

Enhancing Mathematics Learning by Integrating Growth Mindset Principles in Ninth-Grade Supplementary Materials

¹Christian R. Repuya & ²Jedh Esterninos

¹*Bicol State College of Applied Sciences and Technology, Philippines*

²*University of Nueva Caceres, Philippines*

¹*crrepuya@astean.biscast.edu.ph*

Abstract

This paper determined the supplementary materials in ninth-grade mathematics which may be enhanced to integrate growth mindset principles to improve students' procedural fluency and foster their growth mindset in mathematics. This study employed a descriptive-developmental method by administering a quasi-experimental design and mixed-method research approach to determine the research questions. The respondents in this study were the 60 ninth-grade students at a state secondary high school in the Philippines. The study implemented the validated researcher-made procedural fluency test and growth mindset questionnaire in determining students' performance in procedural fluency and mindset in mathematics, respectively. Thematic analysis was employed to investigate students' responses in Focus Group Discussions (FGD), informal interviews and learning journals in scrutinising the learning experiences and mindsets of the students. Findings displayed that the supplementary materials which can be developed in incorporating growth mindset principles were motivational activities, reflection activities, and instructional videos. Utilising the developed supplementary materials elevates students' procedural fluency. It influences students to shift from fixed mindsets to growth mindsets in mathematics by providing them with significant learning experiences that help students enhance a growth mindset. Furthermore, the implementation group performed better than the comparison group, particularly with developing growth mindsets. The study results are limited to the participants encompassing; similar research employing the developed supplementary materials to other learning areas with a larger sample is recommended for more generalisable results.

Keywords: growth mindset in mathematics, motivational, procedural fluency, reflection, instructional videos

Introduction

Studying mathematics is tremendously crucial in people's lives. Mathematics education begins in the early stage of education. Its objective is to assist students acquire the significance of mathematics applications in the real world by enhancing their cognitive ability to recognise forms, patterns, and relationships. However, despite its significance, mathematics is still the least preferred and hated subject among students in general, and encourages for fewer students than other subjects. It is caused by the students who perceive mathematics as a complex subject, particularly following instructions. It results in difficulty obtaining the subject and trouble recalling its equations and methods to discover a solution to a problem (Gafoor & Kurukkan, 2015).

Correspondingly, students who possess a negative attitude towards their teachers and mathematics also perceive it as boring, and they are not encouraged (Mohapi, 2015). Enjoyment and attitude in learning mathematics significantly determine students' performances. Furthermore, the factors influencing the students to like or dislike mathematics encompasses students' social-psychological, environmental, instructional, and abilities

factors. Moreover, the teacher's instructional strategy, institutional sources, weak understanding and evaluation approaches, and failure in comprehending directions are the factors of failure to pass mathematical examinations (Mazana, Montero, & Casmir, 2019).

In the Philippines, the international examination results in the Program for International Student Assessment (PISA) 2018 also presented a low growth mindset among students (Organization for Economic Co-operation and Development (OECD), 2019).

The PISA 2018 (OECD, 2019) results revealed that only 19% of students in the Philippines attained level 2 or higher in mathematics. Only 31% of students in the Philippines possessed a growth mindset. As a result, the Philippines performs low in the PISA examination, with an average score of only 350 points in mathematics, science, and reading during School Year (SY) 2018-2019, which place them in the rank 77th out of nearly 80 nations (OECD, 2019).

Unfortunately, the National Achievement Test (NAT) results formulated this global performance at the local levels. In the 2012 NAT, the Philippines performed low, with a Mean Percentage Score (MPS) of only 46.37 in mathematics. The enhanced performance was not acquired compared with the past years (47.82 in 2006 and 50.7 in 2005) and an overall rating of 48.57 during SY 2011-2012. This dilemma in mathematics paused threats to the future of mathematics education.

This evidence indicates that the students are not motivated and own a low interest in learning mathematics because they possess a low growth mindset. The students believe that learning mathematics is complicated as they own low procedural fluency. Procedural fluency refers to a student's understanding of procedures, as well as when and how to employ them correctly, and also the ability to administer procedures flexibly, precisely, and efficiently (Inayah, Septian, & Suwarman, 2020).

In response, the Department of Education (DepEd) (2020) encourages teachers to design lessons, learning materials, and instructional materials to assist students become motivated and have elevated understanding of the topics. Mendoza, Caranto, and David (2015) recommended that supplementary materials as integrating instructional videos effectively acquire the student's interest. Integrating instructional video into teaching/learning is a method in teaching which utilises videos that allows teachers to deliver lessons and encourage students through video recordings.

Gieras (2020) asserted that designing engaging instructional videos which encourage interactions and engagement to corroborate students' learning can be a very well effective medium for assisting instruction in remote, hybrid, and flipped or blended learning conditions. Moreover, Harackiewicz, Smith, and Priniski (2018), when students improve their interest in studying mathematics, their motivation in learning is also enhanced.

In her article, Campbell (2017) argued that success necessitates students to engage in the individual growth process. She highlighted on how difficult it might be to be open in producing incorrect and altering course all the time. It is normal to be involved to what we believe works and what we are accustomed to. She emphasised that in establishing a growth mindset, students should educate themselves to identify "deficient" as a shortfall in their learning or experience rather than a weakness in their capability. Dweck (as cited in Boaler, 2013) corroborated that intelligence and smartness could be acquired, and that brain grows from training with a growth mindset.

Conley (2014) implemented a growth mindset when providing students feedback, elaborating that praising them for intelligence made them less willing to pursue educational opportunities because they are anxious about losing their “smart” identity if they experienced low. Furthermore, because avoiding academic risks entails avoiding learning, applauding students undermines their academic achievement. The researcher employed the power of the word “yet” associated with a growth mindset. For instance, in praising students, “your sentence structure does not yet match the tone you are attempting to achieve”. The word “yet” accepts negative comment while at the same time conveys confidence that the students receive shortly (a teacher as this one possesses a growth mindset).

In addition to giving feedback, allowing students to perform reflective learning activities help them aware of their performance. In their study, Weng, Puspitasari, Rathinasabapathi, and Kuo (2021) defined reflective learning as activities in facilitating learners’ reflection upon their learning experiences. The findings of their study recommend the significance of reflective learning to enhance students’ recognition of asking and assessing their learning in the class.

Furthermore, Berger (2017) asserted that students are able to elevate the courage to encounter educational and life challenges. He cited one of the secondary schools, which has advanced academic courage in the students. As a result, 98% of their students graduated on time, and all of the students have been admitted to university.

The previous studies were beneficial in conceptualising the present study. Compared to the previous studies, the present study integrates growth mindset principles in the supplementary materials, which become the motivational activities, reflection activities, and instructional videos, that are not specifically implemented in the studies cited. Moreover, based on the literature and studies displayed, there is a crucial need to conduct this study to enhance supplementary materials in accommodating growth mindset principles to enhance students’ mindset and procedural fluency in mathematics.

