# EXPLORING ASIAN STUDENTS' RESILIENCE

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**Abstract**

Resilience can be defined as "good outcomes in spite of serious threats to adaptation or development" [2]. The purpose of our study was to conduct linear regression, random forest, and decision tree analyses based on data from PISA in an Asian context to explore the relationship between multiple independent variables (self, family and social-environmental characteristics) and student resilience. In 2018, nearly 80 countries participated in the Program for International Student Assessment (PISA). PISA assesses 15-year-old students' proficiency in reading, mathematics, and science and collects data on a large number of contextual factors through questionnaires administered to students, teachers, and school leaders [6]. The results of our model analysis indicated that students' perceptions of school belonging and subjective well-being, gender and index of economic, social and cultural status, family wealth, internet access at home and parental moral support were statistically significantly associated with resilience.

# Contents

# 1 Introduction

Students are experiencing a storm of stress and uncertainty. In spite of facing so many inevitable challenges of life, students emerge healthy and continue growing as healthy individuals due to their normal and everyday bases of resilience [3]. Resilience plays an important part in embracing obstacles and overcoming them when students struggle with their schoolwork. When students are bullied or feel excluded, resilience also affects whether they seek revenge aggressively or find more productive solutions. Students with resilient personalities were found to be successful in school [7]. In addition, resilience has been shown to protect teens against online risks, even when they possess high levels of Internet addiction [4]. Both in school and life, resilience is crucial for students [2].

The mathematics scores of Asia countries (China, Thailand, Singapore, Malaysia, Vietnam, Korea, Japan) and other countries are significantly different (t-test=3.209, p-value=0.002). The resilience scores of Asian countries and other countries are also significantly different (t-test=-17.914, p-value=0.001). In the meantime, students' well-being, self-efficacy and resilience are significant predictors of learning performance [5]. Our study aims to understand what factors may affect and predict the resilience of students in Asia countries. According to the study conducted by Hechtman [1], there are three main factors influencing the presence of resilience: the self, the family, and the larger social environment. Hence, we selected *sense of belonging to school* and *subjective well-being* as self-factors, *gender* and *index of economic, social and cultural status* as social factors and *family wealth*, *available be for internet at home* and *parents' emotional support* as family factors from the 2018 Program for International Student Assessment (PISA2018). We hope that our work contributes to a better understanding of the resilience of students. This will enable us to enhance students' general quality of life, which will eventually enhance their educational experience.

