Estimating Student's Mathematics Performanceusing Multiple Linear Regression: A Normal Estimation Equation Approach

Jackie D. Urrutia [1], Flordeliza B. Ferrer[1,2], Jenifer E. Tolang [2]

[1]College of Education – Graduate Studies, Polytechnic University of the Philippines, Manila, Philippines

[2]College of Education, Taguig City University, Taguig City, Philippines

***jackieurrutia20@gmail.com / florbalajadia@gmail.com**

Abstract

This study intendedto formulate a mathematical model in estimating mathematics performance of the Grade 10 students in Taguig City using normal estimation equation.A total of twenty-nine (29) Grade 10 public junior high school mathematics teachersduring school year 2018 – 2019 were selected as respondents of the study.It employed regression analysis with emphasis on survey method usingtwo instruments: 1) BarOn EQ:i-S to determine the emotional quotient,and 2) a researchers-made instrument to describe the 21st century skills of the respondents. Mathematics performance is considered as dependent variable while there are fifteen independent variables which were categorized into two – emotional quotient, and 21st century skills. Out of fifteen independent variables, ten are from 21st century skills and these are creativity and innovation, critical thinking, metacognition, communication, collaboration, information literacy, ICT literacy, citizenship, life and career, and personal and social responsibility. The remaining five independent variables are from emotional quotient which are intrapersonal scale, interpersonal scale, stress management, adaptability, and general mood.When matrix theory was applied for mathematical computations and manipulations, the researchers came up with the mathematical model $\hat{y} = e^{4.32900-0.05645x_1+0.01015x_2-0.01954x_3+0.01441x_4+0.00119x_5-0.00282x_6-0.00343x_7+0.01000x_8+0.00694x_9+0.00046x_{11}+0.00045x_{12}+0.00146x_{13}-0.00039x_{14}+0.00057x_{15}}$ with predicting power of 70 percent. Applying multiple regression, only the variables under emotional quotient are found to be significant predictors of mathematics performance. It can be applied that the emotional intelligence of the teachers has a significant role in estimating the performance of the students. Further, there is no significant difference between the actual mathematics performance, and predicted values according to the result of independent sample t-test.It means that the predicted values obtained using the mathematical model was 70 percent close to the actual ones. It is recommended to conduct a similar study in a national level in order to come up for a stronger model which predicts the mathematics performance of the students.

Keywords Mathematics Performance, Multiple Linear Regression, Normal Estimation Equation, Independent Sample t-Test, 21st Century Skills, Emotional Quotient

DOI Number: 10.14704/nq.2022.20.5.NQ22712 NeuroQuantology 2022; 20 (5):4277-4290

***e*ISSN**1303-5150

1. Introduction

In any nation, one of the development indicators is the quality of teaching in educational institutions, therefore it is imperative for educational institutions to devise strategies which strengthen their performance system. Such strategies according to Aissaoui et. al. (2020) are best planned after an in-depth analysis of students' performance as advanced estimation of failure rate may help educational institutions design preventive measures to decrease failure rate.

The education system in the Philippines is managed by three government organizations--Department of Education (DepEd), the Commission on Higher Education (CHED), and the Technical Education and Skills Development Authority (TESDA. In 2013, from ten years of basic education cycle, the Philippine government added two more years for basic education completion. It is claimed to be the most comprehensive education reform since the establishment of the public education system over a century ago; the supplementary two years in basic education obliged the three governing bodies to work hand in hand to polish up the quality of education of the country.

A member of the Programme for International Student Assessment (Pisa) by the Organization for Economic Cooperation and Development (OECD), the Philippines ranked worst among 79 OECD member-countries in reading literacy and second from the bottom in both mathematical and scientific literacy. The disconcerting ranking result released in December 2019 revealed that Philippines' average score in math was 353 compared to the global average of 489, and was the second lowest score in the subject as cited by Cruz (2019).

DepEd secretary Briones (2019) enjoined the Bureau of Education Assessment to be more enterprising in relating to the units in the education groundworks especially the DepEd's 900,000 frontline teachers. The secretary further appealed to the country's legislators to engender a competent National Education Academy to better train its education frontliners, who if left lacking in skills, may act like barriers to effective learning.

In this modern world, much success rests upon being able to effectively communicate, and utilize the shared and processed information in order to create solutions on complex problems. These skills are significant to be able to adapt and innovate in retort to new demands and changing circumstances, in being able to command and expand the power of technology to foster new knowledge. Thus, recently developed standards for what students should be capable of are replacing the basic skill competencies and knowledge expectations of the past. Meeting where these challenged teachers are, teaching guidelines and schools must be transformative in ways that will empower students to attain the creative thinking, flexible problem solving, collaboration and innovative skills they will need to be functional and successful in work and life in the modern world. The desire of every educator is to see learners achieve greatness in their future career--comprise skills, abilities and learning dispositions as being identified and as being required in twenty first (21st) century society and workplace.