The study was anchored on the following theories. The primary theory of this study is the (1) Mindset Theory (2006) and was corroborated by (2) Constructivists Theory (McLeod, 2019) and (3) Scaffolding theory of Lev Vygotsky (McLeod, 2019).

Carol S. Dweck is the author of the Growth Mindset Theory. She explained that a mindset believes in oneself, and one’s basic qualities. An individual with a fixed mindset believes that traits like intelligence, creativity, and ability are predefined and finite. These attributes are so established in persons with fixed mindsets that whatever they lack, they remain to be inadequate.

A person with a growth mindset, on the other hand, believes that their natural talents were further strengthened via hard work and dedication. These intrinsic traits are merely the beginning; the results of success from hard work, study, and perseverance.

Dweck employed a school setting as an example who explained that fixed and developing mindsets emerge differently. Students with a fixed mindset regulate image above all and, as a result, disregard the essential learning opportunities if performing poorly or admitting mistakes is required. In the classroom, cognitivist teaching approaches strive to help students assimilate new material into their existing knowledge while also make them produce the required modifications to their current intellectual structure in accommodating the new knowledge.

According to the scaffolding theory, scaffolding involves adjusting the amount of assistance to the intellectual abilities of students. During a teaching session, the extent of coaching was modified to fulfil the student's potential level of performance. When a student experiences difficulties with a task, further assistance is provided, and as the student progresses, less guidance is performed.

The objective of this study is to enhance students' mathematics learning by integrating growth mindset principles in ninth-grade supplementary materials in one of the junior high schools in the Philippines. In particular, it examined the supplementary materials in ninth-grade mathematics which may be enhanced to integrate growth mindset principles. Moreover, it was also performed in determining the effects of employing the ninth-grade supplementary materials with growth mindset principles integration in enhancing students' procedural fluency in mathematics and fostering their growth mindset in mathematics.

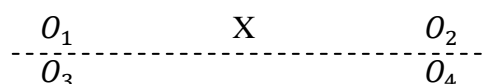
This study is deemed essential to students because the findings would convey messages that mathematics can be learned by all individuals who are able to learn and appreciate mathematics and that their ability is not fixed. For teachers, the findings of the study would assist them appreciate the implementation of supplementary materials promoting a growth mindset through motivational activities, reflective learning activities, and utilisation of instructional videos that make students encouraged, responsible, and possess a robust growth mindset in mathematics. In improving growth mindset and procedural fluency among students in mathematics, the school administrators, curriculum designers, and textbook writers may consider the study's findings in formulating programs, designing curriculums, and selecting a framework for writing textbooks respectively.

Methods

Research Design

The study employed the descriptive-developmental method using a quasi-experimental design. The study also utilised the mixed-method approach of research inquiry. The implementation group applies the innovation to determine the effect of utilising the ninth-grade mathematics supplementary materials with growth mindset integration on students' procedural fluency and mindset in mathematics. The comparison group was implemented for the comparison of results which incorporated the textbook and lesson plans provided by the department of education without the supplemental materials.

Below is the study's design diagram, where O_1 and O_2 are the pretest and posttest of the implementation group, respectively. X is the intervention (developed supplementary materials integrating growth mindset principles). Meanwhile, O_3 and O_4 are the pretest and posttest of the comparison group, respectively, without the intervention:



Respondents

The respondents of the study were purposively selected two classes of one of the public secondary high schools in the Philippines, SY 2020-2021. Purposive sampling is a technique

in which the researcher arranges criteria to select members of the population to be in charge as respondents of the study (Dudovskiy, 2017). The researcher in this study selected the grade 9 students as it was the first level after the middle school, which is appropriate for the study, and they became the next group who conducted the NAT. It is also because, during mid-school classes, there is a rise in an imbalance of mathematics teaching (Sun, 2015).

In selecting the two groups, the students' previous mathematics grades were examined to ensure no significant difference between the student's initial performances in mathematics and were comparable. The implementation group and comparison group were established through a toss coin. Each class comprised of 30 students, 17 male and 13 female in the implementation group, and eight male and 22 female in the comparison group. The researchers have explained the respondents that they were purposively selected, and informed consent was secured. They also discussed the role of the respondents and other ethical details. Moreover, the confidentiality of respondents' scores in the procedural test, mindset questionnaire, and other responses was assured.

Research Procedure

A letter of asking permission to conduct the study was created and proposed to the Department of Education's Schools Division Superintendent and the school supervisors for approval. The researchers began preparing, developing, and validating the data collection instruments after receiving the approval. The group of students in O_1 (implementation) and O_3 (comparison) was provided a pre-test and post-test in 30-item researcher-made test in mathematics to identify their procedural fluency. Before the intervention, a pre-test (O_1) was administered to the group, then a post-test (O_2) was conducted after the intervention. The difference between the pre-test and post-test ($Q_1 - Q_2$) was employed to ascertain whether there is a change or gain due to supplementary materials of integrating growth mindset principles (intervention, X).

Quantitative data encompasses students' responses to the mindset questionnaire and feedback on their journals, and informal interviews regarding their experiences during the supplementary materials implementation. The students' mindset scores from the mathematics interview schedule questionnaire were investigated by utilising a quantitative method. Furthermore, journal and informal interviews were administered to demonstrate the improvement of a growth mindset among students in applying the supplementary materials. The data gathered were then accommodated and organised for presentations and analysis. The researchers prepared the research report after the data were arranged, analysed, and interpreted.

Research Tool and Analysis

The study utilised the adopted validation guide from the DepEd as the instructional materials evaluation tool in validating the developed supplementary materials along with their features (DepEd Naga City Division Order No. 441, series of 2019). The researcher demanded the panel of experts to portray their opinion on the statements and item regarding the features of the supplementary materials by incorporating comments and suggestions for improvement.

The instructional material evaluation tool possesses a five-point scale with the following descriptive interpretation: 4.51-5.00 (outstanding), 3.51-4.50 (very satisfactory), 2.51-3.50 (moderately satisfactory), 1.51-2.50 (poorly satisfactory), and 1.00-1.50 (not satisfactory). The supplementary materials were assessed in three components in particular: mathematics content, features, and technical aspects.

Along with the mathematics content, the supplementary materials were examined concerning the consistency to learning competencies, objectives and accuracy of the content. Along with the features, the evaluation process concentrated on the supplementary materials' features and appropriateness to the objectives as reflective learning activities, motivational activities, and instructional videos. Finally, along with technical aspects, the supplementary materials were evaluated in regarding the application of stimulating graphics, utilising colours pleasing to the eye, readability, and organisation of texts, consistency in the utilisation of font, colours, and design, presentation of the cover page, and the easiness to reproduce.

The validated procedural fluency test was employed for pre-test and post-test in identifying students' procedural fluency. It incorporates the lessons established for the 4th quarter of the SY 2020-2021 based on the Most Essential Learning Competencies (MELCs) under the K-12 Curriculum of the DepEd. The procedural fluency test was designed with a table of specifications to ensure that the test items were equally distributed among the topics and learning competencies encompassed in the test.

