

Learning activity sheets using interactive formative assessment and feedback mechanism for grade 9 mathematics

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Abstract

The demands in the education system, particularly the adoption of distance learning, vastly affected the teaching and learning and put a challenge in the conduct of assessment, including limitations in giving feedback. Hence, this quasi-experimental study developed Learning Activity Sheets (LAS) Using Interactive Formative Assessment and Feedback Mechanism and determined its effect on the Mathematics performance of Grade 9 learners at Bulan National High School, Bulan, Sorsogon. In the study, there was a total of ten (10) LAS developed. The learning activity sheets were designed to use interactive formative assessment which were formative assessments for both individual and group set-ups that resulted in four natures of interaction, namely: student-to-learning activity sheet, student-to-teacher, student-to-student (small group), and student-to-student (large group). These formative assessments were accompanied by and facilitated through feedback mechanisms that consisted of the source of feedback, online tools, feedback models, and manner of delivery which were: (1) Teacher's Feedback using Feedback Sandwich or Pendleton's Model of Feedback via Google Meet during the whole class discussion; and (2) Peers' Feedback using Situation, Behavior, Impact Feedback Tool via Google Meet and Messenger during whole class and small group discussions. After four weeks of utilization, it was identified that use of the developed LAS resulted in improved conceptual understanding, communication skills, and interest in learning math. Furthermore, the feedback mechanisms were found to have positive results for students along with understanding the lesson, completion of tasks, communication, interest in math, and social relationships. Thus, recommending its use and development for distance learning.

Keywords: learning activity sheets, interactive formative assessment, feedback mechanism, feedback, distance learning

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1. Introduction

The demands and challenges in society brought rapid changes to the educational system along with instructional strategies, approaches, and modalities. Today, the trend of moving away from the conventional face-to-face education to online, flexible, and blended distance learning are at its utmost to ensure that the quality education for the learners is served at all times. According to UNESCO (2020) reports, approximately 1.5 billion students have been affected by the closure of schools in about 165 countries due to the COVID-19 pandemic. As a result, educational institutions from different parts of the world were forced to transfer from on-site teaching and learning to blended distance education. In the Philippines, for the school year 2020-2021, the Department of Education (DepEd) developed self-learning modules (SLMs) integrated with alternative learning delivery modalities such as Modular, Online, and TV/Radio-based instruction for the full implementation of distance learning due to the public health situation (DepEd, 2020). Among the options, the most convenient choice for ordinary Filipino students is the Modular Distance Learning. In fact, out of 22.2 million enrollees who responded in the DepEd's National Learner Enrolment and Survey Forms, 8.8 million preferred the utilization of modular distance learning which is 39.6% of the total respondents (Manlangit, Paglumotan, & Separa, 2020).

Modular Distance Learning involves individualized instruction that allows learners to use Self-Learning Modules in print or digital format (DepEd, 2020). The use of modules encourages learning autonomy and can meet the varied learning needs of students when carefully prepared (Nardo, 2017). In addition, learning modules, specifically when contextualized, can also be used to address learning gaps and as instruments for remediation (Madraza & Dio, 2020). Furthermore, it was also found out that modules can improve the students' learning performance (Columbano, 2019). However, some of the concerns in the utilization of modules in distance learning fall under the conduct of assessment, including limitations on giving immediate feedback (DepEd Order No. 31, series of 2020) predominantly in mathematics education which has been perceived as one of the most challenging subjects worldwide (Singh, 2018).

Dangle and Sumaoang (2020) identified that, in modular distance learning, most students struggle in learning the modules independently, while parents also lack the knowledge to academically guide their child/children. For this reason, teachers were uncertain that students enthusiastically studied the material (Bernardo, 2020). In addition, Estrada (2021) was also concerned that students were not able to receive feedback since, after the completion and submission of the learning materials to the teacher, students tend to focus on the next modules. Thus, this poses a big task for the teachers and school administrators to devise mechanisms to ensure that students are actively involved in the learning process, particularly in the conduct of assessments and are able to receive enough educational support through giving feedback, especially in math.