Correspondingly, emotional intelligence (EI) as defined by Goleman (1995) is the capacity to inspire oneself and carry on despite the presence of frustrations; to manage impulse and delay gratification to modulate one's moods and keep distress from impeding the ability to think straight; and to commune hope. In 2019, Palmer, et. al. cited out that in determining success, emotional intelligence is as important as the intellect. In a classroom setting, as stated by Sommers (2016), a teacher without EI can cause a negative impacting to how students feel and their ability to learn.

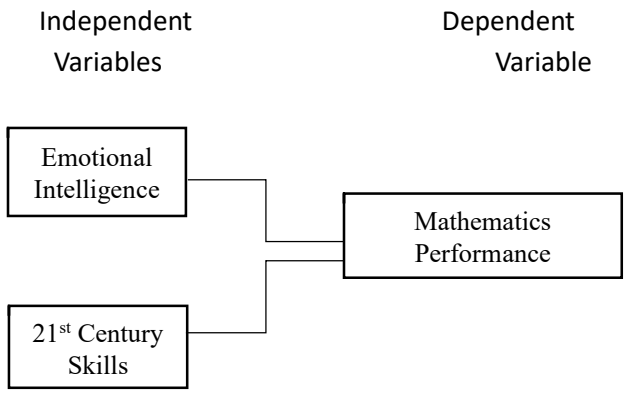
*e*ISSN1303-5150

Based on the abovementioned information, the researchers were keen to formulate a mathematical model in estimating mathematics performance using multiple linear regression. Linear regression is a statistical analysis which depends on modeling relationship between two kinds of variables, dependent and independent. The main purpose of regression is to examine if the independent variables are successful in predicting the outcome variable and which independent variables are significant predictors of the outcome (Birinci, 2018). In this study, a linear regression with multiple independent variables will be built, in order to seek relevant factors that affect the mathematics performance of Grade 10 students for school year 2018-2019. For this study, the 21st century skills of Grade 10 mathematics teachers and their emotional intelligence were gathered and served as the independent variables.

1.1 Purpose of the Study

The purposes of this study were to formulate a mathematical model to estimate the student's mathematics performance and to identify the factors that significantly affects it.

1.2 Conceptual Framework



This study followed a conceptual framework which includes the independent and dependent variables. From the framework, there are two main variables to be considered which are the emotional intelligence and 21st century skills of Grade 10 mathematics teachers. On the other hand, mathematics performance of Grade 10 students is considered as the dependent variable. A normal estimation equation by means of matrices, and a multiple linear regression are applied in order to come up with the expected output which is the mathematical model.

1.3 Statement of the Problem

1. What is the mathematics performance of the Grade 10 students during school year 2018 – 2019?
2. How may the grade 10 teacher-respondents be described as to their:
   2.1 level of competency in 21st century skills; and
   2.2 level of emotional intelligence?
3. What mathematical model can be formulated to estimate student's mathematics performance?
4. Is there a significant difference between the actual values of mathematics performance and predicted values obtained from the formulated model?
5. What predictors can be considered significant to the mathematics performance of the grade 10 students?

1.4 Scope and Limitations

The study assessed the level of emotional intelligence and 21st century skills of mathematics teachers to determine if it significantly affects the mathematics performance of their students. The emotional quotient is limited to five components used in BarOn EQ:i – S and the 21st century skills are limited to ten skills defined by the 'The Assessment and Teaching of 21st Century Skills.'

The respondents of this study are limited to Grade 10 Mathematics teachers who are teaching in public secondary schools in Taguig City. Further, only the mathematics performance of Grade 10 students during school year 2018 – 2019 are included.

1.5 Significance of the Study

Philippines placed second lowest among 79 countries who participated on the international assessment conducted by Pisa in 2019. Several aspects were taken account for this result like the transition of K-12 curriculum, teaching strategies, etc.

The results of this study may contribute on the factors to be considered in the performance of the students. Teacher's emotional intelligence is found to be a significant factor in estimating the student's performance. Hence, the teachers will benefit from this study by attending seminars or trainings to strengthen their emotional state of being. Moreover, the Department of Education benefits from this study as it will serve as one of the bases for enhancing and assessing trainings to be given for their teachers.

