A Study on Mathematical Anxiety, Mathematical Resilience of Phra Dabos Students and a Survey for Improving Mathematical Learning Management Plan

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Abstract
The purpose of this research is to study the mathematical anxiety and mathematical resilience of 45th class Phra Dabos students and design the network diagram for the revision of the subject of mathematics for industrial technicians by using the data obtained from the stakeholders' requirement to improve the teaching process, time management and learners' potential in knowledge application**.** The population of this research is 78 students and 2 volunteers of Phra Dabos**.** The experiment began with collecting the opinions of the students which is divided into 2 phases, phase 1: data collection through mathematical anxiety and mathematical resilience questionnaire, phase 2: data collection through the interview of the students from 8 majors, 2 per major, 16 in total. The questions involved the learning management in the past year and suggestions for the improvements of the learning activities of the volunteers**.** Followed by the design of a network diagram compiled from the obtained data. The diagram was then thoroughly discussed among the volunteers. The data from the questionnaires was analyzed using descriptive statistics, including mean, standard deviation, percentage, and data analysis**.** It was found that the overall mathematical anxiety of the 45th class Phra Dabos students was moderate**.** Likewise, the overall mathematical resilience was also medium. Lastly, the guidelines for improving learning management in the next academic year were obtained and presented in the network diagram**.** Furthermore, the substance linkage between mathematical anxiety and mathematical resilience was found.

Keywords: Mathematical Anxiety, Mathematical Resilience, Stakeholders' Requirement

Introduction

1. Theoretical Background

One of the main purposes of education is to prepare students to be lifelong learners and could adapt to their ever-changing surroundings. This is also true in Thailand, where its education system still has been struggling for several decades to achieve what we mentioned. As it focuses only on contents and memorization without proper integration of questioning techniques or thought processes, Thai adolescents and the workforce's vast potential remains to lie in wait for improvement. Some Thai students might be able to improve themselves past the point where their education system is at and attain the necessary competencies for thriving in modern society, while many students are left out of the usual formal education due to the lack of opportunities. This would greatly increase the number of vulnerable groups that are prone to drugs, violence, and misconduct instead of capable workforces that would drive the economy.

Non–formal education is sought after by many students who have limited resources and access to formal education as it provides a variety of competencies for those who aim to directly apply for jobs rather than higher education or college certificatese (Shabaya, 2022). This is aligned with the principle of Phra Dabos school, "Thrive and strive without certificate," which aims to provide the needed vocational competencies for those who are left out of formal education and in need of opportunities. Regardless of the students' background, the school indiscriminately offers a one – year vocational course that consisted of eight majors namely, carpenter, welder, electrician, electrotechnician, constructionist, repairman, mechanic and machine tool technician. The curriculum includes two aspects that would be sufficient for their designated occupations: basic theory for a career that involves technician skills and real–world practice where the classes are organized by the institute and volunteered teacher.

The good intentions to provide the necessary competencies from the institute could not be more apparent, but as the students usually detest the theory part, the content would often be crammed and taught in the manner of brief but aggressive lecture without proper approach as shown in Figure 1 below.

