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REVISITING MATHEMATICAL RESILIENCE AND ANXIETY AMONG SENIOR HIGH STUDENTS

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Abstract
Resilience is vital in recovering from mathematical anxiety since it gives motivation in pursuing despite obstacles and challenges. This study aimed to measure the mathematical resilience and anxiety of grade 11 students at Visayas State University-Main campus as well as to elucidate its relationship. Secondary data was used in this study from a current paper by Casinillo et al. (2020). Mean average, standard deviation, coefficient of variation, and Spearman rho correlation was employed to summarize and extract inference from the data. On average, the perception scores of students' levels of resilience and anxiety are 82.2 and 29.5, respectively. Results suggested that students are resilient and moderately anxious in learning mathematics. This implies that students are motivated even if they are facing some challenging problems in mathematics. On the other hand, students are somehow uneasy or experiencing a little worry in doing mathematical problems. Findings depicted that there is no significant relationship (*p*-value=0.4725) between the students' level of resilience and anxiety. This means to say that resiliency of students does not lessen the level of anxiety in learning mathematics. In that case, teachers must not only be focusing on the resiliency of their students but also on creativity, self-determination, and motivation, among others. Furthermore, to eliminate the anxiousness of students in facing mathematical problems, teachers must encourage and cultivate their interest in learning mathematics.

Keywords: correlation, mathematical anxiety, mathematical resilience

Introduction
Mathematics is one of the subjects in senior high level with a high demand of complexity and difficulty as well as in the form of abstraction. Consequently, students are experiencing mathematical anxiety that hinders their motivation in learning and affects their academic achievement (Wang et al., 2014). According to Choi et al. (2020), mathematical anxiety is a predictor of the numerical ability of students. It means that anxiety is adversely affecting the cognitive behavior of students which causes tension and stress (Passolunghi et al., 2020). Perry (2004)

depicted that mathematical anxiety has continually haunted most mathematics careers of students by causing them the inability to work positively. Meanwhile, mathematical resilience mediates the effects of anxiety and leads to recovery from the unproductive way of learning. Ariyanto and colleagues (2017) stated that resilience is a way to progress a positive behavior in learning mathematics that will enable students to continue despite the challenges. In that case, it is practical to investigate the role of resilience in students' anxiety in learning mathematics. In fact, several studies in the literature have dealt with the positive stance of mathematical resilience to overcome anxiety in learning (Johnston-Wilder et al., 2013; Johnston-Wilder et al., 2014; Cousins et al., 2019; Muntazhimah and Ulfah, 2020).

The study of Hjemdal (2011) has revealed that the resilience level of students is significantly correlated to anxiety and stress in learning. It is also shown in a study that investigating resilience and its factors may supply suitable interventions to lessen the level of students' anxiety. It is worthy to note that the effect of anxiety on learning is adverse to mathematics achievement. According to Juniati and Budayasa (2020), a higher level of anxiety results to lower mathematical achievement due to depression and stress. On the face of it, mathematical anxiety is a hindrance to students' cognitive thinking and problem-solving skills. Aldrup and colleagues (2020) stated that mathematical anxiety is a problem for most students that results in worrying and unpleasant reactions that adversely affect well-being. Another thing is that anxiety can diminish the students' interest and happiness in learning mathematics. In fact, interest and happiness in learning are important factors of good mathematics achievement (Casinillo & Aure, 2018; Casinillo & Casinillo, 2020). Apparently, it is necessary that teachers must encourage the students and develop their mathematical resilience by being sensitive to their learning attitude to intervene in the process. Hence, studying the students' mathematical resilience and anxiety will help educators and policymakers in the educational system understand, and develop the cognitive behavior and well-being in learning mathematics.

Although resilience and anxiety are well-researched and investigated, some properties of students' mathematical resilience and anxiety are not focused on details. In addition, studies of mathematical resilience and anxiety of senior high students in a University especially in grade 11 students are a bit limited in the literature. Hence, this current study is realized. To accomplish the goal of this research study, it sought the following specific objectives: (1) to measure the level of students' mathematical resilience and anxiety in learning general mathematics; and (2) to determine the relationship between mathematical resilience and anxiety. The significance of this study is to see the role of mathematical resilience in the anxiety of students in learning mathematics. Results of this study may help mathematics teachers understand their students learning behavior in connection to anxiety and create an intervention that might improve their academic achievement. Moreover, the findings may also help mathematics students improve their learning capability, interest, motivation, and well-being, among others. Furthermore, this study may contribute to the body of literature, and serve as a guide for researchers in mathematics education to progress the educational system in the Philippines and beyond.