2. Materials andMethods

2.1 Sampling Technique

To have an ideal sample size, Cochran formula was used in this study. It also allows a level of precision, confidence level, and estimated proportion of the population with common attributes.

The population that will be studied will be small; the Cochran formula will be modified to determine the desired sample size.

To calculate the sample size, the formula below will be used:

$$n = \frac{n_0}{1 + \frac{(n_0 - 1)}{N}}$$

where

n_0 is Cochran's sample size recommendation

N is the population size

n is the adjusted sample size

2.2 Descriptive Analysis

The descriptive method of research was utilized to present the mathematics performance, level of competency in 21st century skills, and level of emotional quotient.

Mathematics performance of 347 Grade 10 students from government schools in Taguig City were gathered. For this study, mathematics performance refers to the average grade in mathematics from 1st to 4th quarter.

The BarOn EQ – i:S and a questionnaire on 21st century skills were used to identify the emotional intelligence and the level of competency in 21st century skills of 29 grade 10 mathematics teacher-respondents from school year 2018-2019 at selected government secondary schools in Taguig City.

The BarOn EQ – i:S has 51 statements which were scored based on their sex, age and on the following scales: intrapersonal, interpersonal, stress management, adaptability, general mood, and positive impression. On the other hand, the questionnaire on 21st century skills have 70 statements which were categorized on the following skills: creativity and innovation, criticalthinking, metacognition, communication, collaboration,

information literacy, ICT literacy, citizenship, life and career, and personal and social responsibility.

Table 1. Interpretation of Scores in BarOn EQ – i:S

Standard Norms	Interpretation
130+	Markedly High
120 – 129	Very High
110 – 119	High
90 – 109	Average
80 – 89	Low
70 – 79	Very Low
Under 70	Markedly Low

Table 1 displays the interpretation of the scores when BarOnEQ – i:S was used while table 2 shows the rating scale and interpretation used to the second part of the questionnaire in 21st century skills.

Table 2. Rating Scale in 21st Century Skills Questionnaire

Numerical Rating	Interpretation
3.51 – 4.00	Highly Competent
2.51 – 3.50	Competent
1.51 – 2.50	Moderately Competent
1.00 – 1.50	Less Competent

2.3 Multiple Linear Regression

To study the relationship between a dependent variable and one or more independent variables, multiple linear regression (MLR) was used. The commonformula of the regression model is written as:

$$\hat{y} = \beta_0 + \beta_1 x_1 + \beta_2 x_2 + \cdots + \beta_k x_k + \varepsilon$$

where $\hat{y}$ is the predicted value of the dependent variable, β_0 is the y intercept, x_1 to x_k are the explanatory variables, β_1 to β_k is the change in y for each one increment change in the explanatory variables, and ε is the disturbances.

2.4 Assumptions in Multiple Linear Regression

Multiple linear regression analysis makes some key assumptions which are

1. Linear relationship
2. Multivariate normality
3. No multicollinearity
4. No auto-correlations
5. Homoscedasticity

Firstly, the relationship between the dependent and independent variables needs to be linear. It is vital to examine the outliers due to its sensitivity on the effects in MLR. Secondly, the analysis on multiple regression requires all variables to be normal. Thirdly, MLR assumes that the data has little or no multicollinearity. Other significant independence assumption is that the error of the mean is uncorrelated; that is that the standard error of the dependent variable is independent from the independent variables. Fourthly, MLR analysis requires that the data has no autocorrelation. And, the last assumption is that multiple linear regression analysis males a homoscedasticity.

2.5 Normal Estimation Equation

In constructing a model, a matrix notation can aid for the computations and manipulations. The whole sample of n observations can be expressed in the matrix notation:

$$y = x\beta + u$$

where y is the n – dimensional column vector, x is a $n(k+1)$ matrix, β is a $(k+1)$ –dimensional column vector of parameters, and u is a n –dimensional column vector of error terms.

$$\begin{bmatrix} y_1 \\ y_2 \\ y_3 \\ \vdots \\ y_n \end{bmatrix} = \begin{bmatrix} 1 & x_1 & \cdots & x_{1k} \\ 1 & x_2 & \cdots & x_{2k} \\ 1 & x_3 & \cdots & x_{3k} \\ \vdots & \vdots & \ddots & \vdots \\ 1 & x_{n1} & \dots & x_{nk} \end{bmatrix} \times \begin{bmatrix} \beta_0 \\ \beta_1 \\ \beta_2 \\ \vdots \\ \beta_k \end{bmatrix} = \begin{bmatrix} u_1 \\ u_2 \\ u_3 \\ \vdots \\ u_n \end{bmatrix}$$