The researcher implemented the mindset questionnaire of Dweck (2006) during interview schedules to collect students' pre- and post-scores in mindset in mathematics. The questionnaire comprises 20 statements illustrating growth or fixed mindset (questions directed to mathematics performance). The respondents responded with the scales of strongly agreed, agreed, disagreed, or strongly disagreed with the statement. The statements were assigned point values. If the statement was a fixed mindset statement, the point values were: 0 points for strongly agree, 1 point for agree, 2 points for disagree, and 3 points for strongly disagree. If the statement demonstrated a growth mindset, the point values were: 3 points for Strongly Agree, 2 points for agree, 1 point for disagree, and 0 points for strongly disagree. The interpretation of the total mindset scores comprises 00-20 (strong fixed mindset), 21-33 (fixed mindset with some growth ideas), 34-44 (growth mindset with some fixed ideas), and 45-60 (strong growth mindset).

The fixed mindset statements encompass, "Some people are good in mathematics and kind (patience in mathematics), and some are not – it is not frequently that people change". Meanwhile, the growth mindset statements incorporated a statement like "all human beings are capable of learning mathematics". For instance, supposing a student's mindset survey score declines between 00-20. In that case, he possesses a strong fixed mindset which implies his belief that mathematics ability is fixed and cannot be learned through effort, as he responded to the questions in the mindset survey. Furthermore, if a survey score of students' mindsets descends between 21-33, he owns fixed ideas about mathematics ability but also believes in any other method that mathematics can be learned through exercise, as he responded to the mindset questions.

Unstructured interview, focus group discussion questionnaires, journals, and outputs were also considered to corroborate the findings of the study through thematic analysis. Frequency

count was employed to calculate the number of occurrences of respondents' answers under the different questions and the number of students' correct responses in the mathematics researcher-made pre-test and post-test in procedural fluency. Moreover, it also administered to measure the number of students' growth mindsets based on the scale and interpretation.

The difference between the pre-test and post-test of the students on the procedural fluency exam was determining the application of the Mean Difference/Mean Gain method. The students' procedural fluency and performance levels were identified by utilising the percentage technique. According to the National Council of Teachers of Mathematics (NCTM) (2014), the ability to implement procedures precisely, efficiently, and flexibly; to transfer procedures to new issues and contexts; to generate and adjust procedures from other procedures, and to comprehend the moment of one technique or method is more appropriate to implement than the other is procedural fluency.

In this study, students' performance level in procedural fluency concerns on the student's scores on a 60-item procedural fluency multiple-choice test formulated and validated by the teacher, and answered by students in the pre-test and post-test. The performance level of the students was interpreted by administering the scale: 35 and below (very low mastery), 36-65 (low mastery), 66-85 (average mastery), 86-95 (moving towards mastery), and 96-100 (mastered).

Results and Discussion

The primary concern of this study is to enhance supplementary materials for ninth-grade mathematics with growth mindset principles integration which was expected to help students encourage and enjoy learning and possess meaningful learning while studying at home. The study's outcomes could serve as supplemental materials to corroborate mathematics teachers in teaching mathematics to enhance students' procedural fluency and mindset in mathematics.

The developed supplementary materials encompassed six lessons for ninth-grade mathematics, such as the six trigonometric ratios, the trigonometric ratios of special angles, angles of elevation and angles of depression, trigonometric ratios to solve real-life problems incorporating right triangles, laws of sines and cosines, and problems accommodating oblique triangles. Each lesson was anchored to the most essential learning competencies of the Ninth-Grade Mathematics Curriculum and adhered the policy on lesson planning of the Department of Education.

Five jurors subjected the developed supplementary materials to critiquing. The jurors provided their comments, suggestions, and recommendations to enhance each part of the lessons and supplementary materials. The developed lessons possess specific features in which the developed supplementary materials incorporate growth mindsets. These are motivational activities, reflective learning activities, and integration instructional videos to assist students enhance a strong growth mindset in mathematics.

Motivational Activities

Table 1 presents the integration matrix of the growth mindset principle through motivational activities in the developed supplemental materials for teaching ninth-grade mathematics. Motivational activities in every lesson were employed to make students more


prepared. Each topic was associated with them, leading them to think about the growth mindset principles.

For instance, in lesson 1, along with the “Let’s start”, the students read the direction and employed the words in the box to complete the sentence. It came up with the phrases “I will do my best”, “I can perform more effort”, “I can learn from my mistakes”, “I can achieve my goals”, and “I can overcome challenges”. These phrases are concerning about the growth mindset that the students require to enhanced. According to Dweck (2006), if the students think that their success is based on hard work, learning, and training, individual possesses a growth mindset. In this activity, students will identify what they require to remember to more succeed the learning on particularly topic. In that case, the student can improve their growth mindset.

In lesson 2, along with the “Let’s start” part, the activity assisted the students develop their growth mindset in a method that they require to realise that for them to enhance their performance, they need to learn new things, welcome constructive feedback, discover creative solutions to solve a problem, elevate with practice, and train their brain. The activities in lessons 3 and 4, “Discovering a Solution to a Problem” and “Converting Negative to Positive”, may enhance the students’ growth mindset.

Table 1
Integration of Growth Mindset Principles via Motivational Activities

Lessons	Activities	Description		
Lesson 1:	Challenge Yourself to Succeed	This activity was anchored on the growth mindset principle. This activity allows students to understand that our belief about intellectual abilities can be enhanced for us to be successful.		
The Six Trigonometric Ratios: Sine, Cosine, Tangent, Secant, Cosecant, and Cotangent	<p><u>Direction:</u> Use the words in the box to fill in the blanks</p> <p>1. I will do my _____</p> <p>2. I can put in more _____</p> <p>3. I can learn from my _____</p> <p>4. I can achieve my _____</p> <p>5. I can overcome _____</p> <div style="border: 1px solid black; padding: 5px; display: inline-block; margin-left: 20px;"> challenges goals best mistakes effort </div>	<p>In this activity, students have discovered what they need to remember to be more successful in understanding the topic. Hence, the students are able to improve their growth mindset.</p>		
Lesson 2:	Improve and Develop	This activity assists the students to be aware that there are principles that we need to follow to enhance our performance. The students matched the appropriate word from column B to complete the sentence to realise this.		
The Six Trigonometric Ratios of Special Angles	<p><u>Direction:</u> Match the appropriate word</p> <table style="width: 100%; border-collapse: collapse;"> <tr> <td style="width: 50%; vertical-align: top;"> Column A I can learn _____ I welcome constructive ____ I can train my _____ I can improve with _____ I can find creative _____ </td> <td style="width: 50%; vertical-align: top;"> Column B a. solutions b. practice c. new things d. brain e. feedback </td> </tr> </table>	Column A I can learn _____ I welcome constructive ____ I can train my _____ I can improve with _____ I can find creative _____	Column B a. solutions b. practice c. new things d. brain e. feedback	<p>This part concerns on developing the students’ growth mindset that knowledge is not fixed but can be improved.</p>
Column A I can learn _____ I welcome constructive ____ I can train my _____ I can improve with _____ I can find creative _____	Column B a. solutions b. practice c. new things d. brain e. feedback			