# 2 Method

## 2.1 Sample

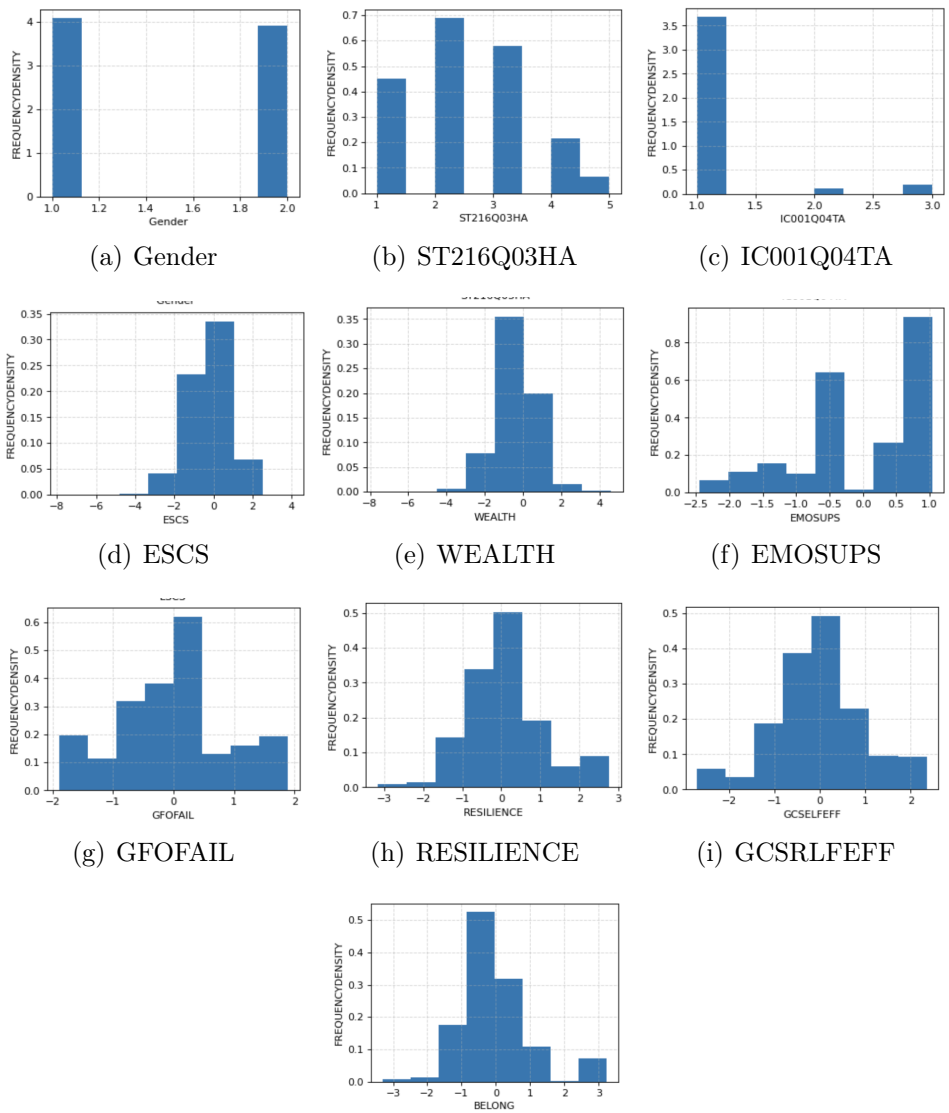
This study is based on data collected in PISA 2018, the most recent edition of the international student assessment intended to measure a student's

ability to meet future challenges. PISA measures students' capacity to use their knowledge and skills in reading, mathematics, and science and to apply them to real-life situations. The OECD organizes PISA assessments every three years. In PISA 2018, 37 OECD countries and 47 associated countries and economies participated in the study. We focus on seven Asia countries (China, Thailand, Singapore, Malaysia, Vietnam, Korea and Japan) that participated in PISA 2018.

The following tables(Figure 1) give us the statistics of variables, which provides a general view of the data. Besides, we plotted the histograms of each variable which gives a better understanding of variable distribution(Figure 2).

| | ST004D01T | ST216Q03HA | IC001Q04TA | ESCS | WEALTH | EMOSUPS | GFOFAIL | RESILIENCE | GCSELFEFF | BELONG |
|---|---|---|---|---|---|---|---|---|---|---|
| count | 231858.000000 | 231858.000000 | 231858.000000 | 231858.000000 | 231858.000000 | 231858.000000 | 231858.000000 | 231858.000000 | 231858.000000 | 231858.000000 |
| mean | 1.489731 | 2.379137 | 1.129114 | -0.205012 | -0.365819 | -0.026714 | 0.026203 | 0.061785 | -0.001335 | -0.033729 |
| std | 0.499896 | 1.047296 | 0.459343 | 1.044193 | 1.034937 | 1.001820 | 0.992589 | 1.001256 | 1.016611 | 1.006774 |
| min | 1.000000 | 1.000000 | 1.000000 | -7.751600 | -7.546500 | -2.446800 | -1.893900 | -3.167500 | -2.714200 | -3.316100 |
| 25% | 1.000000 | 2.000000 | 1.000000 | -0.895800 | -0.965600 | -0.657600 | -0.687000 | -0.517600 | -0.585100 | -0.665900 |
| 50% | 1.000000 | 2.000000 | 1.000000 | -0.131300 | -0.330250 | 0.212700 | 0.052000 | -0.061400 | 0.004300 | -0.318400 |
| 75% | 2.000000 | 3.000000 | 1.000000 | 0.615800 | 0.270100 | 1.034600 | 0.463700 | 0.639700 | 0.493725 | 0.462900 |
| max | 2.000000 | 5.000000 | 3.000000 | 3.999100 | 4.627800 | 1.034600 | 1.890500 | 2.766700 | 2.353500 | 3.233900 |