As stated in DepEd Order No. 8, s. 2015, the Policy Guidelines in Classroom Assessment for the K to 12 Basic Education Program, assessment should inform and improve classroom practices and promote learning outcomes. To do this, the teacher must employ a variety of assessment strategies, with formative assessment taking priority to inform teaching and promote growth and mastery. But, in a distance learning context, teachers need to utilize alternative tools and strategies for assessing and supporting learning. While giving feedback, teachers can maximize the use of available communication options like online platforms (DepEd, 2020). For this note, the identified problems and recommendations gave the researcher the idea to develop learning materials, in the form of learning activity sheets, that will invite positive engagement and extend support for students in their educational experience by shared interaction with teachers and peers through interactive formative assessment and feedback mechanism.

Interactive assessments are assessments that prompt interaction on the part of the learner. It is a test, questionnaire, or interactive tool which requires the learner to engage in the learning process (Curi, 2020). In this study, the Interactive Formative Assessment refers to the set of learning activities that provide greater opportunity for an active interaction of students to their peers, teacher, and learning materials during the formation of learning. It includes the engaging learning activities and quizzes embedded in the learning material as well as the online communication with the teacher and peers through giving and receiving feedback. It focuses on assessing higher-level cognitive skills to demand feedback discussion since, according to Corpuz (2015), assessment should be focused on higher-order thinking and real-world application, not on out-of-context drills. Specifically, formative assessment was the focus since it is the formative assessment where educators can provide ongoing feedback to aid the learning progress of the students (Renard, 2017).

Meanwhile, the key features for supporting effective student learning processes are high quality and immediate feedback (Stenger, 2014; Wiggins, 2012). Research showed that feedback could help students to improve performance. In a study, Noureen, Akhtar, and Awan (2013) mentioned that students who received feedback perform better as compared to the students having no feedback. Also, Barry (2008), in another study, concluded that quality descriptive feedback is beneficial for students in reflecting on their own learning processes. In addition, according to Stenger (2014), when feedback is offered immediately rather than after a few days, weeks, or months, it is of its utmost effectiveness. Operationally, a feedback mechanism refers to the collection of methods and tools which can be used to facilitate the process of providing and receiving feedback of students after a performance while in remote learning. In this study, the feedback mechanism consists a set of online tools or applications for video conferences and group messaging (e.g., google meet and messenger), feedback model/s, definite manner of delivery of feedback (e.g., schedule, procedure), and sources (e.g., teacher, peers).

Nonetheless, among the branches of mathematics, it was found out that Geometry was perceived to be the most difficult. Some of the reasons were: 1) many students do not understand Geometry since is it conceptually difficult for them; 2) Geometry is not interactive unlike other subjects, since it seems boring for students to memorize and follow a set of rules; and 3) poor relationship between student and teacher (Melo & Martins, 2015). In this light, the use of the learning activity sheets was conducted in Bulan National High School (BNHS) for Geometry topics. BNHS was selected since it is the biggest national high school in Bulan, Sorsogon in terms of population and land area where most students utilize modules for distance learning. While in terms of content in Geometry, the Grade 9 curriculum was the most congested in the K–12 curriculum. In this grade level, both the third and fourth quarters are on Geometry, while only one quarter covers Geometry in other grade levels. Hence, the study focused on Grade 9 level with topics about similarity of triangles.

1.1 Statement of the Problem

This study developed Learning Activity Sheets for Grade 9 Mathematics using Interactive Formative Assessment and Feedback Mechanism. Specifically, it sought to answer the following questions: (1) What Learning Activity Sheets may be developed for Grade 9 Mathematics using: (a) Interactive Formative Assessment; (b) Feedback Mechanism? (2) What are the dynamics of the Feedback Mechanism as a result of: (a) Teacher's feedback; (b) Peers' feedback? (3) What are the effects of the Learning Activity Sheets using Interactive Formative Assessment and Feedback Mechanism in terms of: (a) Conceptual Understanding; (b) Communication Skills; (c) Interest in Learning Mathematics?