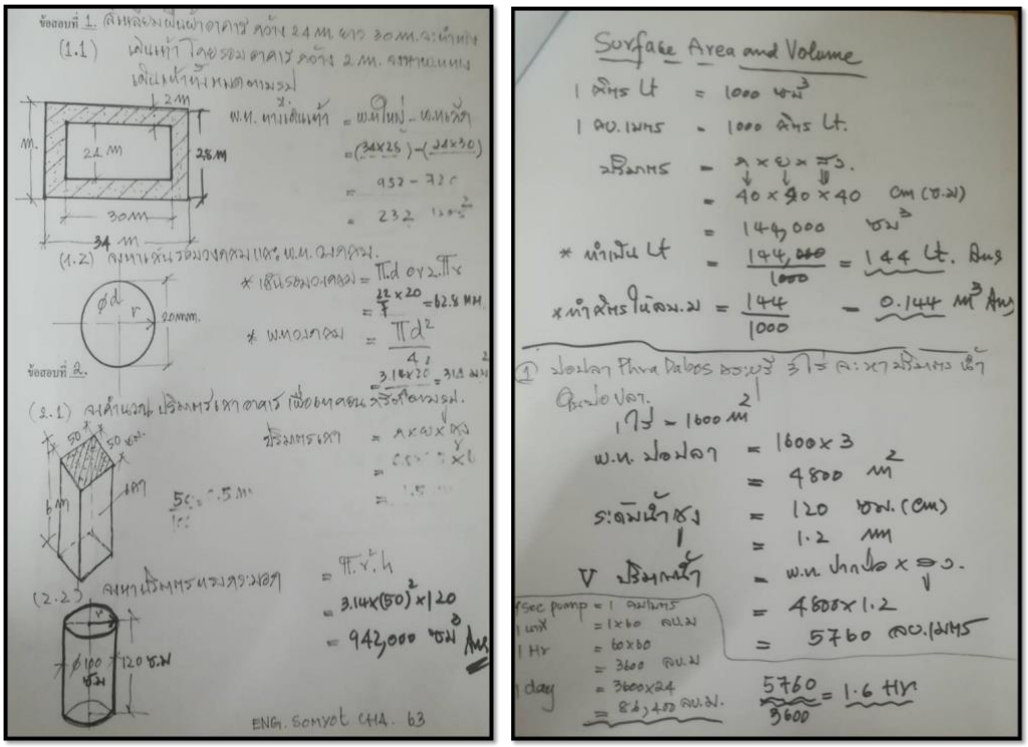

Figure 1: Phra Dabos lectures

And to those who are left behind by the current education system, this would not be ideal. It also proved to be not effective in tackling with the students' mathematical anxiety which was clearly shown during the period of our observation in the subject of mathematic for industrial technician.

Mathematical anxiety is defined as the feeling and anxiety that hinder the mathematical process to solve mathematical problems whether in the context of real world or education (Centre for Neuroscience in Education, 2023). As we interacted with the students, many had shown several indicators of mathematical anxiety, ranging from not being able to explain the answer to the questions that they recently solved to feigning ignorance during the class because there is a chance of being humiliated from the feeling of answering the questions wrong. The problematic situations did not elevate, but it tended to impede the thought process needed for their future professions.

The key to reduce their mathematical anxiety might be lying dormant with the aspects of mathematical resilience as it was stated that teaching the students to be resilient in real life is crucial as they would bounce back from the devastating situation in their life (Casinillo, 2022). Likewise, mathematical resilience is the right dose to the poisonous mathematical anxiety since it would teach the students how to handle the anxious feeling that hinder the mathematical process.

The term mathematical resilience is understood as the confidence, effort and perseverance which support an individual to go through the mathematical process and arrive at the desired outcome (Lee and Ward – Penny, 2022). As we can see, if it is implemented into the curriculum, the students would greatly benefit from it, and it would also be a great help to the school if the process of revising the subject is compiled into a diagram for further autonomous practice of the curriculum.

Hence, the purpose of this research is to study the mathematical anxiety and mathematical resilience of the 45th class Phra Dabos students and design the network diagram for the revision of the subject of mathematics for industrial technicians.

2. Implementation and Results

The experiment is conducted at Phra Dabos school, Samut Prakan with the population of 78 students of class 45 at the institute and 2 volunteer teachers. The experiment was in the manner of data collection through questionnaires and interviews, and divided into three sections namely, the students' opinions, network diagram design and volunteer teachers' opinions. The first section consisted of two phases, phase 1: data collection through 10 – item mathematical anxiety questionnaire and mathematical resilience scale of 23 items, phase 2: data collection through the interview of the students from 8 majors, 2 per major, 16 in total. The questions involved the learning management in the past year and suggestions for the improvements of the learning activities of the volunteers. The second section would focus on constructing the method from the obtained data from the first section to revise the subject and present it as a diagram. The last section would focus on discussion with the volunteer teacher with the results obtained from the prior sections to make an agreement upon the revised teaching approach.

The Students' Opinions

Phase 1: The Results of the Questionnaires

As the mathematical resilience and anxiety of the class 45 Phra Dabos students are within our concern, we had deployed the questionnaires (Johnston-Wilder, 2014) of both variables for data collection.

