



# **The Mediating Effect of Students' Resiliency on the Relationship of Self-Concept and Mathematics Performance**

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## **Authors' contributions**

*This work was carried out in collaboration between both authors. Both authors read and approved the final manuscript.*

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## **ABSTRACT**

Several studies have found links between students' self-concept and mathematics performance. However, few related researches has been conducted during this time of COVID-19 where learning mathematics is said to be really tough and challenging for the students. Recent articles also claimed that in this difficult times, students' resiliency really matters towards their performance. Hence, this study investigated the mediating effect of students' resiliency on the relationship between self-concept and mathematics performance of junior high school students. The study was conducted using descriptive - correlational method. Employing stratified random sampling, a total of 278 students were subjected to the study. Descriptive statistics was used to describe the respondents' self-concept, resiliency, and mathematics performance. Mediation analysis was then

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employed to describe the mediating effect of students' resiliency. Results revealed that the respondents' obtained a mean rating of 2.61 level of self-concept which means that students maintained positive perception towards mathematics in this new normal. The resiliency level of 3.70 indicated that students exhibited persistence in learning mathematics in the face of adversity. Data confirmed that self-concept directly influenced mathematics performance by an estimate of 3.49, but also had an indirect effect through the students' resiliency by 1.06. Hence, resiliency partially mediated the relationship of students' self-concept and mathematics performance. This result supports the importance of self-concept to the students' mathematics performance, but also stress the significance of cultivating students' resiliency in this new normal.

*Keywords: Self-concept; resiliency; mathematics performance; new normal; mediation analysis.*

## 1. INTRODUCTION

The world is now experiencing an unexpected crisis that causes the most challenging pivotal phases in education [1]. "Due to the strict implementation of public health measures [2], the traditional face-to-face mode of learning delivery is prohibited and shifted to distance learning approach, a learning delivery mode where interaction takes place between the teachers and students which they are geographically remote from each other during instruction and the lesson proper delivers outdoors the traditional face-to-face platform" [3].

"Learning mathematics is considered by many students to be really tough and challenging, much more in the new normal. As observed in the Davao Occidental, Philippines, high school students struggle to understand the mathematical concepts and to perform mathematical operations stipulated in modules. Uncertainties and anxieties on the subject seems to develop among the students. There may be misconceptions on the topics which may lead to students' negative self-perception towards mathematics. Students' self-concept about their academic abilities is vital in their effort to adjust with their school tasks and responsibilities because these perceptions could influence the extent of efforts students to exert for their school tasks" [4]. "The academic performance of students who have lesser interest in doing the task would be negatively affected" [5]. "On the other hand, students who have high self-concept on a particular subject likely aims to perform well in whatever related tasks are given to them. In turn, this brings positive effects on their performance in the subject. A high academic self-concept directly relates to better academic achievement" [6]. "*Mathematics self-concept* has been defined as one's beliefs about one's competence in mathematics [7] and is significantly related to mathematics performance"

[8]. Thus, understanding students' self-perception towards their mathematical abilities is important in the teaching-learning process.

According to Rahayu, Altaftazani, Kelana, et al. [9], "the implementation of learning with methods that are different from usual will certainly have an impact on students both positive and negative impacts. A positive impact is that children can learn from home with family and children can avoid COVID-19 exposure. While the negative impact is that 80% of children want to go back to school, the majority of students are not happy about distance learning. Students find it difficult to understand the material delivered through distance learning, students are confused in completing requirements, and students lack confidence when completing math assignments".

"Despite of the challenges, the ingenuity and resilience of the Filipinos were demonstrated in the midst of the pandemic" [10]. "The sudden shift from face-to-face classes to blended learning requires resiliency among educators and students as well. Resilience in mathematics is student reflexivity in making the decision when encountering a new situation" [11]. Many studies on resilience have been done proving that resilience is one of the reasons for student success in mathematics [14,15]. On the other hand, links between students' self-concept and mathematics performance were already established. However, few related researches involving these three variables (self-concept, resiliency, and mathematics performance) has been conducted, particularly in this time of COVID-19 where learning mathematics is said to be really tough and challenging for the students. Now that our educational institutions navigate the new mode of teaching-learning modalities, it is worthy therefore to study the mediating effect of students' resiliency to the relationship of self-concept and mathematics performance of the students.