2. Methodology

Research Design - The study utilized the pretest-posttest quasi-experimental design to test the effects of the learning activity sheets using interactive formative assessment and feedback mechanism on the Grade 9 students' conceptual understanding, communication skills, and interest in mathematics. The pretest-posttest design is a within-subjects experiment in which the dependent variable is measured before and after the implementation (Price, Jhangiani, & Chiang, 2015). This quasi-experimental design was appropriate for gathering data since the researcher

compared the experimental and control groups. Also, the researcher used the developmental research method for the development of learning activity sheets using interactive formative assessment and feedback mechanism. In the conduct of the study, each group consisted of seventeen (17) Grade 9 students enrolled through modular distance learning. The experimental group was given a pre-test, received a treatment, and then a post-test. Likewise, the control group was given a pre-test and a post-test but did not receive treatment.

Respondents - The respondents of this study were thirty-four (34) Grade 9 students from Bulan National High School chosen through a combination of purposive and random sampling. The purposive sampling technique was employed to select the regular class sections with at least 15 students who met the requirements to participate in this study. These requirements were: (1) must be enrolled in modular distance learning; (2) have an operational gadget or device; and (3) have reliable and accessible internet connectivity. After identifying the sections, with the help of the data collected by the teacher on students' profiles, one class was randomly selected, wherein both the experimental and control group were formed. For the experimental group, all students who met the requirements to participate in the intervention were given letters, and only those who were permitted became part of the group. Meanwhile, for the control group, 17 students from those remaining learners in the selected class section were chosen to match the number of participants in the experimental group. These students were randomly selected from those students who were able to complete all required activities and tests to be taken.

Additionally, the jurors who evaluated the developed learning activity sheets were nine (9) mathematics teachers from Bulan National High School (BNHS) and San Francisco National High School (SFNHS). In contrast, those who evaluated the research instruments were teachers from Gallanosa High School (GNHS), Bulan National High School (BNHS), JP Laurel High School, Sta. Magdalena National High School, and Sorsogon State University (SorSU). All of these teachers are designated in schools within the province of Sorsogon. Furthermore, the pilot test of the conceptual understanding test was administered to one regular section of Grade 10 students from GNHS.

Procedures - The Learning Activity Sheets (LAS) using Interactive Formative Assessment and Feedback Mechanism were conducted on Grade 9 students of Bulan National High School for four weeks. The experimental group used the developed LAS by the researcher throughout the study, while the control used the learning activity sheets developed and provided by the school. However, both the developed LAS and the LAS provided by the school hold the same learning objectives and competencies and include parallel learning activities. The main difference was that the learning activity sheets developed by the researcher were designed to use interactive formative assessment and feedback mechanism, allowing the experimental group to engage in both offline and online learning tasks. In contrast, the control group was purely offline or modular. Moreover, in the LAS made by the school, the *Let Us Practice* is a multiple-choice method of evaluating student learning and includes the answer for the activities.

Both experimental and control groups each composed of 17 students. For the control group, the students followed the activities prescribed by their school. These students receive the LAS, learn the lessons independently then submit them at the designated time period. On the other hand, the experimental group had modified learning activities. These students received the developed learning material, learned and responded to the activities independently, submitted answers at the designated time period to the teachers' personal messenger account, attended a video conference for some interactive assessment and received feedback from their teacher and peers. It is the researcher who facilitated these activities for the experimental group.

During the video conference, students in the experimental group were able to interact with their teacher and classmates. For the first phase of interaction, students were randomly asked to present their answers on the activities for checking then both their teacher and classmates could give them feedback. Next, students were divided into small groups to complete a unified work for the quiz. They made use of messenger group chat for this task, where the teacher was also a member for the purpose of monitoring. And lastly, present their group's output in a whole class discussion where both their classmates and teacher can again give them feedback. For all these

interactions, students were allowed to react to the feedback provided to them. Furthermore, this cycle of learning tasks was repeated for all the learning activity sheets developed.

The result from the pre-test and post-test was compared, analyzed, and interpreted to discuss the effects of Learning Activity Sheets using Interactive Formative Assessment and Feedback Mechanism on students' conceptual understanding, interpersonal communication skills, and interest in learning mathematics. Also, the analysis of students' journals, teachers' observations, and focus group discussions was made to determine the dynamics of the feedback mechanism used in this study.