Lessons	Activities	Description
Lesson 3: Angle of Elevation and Angle of Depression	<p>Finding a Solution to a Problem Direction: Match the correct solution to a problem from column A to column B</p> 	<p>The students matched column A to column B to get the correct solution to a problem or scenario.</p> <p>This activity focuses more on developing the students' growth mindset that there is no problem if there is no solution.</p>

Lesson 4: Solving Word Problems Involving Right Triangles	<p>Negative to Positive Direction: Convert the following negative thought to positive thinking.</p> <table border="1"> <thead> <tr> <th>Negative Thoughts</th> <th>Your Positive Thoughts</th> </tr> </thead> <tbody> <tr> <td>1. Mathematics is a very hard subject for me.</td> <td>1.</td> </tr> <tr> <td>2. I cannot solve any problems in Trigonometry concerning right triangles.</td> <td>2.</td> </tr> <tr> <td>3. I never understand the concept and process of solving problems in Mathematics.</td> <td>3.</td> </tr> <tr> <td>4. I think that my teacher does not care about my learning.</td> <td>4.</td> </tr> <tr> <td>5. I could not complete high school because there was a lot of homework and projects.</td> <td>5.</td> </tr> <tr> <td>6. I cannot go to college because it is very hard.</td> <td>6.</td> </tr> <tr> <td>7. I cannot study without the help of my classmates or my friends</td> <td>7.</td> </tr> <tr> <td>8. I think that I am not good at anything.</td> <td>8.</td> </tr> <tr> <td>9. I never do anything to succeed.</td> <td>9.</td> </tr> <tr> <td>10. I cannot achieve my dream and be a successful person.</td> <td>10.</td> </tr> </tbody> </table>	Negative Thoughts	Your Positive Thoughts	1. Mathematics is a very hard subject for me.	1.	2. I cannot solve any problems in Trigonometry concerning right triangles.	2.	3. I never understand the concept and process of solving problems in Mathematics.	3.	4. I think that my teacher does not care about my learning.	4.	5. I could not complete high school because there was a lot of homework and projects.	5.	6. I cannot go to college because it is very hard.	6.	7. I cannot study without the help of my classmates or my friends	7.	8. I think that I am not good at anything.	8.	9. I never do anything to succeed.	9.	10. I cannot achieve my dream and be a successful person.	10.	<p>In this Activity, “Negative to Positive”, The students convert the following negative thoughts to positive thinking.</p> <p>This activity is more on elevating the students' growth mindset that for us to be successful in life, we require to practice converting negative thoughts into positive thinking.</p> <p>The students answered the following questions:</p> <ol style="list-style-type: none"> How did you convert the following negative thoughts to positive thoughts? How can this activity assist you to be optimistic and motivated to learn?
Negative Thoughts	Your Positive Thoughts																							
1. Mathematics is a very hard subject for me.	1.																							
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Lessons	Activities	Description
Lesson 5: Oblique Triangles: Sine Law, Cosine Law, and the application	<p>You Can Do It. Trust Yourself</p> <p><u>Direction:</u> Formulate your own motivational quotes that you can always remember to be a successful person someday.</p> <p><u>Answer the following questions:</u></p> <ol style="list-style-type: none"> 1. How can this motivational quote help you in your study about this topic in this module? 2. What are the things you need to perform now to achieve your dreams? 3. From the quotes you have encountered in the previous modules, what quote do you like the most? Why and how will you apply those to grow and develop as an individual? 	In this activity, the students generated motivational quotes that they can always remember for them to be a successful person someday. Hence, it helps the students to enhance their growth mindset.

This section is able to develop the students' growth mindset; hence, they need to realise that every problem, big or small, must possess a solution, and failure and mistakes are not bad things. The motivational activity in lesson 5 is "You can do it, Trust Yourself". In this activity, the students created motivational quotes that they can always remember to be a successful person someday. This section enhances students' growth mindset; thus, the students will realise that there is no other way to enhance themselves but by trusting themselves.

Briggs (2015) stated in his article that learning takes time and do not anticipate learning everything in one session. It indicates that the students need to exert efforts to learn and realize that knowledge is not fixed but can be enhanced. When students make a mistake or own a problem, they have not failed but they have learned instead. He recommended replacing the word "failing" with "learning" which can improve students' growth mindset. Furthermore, students should stop finding approval from others because when students prioritise approval over learning, they sacrifice their growth potential.

Reflective Learning Activities

Reflective learning was one of the features of the developed supplementary materials accommodated on the growth mindset employed in this study. Gray (2021) defined reflective learning as students' thinking about what they have learned in the classroom and how it is implemented into their individual life. It is a method of learning in which students reflect upon their learning experiences. Reflective learning also allows the students to reflect on their learning.

In this study, reflective learning concerns on the students' reflections in the lesson format which implement supplementary material attached on growth mindset principles and the approach employed in the development of the lessons. Table 2 presents the promotion of reflective learning, another feature of the developed supplemental materials for teaching ninth-grade mathematics.

Table 2
Promoting Reflective Learning

Lessons	Reflective Learning Theme	Description
1	“Success is not an accident. Success is a choice”. – Stephen Curry (n.d.)	In this lesson, reflective learning was performed in the “Let’s Reflect” part, in which the students reflect on their learning. The students reflect on the provided quotation, that is about being successful. This activity will motivate the students to study hard for the successful outcome.
2	“Learn everything you can, learn anytime you can from anyone you can – there will always come a time when you will be grateful for what you did” – Sarah Caldwell (n.d.)	The quotation about learning by Sarah Caldwell was employed to promote reflective learning. In the “Let’s reflect” part, the students reflect on their learning and the provided quotation about the importance of learning. The students will realise that learning is essential. It also helps to improve the growth mindset of the students.
3	“Work to find solutions instead of always highlighting the problems”. – picturequotes.com (n.d.)	The promotion of reflective learning in this lesson is on the “Let’s reflect” part, in which the students reflect on the quotation about discovering a solution for a problem. It will also assist the students to enhance their problem-solving skills, accommodated to the growth mindset principles.
4	“Once you replace negative thoughts with positive ones, you will start having positive results” – Willie Nelson (n.d.)	In this lesson, reflective learning was introduced in the “Let’s Reflect” part, in which the students reflect on their learning. The students also reflect on the provided quotation, which is about being positive. This activity will encourage students to study hard and avoid any negative thoughts.
5	“Trust yourself. You know more than you think you do”. – Benjamin Spock	The quotation about trusting oneself by Benjamin Spock was administered to promote reflective learning. In the “Let’s reflect” part, the students reflect on their learning and the provided quotation about the importance of self-confidence. The students will realise that trusting oneself is crucial in learning and achieving goals.