Table 1: The results of mathematical resilience and mathematical anxiety questionnaires

	Mean ($\bar{X}$)	**S.D.**	**Interpretation**
Mathematical Resilience	76.79	7.92	Medium
- Value	28.79	4.40	High
- Struggle	27.95	3.35	High
- Growth	20.05	3.25	Medium
Mathematical Anxiety	26.10	4.20	Medium

The data obtained showed that students' mathematical resilience was on the medium level while its aspects, namely, value, struggle, and growth, were on a high, high, and medium levels, respectively. It was shown that while mathematical resilience was of substance, mathematical anxiety was also on the level that might impact the development of positive attitude and achievement toward mathematics. The level of both variables also sparked the question whether there is any significant relation between them. Though concluding that there is any relation between the variables would require further investigation and study, we would like to see if there is any lead toward what we suspect. Thus, linear-regression where both variables were used as independent and dependent variable was conducted, and the results are shown in the figures below.

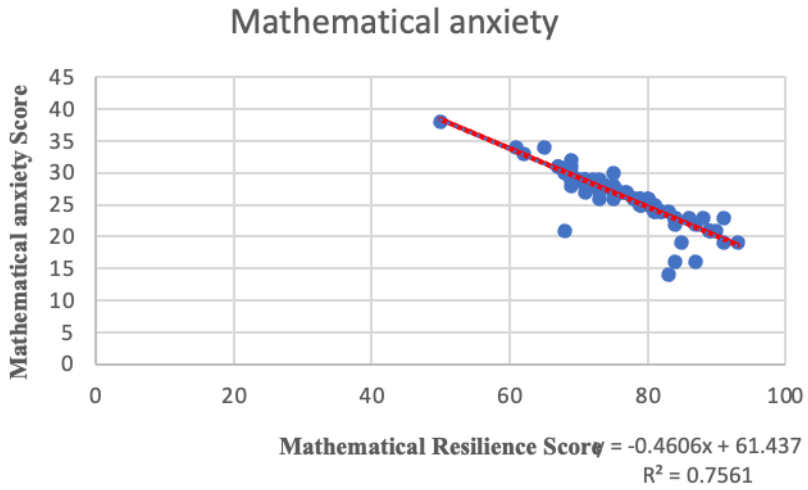

Figure 2: The linear-regression of mathematical anxiety using mathematical resilience as the independent variable

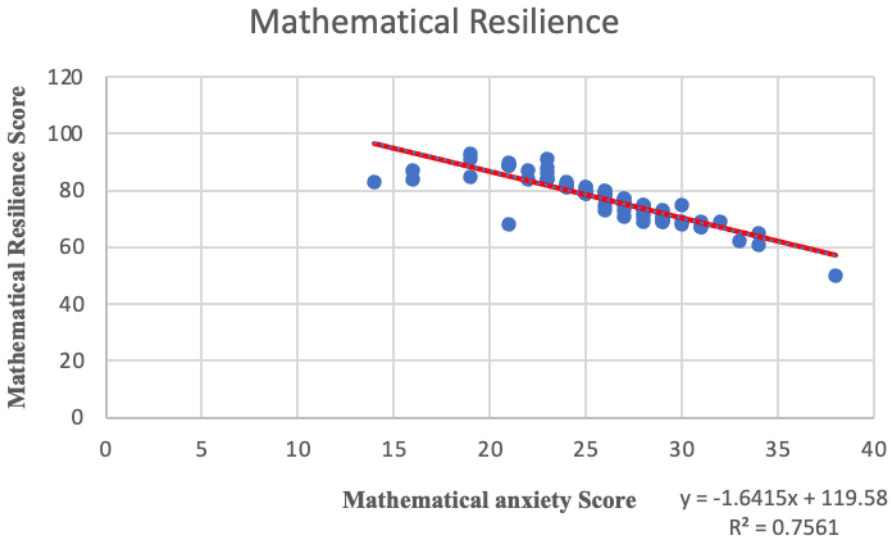

Figure 3: The linear-regression of mathematical resilience using mathematical anxiety as the independent variable