3. Results and discussion

3.1 Developed learning activity sheets using interactive formative assessment and feedback mechanism

There were ten (10) learning activity sheets (LAS) developed in this study which were designed to deliver the lessons on the learning competencies for similarity of triangles of Grade 9 Mathematics mentioned in the curriculum guide provided by the Department of Education (DepEd). Each developed learning activity sheet also used two features which are Interactive Formative Assessment and Feedback Mechanism, aside from including the suggested parts of the LAS cited in DepEd V Regional Memorandum No. 51 S. 2020. Interactive Formative Assessment refers to the set of learning activities that provide greater opportunity for an active interaction of students to their peers, teacher, and learning materials during the formation of learning. On the other hand, Feedback Mechanism is the collective method and tools which can be used to facilitate the process of providing and receiving feedback while in remote learning.

In order to give way for the use of the two features, some modifications were made to the prescribed content of Learning Activity Sheets in Regional Memorandum No. 51 S. 2020. There were parts that were removed, added, replaced, and rearranged for all the activity sheets. Now, the parts of the developed learning activity sheets were: Learning Skills from MELCs, General Instructions, Introductory Concept, Activities, Rubrics for Scoring, and References. The Learning Skills from the MELCs part presents the objectives and competencies that students need to learn and perform in line with the Most Essential Learning Competencies (MELCs) provided by the Department of Education. MELCs was a simplified version of the original curriculum to achieve the content and performance standards expected of the students in various learning domains under the challenges brought by the COVID-19 pandemic. Meanwhile, the General Instructions include the overall directions for students on what needs to be accomplished in connection with the learning tasks, what can be expected from the LAS, what preparations must be done, and what activities need to be attended. Next, the Introductory Concept presents an overview of the present topic through trivia, examples, illustrations, etc., so that the students would have a clear perspective of the lesson. It also introduces and describes the activities that the learner needs to perform throughout the activity sheet.

Then, in the Activities, a review of the previous lesson, discussion of the present topic, guide questions, learning tasks, quiz, and pointers to remember are included. This part was subdivided into four sections, namely: Let Us Review, Let Us Study, Let Us Practice, and Let Us Remember. Let Us Review emphasizes recall of the relevant concept/s learned from the previous lessons in order to connect them to the present topic. Let Us Study presents different tasks that will deepen the learner's understanding of a skill or concept identified in the objectives or MELCs. This section includes the lesson and exercises necessary for the lesson focused on problem-solving and measuring higher-order thinking skills. Moreover, Let Us Practice serves as the quiz, which gives highlights the use of open-ended questions, while Let Us Remember highlights the key concepts students need to grasp in that particular lesson. After Activities was the Rubrics for Scoring, the Rubrics for Scoring was intended to serve as a guide for the teacher and peers in the evaluation of the performance, problem-solving, and process skills of the learners. It shows what are the expected answers and performances from the students along with those mentioned areas. Last, the References contains the sources of the information, images, data, and even the sources of the modified activities and the included contents that came from books or online sources. Concurrently,

Reflection and Answer Keys are not included in the Learning Activity Sheets since separate journals were provided for the students, and the correct answers were revealed through a feedback mechanism.

Table 1 presents the concepts covered by each developed learning activity sheet (LAS). It includes the Most Essential Learning Competencies (MELCs) being covered, the title and number of the learning activity sheets, and the learning objectives each activity sheet aims to achieve.