In the “Let’s Reflect” part, the last part of every developed lesson, the students reflect on the provided quotations. For instance, in lesson 1, the quotation is about success by Curry (n.d) “Success is not an accident, success is a choice”. The student reflected on this quote to encourage them to study hard for being successful. This part also allows the students to review and reflect on their learning and new understanding.

In this part, the students were also asked about what they have learned, the difficulties they experienced, what they learned from these quotes at each start of the lesson, and the way to apply the things they have learned to acquire their goals. As another part of their reflections, they were also asked to write their significant learning experiences to capture their significant learning experience during the conduct of the study.

Elias (2010) explained that students’ reflections were identified as one of the top six activities to assist students to be successful. He asserted that students should formulate their goals, record the achievements, and show and share the learning with others.

Promoting reflective learning in lesson 2 was on the “Let’s Reflect” part. The students reflected on the quote by Caldwell (n.d), which is “Learn everything you can, learn anytime you can, learn from anyone you can – there will always come a time when you will be grateful for what you did”. In this activity, the students realised that learning was essential and help them enhance their growth mindset.

Malec (2021) elaborated that continuous learning is vital because it assists students feel joy in life and elevate their productivity. When students realise the importance of learning, they will be encouraged and eager to learn. The students also reflected on what they did and learned from activity two and how it helped them prepare for the topic. The difficulties they have encountered in the lesson and how they solved it, how the concepts they have learned are applied in real life, and how it may assist them to achieve their goals.

The theme in lesson 3 was “finding a solution to a problem”. Problems in learning are frequently present, hence, the students sometimes do not understand what to perform. In this part of the promotion of reflective learning, the students reflected on the quotation about finding a solution to a problem: “Work to find solutions instead of always highlighting the problems” (picturequotes.com). It helps the students improve their problem-solving skills and promote growth mindset principles.

In lessons 4 and 5, the students reflected on the quotations about possessing positive thoughts and trusting themselves. One of methods for them to succeed is to be positive and trust themselves. As cited by Williams (2017), Dewey asserted that reflection was a tremendous significant part of learning. He advocates that reflective learning is not merely reading and obtaining knowledge. It is an active examination of learning from the information in accordance with the students’ learning experiences. The students need to think deeply based on what they have read and learned from the lesson. Then, they can implement the knowledge to their context. The implementation of supplementary material with its features makes learning meaningful to the students since they can reflect and freely express their selves about what they have studied. It also encourages learning transfer because students would easily identify the concepts as they reflect on their personal experiences.

Furthermore, the DepEd promoted reflective learning in the K to 12 Basic Education to provide a meaningful learning experience. Reflective learning allows learners to employ what they have learned and why they need to learn (Department of Education Order No. 21, series of 2019). Additionally, Briggs (2015) stated that if the students are allowed to reflect on their understanding at least regularly, they can enhance their growth mindset. Opportunities for reflection encourage the students to be motivated to learn and elevate their interest in learning.

Integration of Instructional Videos

Integrating instructional videos was one of the features of the developed supplementary materials encompassed on the growth mindset employed in this study. Any video displaying a procedure, transmitting knowledge, explaining a concept, or presenting someone how to accomplish something are classified as an instructional video. It means that it is a form of instruction utilising technology to convey knowledge to the viewers (Simon, 2012). According to Mendoza et al. (2015), employing instructional materials and integrating instructional video obtains the student's interest. It also helps the students to concern on the lessons.

Table 3 presents the developed supplemental materials featuring the integration instructional video teaching ninth-grade mathematics. Videos in each lesson were utilised as instructions that assisted students to comprehend each topic in mathematics and were

associated with them, improving their understanding and interest in mathematics.

In this study in lesson 1, the instructional video is all about the concept of the six trigonometric ratios, portraying the parts of a right triangle and illustrating the six trigonometric ratios. It also displays the method to identify the missing parts of the triangle and its application in real life. In lesson 2, the instructional video discusses about the “trigonometric ratios of special angles”. The students watched the video which portrays the concept of Trigonometric Ratios of Special Angles, discovering the missing parts of the triangle utilising special angles, and its application in real life. After watching the instructional video, they were writing what they had learned in their notebook and answered some questions associated with the discussion.

Table 3
Integrating Instructional Videos

Lessons	Instructional Videos	Descriptions
Lesson 1: The Six Trigonometric Ratios: Sine, Cosine, Tangent, Secant, Cosecant, and Cotangent	“The Parts of the Right Triangle”	This instructional video in this section integrated into the “Let’s Start” part, activity number 2, in which the students watched the video segment to assist them to recall the different concepts about a triangle and answered the following <u>questions</u> : 1. What are the parts of the right triangle? 2. What are the definitions of the parts of a right triangle? 3. Is it easy to identify the parts of a right triangle? Why? or why not?
	“The Six Trigonometric Ratios”	Another instructional video in this section also accommodated “Let’s find out” part, and they wrote the things they had learned from the video. The concepts of The Six Trigonometric ratios were further discussed.
	“Trigonometry – Application”	In the “Let’s apply” part, the students watched the instructional video and solve the provided worded problem about the six trigonometric ratios and answered the following questions: 1. Did you obtain the correct answer? How? 2. Is the problem easy to solve? Write the difficulties you’ve encountered if you have one? 3. If you were asked to make your trigonometric ratio problem, how would you make it?
Lesson 2: The Six Trigonometric Ratios of Special Angles	“Exact Trigonometric Ratios by Employing Your Hands”.	The instructional video in the “Let’s Start” part was on activity number 2. The students watched the video segment to help them remember the exact trigonometric values employing their hands. Then, they answered the following questions: 1. How did you feel after you watched the video? 2. Did employing the hand trick in finding exact trigonometric values make you easily compute the values of trigonometric ratio? 3. How could you utilise the trigonometric ratios hand trick in finding the unknown angles or sides of a special right triangle?
	“Trigonometric Ratios of Special Angles”	In the “Let’s find out” part, the instructional video in this part talks about the concept of Trigonometric Ratios of Special Angles. The students watched the video, and they wrote the things that they had learned.
	“Trigonometry – Application”	Another instructional video incorporates on “Let’s apply” part. The students watched the video about solving problems involving trigonometric ratios of special angles and solve the provided worded problems.