Ordinary least squares (OLS) minimizes the squared distances between the observed and predicted variable y:

$$S(\beta) = \sum_{i=1}^{n} (y_i - x_i\beta)^2 = (y - x\beta)'(y - x\beta) \to \min \beta$$

The resulting OLS estimator of β is written as

$$\beta' = (x'x)^{-1}x'y$$

Its matrix nature is written in the form of

$$\begin{bmatrix} n & \sum_{i=1}^{n} x_{1i} & \cdots & \sum_{i=1}^{n} x_{2i} & \sum_{i=1}^{n} x_{ki} \\ \sum_{i=1}^{n} x_{1i} & \sum_{i=1}^{n} x_{1i}^2 & \cdots & \sum_{i=1}^{n} x_{1i}x_{2i} & \sum_{i=1}^{n} x_{1i}x_{ki} \\ \vdots & \vdots & \cdots & \vdots & \vdots \\ \sum_{i=1}^{n} x_{ki} & \sum_{i=1}^{n} x_{ki}x_{1i} & \cdots & \sum_{i=1}^{n} x_{ki}x_{2i} & \sum_{i=1}^{n} x_{ki}^2 \end{bmatrix} \begin{bmatrix} \beta_0 \\ \beta_1 \\ \vdots \\ \beta_k \end{bmatrix} = \begin{bmatrix} \sum_{i=1}^{n} y_i \\ \sum_{i=1}^{n} x_{1i}y_i \\ \vdots \\ \sum_{i=1}^{n} x_{ki}y_i \end{bmatrix}$$

This can be used to predict the dependent variable, and the error term called as residual.

2.6 Independent Sample t –test

Independent samples t –test is commonly used to associate two collectionsof data whose means are not dependent on one another (Banda, 2018). If the sample values from one population are not related from the sample values of another population then, two samples are independent. An independent sample t –test tells the researcher whether there is a statistically significant difference in the mean scores for the two groups or

not. The following is the formula that can be used to calculate an independent sample t –test.

$$t = \frac{\bar{X}_1 - \bar{X}_2}{\sqrt{\frac{\sum_{i=1}^{n} x_{i1}^2 - \frac{\left(\sum_{i=1}^{n} x_{i1}\right)^2}{n_1} + \sum_{i=1}^{n} x_{i2}^2 - \frac{\left(\sum_{i=1}^{n} x_{i2}\right)^2}{n_2}}{n_1 n_2 \left(1 - \frac{2}{n_1 + n_2}\right)}}}$$

From the formula above,
n_1 is the sample size of the first group and n_2 is the sample size of the second group.
$\bar{X}_1$is the sample mean of the first group and $\bar{X}_2$is the sample mean of the second group.
$\sum_{i=1}^{n} x_{i1}$is the sum of the scores of the first group and $\sum_{i=1}^{n} x_{i2}$ is the sum of scores of the second group.
$\sum_{i=1}^{n} x_{i1}^2$ is the sum of squared scores of the first group and $\sum_{i=1}^{n} x_{i2}^2$is the sum of the squared scores of the second group

3. Results and Discussion

3.1 Mathematics Performance

Table 3 shows the mathematics performance of grade 10 students. It could be seen that most of the students has a grade ranging 85 to 89 which is 28.53% of the sample size and denotes proficient in verbal description. There are eighty-nine (89) students who garner 80 to 84 which is 25.65% of the sample size with verbal interpretation as approaching proficiency. It implies that most of the students are in the range 85 to 89. However, anotable number (10) got the lowest rating of below 75 with verbal interpretation of beginning. The result implies that most of the students are in the approaching proficiency and proficient in terms of their performance in Mathematics.

Table 3. Mathematics Performance of Grade 10 Students

Mathematics Performance	Frequency	Percent
90 – 100 (Advanced)	73	21.04
85 – 89 (Proficient)	99	28.53
80 – 84 (Approaching Proficiency)	89	25.65
75 – 79 (Developing)	76	21.90
Below 75 (Beginning)	10	2.88
Total	347	100.00

In contradiction to the result, Peteros et. al (2020) showed that the most of the Grade 10 respondents in Cebu City had reasonably satisfactory in mathematics

performance ranging from 75 – 79 which is 53.01% of their sample size. Their study revealed that students' self-concept has a contribution in mathematics performance. Also, in 2018, Philippines joined an educational achievement test through Pisa. An assessment was a two-hour computer-based test was administered to 600, 000 15-year old students partaking countries. The results revealed that the global average in mathematics was 489 and Philippines' average in mathematics was 353. It was the lowest score among all the subjects.