Table 1

Concepts Covered by the Developed LAS for Grade 9 Mathematics

Most Essential Learning Competencies	Learning Activity Sheet Number and Title	Objectives
The learner describes a proportion.	LAS 1 Describing Proportion	<ul style="list-style-type: none"> Write proportions of quantities from a given illustration. Define a proportion. Solve for the unknown term in a proportion.
The learner applies the fundamental theorems of proportionality to solve problems involving proportions.	LAS 2 Properties of Proportion	<ul style="list-style-type: none"> Rewrite proportions according to the fundamental theorems of proportion. Verify the proportionality of the rewritten proportions. Solve problems involving proportions.
The learner illustrates the similarity of figures.	LAS 3 Similarity of Figures	<ul style="list-style-type: none"> State the conditions which guarantee that given figures are similar. Identify similar figures. Solve for the missing measures of similar figures.
The learner proves conditions for similarity of triangles. <ul style="list-style-type: none"> SAS Similarity Theorem SSS Similarity Theorem AA Similarity Theorem Right Triangle Similarity Theorem Special Right Triangle Theorems 	LAS 4 AA Similarity Theorem	<ul style="list-style-type: none"> Describe the AA Similarity Theorem. Prove the conditions for similarity of triangles involving AA Similarity Theorem.
	LAS 5 SSS Similarity Theorem	<ul style="list-style-type: none"> Describe the SSS Similarity Theorem. Prove the conditions for similarity of triangles involving SSS Similarity Theorem.
	LAS 6 SAS Similarity Theorem	<ul style="list-style-type: none"> Describe the SAS Similarity Theorem. Prove the conditions for similarity of triangles involving SAS Similarity Theorem.
	LAS 7 Right Triangle Similarity Theorem	<ul style="list-style-type: none"> Describe the Right Triangle Similarity Theorem. Prove the conditions for similarity of triangles using Right Triangle Similarity Theorem. Solve Problems involving the Right Triangle Similarity Theorem.
	LAS 8 Special Right Triangle Theorems	<ul style="list-style-type: none"> Prove the conditions for similarity of triangles involving 45-45-90 special right triangles. Prove the conditions for similarity of triangles involving 30-60-90 special right triangles. Solve problems using Special Right Triangle Theorems.
The learner applies the theorems to show that given triangles are similar	LAS 9 Applying the Triangle Similarity Theorems	<ul style="list-style-type: none"> Prove the similarity of two triangles using similarity theorems. Solve for the unknown measures of similar triangles using similarity theorem to show that given triangles are similar.
The learner proves the Pythagorean Theorem.	LAS 10 Pythagorean Theorem	<ul style="list-style-type: none"> Prove the Pythagorean Theorem. Solve problems applying the Pythagorean Theorem.

Interactive Formative Assessment - In each of the developed learning activity sheets, there were interactive formative assessments used. These were a set of learning activities that provide greater opportunity for students to have an active interaction with their teacher, peers, and learning material while the teacher monitors student learning progress. In this study, interactive formative assessment prompted four natures of interaction, namely: student to the learning activity sheet, student to other students during small group discussion, student to other

students while in the large group, and student to the teacher. Table 2 presents the interactive formative assessment used in the developed learning activity sheets according to the nature of interaction.

Table 2

Interactive formative assessment according to the nature of interaction

Student-to-Learning Activity Sheet	Student-to-Teacher	Student-to-Student (Small Group)	Student-to-Student (Large Group)
<ul style="list-style-type: none"> Ask students to independently provide complete answers for the Activities, Guide Questions, and Practice Task included in the LAS by following the indicated instructions. Then, let the students submit a photo of their answers on a scheduled date through messenger. 	<ul style="list-style-type: none"> Randomly select students to answer a particular question or problem during the checking of activities included in the LAS. Require short responses (keywords) to questions or instructions. 	<ul style="list-style-type: none"> Through a Small Group Discussion, allow the students to revise and complete their responses in the Let Us Practice within a limited time by contributing ideas, providing meaningful arguments, giving feedback, and formulating one final output. 	<ul style="list-style-type: none"> Ask each small group to have a presentation of their output in the video conference. Allow other students or groups to provide feedback to the presenting student or group. Instruct students to answer follow-up questions or discussions.

The *student-to-learning activity sheet interaction* is the engagement of the students to the activity sheet itself, particularly in every of its part, such as the Activities, Guide Questions, and Practice Task (Let Us Practice). In this light, students are required to independently complete and answer the learning tasks, guide questions, and problems in the learning activity sheet (LAS) by providing the appropriate answers as demanded in the activity/problem and by following the instructions indicated in each part of the LAS. To make this possible, the included activities all throughout the activity sheets were designed just as if it guides the students to have the correct answer by providing substantial examples, hints, systematic step-by-step procedure, and accurate visual illustrations of the problem at hand. Also, the problems and questions in the LAS were focused on problem-solving and measuring higher-order thinking skills where students need to create solutions and provide justifications. Aside from the activities, each learning activity sheet also includes an interactive quiz at the end of every lesson. This quiz was labeled as Let Us Practice and is strictly consistent with the lesson's objectives which mostly consisted of one item per objective. More importantly, for monitoring, the students were then tasked to submit pictures of their output on a fixed schedule via the teacher's personal messenger account.