Method

This study considered a descriptive-correlational research design to elucidate the mathematical resilience and anxiety of grade 11 students. Descriptive statistics and correlation analysis was employed to capture the objectives of this study. A secondary data from the study of Casinillo and colleagues (2020) titled "Assessing Senior High Student's Learning Experiences in Mathematics" was utilized. Table 1 shows the cross-tabulation of the age and sex of students involve in this study.

Table 1. Demographic profile of students

Sex	**Age**			**Total**
	16 years old	***17 years old***	***18 years old***	
Female	15	45	11	71
Male	2	37	9	48
Total	17	82	20	119

The study focused on the different learning experiences of students in mathematics but has not dug into the different characteristics of their mathematical resilience and anxiety. In that case, the study investigates the characteristics of mathematical resilience and used the Mathematics Resilience Scale (MRS) by Kooken et al. (2013) to seize the level of resiliency of grade 11 students in learning general mathematics. In the questionnaire, a low level of mathematical resilience score refers to the least resilient and a high level of mathematical resilience score refers to the most resilient students. In addition, the said questionnaire deals with six (6) negative questions and seventeen (17) positive questions in relation to the mathematical resiliency of students in general mathematics subjects. Meanwhile, the study also considers a questionnaire for anxiety, that is so-called the Mathematics Anxiety Scale (MAS) formulated by Betz (1978) which measures the mathematical anxiety of students. MAS questionnaire deals with five (5) positive questions and 5 negative questions. A lower score in the MAS tells the least anxious and a higher score tells the most anxious in terms of learning general mathematics. The two said questionnaires (MRS and MAS) follow a Likert scale consisting of the following choices: 5-Strongly agree, 4-Agree, 3-Undecided, 2-Disagree, and 1-Strongly disagree. Table 2 depicts the range of perception scores and their corresponding qualitative response.

Table 2. Summary of students' perception score and their over-all response

Range of perception Scores	**Response**
1.00 – 1.80	Strongly disagree
1.81 – 2.60	Disagree
2.61 – 3.40	Undecided
3.41 – 4.20	Agree
4.21 – 5.00	Strongly agree

Readers may pertain to the study by Casinillo et al. (2020) in regards to the scoring guidelines of both MRS and MAS questionnaires. Table 3 shows the reliability test (Cronbach's alpha) which indicates the two instruments are reliable to use (Cronbach, 1951).

Table 3. Reliability test for the research instrument

Instrument	No. of Items	Average Inter-item Covariance	Scale Reliability Coefficient
MRS	23	0.1591	0.8743
MAS	10	0.2762	0.8289

In data management, the study used descriptive measures (mean (M), standard deviation (SD), and coefficient of variation (CV)) to summarize and evaluate the variables of interest. Moreover, in elucidating the relationship between the mathematical resilience and anxiety of students, the Spearman rho correlation coefficient (r) was used and adopted the following range of values and its interpretation (Table 4). Lastly, all calculations in the data analysis were done using a statistical software called STATA version 14.0.

Table 4. Range of correlation coefficient and its interpretation.

Correlation Coefficient (r)	Degree of Association
$0.0 < \|r\| \leq 0.3$	Weak
$0.3 < \|r\| \leq 0.7$	Moderate
$0.7 < \|r\| \leq 1.0$	Strong

Note: Adapted from Casinillo and Guarte (2018).