The schools, teachers, and students may benefit from the results of this study. Schools may refer to the findings of this study in planning institutional activities which may boost students' non-cognitive attributes, such as self-concept and resiliency, which were linked to mathematics performance. Mathematics teachers may consider the recommendations derived from the study results in designing meaningful class activities, planning intervention programs, and in enhancing individual teaching pedagogies. With these, students learning experiences would still be meaningful even in this time of COVID-19.

### 1.1 Objectives

This study investigated the mediating effect of students' resiliency to the relationship of self-concept and mathematics performance of junior high school students in public schools of Malita East District, Davao Occidental, Philippines for the School Year 2021-2022. Specifically, this study had the following objectives:

1. To determine the level of self-concept of the students in Mathematics;
2. To determine the level of students' resiliency in Mathematics;
3. To determine the Mathematics performance of the students in terms of their Mathematics subject grade for the SY 2021-2022;
4. To determine the mediating effect of students' resiliency to the relationship of self-concept and mathematics performance of the students.

### 1.2 Conceptual Framework

Fig. 1. displays the independent variable (IV) – Mathematics Self-concept, with its direct interaction to the dependent variable (DV) – the

Mathematics Performance. It also shows the interaction of the IV to the DV with the influence of the mediating variable (MV) – Students' Resiliency with three constructs: the Value, Struggle, and Growth.

It is the goal of this study to find out how resiliency influence the relationship of the self-concept and mathematics performance of the junior high school students.

### 1.3 Hypothesis

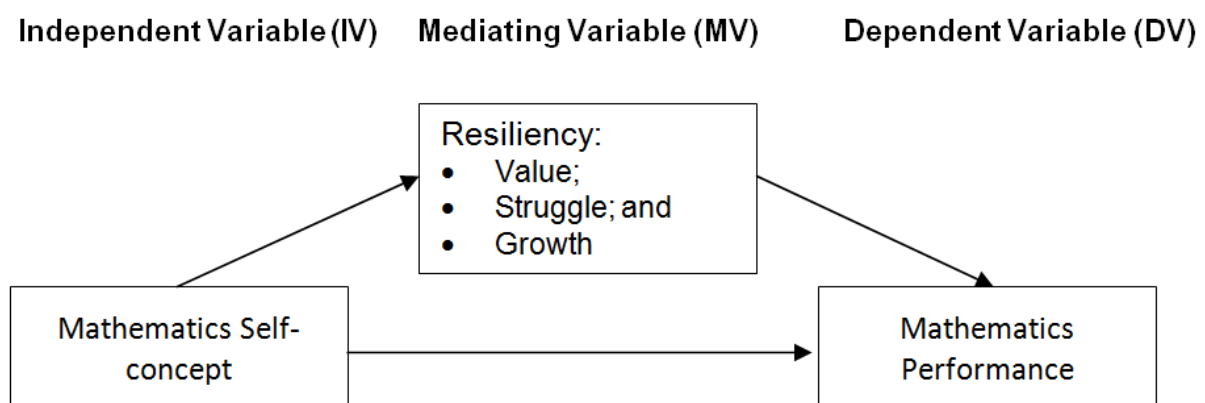
At 95% confidence interval, the following hypothesis will be tested:

$H_{01}$ : There is no mediating effect of students' resiliency on the relationship of self-concept and mathematics performance of the students.

## 2. MATERIALS AND METHODS

### 2.1 Research Design

Descriptive correlational research design was used in this study since the researchers wanted to describe the students' self-concept, resiliency and mathematics performance. Further, the interaction among these variables were investigated. In gathering of data, descriptive-survey was employed which utilized adopted questionnaires to find out the levels of students' resiliency and self-concept as perceived by the junior high school students. The variables students' resiliency, self-concept, and mathematics performance of the students, were not, in any way manipulated. The data were simply subjected to observation and investigation.