Next, the *student-to-teacher interaction* is the interaction between the students and the teacher. This takes place during small and large group discussion when the teacher provides the correct answer and give feedback to students as an individual or group. In this, students are expected to listen attentively and follow all the instructions, participate actively, and answer supplementary questions during the whole class discussion. In relation to this, the teacher used two formative assessments: First, randomly selecting students to answer a particular question or problem during the checking of activities included in the LAS, which also oblige the students to present output in the google meet and provide a clear explanation of their answers that directly reveals their understanding of the lesson; and second, requiring students to send short responses to questions or instructions, like keywords or emojis, in the google meet chat box or messenger group chat to secure that they understood clearly the directions or topic.

Meanwhile, the *student-to-student (small group)* is the resulting interaction when the students from the same small group work collaboratively via messenger group chat to finish a common task. To realize this, each student was asked to contribute ideas by sending their answers in the form of text or pictures, have meaningful arguments or discussions with groupmates, and give feedback. The main objective of the small group discussion was for each group to revise and complete their response in the *Let Us Practice*. For monitoring, as one of the purposes of formative assessment, the teacher was a member of every small group's group chat, and there was an assigned leader to facilitate the discussion. On the other hand, *student-to-student (large group)* is the interaction of students in a whole class set-up. This was done in two events: firstly, during the checking of activities, and secondly, after

the small group discussion. For both events, students were asked to present the output in a large group setting and were urged to give feedback on the output of the other student or group. Aside from that, if there's a follow-up question or discussion from the teacher or classmates, they are obliged to respond. Generally, all of these four types of interactive formative assessments were applied and observed in every developed learning activity sheet.

In addition, Interactive Formative Assessment was mainly rooted in the nature of the questions or problems of every task and in the process of giving and receiving feedback. Hence, for the questions or problems, the whole thing was anchored to problem-solving and measuring higher-order thinking skills to let the students provide or share answers based on their creativity. This type of problem also gave them the opportunity to discuss with their classmates and then later on, exchange feedback. Meanwhile, feedback, as a vital element of assessment, was the core component of interactions in the formative assessments, particularly during student-to-student and student-to-teacher interactions. Through delivering and receiving feedback, students had a meaningful interaction with their classmates and teacher throughout the lessons. Thus, here is where Feedback Mechanism comes in, in order to manage these formative interactions.

Feedback Mechanism - The feedback mechanism includes an organized method to facilitate two-way feedback communication between students and teacher. It identifies where the feedback will come from, what tools can be used to deliver the feedback, how to properly for the feedback, and how the feedback can be delivered to and received by the students. Hence, the feedback mechanism, as defined in this study, is the systematic method that both students and teachers can use to deliver and receive appropriate and meaningful feedback with ease and efficiency. Table 3 shows the feedback mechanism used in the developed learning activity sheets. It presents the sources of feedback, online tools, feedback models, and manner of delivery (e.g., schedule, procedure) of the feedback mechanism used in this study.