Results and Discussion

Mathematical Resilience

Table 5 depicts the different characteristics of mathematical resilience that are experienced by grade 11 students. It is worth noting that all the coefficients of variation are greater than 10%, which indicates that students' responses are inconsistent and might change depending on their situation (Casinillo & Guarte, 2018). Most of the students understood that struggles and obstacles are normal in working with mathematical problems (M=4.41, SD=0.62). This implies that students are anticipating a challenging experience in doing mathematics activities. Even mathematics teachers are doing some interventions to lessen the difficulties of students in learning mathematics concepts (Utterberg et al., 2019). Students do not believe that nothing can be done if someone is weak in mathematics (M=1.96, SD=1.00). They believe that through hard work and dedication, mathematics can be achieved by someone who is not a good student. Casinillo and Aure (2018) stated that to increase the level of achievement in mathematics, a teacher must cultivate their interest to work hard in doing their class activities. Additionally, students expect that mathematics can be learned by anyone (M=4.53, SD=0.61).

Students also have an understanding that if they face mathematics problems, they will somehow encounter struggles at some point (M=4.36, SD=0.70). Guntur and colleagues (2019) stated that challenges and obstacles are normal in mathematics learning that needs to be addressed to further improve students' understanding. On average, students are likely undecided (M=3.28, SD=0.99) to believe that a certain individual is good or not good in mathematics. In other words, mathematics can be learned by anyone who wants to study the said subject comprehensively. In fact, with the right learning strategies, students can easily comprehend the lessons and activities in mathematics (Lin & Tai, 2015). Students also believe that in the middle of the learning process, it is natural that they can

commit mistakes (M=4.27, SD=0.67). Moreover, students agree that mistakes are meant to be learned to progress their learning ability in mathematics problems (M=4.11, SD=0.81). Santagata (2005) depicted that mistakes must be handled carefully by teachers to avoid the negative response behavior of students. Meanwhile, students disagree that some people cannot learn mathematics (M=2.34, SD=0.94). This goes to infer that students believe that mathematics can be learned by anyone and not by some people only. They also disagree that mathematics can be learned only by smart people (M=1.84, SD=0.81). Gamoran and Hannigan (2000) stated that mathematics can be learned by anyone who wants to put their focus on it and also found out that mathematics is worthwhile to all students.

Furthermore, students believe that learning skills in mathematics can develop their critical thinking skills which are useful in their chosen careers in the future (M=3.96, SD=0.73). Apparently, students depict that without knowledge of mathematics, it is difficult to be successful in life (M=3.45, SD=1.05). In fact, Watt and colleagues (2017) expressed that a mathematics background plays a very crucial role in choosing careers. The overall perception score of students is 82.20 which can be interpreted as "resilient". This implies that students, on average, are motivated to learn mathematics despite the obstacles and challenges that they are facing. According to Ariyanto et al. (2017), a resilient and positive behavior towards learning can progress their mathematical ability to solve challenging problems. In the study of Ishak et al. (2020), it is depicted that resilience is defined as an attribute that results in a positive attitude that adapts to adverse scenarios or challenging situations. On the face of it, through resilience, students can be progressive in their learning behavior and attain a desired academic performance in mathematics.

Table 5. Mathematical resilience of students

		M ± SD	**CV (%)**	**Response[a]**
1.	Maths is very helpful no matter what I decide to study.	3.82±0.82	21.47	Agree
2.	Struggle is a normal part of working on Maths.	4.41±0.62	14.06	Strongly agree
3.	If someone is not good at Maths, there is nothing that can be done to change that.	1.96±1.00	51.02	Disagree
4.	Maths can be learned by anyone.	4.53±0.61	13.47	Strongly agree
5.	Everyone struggles with Maths at some point.	4.36±0.70	16.06	Strongly agree
6.	Maths is essential for my future.	4.02±0.92	22.89	Agree
7.	If someone is not a Maths person, they won't be able to learn much Maths.	2.56±0.93	36.33	Disagree
8.	Good Mathematicians experience difficulties when solving problems.	4.18±0.79	18.90	Agree
9.	People who work in Maths-related fields sometimes find Maths challenging.	4.27±0.71	16.63	Strongly agree
10.	People are either good at Maths or they aren't.	3.28±0.99	30.18	Undecided
11.	Everyone makes mistakes at times when doing Maths.	4.27±0.67	15.69	Strongly agree
12.	Maths will be useful to me in my life's work.	3.82±0.82	21.46	Agree

