is a black box model, which means that SVM computation is complicated and is impossible to be done manually. Thus, analysis on SVM must be carried out by using software. It is practical to rely on software outputs to get the results.

Software

The software used in this study was XLSTAT software. It is a user-friendly software for statistics and data analysis that works as an add-on to Microsoft Excel. It is suitable for analyzing data for support vector machine method.

Confusion Matrix

One of the important outputs provided by XLSTAT software is confusion matrix. Confusion matrix is a table used to describe the performance of an SVM model. Table 1 shows the example of a confusion matrix.

Table 1. The example of a confusion matrix.

Actual	Predicted	
	No	Yes
No	True Negative (TN)	False Positive (FP)
Yes	False Negative (FN)	True Positive (TP)

From Table 1, it can be seen that there are two classes namely no and yes which are put into actual and predicted group. Actual group represents the original data while predicted group represents the result produced by SVM.

When the data is originally no and is predicted as no by SVM, it is said to be true negative (TN). But, when the data is originally no and is predicted as yes by SVM, it is said to be false positive (FP). Similarly, when the data is originally yes and is predicted as yes by SVM, it is said to be true positive (TP). But, when the data is originally yes and is predicted as no by SVM, it is said to be false negative (FN).

Confusion matrix gives information about the accuracy of a model. Accuracy shows the overall correctness of the model and can be calculated as follows:

$$\text{Accuracy} = \frac{\text{TP} + \text{TN}}{n} \times 100,$$

where n is total number of sample. If the accuracy value is more than 0.7, the classification made by the model is said to be strongly correct, if the accuracy value is between 0.5 and 0.7, the classification made by the model is said to be moderately correct and if the accuracy value is less than 0.5, the classification made by the model is said to be weakly correct.

Results and Discussion

75% of the data (45 observations) had been set to be the training sample and 25% of the data (15 observations) had been set to be the validation sample. The classification results are given by the validation sample and are shown in Table 2 – 7.

Table 2. The classification of students based on physical health and academic performance.

Actual	Predicted	
	Low	High
Low	0	3
High	0	12

Table 2 shows the confusion matrix for the classification of students based on physical health and academic performance. From Table 2, it can be seen that 3 students who have low academic performance are classified into high academic performance class and 12 students who have high academic performance are classified into high academic performance class. There are no students who have been classified into low academic performance class. This indicates that students with healthy physical being are bound to have high academic performance. In other words, as long as a student is physically healthy, he or she has the potential of getting high academic performance. The accuracy of physical health versus academic performance model is 80%. This implies that the classification made by the model is strongly correct.

Table 3. The classification of students based on psychological health and academic performance.

Actual	Predicted	
	Low	High
Low	0	2
High	0	13

Table 3 shows the confusion matrix for the classification of students based on psychological health and academic performance. From Table 3, it can be seen that 2 students who have low academic performance are classified into high academic performance class and 13 students who have high academic performance are classified into high academic performance class. There are no students who have been classified into low academic performance class. This indicates that students with healthy psychological being are bound to have high academic performance. In other words, as long as a student is psychologically healthy, he or she has the potential of getting high academic performance. The accuracy of psychological health versus academic performance model is 86.67%. This implies that the classification made by the model is strongly correct.

Table 4. The classification of students based on social relationship and academic performance.

Actual	Predicted	
	Low	High
Low	0	3
High	0	12

Table 4 shows the confusion matrix for the classification of students based on social relationship and academic performance. From Table 4, it can be seen that 3 students who have low academic performance are classified into high academic performance class and 12 students who have high academic performance are classified into high academic performance class. There are no students who have been classified into low academic performance class. This indicates that students with good social relationship are bound to have high academic performance. In other words, as long as a student has good social relationship, he or she has the potential of getting high academic performance. The accuracy of social relationship versus academic performance model is 80%. This implies that the classification made by the model is strongly correct.

Table 5. The classification of students based on environment and academic performance.