Table 3

Feedback Mechanism used by each Learning Activity Sheet

Source of Feedback	Teacher	Peers
Online Tools	Google Meet	Google Meet, Messenger
Feedback Model/s	Feedback Sandwich, Pendleton's Model of Feedback	Situation, Behavior, Impact Feedback Tool
Manner of Delivery	<ul style="list-style-type: none"> • A day after the scheduled sending of answers, ask the students to join a synchronous online meeting via Google Meet. • In the video conference, randomly selected students will be allowed to share/present their output during the checking of activities while the other students and the teacher will provide feedback afterward. • Then, for the next 30 minutes, the class will be divided into three (3) groups. Each group will be invited to a Messenger Group Chat (GC) exclusive for the group members and the teacher. In the GC, the students will be allowed to share discussions through constructive feedback by maximizing the features of the app like chatting, sharing pictures, sending emojis, having a group call, etc. • After the allotted time, a whole class presentation will then take place in the Google Meet. Each group has a presentation. And then again, other students/groups and the teacher will provide feedback afterward. • All throughout, each student can use the Situation, Behavior, Impact Feedback Tool by following these directions: 1) Select and describe a particular situation/topic/item to discuss with; 2) Discuss the performance; 3) Describe the impact of the performance to the output. • Meanwhile, the teacher can provide overall feedback using Feedback Sandwich: 1) What are skills/topics the student/s good at? 2) What things were done wrong?; 3) What are the things they can keep going? or by using Pendleton's Model of Feedback: 1) Select a positive performance; 2) Reinforce the Positive Performance; 3) Suggest/Recommend other way to answer the problems. 	

There were only two sources of feedback for every student's output, that is, the students' peers and teacher. Peers include all classmates in the small group or from the class as a whole, while the teacher was the researcher that conducted the study. Meanwhile, for the online tools, there are two online platforms, along with their built-in features, that were used. Google Meet (formerly known as Hangouts Meet) is a video-communication service

developed by Google and Messenger that is an instant messaging app and platform developed by Meta Platforms (formerly known as Facebook). These online applications were used by students and the teacher to give and receive feedback on the checking of activities and small and large group discussions. Particularly, the Google Meet was used for video conference and chat, while Messenger for chat, video call, voice call, sharing pictures or video, giving emoji reactions, gifs, or stickers, and sending voicemail.

From the above description, the feedback model was used in this study through the following organized guide. First, for Feedback Sandwich Model, the questions were: What are the skills/topics he/she good at?; What things were done wrong?; and What are the things they can keep doing?. Next, for Situation, Behavior, Impact Feedback Tool, the process was: Select and Describe a particular situation/topic/item to discuss with; Discuss the performance; and Describe the impact of the performance to the output. Lastly, in Pendleton's Model of Feedback, the procedure was: Select a Positive Performance; Reinforce the Positive Performance; and Suggest/Recommend other ways to answer the problems. In order to deliver more structured feedback, the teacher and students followed these guides. It was recommended for teachers to use the Feedback Sandwich Model and Pendleton's Model of Feedback while the Situation, Behavior, Impact Feedback Tool for the students.

The students are encouraged to provide feedback on other students' or groups' output and performance during large group and small group discussions. They are allowed to use all the features of the online tools, specifically Google Meet for Large Group and Messenger for Small Group, with the guidance of the feedback models. Meanwhile, the teacher will only provide feedback during large group discussions unless there's a necessity to do it during small group discussions, such as addressing misconceptions. More importantly, it is always the teacher who gives the final feedback to the student or group. These mechanisms were applied all throughout the developed learning activity sheets. With both interactive formative assessment and feedback mechanism used in the developed learning activity sheets, the students were hence exposed to both online and offline instruction while learning through distance education.

3.2 Dynamics of the Feedback Mechanism

Teacher's Feedback

Guides the Student in Achieving the Intended Outcome. The main goal of providing feedback is to help students improve in their situation or performance (Mind Tools, n.d.). This implies that students need to receive feedback on what they did either correctly or incorrectly in order for students to properly achieve the expected outcome set before them. Throughout the use of the feedback mechanism in this study, the teacher served as the main facilitator that offers guidance by being the last person to give feedback for every output in an individual or group setup through giving affirmation or correction on students' output, explaining and clarifying misconceptions, and providing recommendations. Each time the teacher gives feedback to students, he covers both correct and incorrect answers. For the correct ones, the teacher affirms the answers and encourages students to continue doing the positive behavior they executed during the performance while for the incorrect answers, he gives the necessary correction, explains why and what the students did wrong, then offers recommendations on how to improve the performance. By doing these, the students were able to confirm their understanding of the lesson and were able to know what additional knowledge and skills they still need to acquire which can be used in future performances. As a result, the feedback mechanism became helpful for students to achieve the standard of the lesson with ease.