13. People in my peer group sometimes struggle with Maths.	4.18±0.64	15.31	Agree
14. Everyone's Maths ability is determined at birth.	2.24±0.93	41.52	Disagree
15. People who are good at Maths may fail a hard Maths test.	3.53±0.95	26.91	Agree
16. Knowing Maths contributes greatly to achieving my goals.	3.75±0.77	20.53	Agree
17. Having a solid knowledge of Maths helps me understand more complex topics in my field.	3.86±0.83	21.50	Agree
18. Some people cannot learn Maths.	2.34±0.94	40.17	Disagree
19. Learning Maths develops good thinking skills that are necessary to succeed in any career.	3.96±0.73	18.43	Agree
20. Making mistakes is necessary to get good at Maths.	4.11±0.81	19.71	Agree
21. Thinking mathematically can help me with things that matter to me	3.55±0.77	21.69	Agree
22. Only smart people can do Maths	1.84±0.81	44.02	Disagree
23. It would be difficult to succeed in life without Maths.	3.45±1.05	30.43	Agree
Over-all Perception Score	**82.20[b]**		**Resilient[c]**

Note: **a** - See Table 2 for details; **b** - See scoring guidelines in Casinillo et al. (2020); **c** - (23.0-41.4)-Not resilient, (41.5-59.8)-Slightly resilient, (59.9-78.2)-Moderately resilient, (78.3-96.6)-Resilient, (96.7-115.0)-Very resilient.

Mathematical Anxiety

Table 6 shows that the coefficient of variation for all anxiety characteristics is above 10%, which implies that all responses are not consistent (Casinillo & Guarte, 2018). Students are bothered if they have to take more classes in mathematics (M=2.60, SD=0.98) as shown in Table 6. This means that students are worried about the challenges and difficulties when they encountered mathematical problems. Additionally, students are uneasy during their mathematics tests (M=2.50, SD=0.89). In that case, students are not comfortable taking their mathematics examinations due to anxiousness about the challenging problem-solving items.

Table 6 also shows that students are undecided to say that they are at ease or comfortable in any mathematics class (M=2.61, SD=0.89). Moreover, students are worried about their learning ability in cognitive mathematics concepts (M=2.39, SD=0.90). On the face of it, they are facing uncomfortable feelings or anxiousness while answering mathematics problems. Students are undecided if they are uptight while taking exams in mathematics (M=2.72, SD=0.74). This means that they are in the middle of being anxious or not about the challenges and obstacles. According to Milovanović (2020), anxiety is a significant determinant of lower mathematics achievement. In other words, anxiety kills the confidence of students and adversely affects their cognitive thinking. Ramirez et al. (2013) depicted that mathematics anxiety is a negative response to the topics and concepts of mathematics subjects.

On average, students are having a sinking feeling when they are trying to solve hard mathematical problems (M=3.50, SD=0.85). There were times also when these students are experiencing loss of memory and were unable to think clearly in doing mathematics problem activities (M=3.14, SD=1.02). In addition to that, some students feel nervous and not comfortable with mathematics class (M=3.38, SD=1.04). And they are uneasy and confused about what to think during the mathematics problem-solving activities (M=3.45, SD=1.03). Overall, students are moderately anxious based on their perception score of 29.5 (Table 6). This implies that students are troubled when they are doing their mathematics lessons and in times of examinations. Apparently, mathematical anxiety affects negatively the working memory and causes tension and stress to students (Passolunghi et al., 2020). The result coincides with the findings of Aldrup and colleagues (2020) that anxiety causes a problem for students in the aspect of critical thinking ability, and diminishes their motivation and interest in learning mathematics.

Table 6. Mathematical anxiety of students

		M ± SD	**CV (%)**	**Response[a]**
1.	It wouldn't bother me at all to take more maths classes.	2.60±0.98	37.69	Disagree
2.	I have usually been at ease during maths tests.	2.50±0.89	35.60	Disagree
3.	I have usually been at ease in maths courses.	2.61±0.89	34.10	Undecided
4.	I usually don't worry about my ability to solve maths problems.	2.39±0.90	37.66	Disagree
5.	I almost never get uptight while taking maths tests.	2.72±0.74	27.21	Undecided
6.	I get really uptight during maths tests.	3.22±0.80	24.84	Undecided
7.	I get a sinking feeling when I think of trying hard maths problems.	3.50±0.85	24.29	Agree
8.	My mind goes blank and I am unable to think clearly when working on mathematics.	3.14±1.02	32.48	Undecided
9.	Mathematics makes me feel uncomfortable and nervous.	3.38±1.04	30.77	Undecided
10.	Mathematics makes me feel uneasy and confused.	3.45±1.03	29.86	Agree
Perception Score		**29.5[b]**		**Moderately Anxious[c]**