Figure 1: statistics of variables




(a) Gender (b) ST216Q03HA (c) IC001Q04TA

(d) ESCS (e) WEALTH (f) EMOSUPS

(g) GFOFAIL (h) RESILIENCE (i) GCSRLFEFF

(j) BELONG

Figure 2: histograms of each variable

## 2.2 Variables

### 2.2.1 ESCS

ESCS is the index of economic, social and cultural status. The ESCS is a composite score built by the indicators of parental education (PARED), highest parental occupation (HISEI), and home possessions (HOMEPOS) including books in the home via principal component analysis (PCA).

### 2.2.2 Sense of belonging at school

Students feelings about integration and social connections are measured by the index of sense of belonging: whether they make friends easily at school and feel like other students seem to like them or, in contrast, if they feel awkward, out of place, or lonely. In order to measure students' sense of belonging at school, PISA asked students to report whether they "strongly agree", "agree", "disagree" or "strongly disagree" with six statements (see the Appendix).

### 2.2.3 Subjective well-being

Subjective well-being (SWBP, ST186) measures students' life satisfaction and affective feelings by asking them about different feelings they might have had. This index reflects how often students feel they are happy, joyful or cheerful. Adolescents answered on a four-point Likert scale of positive (i.e., 'happy ', 'lively ', 'proud ', 'joyful ', and 'cheerful ') and negative (i.e., 'scared', 'miserable', 'afraid', and 'sad') feelings ranging from 1 (never) to 4 (always).

### 2.2.4 Fear of failure

This index was measured based on adolescents' worries about and fears of failure in managing activities and tasks [8]. The students who have a higher fear of failure worry about how others perceive them, fear that they are not talented enough, and doubt their future plans. In PISA2018, adolescents were asked to report the extent to which they agreed with three statements about themselves (see the Appendix). Adolescents answered on a four-point Likert scale ranging from 1 (strongly disagree) to 4 (strongly agree).

#### 2.2.5 Family wealth

The family wealth of students is assessed by asking them about items they own. Students reported the availability of 16 household items at home including three country-specific household items that were seen as appropriate measures of family wealth within the country's context. In addition, students reported the number of possessions and books at home.

#### 2.2.6 Home internet availability

Students were asked if they can get access to the internet at home. There are three options to be chosen: *Yes and I use it*, *Yes but I don't use it*, and *No*.

#### 2.2.7 Parents' emotional support

This index reflects whether students feel that their families support them emotionally. Specifically, whether their families encourage them to be confident, support their educational efforts and achievements, and support them when they are facing difficulties at school.

### 2.3 Analysis

## 3 Results

Python was employed in this study to conduct data analysis. First, a multiple linear regression model was applied to study the association between resilience and other explanatory variables. Besides, Decision Tree and Random Forest were also introduced into the model.

### 3.1 Correlation between variables

The correlation statistics between variables are demonstrated in Figure 3. As hypothesized, Resilience was negatively correlated with Home Internet Available(-0.042507) and Fear of Failure(-0.133077) and had a strong positive relationship with Parent's Emotional Support(0.285251), Subjective well-being(0.279729) and Sense of belonging at school(0.295124). A relatively small positive relationship was found between Resilience and Gender(0.055478), ESCS(0.064611), and WEALTH(0.032166).