Table 2: The significance level of the linear regression between mathematical anxiety and mathematical resilience

	Mean	**S.D.**	**Multiple R**	**R Square**	**Sig.**
Mathematical anxiety Score	26.1	4.20	0.87	0.76	$5.404e^{-25}$
Mathematical Resilience Score	76.79	7.92			

The results from the regression had shown that both variables could, in a sense, explain each other to a certain degree since the R^2 of the regression is equal to 0.76 and the significance level is less than 0.05. This proved that there might be a worthy lead for further investigation

of the relation between the two variables. Hence, we would subject this as one of the main objectives of our next study.

Phase 2: The Interview

According to the interview, many students had told us that they understand that mathematics is important and would be used in many parts of their lives, but as they proceed in the class regardless of any context or formality, they are usually faced with unknown symbols, rushed lectures and very hard problems. And along the way, they might get humiliated for doing something wrong in the class, hence, they would avoid interacting with teachers during the class and remain silent when vital questions emerge. Some even believed that they would not get any better at mathematics and only the chosen few would excel at learning it.

The content should be consistent with what they were practicing, but it should not be crammed and thought aggressively. They would prefer an organized and comprehensive class if possible. Moreover, teaching mathematics in theory seemed to not intrigue them very well as they demand mathematics in the sense of application as they view it as a more necessary skill.

Thus, presenting them with real – world mathematic problems would be ideal in teaching them the basic theory. Some excerpts from the interview are shown below:

> "Learning mathematics is not for me, I mean it is only who has innate talent."
>
> "I don't really like the theory part as I want to be a technician. I think practice and application are more important."
>
> "We would not usually use the content to its fullest, hands – on activity may suit us more."
>
> "Answering mathematical questions make me really nervous. I usually forget what is on my mind when I am about to answer them."

According to the interview and the results in Table 1, we would say that the students rather had fixed mindset and anxiety in studying mathematics and solving this problem should be of haste by using the approach that would encourage them to see the value of learning process and foster mathematical resilience (Johnston-Wilder et al, 2021).

Network Diagram Design

As we collect the data from the students and curriculum, we present the new outline of the subject as a network diagram below.