Actual	Predicted	
	Low	High
Low	0	1
High	0	14

Table 5 shows the confusion matrix for the classification of students based on environment and academic performance. From Table 5, it can be seen that 1 student who has low academic performance is classified into high academic performance class and 14 students who have high academic performance are classified into high academic performance class. There are no students who have been classified into low academic performance class. This indicates that students with good environment are bound to have high academic performance. In other words, as long as a student is in good environment, he or she has the potential of getting high academic performance. The accuracy of environment versus academic performance model is 93.33%. This implies that the classification made by the model is strongly correct.

Table 6. The classification of students based on overall quality of life and academic performance.

Actual	Predicted	
	Low	High
Low	0	3
High	0	12

Table 6 shows the confusion matrix for the classification of students based on overall quality of life and academic performance. From Table 6, it can be seen that 3 students who have low academic performance are classified into high academic performance class and 12 students who have high academic performance are classified into high academic performance class. There are no students who have been classified into low academic performance class. This indicates that students with good overall quality of life are bound to have high academic performance. In other words, as long as a student has good overall quality of life, he or she has the potential of getting high academic performance. The accuracy of overall quality of life versus academic performance model is 80%. This implies that the classification made by the model is strongly correct.

Table 7. The classification of students based on all quality of life domains and academic performance.

Actual	Predicted	
	Low	High

Low	0	4
High	0	11

Finally, Table 7 shows the confusion matrix for the classification of students based on all quality of life domains and academic performance. From Table 7, it can be seen that 4 students who have low academic performance are classified into high academic performance class and 11 students who have high academic performance are classified into high academic performance class. There are no students who have been classified into low academic performance class. This indicates that students with good quality of life are bound to have high academic performance. In other words, as long as a student has good quality of life, he or she has the potential of getting high academic performance. The accuracy of social relationship versus academic performance model is 73.33%. This implies that the classification made by the model is strongly correct.

Conclusion

There are many studies done on factors affecting academic performance but only few touched on quality of life factor. Thus, the effect of quality of life on students' academic performance remains to be clarified. Also, results from previous studies were varied and inconsistent which drive the need for continuous study on the matter. In addition to that, most studies done in the past on factors affecting academic performance only used correlation and regression analysis. There are not many studies that use classification analysis. Hence, this study sought to classify students based on quality of life and academic performance.

In order to measure quality of life, this study used WHOQOL-BREF questionnaire which consists of 26 items. The items are divided into five quality of life domains namely physical health, psychological health, social relationship, environment and overall quality of life. The questionnaires were distributed to 60 UiTM Perlis students taking Bachelor of Science (Hons.) Management Mathematics program. Students' academic performances were measured from Cumulative Grade Point Average (CGPA). This study employed support vector machine (SVM) method. The data were run and analyzed by using a software called XLSTAT.

For every quality of life domain, SVM classified all students, either those with low or high academic performance, into high academic performance class. Furthermore, for the combination of all quality of life domains, SVM also classified all students into high academic performance class. The model showed 80% accuracy for physical health domain, 86.67% for psychological health domain, 80% for social relationship domain, 93.33% for environment domain and 80% for overall quality of life domain. When combining all domains, the model showed 73.33% of accuracy.

The results indicated that students who are physically and psychologically healthy, have good social relationship, are in good environment and have good overall quality of life have the potential of having good academic performance. The results also indicated that as long as a student has some quality of life, he or she has the possibility and chance of getting high academic performance.

All in all, the findings of this study showed that physical health, psychological health, social relationship, environment, overall quality of life and quality of life itself as a whole contribute to high academic performance. The findings of this study supported the result presented by Shareef et al. (2015) who found a positive correlation between quality of life and academic performance. This study also showed that SVM provides good result in classifying students based on quality of life and academic performance.

The findings of this study provide insight to both students and educators by unveiling the importance and the role of quality of life towards academic performance.

The limitation of this study lies on the small sample size. SVM is a machine learning method which performs better with large data. However the sample size used in this study is fairly acceptable since this study is just a preliminary study. It is recommended that a larger sample size is used in the future study.

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