**Fig. 1. Paradigm showing interactions of the variables of the study**

## 2.2 Research Instrument

A descriptive survey questionnaire was used to gather the desired data of this study, which consists of three parts. The first part consists of questions that elicit the demographic profile of the respondents in terms of age and gender. The second part was the Mathematical Resilience Scale (MRS) that was adopted from Kookan, Welsh, McCoach, et al. [12] and composed of 23-item survey for the measurement of students' resiliency in mathematics, with reported reliability values of 0.92, 0.80, 0.76, and 0.87 for the value factor, the struggle factor, the growth factor, and the entire scale, respectively. The *value* factor refers to the extent to which students find studying mathematics valuable in attaining their current or future goals. For students to succeed in mathematics, they need to perceive math as valuable [13]. The *struggle* factor refers to the student belief that because mathematics can be a difficult subject to learn, there is an expectation that the process of learning it will require overcoming challenges. The *growth* factor in learning mathematics refers to the belief that level of knowledge of mathematics is a malleable attribute that can grow. The overall concept of mathematical resilience refers to learners' stance to approach mathematics with confidence and persistence (Johnston-Wilder and Lee, 2010). The third part was an adopted 20-item self-report questionnaire titled, "Self-concept towards Mathematics" that was developed by Ayodele [11] in which students were asked to rate how they feel, act, value and evaluate themselves in mathematics on a four-point scale. The reliability coefficient of the instrument is reported to be at 0.74 Cronbach- $\alpha$ .

The data on students' mathematics performance is a secondary data that was gathered from the planning designates of the participating schools. The data includes the first quarter and second quarter mathematics subject grades of the respondents in SY. 2021 – 2022.

## 2.3 Data Analysis

The junior high school students' resiliency levels, based on the Mathematical Resilience Scale (MRS), was analyzed using the range below (Table 1).

## 2.4 Respondents of the Study

In getting the sample size, the Slovin's formula was used. The stratified random sampling was

employed so that respondents will be proportionally distributed to different Secondary Schools of Malita East District. The respondents of this study were the randomly selected Junior High School students of Malita East, Davao Occidental, Philippines for the School Year 2021-2022. The distribution of respondents is presented in Table 2.

**Table 1. Mathematical Resilience Scale (MRS)**

Range of means	Descriptive level
4.20 – 5.00	Very High
3.40 – 4.19	High
2.60 – 3.39	Moderate
1.80 – 2.59	Low
1.00 – 1.79	Very Low

In evaluating the levels of self-concept of the students towards mathematics, the following scale was used:

Range of means	Descriptive level
3.25 – 4.00	Very High
2.50 – 3.24	High
1.75 – 2.49	Low
1.00 – 1.74	Very Low

The Mathematics performance of the respondents was interpreted based on the DepEd Order No. 31, s. 2012:

Range of means	Descriptive level
90% and above	Advanced
85% – 89%	Proficient
80% – 84%	Approaching Proficiency
75% – 79%	Developing
74% and below	Beginning

**Table 2. The Distribution of respondents**

High school	Population	Sample size
1. A	498	151
2. B	292	89
3. C	125	38
TOTAL	915	278

## 2.5 Data Gathering

After obtaining the necessary permissions to conduct the study from the Schools Division Superintendent and school principals of the selected schools, the researcher initiated orientation to the parents and students during the scheduled module distribution. The respondents were assured that all collected data will be treated with utmost respect and confidentiality and shall be used collectively for the study purposes only. It was emphasized that in responding to the instrument, parents and

students are giving their consent to be respondents of the study. The questionnaires were then given to the respondents and was retrieved along with the module retrieval.

The mathematics performance data considered is the average of the first quarter and second quarter subject grades in Mathematics for the SY 2021-2022 and were secured from the Guidance Designate/planning officer of the respective schools.

## **2.6 Statistical Analysis**

The data gathered were tallied, tabulated, and prepared in a manner suitable for use in SPSS. The following statistical tools were then being employed to generate and interpret the results:

### **2.6.1 Frequency count and percentage**

Frequency count and percentage were used to describe the distribution of the respondents. Percentage was also used to describe the indirect and direct effects of self-efficacy with respect to the total effect to the mathematics performance.

### **2.6.2 Mean**

Mean was used to describe the levels of students' resiliency, self-concept, and mathematics performance.

### **2.6.3 Mediation analysis**

This tool was used to determine the mediation effect of students' resiliency to the relationship of self-concept and students mathematics performance of the junior high school students.

### **2.6.4 Sobel test**

This tool was employed to determine the significance of the mediation effect of students' resiliency to the relationship of self-concept and mathematics performance of the students.