| | Gender | HIA | ESCS | WEALTH | EMOSUPS | GFOFAIL | SWBP | RESILIENCE | BELONG |
|---|---|---|---|---|---|---|---|---|---|
| **Gender** | 1.000000 | 0.000838 | -0.005913 | 0.005156 | -0.055419 | -0.134429 | -0.080678 | 0.055478 | 0.014486 |
| **HIA** | 0.000838 | 1.000000 | -0.194358 | -0.199335 | -0.062431 | -0.019055 | -0.027265 | -0.042507 | -0.060095 |
| **ESCS** | -0.005913 | -0.194358 | 1.000000 | 0.745905 | 0.167293 | 0.059909 | -0.050459 | 0.064611 | 0.165025 |
| **WEALTH** | 0.005156 | -0.199335 | 0.745905 | 1.000000 | 0.111374 | 0.074604 | -0.059571 | 0.032166 | 0.124630 |
| **EMOSUPS** | -0.055419 | -0.062431 | 0.167293 | 0.111374 | 1.000000 | -0.022707 | 0.233648 | 0.285251 | 0.294814 |
| **GFOFAIL** | -0.134429 | -0.019055 | 0.059909 | 0.074604 | -0.022707 | 1.000000 | -0.116628 | -0.133077 | -0.165250 |
| **SWBP** | -0.080678 | -0.027265 | -0.050459 | -0.059571 | 0.233648 | -0.116628 | 1.000000 | 0.279729 | 0.293172 |
| **RESILIENCE** | 0.055478 | -0.042507 | 0.064611 | 0.032166 | 0.285251 | -0.133077 | 0.279729 | 1.000000 | 0.295124 |
| **BELONG** | 0.014486 | -0.060095 | 0.165025 | 0.124630 | 0.294814 | -0.165250 | 0.293172 | 0.295124 | 1.000000 |

Figure 3: Correlation between variables

## 3.2 Multiple linear regression model

In order to check for the influence of multicollinearity among all variables, we calculated the VIF(Variance inflation factor). The results in Figure 4 are all below 15 which demonstrates that there is no multicollinearity among variables.

| | feature | VIF |
|---|---|---|
| 0 | Gender | 5.253239 |
| 1 | HIA | 5.883461 |
| 2 | ESCS | 2.764194 |
| 3 | WEALTH | 3.492773 |
| 4 | EMOSUPS | 1.212606 |
| 5 | GFOFAIL | 1.113309 |
| 6 | SWBP | 1.190682 |
| 7 | RESILIENCE | 1.218462 |
| 8 | BELONG | 1.310406 |

Figure 4: VIF among variables

The results of the multiple linear regression model analysis are displayed in Table 2. Resilience was significantly and positively associated with Parents' emotional support(b=.161), Sense of belonging(b=.123) at school, and Gender(b=.124). Other explanatory variables: the index of economic, social, and cultural status(b=-.002), Family wealth(b=-.086), Fear of failure(b=-.081), Subjective well-being(b=-.251), Home Internet Available(b=-.201) and School

Table 1: output of multiple regression model

| variable | b | S.E. | $\beta$ | 95%CI |
|---|---|---|---|---|
| Intercept | -.242 | .006 | | [-.253, -.231] |
| ESCS | -.002 | .004 | -.002 | [-.101, .007] |
| WEALTH | -.086 | .005 | -.105 | [-.096, -.077] |
| EMOSUPS | .161 | .004 | .172 | [.154, .168] |
| GFOFAIL | -.081 | .004 | -.083 | [-.089, -.074] |
| SWAP | -.251 | .004 | .250 | [.244, .259] |
| BELONG | .123 | .004 | .119 | [.155, .131] |
| GENDER | .124 | .006 | .071 | [.111, .137] |
| HIA | -.201 | .024 | -.031 | [-.245, -.154] |
| R square | 0.056035089694298046 | | | |

Table 2: Comparing of three models

| method | Train/Test Proportion | Mean Square Error | R square |
|---|---|---|---|
| Multiple Regression | 0.8/0.2 | 0.797 | 0.056 |
| Decision Tree | 0.8/0.2 | 0.619 | 0.258 |
| Random Forest | 0.8/0.2 | .005 | 0.251 |

Internet Available(b=-.217) all have a negative relationship with Resilience. In addition, the table gives the 95% confidence interval of each explanatory variable and the R square of the model.