Table 4 displayed the emotional quotient of the grade 10 mathematics teachers. The table depicted that the respondents have adequate emotional and social capacity in terms of positive impression with 109 as its average score.Conversely, five other components were interpreted as "low" and these are stress management, general mood, intrapersonal scale, adaptability, and interpersonal scale with scores of 88, 87, 86, 85, and 81 respectively. These results are quite similar on study of Gamban et. al. (2014) which revealed that Letran Calamba teachers varied in EQ ranging from low to above average levels; mostly below average in all dimensions on innovation, intuition, emotion, self-awareness, motivation, empathy, and social skills. It means that the teacher-respondents have underdeveloped emotional and social capacity.

Yazon et. al. (2019) discussed that Filipino teachers have moderate level of emotional intelligence using the Ganos Emotional Intelligence Inventory. It means that the teacher-respondents possess an average level of accurate appraisal of emotions among themselves and others. However, the respondents admitted that they sometimes fail to handle stressful situations at work and fail to keep calm in difficult situations. The self-reported assessment may be attributed by voluminous workload among teachers which triggers mismanagement of their emotions.

Table 4. Summary of the Emotional Quotient of Teacher-Respondents

Components of Emotional Quotient	Average Score	Interpretation
Intrapersonal Scale	86	Low
Interpersonal Scale	81	Low
Stress Management	88	Low
Adaptability	85	Low
General Mood	87	Low
Positive Impression	109	Average

Table 5. Level of Competency in 21st Century Skills

21st Century Skills	Mean	Verbal Interpretation
Creativity and	3.00	Competent

Innovation		
Critical Thinking	3.13	Competent
Metacognition	3.17	Competent
Communication	2.97	Competent
Collaboration	3.20	Competent
Information Literacy	2.96	Competent
ICT Literacy	2.89	Competent
Citizenship	3.09	Competent
Life and Career	3.18	Competent
Personal and Social Responsibility	3.12	Competent
General Mean	3.07	Competent

Table 5 summarizes the level of competency on 21st century skills of Mathematics teachers. It can be gleaned that skills under collaboration got the highest mean with 3.20 and verbal interpretation as competent. On the other hand, skills under ICT literacy got the lowest mean among the 10 identified skills with 2.89 and verbal interpretation of competent.

One of the new trends of 21st century is collaboration. Society needs to think and work hand-in-hand on the increasing critical concerns with regards to the emphasis of shifting individual efforts to group work that leads to independence to community. Collaboration is a philosophy of personal lifestyle and interaction where each individual is responsible for his action that includes respect to the abilities and learnings contributed by his peers (Laal et. al., 2012).

Moreover, the overall mean for the level of competency ofMathematics teachers is 3.07 with verbal interpretation of competent. Results showed that the teachers have substantial knowledge and understanding on the aspects of 21st century skills. This is supported by the study of Pa-alisbo (2017) on his study titled, "*The 21st Century Skills and Job Performance of Teachers*" which showed a self-assessmentof teachers and rated themselves as moderately competent on the identified the 21st century skills. Further, the results are reinforced by the report articulated by Corpuz and Salandanan (2012) that the teacher must possess 21st century skills in order to remain relevant and stimulating.

3.3 Mathematical Model

Initially, the formula in multiple linear regression was used to determine the relationship between the student's mathematics performance and level of competency in 21st century skills and level of emotional quotient of their teachers. Since there are fifteen independent variables, the regression model can be written in general as:

$$\hat{y} = b_0 + b_1x_1 + b_2x_2 + b_3x_3 + b_4x_4 + b_5x_5 + b_6x_6 + b_7x_7 + b_8x_8 + b_9x_9 + b_{10}x_{10} + b_{11}x_{11} + b_{12}x_{12} + b_{13}x_{13} + b_{14}x_{14} + b_{15}x_{15} + \varepsilon$$

where

$\hat{y} =$ Mathematics Performance

$x_1 =$ Creativity and Innovation

$x_2 =$ Critical Thinking

$x_3 =$ Metacognition
$x_4 =$ Communication
$x_5 =$ Collaboration
$x_6 =$ Information Literacy
$x_7 =$ ICT Literacy
$x_8 =$ Citizenship
$x_9 =$ Life and Career
$x_{10} =$ Personal and Social Responsibility
$x_{11} =$ Intrapersonal
$x_{12} =$ Interpersonal
$x_{13} =$ Stress Management
$x_{14} =$ Adaptability
$x_{15} =$ General Mood

Next, in order to formulate the model in estimating mathematics performance, the matrix theory was applied.The equation on appendix 1shows the matrix notation for the regression model.