Note: **a** - See Table 2 for details; **b** - See scoring guidelines in Casinillo et al. (2020); **c** - (10.0-18.0)-Not anxious, (18.1-26.0)-Slightly anxious, (26.1-34.0)-Moderately anxious, (34.1-42.0)-Anxious, (42.1-50.0)-Very anxious.

Correlation Analysis

Table 5 shows that students' mathematical resilience and anxiety have a weak correlation (See Table 2 for details). In fact, the relationship between these two variables is not significant (*p*-value=0.4725). This result implies that the level of resilience of students does not lessen the anxiety in learning mathematics. Even if resilience is helping the students cope with the obstacles and challenges, anxiety remains constant as the result suggested. The resilient behavior of students does no anymore affects their anxiety level. Based on the coefficient of variation, only 0.44% of the variation of the resilience perception scores can be attributed to the

anxiety perception scores. This result is not consistent with the findings of Hjemdal et al. (2011) that has shown a significant relationship between the level of mathematical resilience and the level of anxiety of students. Likewise, the study of Trigueros and colleagues (2020) has shown that resilience and meta-cognitive strategies help decrease the level of mathematical anxiety. It proves that resilience gives motivation to learning which is positively related to mathematics achievement. Hence, the result shows a contradictory outcome that mathematical resilience does not influence the students' anxiety. This goes to infer that students lack proper motivation and guidance from their mathematics teachers. Aydin and Aytekin (2019) depict that mathematical anxiety can be controlled by guidance and counseling in the middle of the class session. Moreover, to progress their academic performance and lessen students' anxiety, teachers must cultivate their interest and motivation (Casinillo & Aure, 2018; Casinillo & Casinillo, 2020). Furthermore, in the study of Calderon et al. (2021) and Hood et al. (2021), it is progressive to increase the well-being and happiness in learning of students to develop their level of achievement in mathematics. In fact, lively and active students will result in a positive attitude that gains confidence in facing mathematical problems.

Table 7. Relationship (Spearman rho) between the student's mathematical resilience and anxiety

Variables	**Sample size**	$\widehat{r_s}$	$\widehat{r_s}^2 x$ **100 (%)**	p**-value**
Resilience and Anxiety	119	0.0665^{ns}	0.4422	0.4725

Note: ns - not significant.

Conclusion

The study's aim is to investigate the level of mathematical resilience and anxiety of senior high students and its correlation. The students' perception score for their level of resilience in learning mathematics is interpreted as resilient. Students believe that the challenges and obstacles they are facing in mathematics class are just part of their learning experiences. It is also shown that they are somehow motivated to learn mathematics concepts since they think that their learning is useful for their future career. They also think that learning mathematics is helpful in their everyday lives because it develops their cognitive thinking. On the other hand, it is concluded that students are moderately anxious about learning mathematics. Every time they are taking mathematics exams, they feel nervous and uncomfortable due to the challenges and obstacles.

The correlation analysis has shown that students' mathematical resilience and anxiety have no relationship. This implies that the current resilience level does not lessen or influence the level of anxiety. As we all know, anxiety can adversely affect mathematical achievement, hence, it is necessary to investigate factors that may influence anxiety aside from resilience. In that case, it is concluded that interest, well-being, learning attitude, cognitive thinking, and motivation, among others, must be focused on to lessen the students' anxiety and progress their performance in mathematics. It is highly recommended that mathematics teachers must boost a positive attitude toward their students and encourage them to work hard despite challenges and difficulties. Furthermore, teachers must give their students interesting and real-life mathematics activities to motivate them in doing their

learning tasks. For future studies, one may focus on the process of boosting resilience in learning mathematics to diminish the level of anxiety.

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