Lessons	Instructional Videos	Descriptions
Lesson 3: Angle of Elevation and Angle of Depression	“Angle of Elevation and Angle of Depression”	The instructional video in this lesson was on the “Let’s find out” part, and it discussed about the concept of the Angle of Elevation and the angle of depression. This content discussed all the content. The students watched the video segment and wrote what they had learned. <u>Questions:</u> 1. Based on the video you’ve watched, what is the definition of angle of elevation? 2. What is angle depression? 3. What are the differences between the angle of elevation and depression?
	Clinometer (How to make and use)	The instructional video in this part was the video containing the way to create a clinometer. The students followed the steps in making a clinometer based on the instructions from the video, and then the students performed activity 4. In Activity 4, “Your Shadow”, students calculate the height of their friend and the length of his/her shadow. Applying the concept of trigonometric ratios, the students determined the angle of elevation from the ground to the sun.
Lesson 4: Solving Word Problems Involving Right Triangles	“The Scientific Calculator” and “Example Problem”	The instructional video in this lesson was about utilising the scientific calculator and solving problems incorporating the right triangle. The students watched the video segment about the example of problems involving right triangles applying the trigonometric ratios and wrote what they had learned.
Lesson 5: Oblique Triangles: Sine Law, Cosine Law, and its application	“Sine and Cosine Law: Finding the missing parts of an oblique triangle”. “Sine and Cosine Law – Application”	The instructional video in this lesson was all about oblique triangles. The students watched the video segment entitled “Oblique Triangles” Sins and Cosine Law: Finding the missing part of an Oblique Triangle, and afterward, they wrote the things they had learned. From the video, the concepts were further discussed. Another video on this part discussed about the application of Sine Law and Cosine Law. The students watched the video about Sine Law and Cosine Law–Applications and solved the provided worded problems.

There is an instructional video in activity 2, in which the students were watching the video segment entitled “trigonometric ratios shortcuts” to assist them remember the exact trigonometric values by employing their hands. The short video presents the way to memorise exact trigonometric values by employing the hand trick. The video helps the students easily compute trigonometric ratios’ values, and employ the trigonometric ratios hand trick in identifying the unknown angles or sides of a special right triangle. There is also a video about the implementation and how to solve problems regarding trigonometric ratios of special angles. This video displays the students how to solve problems involving trigonometric ratios of special angles.

In lesson 3, the instructional video in this lesson is on the “Let’s find out” part. It discusses about the “angle of elevation and angle of depression”. The students were watching the video segment about the “angle of elevation and angle of depression”. The video displays the way the angle of elevation and angle of depression is employed in solving word problems

incorporating right triangles and application in real life. They were also writing about what they had learned from the video for their reflection and evaluation purposes. There is also a video about how to make a clinometer. The video teaches the students on how to make and utilise the clinometer to calculate the angle of objects.

After they have watched the video, an activity follows, which is activity 4. In Activity 4, entitled “Your Shadow”, students measured the height of their friend and the length of his/her shadow. Employing the concept of trigonometric ratios, the students examined the angle of elevation from the ground to the sun. Employing the clinometer, they could calculate the angles. After the activity, there are also questions that they require to answer as a part of the evaluation,

In lesson 4, the instructional video is on the “Let’s find out” part. It is all about solving problems encompassing the right triangle, utilising the scientific calculator, and employing concepts in the previous lesson to solve problems incorporating the right triangle. The students watched the video segment about example problems concerning right triangles utilising the trigonometric ratios.

In lesson 5, the instructional video is on the “Let’s find out” part. It was about oblique triangles. The students watched the video segment entitled “Oblique Triangles” sine and cosine law: discovering the missing part of an oblique triangle. There was also a video on the “Let’s apply” part. The video on this part discussed about implementing sine and cosine law. The students watched this video and solved the provided worded problems.

There are six lessons developed with instructional videos, that are the six trigonometric ratios, the six trigonometric ratios of special angles, the angle of elevation and angle of depression, solving word problems incorporating right triangles, and oblique triangles: sine law, cosine law, and its application.

Effects on the Students’ Procedural Fluency in Mathematics

Procedural fluency is the ability to implement procedures accurately, efficiently, and flexibly, to correlate procedures to different problems and contexts, build and modify procedures from the other ones, and recognise when one strategy or procedure is more appropriate. In developing procedural fluency, students should experience rationalising both informal approaches and general employed procedures mathematically, should establish and defend their choices of appropriate procedures and reinforce their knowledge and skills through the distributed practice (NCTM, 2014).

Employing supplementary materials anchored on growth mindset principles in the development of the lessons in ninth-grade mathematics allows students to enhance procedural fluency. Table 4 presents the pre-test and post-test results provided for students in the implementation group. It indicates that the mean scores of the students in the implementation group during the pre-test were all interpreted as very low mastery except for the fourth competency on solving real-life problems which encompass right triangles classified as low mastery.

Table 4
Result of Pre-test and Post-test in the Procedural Fluency

Topics	No. of Items	Implementation Group					Comparison Group				
		Pre-test		Post-test		Mean Gain	Pre-test		Post-test		Mean Gain
		Mean	Interpretation	Mean	Interpretation		Mean	Interpretation	Mean	Interpretation	
The six trigonometric ratios	4	0.97 (24.3%)	VLM	3.1 (77.5%)	AM	2.13	1.2 (30%)	VL M	2.2 (55%)	LM	1
Trigonometric ratios of special triangles	4	0.93 (23.3%)	VLM	1.9 (47.5%)	LM	1.27	1.1 (27.5%)	VL M	1.5 (37.5%)	LM	0.4
Angles of elevation and depression	7	1.37 (19.6%)	VL M	3.7 (52.9%)	LM	2.33	2.6 (37.1%)	LM	3.1 (44.3%)	LM	0.5
Solving real-life problems involving right triangles	3	1.4 (46.67%)	LM	2.3 (76.7%)	AM	0.9	1.4 (46.7%)	LM	1.9 (63.3%)	LM	0.5
The laws of sines and cosines.	9	2.37 (26.3%)	VLM	4.6 (51.1%)	LM	2.23	3.5 (38.9%)	LM	4 (44.4%)	LM	0.5
Solving problems involving an oblique triangle	3	0.6 (20%)	VLM	1.4 (46.7%)	LM	0.8	0.8 (26.7%)	VL M	1.2 (40%)	LM	0.4
Total	30	7.63 (25.5%)	VLM	16.87 (56.2%)	LM	9.24	10.67 (35.6%)	VL M	13.93 (46.4%)	LM	3.23

Legend: VLM – Very low Mastery, LM – Low Mastery, AM – Average Mastery, HM – High Mastery, VHM – Very high mastery, p^* tested at a .05 level of significance

Looking at the data, the learning competency “solving real-life problems involving right triangles” (46.67%) owned the highest performance level, while the lowest was on “illustrates angles of elevation and angles of depression” (19.6%). During the post-test, the students acquire the highest performance level on “The six trigonometric ratios” (77.5%), while the lowest performance was on “Solving problems involving oblique triangle” (46.7%).

Overall, the total mean score for the pre-test was 7.66 (25.5%), interpreted as very low mastery, and 16.87 (56.2%), construed as a low mastery for the post-test, which displayed an increase of 9.24. Results presented a difference in the students' performance in the group from pre-test to post-test. The table revealed an increase in the mean of post-test of 3.1, 1.9, 3.7, 2.3, 4.6, and 1.4 on competencies 1 to 6, respectively. It indicates that the students in the implementation group who employed the instructional materials enhanced the students' procedural fluency in terms of the lessons incorporated in the study. With the result, it is implied that the students who were taught utilising the supplemental materials obtained a high mean score in the post-test since there was an increase in the mean score of the pre-test.