MATLAB was used to obtain the coefficients which is written below.

$$\hat{y} = 80.071824 - 5.025371x_1 + 0.192228x_2 - 2.048085x_3 + 1.522614x_4 - 1.575412x_5 + 1.234693x_6 - 2.195400x_7 - 0.177663x_8 \pm 0.094754x_9 + 4.007365x_{10} + 0.029233\,x_{11} + 0.002929\,x_{12} + 0.120298x_{13} - 0.038541x_{14} + 0.074943x_{15} + \varepsilon$$

To satisfy the assumptions of the normality residuals, the dependent variable was then multiplied by the natural logarithmic. And, because of multicollinearity of the independent variable, x_{10} was removed. The matrix notation can be seen on appendix 2. Now, the mathematical model can be written as:

$$\hat{y} = e^{4.32900 - 0.05645x_1 + 0.01015x_2 - 0.01954x_3 + 0.01441x_4 + 0.00119x_5 - 0.00282x_6 - 0.00343x_7 + 0.01000x_8 + 0.00694x_9 + 0.00046x_{11} + 0.00045x_{12} + 0.00146x_{13} - 0.00039x_{14} + 0.00057x_{15}}$$

3.4 Significant Difference

The researchers were able to predict the student's mathematics performance using the formulated mathematical model. Independent sample t −test is applied to analyze and determine whether there exist significant difference between the actual and predicted values of the dependent variable.

Table 4. Independent Sample t −Test

Indicator: Student's Mathematics Performance					
	Mean	t	p	Decision	Remarks

		value	value		
Predicted Value	84.0690	-0.0461	0.9633	Retain H_0	Not Significant
Actual Value	84.1038				

Note: *"If p-value is less than or equal to the level of significance (0.01), reject H_0, otherwise failed to reject H_0."*

As shown on table 4, the p-value of 0.9633 is greater than the level of significance of 0.01. Hence, the null hypothesis is rejected. It is then concluded that there is o significant difference between the actual student's mathematics performance and predicted values from the formulated model.

Table 5. Significant Predictors that affect the Student's Mathematics Performance

Independent Variables	Regression Coefficient	p-value	Decision	Remarks
Constant	79.307	.000	Reject H_0	Significant
Emotional Quotient	0.130	.016	Reject H_0	Significant
21st Century Skills	-1.869	.175	Failed to Reject H_0	Not Significant

Note: *"If p value is less than or equal to the level of significance (0.05) reject Ho, otherwise failed to reject Ho."*

3.5 Significant Factors

Multiple linear regression was used to determine the significant predictors that affects the student's mathematics performance. Before conducting the regression analysis, a logarithmic transformation was taken place to satisfy all the required assumptions. The level of significance was considered to be 0.05. After applying multiple linear regression, those factors which has a p-value of less than or equal to 0.05 are therefore concluded to be a significant predictors of mathematics performance.

As presented on table 5, only one independent variable was found to be a significant predictor to student's mathematics performance and it was emotional quotient. This means that any increase or decrease on the said variable may cause the mathematics performance of the students. On the other hand, the level of competency in 21st century skills are found to be insignificant predictors due to the computed p-value which is greater than 0.05

4. Conclusions

Students' performance is one of the bases in justifying quality education. In this study, the researchers found out that the level of students' performance in mathematics for S. Y. 2018 – 2019 entailed as 'proficient'. The result implied that most of the students were in the average performance in mathematics.

The results showed that among the ten identified 21st century skills, the skills on ICT literacy were the least and the highest is collaboration skills. Also, the teacher-respondents were marked 'competent' in general as to their level of competency in 21st century skills. On the other hand, the self-assessment report on emotional quotient depicted that the respondents have underdeveloped

emotional and social capacity.

Moreover, the researchers were able to formulate a mathematical model in estimating mathematics performance for Grade 10 students in Taguig City with predicting power of 70 percent. Upon applying regression analysis, emotional quotient of Grade 10 mathematics teachers is found to be significant predictor for their student's mathematics performance. It can be implied that the actual values of mathematics performance and the predicted values using the mathematical model was close by 70 percent.

5. Recommendations

In view of the foregoing conclusions, the following recommendations are hereby proposed.