## **3. RESULTS AND DISCUSSION**

### **3.1 Self-concept of the Students towards Mathematics**

The level of self-concept of the students towards Mathematics is presented in Table 3. Among the 20 indicators of self-concept, Mathematics improves understanding of other subjects and

feeling delighted when answering Mathematics questions; both obtained the highest mean rating of 2.680 with qualitative description "High". Aside from the mentioned indicators above, capability of making a good grade in Mathematics and learning Mathematics gives meaning to learning activities, as well as, mathematics is suitable only for gifted students and encourages to apply detailed steps to solving personal problems also shared an equal mean rating of 2.586 and 2.597, respectively, with descriptive rating of "High". On the other hand, mathematics is an easy subject to pass obtained the lowest mean rating of 2.554 with qualitative description "High". The overall level of self-concept of the students towards Mathematics is "High" with mean rating of 2.611. This means that in learning Mathematics, students' interest towards the subject is notable. They display positive perception towards Mathematics.

### **3.2 Students' Resiliency in Mathematics**

The level of students' resiliency in Mathematics is presented in Table 4. Among the three constructs of students' resiliency, Struggle obtained the highest mean rating of 3.703 with qualitative description "High". It is followed by Value and Growth with 3.69514 and 3.690 mean ratings, respectively, with descriptive rating of "High". The overall resiliency level of the respondents is "High" with mean rating of 3.696. This implies that students exhibit persistence in learning mathematics in the face of adversity. They recognize that struggle is part of learning mathematics. And for students to succeed in mathematics, they need to perceive math as valuable [13]. Bandura and Cervone [16] found that "when the motivational investment of the group is high, the staying power in the face of setbacks is strengthened, hence enhancing performance. Students need to be challenged at the appropriate degree in order to continue to engage in the study of mathematics". Similarly, students should be able to adapt to the learning pattern without going through face-to-face [17].

### **3.3 Mathematics Performance of the Students**

Table 5 shows the level of Mathematics performance of the students. Majority of the respondents displayed Proficient Level of mathematics performance with 48.56% of the total sample population. It is followed by Approaching Proficiency Level, Developing Level, Advanced Level, and Beginning Level with 29.14%, 16.55%, 5.76%, and 0%, respectively,

of the total sample population. The average Mathematics grades of the respondents for the School Year 2021 – 2022 is 84.39 with qualitative description “Approaching Proficiency” and a standard deviation of 3.86. This implies that in general, the respondents developed fundamental knowledge, skills and guidance from the teacher or with peers and can transfer them these understanding through authentic tasks.

**3.4 The Mediating Effect of Students’ Resiliency to the Relationship of Self-concept and Mathematics Performance of the Students**

The Mediation Effect Analysis of students’ resiliency to the relationship of self-concept and mathematics performance of the students is presented in Table 6. It was found that the level of Self-concept towards Mathematics significantly affects the level of Students’ Resiliency with the regression coefficient of 0.91 and p-value of less than 0.05. Further, results also showed that Students’ Resiliency had a significant effect on their Mathematics Performance with regression coefficient of 1.16 with p-value of less than 0.05. These results conform to the study of Kwek, Bui, Ryne, & Fung So [18] that self-concept and

resilience are significant predictors of academic performance.

The overall indirect effect is 1.06 which is the product of the direct effects of Self-Concept to Students’ Resiliency and Students’ Resiliency to the Mathematics Performance with p-value of less than 0.05.

On the other hand, the direct effect of Self-concept to the Mathematics Performance of the Students has a regression coefficient of 3.49 with p-value of less than 0.05. This implies that Self-concept had a significant effect on the Mathematics Performance of the Students. The result supported the study of Guay, Ratelle, Roy, & Litalien [19], “which aimed to investigated the self-concept of the students, as they found that students who have high academic self-concept have higher grades because they are more motivated to perform well in school”.