The possible reason for this accomplishment and improvement in performance level may be attributed to the supplemental materials, which enable students to comprehend well and exert effort in learning. One of the students expressed her thoughts about learning with the materials which is the way she applied what she has learnt and the way to achieve the goal.

The students explained:

Student 3: "In achieving our goal, we require to possess hardship or work through step by step, hence, it will be easy for us to perform such things".

Student 7: "I have some difficulties in finding the best way to solve the problem, particularly of which trigonometric ratios will be utilised. However, by trying to understand the problem, again and again, I can solve the problem".

Based on the student's entry, they learned to solve trigonometric ratios based on their growth mindset. Even though solving worded problems was complicated, they attempted their best to discover the right answer. The student explained that learning step by step to solve the problem was significant for her to better understand the problem and to succeed identifying solutions.

In conclusion, the lessons and activities in the supplementary material significantly enhanced the students' procedural fluency. The data collected corroborated the students' reflection, and it revealed that employing activities (such as studying with the instructional videos that allow them to think, reflect and correlate their lives to the lessons) enables the students to understand the mathematics concepts better. Moreover, the students manifested a growth mindset in mathematics, leading them to strive and learn the topics more.

Table 4 portrays that the mean scores of the students in the comparison group during the pre-test were interpreted as low mastery of "angles of elevation and depression", "Solving real-life problems involving right triangles", and "the laws of sines and cosines, and very low mastery for "the six trigonometric ratios", "trigonometric ratios of special triangles" and "solving problems involving oblique triangle". Observing the data, the learning competency "solving real-life problems involving right triangles" (46.7%) possessed the highest performance level while the lowest was on "Solving problems involving oblique triangle" (26.7%).

Based on the same table, in the post-test of the comparison group, the students acquired the highest performance level on "real-life solving problems involving right triangles" (63.3%), while the lowest performance was on "trigonometric ratios of special triangles" (37.5%). Data also unveiled that the students owned low mastery of all six competencies.

Overall, the total mean score for the pre-test was 10.67 (35.6%), construed as very low mastery, and 13.93 (46.4%), also portrayed as a low mastery for the post-test. Based on the table, it could be inferred that the utilisation of the traditional method of teaching and reference materials also enhanced the students' procedural fluency in terms of the lessons encompassed in the study, with the mean scores of 10.67 and 13.93 in the pre-test and post-test, respectively, which displayed an increase of 3.23.

The implementation group possesses a higher increase with an increase of 9.24 for the implementation group than the comparison group with an increase of 3.23. A t-test for an independent sample was administered to determine if there was a significant difference in the mean gain scores of the students between the implementation and comparison groups in procedural fluency. The results revealed a significant difference between the mean gain scores of the two groups, conveyed by the t-value of 4.890 and p-value of 0.000, which was significant at a 95% confidence level.

Comparing the increase of the mean score of the implementation group to the comparison group, the implementation group owns a higher increment with an increase of 9.24 for the implementation group compared to the comparison group with an increase of 3.23. The study uncovered that the students in the implementation group taught by applying the supplementary materials enhanced procedural fluency in mathematics more than those in the comparison group. The latter was taught by the traditional method and did not employ supplementary materials.

Bautista (2013), in his study, revealed that to remodel students' performance on procedural fluency and mathematical explanation toward problem-solving, the instructional activities, mindset, and contents have to be complementary to one another. Furthermore, the study by Arthur, Dogbe, and Asiedo-Addo (2021) discovered that motivation in learning mathematics and quality of mathematics teaching obtained significant positive effects on students' mathematics performance.

In the present study, the improvement in the implementation group could be attributed to the student's application of the supplementary materials in which they are able to learn the materials at home. The contribution of the study in elevating the students' procedural fluency were administering the motivational activity with a growth mindset that helps the students be motivated to learn and possess a high interest in learning the topics in mathematics. Reflective learning activities provide a clear goal for attaining the learning objectives in which students are encouraged to perform reflection activities. The instructional videos help students learn and comprehend more of the concept at home and be able to employ technology such as phones and computers as an additional tool for researching instructional resources.

The study by Sharma (2018) discovered that students receiving steady experience to instructional videos and real-life activities performed better than students receiving some of the exclusive instructional treatments. The students, during the interviews, manifested their belief that instructional videos and real-life activities were able to enhance their understanding on mathematical concepts.

Effects on the Students' Mindset in Mathematics

The effects of the motivational activities on students' mindsets were also the manifestations of the development of a growth mindset among students in performing the activity. Dweck's (2006) mindset questionnaire was administered to calculate it by utilising an interview schedule. Students answered with a growth mindset or a fixed mindset for each statement. A student with a growth mindset and some fixed ideas experienced that his or her mathematical skill could be improved, but he or she also believed that some aspects of his or her mathematical skills could not be modified.

A student with a fixed mindset, on the other hand, acknowledged that his or her mathematical skills could not be changed or elevated; nevertheless, he or she might believe that it could be enhanced in certain ways. The data was analysed through frequency count after determining the students' mindsets. Table 5 presents the summary of the pre-test and post-test frequency counts of the students' mindsets in the implementation group and comparison group.

In the implementation group, 17 students owned a “fixed mindset with some growth ideas”, while 13 possessed a “growth mindset with some fixed ideas”. 13 students owned a fixed mindset with some growth ideas during the post-test, 14 students possessed a growth mindset with some fixed ideas, and three students owned a strong growth mindset.

Table 5
Summary of the Pre-test and Post-test Frequency Counts of Two Groups on Growth Mindset in Mathematics

Mindsets of the students in Mathematics	Pre-test		Post-test	
	Implementation Group	Comparison Group	Implementation Group	Comparison Group
Fixed mindset	0	0	0	0
The fixed mindset with some growth ideas	17	10	13	9
Growth mindset with some fixed ideas	13	19	14	19
Strong growth mindset	0	1	3	2
Total	30	30	30	30

While 19 students in the comparison group possessed a growth mindset with some fixed ideas, ten students owned a fixed mindset with some growth ideas, and one student possessed a strong growth mindset during the pre-test. Nine students acquired a fixed mindset with some growth ideas during the post-test, 19 students obtained a growth mindset with some fixed ideas, and two students gained a strong growth mindset.

Based on the results, the implementation and comparison groups had students in the pre-test with a “fixed mindset with some growth ideas”. The students in the implementation group all exhibited a growth mindset in the post-test, with no students possessing a robust fixed mindset. However, the post-test presented that one student was moved from the students with a “fixed mindset with some growth ideas” to the students with a “growth mindset with some fixed ideas”, and nothing was added to the students with a “growth mindset with some fixed ideas”, elevating the strong growth mindset from one (1) to two (2).

Specifically, during the post-test in the implementation group, three students from growth mindset with some fixed ideas were involved to the students with a strong growth mindset, and four students from fixed mindset with some growth ideas were joined into a growth mindset with some fixed ideas. Meanwhile, the one student in the comparison who was transferred to possess a growth mindset with fixed ideas in the post-test obtained a fixed mindset with some growth ideas in the pre-test. Furthermore, one from a growth mindset with fixed ideas was switched to strong growth mindset.