1. A nationwide survey on mathematics performance might be conducted and intervention program may be mapped out so that students will be catered according to what level of performance they are in.
2. Mathematics teachers in secondary schools are recommended to engage themselves in seminars, trainings and/ or mentorship relating to the enhancement on ICT Literacy.
3. Include seminars which enhance teacher's capacity in understanding their emotions.
4. The school administrators may take account on the said significant predictors.
5. Future research may be conducted in the national level to formulate a stronger mathematical model to estimate the performance of the students

References

[1] Adeyo, D. A. & Chukwudi A. R. (2014). Emotional Intelligence and Teacher Efficacy as Predictors of Teacher Effectiveness among Pre-Service Teachers in Some Nigerian Universities. International Journal of Evaluation and Research in Education Vol. 3, No. 2.

[2] Aissaoui, Ouafae & Madani, Yasser & Oughdir, Lahcen & Dakkak, Ahmed & EL ALLIOUI, Youssouf. (2020). A Multiple Linear Regression-Based Approach to Predict Student Performance. 10.1007/978-3-030-36653-7_2.

[3] Ismall, Z., Nor, N. A. K., & Yusof, Y. (2016). Relationship between Emotional Intelligence and Mathematical Competency among Secondary School Students. 10.22342/jme.7.2.3534.91-100.

[4] Oughdir L., Allioui, Y., & Dakkak, A. (2020). A Multiple Linear Regression-Based Approach to Predict Student Performance. 10.1007/978-3-030-36653-7_2

[5] Pa-alisbo M. C. (2017). The 21st century skills and job performance of teachers.Journal of Education and Practice Vol.8, No.32.

[6] Pacific Policy Research Center. (2010). "21stCentury Skills for Students and Teachers."

[7] Paulsen E. K. (2017). "Addressing 21st century skills: breakout games in the EFL classroom."

[8] Reddy, P. R. & Sarma, K. L. A. P. (2015). A Multiple Linear Regression Approach for the Analysis of Stress Factors of Faculty in Higher Educational Institutions. International Journal of Mathematics and its Applications. Volume 3, Issue 4-A.

[9] Samuels, P. (2014). Independent sample t-test. ResearchGate.

[10] Scardamalia M. (2010). "Assessment and teaching of 21st century skills."

[11] Smit L. S. (2016). "A better understanding of 21st century skills in mathematics education and a view on these skills in current practice."

[12] Uyanik, G. K. & Guler, N. (2013). A study n multiple linear regression analysis. Procedia – Social and Behavioral Sciences 106 (2013) 234 – 240.

[13] Yazon, A. D. & Manaig, K. A. (2019). Emotional Intelligence and Occupational Stress among Filipino Teachers. Universal Journal of Educational Research 7(11).

*e*ISSN1303-5150

Appendices

Appendix 1. Matrix Notation in Normal Estimation Equation

$$\begin{bmatrix} 15 & 87.14 & 90.71 & 92.00 & 86.14 & 92.86 & 85.86 & 83.86 & 89.57 & 92.14 & 90.43 \\ 87.14 & 266.37 & 276.90 & 279.90 & 279.82 & 262.00 & 282.86 & 259.51 & 253.65 & 273.63 & 281.63 \\ 90.71 & 276.90 & 292.39 & 292.86 & 274.37 & 296.84 & 271.12 & 264.08 & 286.47 & 295.98 & 290.24 \\ 92.00 & 279.82 & 292.86 & 298.45 & 278.69 & 301.22 & 275.51 & 268.65 & 289.98 & 298.90 & 293.86 \\ 86.14 & 262.00 & 274.37 & 278.69 & 263.08 & 282.61 & 259.35 & 253.06 & 272.63 & 280.82 & 275.71 \\ 92.86 & 282.86 & 296.84 & 301.22 & 282.61 & 306.20 & 279.24 & 272.27 & 294.06 & 303.18 & 298.24 \\ 85.86 & 259.51 & 271.12 & 275.51 & 259.34 & 279.24 & 262.88 & 254.76 & 269.22 & 278.08 & 271.96 \\ 83.86 & 253.65 & 264.08 & 268.65 & 253.06 & 272.27 & 254.76 & 248.51 & 262.76 & 270.84 & 265.61 \\ 89.57 & 273.63 & 286.47 & 289.98 & 272.63 & 294.06 & 269.22 & 262.76 & 285.29 & 292.92 & 288.10 \\ 92.14 & 281.63 & 295.98 & 298.90 & 280.82 & 303.18 & 278.08 & 270.83 & 292.92 & 303.41 & 296.78 \\ 90.43 & 276.88 & 290.24 & 293.86 & 275.71 & 298.24 & 271.96 & 265.61 & 288.10 & 296.78 & 292.67 \\ 2490 & 7464.00 & 7730.71 & 7862.00 & 7349.43 & 7939.42 & 7323.57 & 7165.14 & 7656.29 & 7851.57 & 7715.57 \\ 2344 & 7088.71 & 7372.71 & 7498.86 & 7007.71 & 7567.29 & 6978.14 & 6799.43 & 7325.71 & 7512.57 & 7423.43 \\ 2552 & 7697.57 & 7982.57 & 8132.43 & 7560.43 & 8182.00 & 7518.43 & 7359.14 & 7898.29 & 8123.29 & 7987.29 \\ 2467 & 7476.00 & 7771.71 & 7927.71 & 7395.14 & 7990.43 & 7344.57 & 7151.43 & 7723.71 & 7917.29 & 7795.71 \\ 2533 & 7633.86 & 7950.29 & 8085.43 & 7557.14 & 8174.57 & 7510.57 & 7330.71 & 7873.14 & 8073.14 & 7937.29 \end{bmatrix}$$