## 3.3 Machine learning model

However, the R square in the multiple linear models is only 5.60%, which means the produced multiple linear model only explained 5.60% variation of data. It is likely that the model is not applicable to the data set. Thus, machine learning models: Decision Tree, and Random Forest are introduced to fit the data better. The output of these two models is shown in Table 3. The Decision Tree model and Random forest models increased R square to 25.80% and 25.09% respectively. Apart from that

# 4 Discussion

It is noteworthy that the figure separately reflects the different levels of explanation for resilience when different primary factors are chosen as independent variables. On the self side, school belonging and subjective well-being exhibited a 14.5% correlation on resilience; on the family side, wealth and access to home Internet and parental emotional support reflected an 8.2% correlation on students' resilience; on the social side, gender and the index of economic, social and cultural status showed only a 0.5% correlation on resilience. Although the social environment has an effect on students' resilience, it is not particularly significant in comparison to other factors. In contrast, factors like family and school, which are more closely related to the student, have a greater impact on the student's resilience. It may also be due to the influence of gender, as women are usually more emotional compared to men and therefore they may be more deeply affected after experiencing challenges and obstacles [10].

**Model Summary**

| Model | R | R Square | Adjusted R Square | Std. Error of the Estimate |
|---|---|---|---|---|
| 1 | .381[a] | .145 | .145 | 6.93845858 |

a. Predictors: (Constant), BELONG, GFOFAIL, SWBP

**Model Summary**

| Model | R | R Square | Adjusted R Square | Std. Error of the Estimate |
|---|---|---|---|---|
| 1 | .286[a] | .082 | .082 | 7.19064863 |

a. Predictors: (Constant), EMOSUPS, IC001Q04TA_2.0, IC001Q04TA_3.0, WEALTH

**Model Summary**

| Model | R | R Square | Adjusted R Square | Std. Error of the Estimate |
|---|---|---|---|---|
| 1 | .073[a] | .005 | .005 | 7.48419927 |

a. Predictors: (Constant), ST004D01T_2, ESCS

Figure 5: factors as independent variables

However, there are several limitations to this study. First of all, the findings were only apply to 15-year-old students in countries in the Asian region, and future studies need to use representative data covering other age groups of teenagers or need to be supported by data from countries other than Asia [14]. Second, students in different Asian countries may have different resilience in the face of obstacles or challenges based on their own cultural influences, little has been known about the cross-cultural differences in these relationships. Future research should examine cross-cultural differences by comparing the cultural contexts of individual countries to those of multiple countries [15]. Third, this study was essentially cross-sectional and was unable to establish causal relationships between the study variables. It is possible that students' family wealth and parents' emotional support as important influences on the family side, have an impact on students' subjective well-being [16]. The direction of the research variables in this study need to be validated in a future longitudinal with study design. Finally, although the dataset from PISA applied to the regression model and the random forest and decision tree models in this study can be used effectively for data analysis and to derive our findings, future studies can be more random in the selection of variables and regions to reduce measurement error therein.

# 5 Conclusion

The aim of this study was to provide evidence for the complex interactions between resilience and students by applying three methods of linear regression, random forest and decision tree. We conclude that support from family, economic, social and cultural status, and students' sense of belonging to the school and subjective well-being are important factors in students' resilience [2]. Among them, students' sense of belonging to the school and subjective well-being as students' self-factors are the most influential factors in resilience. This study can provide insights for school social work practitioners to help improve students' quality of life and educational experiences by providing students with the skills, resources, and beneficial environments they need to thrive. Because as students grow up in our educational system, all of them will face adversity to one degree or another, whether socially or academically. This is why we need scientifically tested methods to show us how to truly enhance student resilience [14]. On a broader theoretical level, we provide evidence that resilience is not only a personal or environmental quality but

can also be the result of an individual's interpretation of the adversity he or she faces.

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# Appendix

Fear of failure:
When I am failing, I worry about what others think of me.
When I am failing, I am afraid that I might not have enough talent.
When I am failing, this makes me doubt my plans for the future.
Sense of belonging at school:
I feel like an outsider or left out of things at school.
I feel awkward and out of place in my school.
I feel lonely at school.
I make friends easily at school.
I feel like I belong at school.
Other students seem to like me.