During the post-test in the implementation group, the three students who leaped to students with a strong growth mindset enhanced more than the other students. The other students have also developed their growth mindset, although just a little. Based on the findings, students in the implementation group cultivated a stronger growth mindset than students in the comparison group.

The students in the implementation group acknowledge the significance of a growth mindset in their education. During the interview, a student (Student 21) moving from a growth mindset with some fixed ideas to a strong growth mindset stated the following:

“Nakatabang po talaga sya (motivational activities) sako kasi, sa kada lesson, ugwa pong inspiring quotes na nagmomotivate samo, pati si mga activities about motivation nakatabang sya na marealize me na kaipuhan ming mag adal para makatapos saka makagraduate” (The motivational activities tremendously assisted me a lot because in every lesson, there are quotes which encourage us to possess a growth mindset, and the activities about motivation help us realise that it is crucial for us to learn diligently to accomplish our study, to graduate).

Students’ development of a growth mindset might be associated with utilising supplemental materials, which enhances a growth mindset through self-learning that emphasises efforts in learning mathematics, in accordance with the students’ statements, as previously outlined in their learning experiences. Sun (2019) argued that current school mechanisms, such as tracking regulations, instructional methodologies, and standardised assessment, may postpone teaching which consistently initiates growth mindset messages concerning mathematics ability. It indicates that supplementary materials which utilise activities to promote a growth mindset in mathematics could help the students develop a growth mindset despite different external factors that convey fixed mindsets.

The supplementary materials were formulated to enhance students’ growth mindset in mathematics, as the motivational activities with the integration of the principles of growth mindset are able to make students more engaged in the learning process. Harackiewicz et al. (2018) emphasised that interest is a robust motivational mean which elevates learning and is essential for the educational success. When students develop their interest in studying mathematics due to the motivation, their desire to learn escalates. It implies that teachers should determine both considerations in enhancing students’ interest and growth mindset in their instruction.

Boaler (2013) explained that through instructional and classroom activities, teachers and institutions regularly transfer messages to students regarding their skill and comprehension (i.e., instructional materials). She emphasised that a thorough review of all areas of education is required if one is genuinely committed to the transfer and training of a growth mindset. She added that, norm-setting, questioning, committing mistakes, providing activities, grouping, grading, and feedbacking were all employed to convey mindset messages.

Briggs (2015) asserted that a growth mindset can alter goals and perceptions of achievement. He emphasised that conducting growth mindset-related actions such as employing the word “yet”, learning from others’ failures, setting new goals for each goal achieved, taking opportunities in the company of others, and thinking realistically about time and effort can eventually help students enhance the growth mindset.

The students were demanded to share their experiences by writing them in their journals to corroborate the study’s findings with the actual manifestations of the development of a growth mindset among the students in performing the activities. The students’ responses in the informal interviews and focus group discussions were also sources to examine the manifestations of the development of a growth mindset among the students.

After thematic analysis of the unstructured interviews responses, focus group discussion notes, and journals entries of the student during the implementation and after the utilisation of the supplemental materials, five themes were generated (Table 6): The students (1) acknowledging and embracing imperfections, (2) viewing challenges as opportunities, (3) replacing the word “failing” with the word “learning”, (4) providing regular opportunities for reflection, and (5) thinking realistically about time and effort. Sample statements of the students in each theme were presented in the matrix in Table 6.

The students’ statements imply that the students developed their growth mindset by acknowledging and embracing imperfections. The students accepted that the activities were difficult, but it manifested that they possessed a growth mindset due to their acknowledgement of imperfections. Another manifestation of the development of a growth mindset was the student’s response during the interview, which was by replacing the word “failing” with the word “learning”, and the students learned to perform their best even when they committed mistakes. It may be attributed to one of the elevated supplementary materials, reflective learning activities, which allow the students to reflect on their learning. It is a method of learning in which the students are able to reflect upon their learning encounters.

Based on the students’ reflection, they acknowledged that through the effort, he could learn to solve problems. According to Le Cunff (2022), another thing about enhancing a growth mindset is situating growth before speed. She asserted that fast learning does not necessarily mean equate to good education and learning well requires an investment of time. It means that students should also think about the importance of time and effort in acquiring new skills. Based on the student’s response, it was identified that the student understands that it takes time to grow and improve.

Table 6
Sample Statements of the Students in Each Theme

	Themes	Description
1	Acknowledge and embrace imperfections	<i>“Today, I experienced that those activities are not easy to resolve, but if we perceive all things positively, we can achieve our goals”.</i>
2	Perceive challenges as opportunities	<i>“I learned to improve myself, particularly in solving skills, by studying in this module about matrices solving real-life problems and being positive”.</i>
3	Replace the word “failing” with the word “learning”.	<i>“Today, I also learned to be positive. Even though I committed mistakes, I attempted my best to learn from them. Somehow solving involving right triangle is not easy, but I was willing to learn so that I tried”.</i>
4	Provide regular opportunities for reflection	<i>“I learned that learning could be everywhere. We could learn everything at any time from anyone or ourselves. I learned that to learn. We required the effort to accomplish something. Today, I learned that learning is the best way to progress. We required to perform whatever we could do; we just needed to put some effort to do good and solve problems even in real-life experiences”.</i>

Themes	Description
5 Think realistically about time and effort	<p><i>“Learning fast does not mean learning well, and learning well requires allowing time for mistakes. Thinking realistically about the time and effort is required to acquire a new skill”.</i></p> <p><i>“In our life, success is the very best thing to acquire but in order to succeed, you need to set your goals, put more efforts, learn from mistakes, try our best to solve the challenges we have, like in solving trigonometric, we need to effort to solve and identify the solution to attain the correct answers and try our best to determine the right value of it”.</i></p>

Overall, the students’ mindsets shifting from a fixed mindset to a growth mindset is one of the impacts of utilising the developed supplementary materials such as motivational activities, reflection activities, or instructional videos. The study results are associated with the study of Masterson and Koch (2021). The research result discovered that moving from a fixed mindset to a growth mindset required adjustments to the mathematics methods. In this study, supplementary materials integrating growth mindset principles are able to help students develop a growth mindset in mathematics.

Conclusion

The supplementary materials developed to integrate growth mindset principles were motivational activities, reflection activities, and instructional videos. The students possessed significant learning experiences by employing supplementary material, which developed procedural fluency and assisted students in shifting from fixed mindsets to growth mindsets in mathematics. The students learned to acknowledge and embrace imperfections, view challenges as opportunities, acknowledge failures as a key to learning, reflect on learning, and think realistically about time and effort. The implementation of the supplementary materials affects students’ procedural fluency and mindset in mathematics better than conventional teaching in accordance with the findings of this study. In strengthening students’ learning and growth mindset, researchers could employ the supplementary materials in various areas of learning and with larger sample sizes.

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