Moreover, the Total Effect has a regression coefficient of 4.55 which is the sum of indirect and direct effect. The Indirect Effect is 1.06 which means that mediation of resiliency to relationship of self-concept and mathematics performance of the students is about 23.30%, while direct effect of self-concept to mathematics performance is

**Table 3. The level of self-concept of the students towards Mathematics**

<b>Items</b>	<b>Mean</b>	<b>Std. deviation</b>	<b>Description</b>
Mathematics is an easy subject to learn.	2.583	.7398	High
Mathematics is an easy subject to pass.	2.554	.7227	High
Mathematics helps me find a new way of doing things.	2.568	.8416	High
Every question in Mathematics is answerable.	2.604	.8592	High
Mathematics lessons give me satisfaction.	2.647	.8443	High
Mathematics improves my understanding of other subjects.	2.680	.7937	High
Mathematics improves my learning and retention capacities.	2.558	.8381	High
I am good at Mathematics as a subject.	2.651	.7815	High
I am capable of making a good grade in Mathematics.	2.586	.8442	High
I feel delighted when answering Mathematics questions.	2.680	.8423	High
Mathematics facilitates my studying independently.	2.655	.8600	High
Mathematics is suitable only for gifted students.	2.597	.8473	High
Mathematics encourages me to apply detailed steps to solving my personal problems.	2.597	.8036	High
Mathematics makes me think fast.	2.619	.8273	High
My present knowledge of Mathematical concepts is high.	2.601	.8762	High
Mathematics is worth passing well.	2.622	.8224	High
I do extra work to learn Mathematics.	2.665	.8280	High
Mathematics is important in my future career.	2.594	.7673	High
I am comfortable in Mathematics lessons.	2.579	.8577	High
Learning Mathematics gives me meaning to learning activities.	2.586	.8442	High
<b>Self-concept (overall)</b>	<b>2.6113</b>	<b>.74772</b>	<b>High</b>

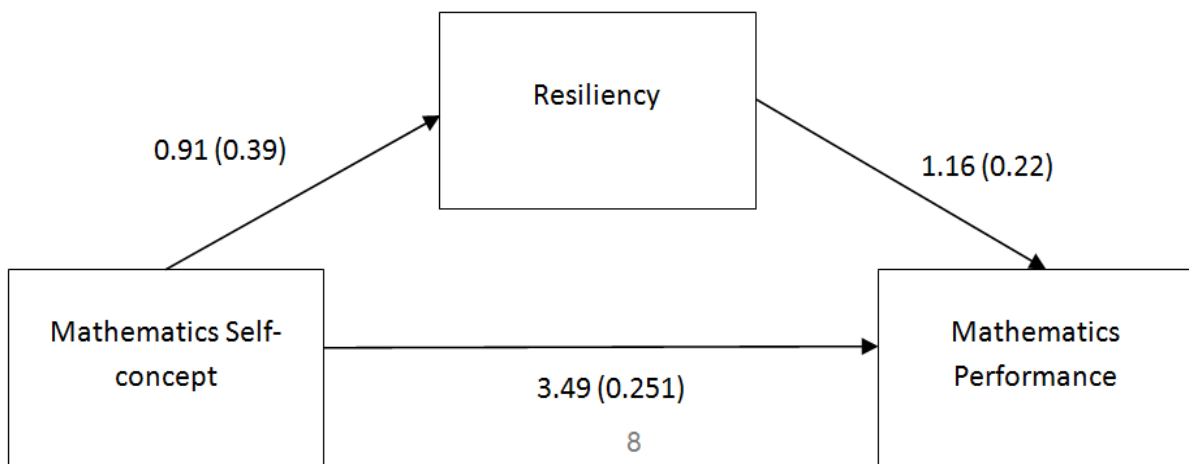
**Table 4. The level of students’ resiliency in mathematics**

Resiliency constructs	Mean	Std. deviation	Description
Value	3.695	.8628	High
Struggle	3.703	.8469	High
Growth	3.690	.8390	High
<b>Resiliency (overall)</b>	3.696	.8394	High

**Table 5. The Mathematics performance of the students**

Range of Means	Descriptive Level	Frequency (f)	Percentage (%)
90% and above	Advanced	16	5.76
85% – 89%	Proficient	135	48.56
80% – 84%	Approaching Proficiency	81	29.14
75% – 79%	Developing	46	16.55
74% and below	Beginning	0	0.00

*n=278; Mean=84.39; SD=3.89*



**Fig. 2. The mediating effect of resiliency on the relationship between students’ self-concept and their mathematics performance**

**Table 6. Mediation effect analysis of students’ resiliency to the relationship of self-concept and mathematics performance of the students**