$$= \begin{bmatrix} 2439.01 \\ 7319.04 \\ 7621.76 \\ 7733.68 \\ 7238.75 \\ 7806.06 \\ 7212.90 \\ 7046.03 \\ 7529.25 \\ 7743.04 \\ 7601.78 \\ 209766.38 \\ 197284.35 \\ 215259.74 \\ 207712.24 \\ 213424.31 \end{bmatrix}$$

Appendix 2. Matrix Notation in Normal Estimation Equation after Satisfying All the Assumptions of Multiple Linear Regression

$$\begin{bmatrix} 15 & 87.14 & 90.71 & 92.00 & 86.14 & 92.86 & 85.86 & 83.86 & 89.57 & 92.14 & 2490 \\ 87.14 & 266.37 & 276.90 & 279.90 & 279.82 & 262.00 & 282.86 & 259.51 & 253.65 & 273.63 & 276.88 \\ 90.71 & 276.90 & 292.39 & 292.86 & 274.37 & 296.84 & 271.12 & 264.08 & 286.47 & 295.98 & 7730.71 \\ 92.00 & 279.82 & 292.86 & 298.45 & 278.69 & 301.22 & 275.51 & 268.65 & 289.98 & 298.90 & 7862.00 \\ 86.14 & 262.00 & 274.37 & 278.69 & 263.08 & 282.61 & 259.35 & 253.06 & 272.63 & 280.82 & 7394.43 \\ 92.86 & 282.86 & 296.84 & 301.22 & 282.61 & 306.20 & 279.24 & 272.27 & 294.06 & 303.18 & 7323.57 \\ 85.86 & 259.51 & 271.12 & 275.51 & 259.34 & 279.24 & 262.88 & 254.76 & 269.22 & 278.08 & 7165.14 \\ 83.86 & 253.65 & 264.08 & 268.65 & 253.06 & 272.27 & 254.76 & 248.51 & 262.76 & 270.84 & 765.29 \\ 89.57 & 273.63 & 286.47 & 289.98 & 272.63 & 294.06 & 269.22 & 262.76 & 285.29 & 292.92 & 7851.57 \\ 92.14 & 281.63 & 295.98 & 298.90 & 280.82 & 303.18 & 278.08 & 270.83 & 292.92 & 303.41 & 7715.57 \\ 2490 & 7464.00 & 7730.71 & 7862.00 & 7349.43 & 7939.42 & 7323.57 & 7165.14 & 7656.29 & 7851.57 & 217220 \\ 2344 & 7088.71 & 7372.71 & 7498.86 & 7007.71 & 7567.29 & 6978.14 & 6799.43 & 7325.71 & 7512.57 & 200592 \\ 2552 & 7697.57 & 7982.57 & 8123.43 & 7560.43 & 8182.00 & 7518.43 & 7359.14 & 7898.29 & 8123.29 & 220639 \\ 2467 & 7476.00 & 7771.71 & 7927.71 & 7395.14 & 7990.43 & 7344.57 & 7151.43 & 7723.71 & 7917.29 & 212132 \\ 2533 & 7633.86 & 7950.29 & 8085.43 & 7557.14 & 8174.57 & 7510.57 & 7330.71 & 7879.14 & 8073.14 & 218919 \end{bmatrix}$$

$$= \begin{bmatrix} 2439.01 \\ 7319.04 \\ 7621.76 \\ 7733.68 \\ 7238.75 \\ 7806.06 \\ 7212.90 \\ 7046.03 \\ 7529.25 \\ 7743.04 \\ 209766.38 \\ 197284.35 \\ 215259.74 \\ 207712.24 \\ 213424.31 \end{bmatrix}$$

*e*ISSN1303-5150