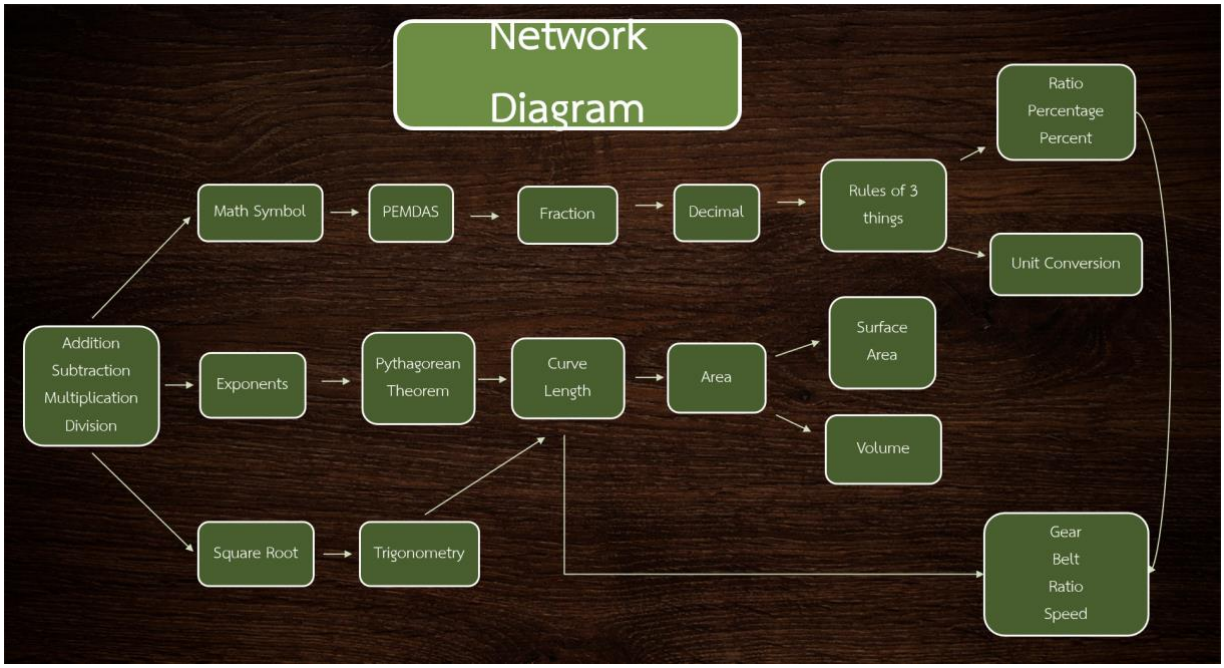

Figure 4: The network diagram of the revised subject

The network diagram presents on how we would redesign the subject to be more consistent with their practice. Furthermore, we decided to compose the necessary linkage and connection between each topic for seamless implementation and recollection as shown in the above figure.

The Volunteer Teachers' Opinions

As we presented and discussed the revised subject and students' opinions with the other volunteer teachers, we had arrived at the three crucial points to enhance the teaching approach, which are presented below:

1. Interactive learning: Implementing interactive learning methodologies would keep students engaged and foster a deep understanding of mathematical concepts.
2. Practical application: Integrating real-world examples and practical applications of mathematics would help students see the relevance of the subject in their future careers.
3. Collaborative learning: Promoting group projects and collaborative learning environments would develop teamwork skills and encourage peer-to-peer knowledge sharing.

We also agreed upon the use of problem – based learning to cover the three key points above and as the main approach in teaching the course in the next academic year since presenting the students with the approach that focuses more on real – world problems, self – learning and the process of learning would help quell the mathematical anxiety and promote mathematical resilience (Ariyanto et al., 2019; Johnston-Wilder et al, 2021).

Conclusions

In conclusion, this research on mathematical anxiety and resilience among Phra Dabos students offers valuable insights into enhancing the teaching process for the subject of mathematics for industrial technicians. By implementing problem–based learning, students

will have the opportunity to overcome anxiety, develop resilience, and apply their knowledge effectively. The next academic year will witness an even more engaging and impactful mathematics learning experience.

The study also suggests that there might be a linkage between mathematical anxiety and mathematical resilience, which will be explored in our next study. We also aim to promote the students to have a growth mindset for the better development of mathematical resilience, create engaging material to improve learning motivation and focus on mathematical connection to promote the application of mathematics in the real world.

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References

Ariyanto, L., Herman, T., Sumarmo, U. and Suryadi, D. (2019). Prospective teachers' mathematical resilience after participating in Problem-based Learning. *Journal of Physics: Conference Series*, 1280, 042036. DOI:10.1088/1742-6596/1280/4/042036

Casinillo, L.F., Casinillo, E.L., Lagumbay, C.T., Abad, H.R.F. and Dagongdong, M.L. (2022). Revisiting Mathematical Resilience and Anxiety among Senior High Students. *International Journal of Indonesian Education and Teaching*, 6(2), pp. 193 – 203.

Centre for Neuroscience in Education. (2023). *What is Mathematics Anxiety*. https://www.cne.psychol.cam.ac.uk/what-is-mathematics-anxiety

Johnston-Wilder, S., Brindley, J. and Dent, P. (2014). *A survey of Mathematics Anxiety and Mathematical Resilience amongst existing apprentices.* London: The Gatsby Foundation.

Johnston-Wilder, S., Lee, C. and Mackrell, K. (2021). Addressing Mathematics Anxiety through Developing Resilience: Building on Self-Determination Theory. *Creative Education*, 12, 2098 – 2115. DOI:10.4236/ce.2021.129161

Lee, C. and Ward-Penny, R. (2022). Agency and fidelity in primary teachers' efforts to develop mathematical resilience. *Teacher Development*, vol. 26(1), pp. 75-93, DOI:10.1080/13664530.2021.2006768

Shabaya, A. (2022). Building Resilience in Non-formal Education: The Case of Kenya. *Pan – Commonwealth Forum*, 10, 25th August 2022, Canada.