Effect	Estimates	SE	Lower CI	Upper CI
Indirect Effect	1.06*	0.22	0.62	1.51
Self-Concept→ Resiliency	0.91*	0.39	0.84	0.99
Resiliency → Math Performance	1.16*	0.22	0.72	1.60
Direct Effect				
Self-Concept→ Math Performance	3.49*	0.25	2.99	3.98
Total Effect	4.55*	0.15	4.25	4.85

*\*p<0.05; SE=Standard Error; CI= Confidence Interval*

**Table 7. Summary of sobel test of mediation**

Indirect effect	Estimates	SE	p-value
Self-Concept → Resiliency	0.91	0.39	0.031
Resiliency → Math Performance	1.16	0.22	

76.70%. Since, the direct effect of Self-concept to Mathematics performance is nonzero and is significant, we can say that the mediation of resiliency exhibited is partial mediation. This result implies that mathematics self-concept remains a predictor to mathematics performance. However, students' resiliency in mathematics also matters in this time of COVID-19. Nurturing students' resiliency would significantly improve the effect of mathematics self-concept towards mathematics performance.

Finally, to check whether the mediation exists is significant, Sobel Test was employed and the result is presented in Table 7. Since the p-value is less than 0.05 level of significance, then we reject the null hypothesis and conclude that the mediation effect of Resiliency to the Relationship between Students' Self-concept and their Mathematics Performance is significant (Fig. 2).

The result of the study was somehow related to the previous study of Martinez, Landa, Lopez, & Leon [20], that self-concept mediates the relationship between resilience and academic achievement. Their results suggest that, although resilience is not able to predict students' academic scores directly, they are able to do it through self-concept.

## **4. CONCLUSION AND RECOMMENDATIONS**

### **4.1 CONCLUSION**

Educators have been paying attention to students' math performance for many years. Several scholars have tried to model mathematical performance. It is commonly accepted that a variety of factors affect learners' academic success. Identifying which of the several factors are significant is one of the key steps [21]. The results of this study contributed to the body of knowledge in mathematics education by acknowledging self-concept as a predictor to students' mathematics performance and resiliency as the significant mediating variable. Further, the following conclusion were drawn:

1. The respondents display high level of self-concept towards Mathematics which means that in learning Mathematics, students' interest towards the subject is notable. They display positive perception towards Mathematics inspite of the challenges in this time of COVID-19.

2. The respondents display high level of resiliency which means that students exhibit persistence in learning mathematics in the face of adversity. They recognize that struggle is part of learning mathematics.
3. Students exhibit approaching proficiency level on their Mathematics grades which means that the students developed fundamental knowledge, skills and guidance from the teacher or with peers and can transfer them these understanding through authentic tasks.
4. Mathematics self-concept remains a significant predictor to mathematics performance, hence, nurturing this variable is important in enhancing mathematics performance.
5. Students' Resiliency significantly mediates the relationship of Self-concept and Mathematics Performance of the students. Cultivating students' resiliency would significantly improve the effect of mathematics self-concept towards mathematics performance.

### **4.2 RECOMMENDATIONS**

In the light of the foregoing findings and conclusions of this study, the researchers formulated the following recommendations for consideration:

1. The Junior High School students display high level of self-concept towards Mathematics and mathematical resilience. It is recommended to continue inculcating these variables among the students by designing meaningful classroom and school activities which may boosts self-concept and resiliency among students.
2. Though respondents exhibit an approaching proficiency level on their Mathematics grades in the distance learning approach of education, but still, lot of students struggle in learning Mathematics and perform poorly in the subject. Hence, it is recommended to develop and implement intervention programs that will address the learning needs of the learners particularly in this challenging time of COVID-19 pandemic.
3. Even in this new normal, mathematics self-concept significantly influence mathematics performance. Hence, it is recommended to consider the lens of mathematics self-concept in designing



instructional activities for mathematics subject.

4. Mathematics resiliency significantly mediates the relationship between self-concept and mathematics performance of students. Hence, cultivating resiliency among the learners shall always be considered in school programs and activities to prepare the students in uncertain times and cope with adversities.
5. Further exploration on the interaction of students' self-concept, resiliency, and mathematics performance would be worthwhile. Inclusion of other non-cognitive variables and studying them in a structural equation modelling is recommended.

## CONSENT

As per international standard or university standard, Participants' written consent has been collected and preserved by the author(s).

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## COMPETING INTERESTS

Authors have declared that no competing interests exist.

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