For instance, during the checking of activities for LAS 6, a student presents her answer for the proof to show that the pair of triangles given in the problem are similar under SAS Similarity Theorem. The student was able to present the right statements in the S-R proof but gave some wrong reasons under the proof, particularly in the statements concerning the properties of equality, such as the distinctions between reflexive, symmetric, and transitive properties. The teacher then provided feedback by stating the correct things the student was able to do. It was followed by identifying the wrong responses in the presentation, which resulted in the discussion of the conditions and differences of reflexive, symmetric, and transitive properties of equality. Meanwhile, after the

checking of activities, the students were divided into small groups to complete the tasks in the *Let Us Practice*. Then, a presentation of output in a whole class setup took place.

During the presentation of group output for LAS 6, most groups were able to arrive at the correct proof about the similarity of two triangles that involve the properties of equality which were one of the emphases of the feedback during the checking of activities. These indicate that the teacher's feedback guides the students to achieve the appropriate learning concepts, skills, and attitudes intended for that lesson. To further support this claim, students were asked, through a student journal, by the question, "did your teacher's feedback improve your knowledge on that particular lesson? Why or why not?". One student answered: "*yes, because with the teacher's feedback it makes me know what's right and what's wrong.*" Also, another student answered the same question and mentioned: "*Nakatulong po ito dahil mas naging malinaw at mas naging madali ang lesson.*" (Yes, it helped me because it made the lesson clear and easy). These statements reveal that the feedback of the teacher was able to contextualize the lesson based on what students needed to do or not to do, and it was able to give students a clear understanding of the tasks. These statements were consistent with the responses of the students when interviewed through online focus group discussion, and were asked to share how receiving feedback from their teacher affected their learning. Two students said, "*may-on po pano didto sang ang iba po na namali po talaga ako sa pag answer sa mga activities, tapos pag abot po namo sa Let Us Practice, sa GC po бага, nakadanon man ako kay nabati ko na saimo ang tama na answer, sir*" (There are some parts of the activities that I answered incorrectly. Then, on our GC, while doing the Let Us Practice part, I was able to contribute ideas because I already know how to do it based on your discussion, sir); and "*nakocorrect tapos mas napapaayos ang work para next time diri na po masala*" (It helps to correct and improve the work so that the mistakes will not be committed again next time), respectively. These statements signify that the students recognize the ability of the teacher's feedback to let them achieve the intended learning outcome.

Provides Student a Challenge. Since the feedback mechanism was new to the students during the first day of implementation, there were challenges observed on the part of the students, such as being shy in interacting with others, specifically the teacher, having a fear of doing the presentation, and acquiring the courage to respond on the feedback given to them. As an observer viewed the recorded videos of the actual conduct of activities in google meet, it was noticed that some students were shy and hesitant to interact in the presence of the teacher. Moreover, it was also observed that students are very selective in responding to their teacher's feedback. Oftentimes, the learners just wholly receive the feedback without showing any feeling of doubt. The teacher-observer said that "Students are shy and hesitant. They often agree with the feedback. There are also who makes a follow-up question but very minimal." During the video conference, in time for providing feedback on students' output, the teacher gives feedback for both correct and incorrect performances as guided by feedback models. It's a combination of affirmative and corrective feedback. These gave students encouragement to continue what they did correctly and also correction for those incorrect items. Even though students don't have any knowledge of what the content of the teacher's feedback will be, the students still become nervous during the session.

In addition, during the presentation of groups' output to the class with the teacher, it was seen that the answer of the presenting group was incomplete in the task where they were asked to provide a two-column proof for a given problem. While preparing, the representative was heard speaking the words "*kinukulbaan ako*" (I'm nervous). Moreover, in the presentation, the student was also noticed to display stuttering and shaky voice, uttering repeated words, and breathing rapidly, as reflected in the sound generated from the microphone. But, in the end, the student was able to properly present the output, and the teacher commended their work and then taught them what the correct answer for that incomplete item was and how to complete the proof. This observation was similar to the response of one student during an online focus group discussion which mentioned, "*kapag nagfeedback na ang aming guro sa aming ginawa, minsan kinakabahan lalo na kapag alam na naming may kulang kami*" (when the teacher starts to give feedback on our output, sometimes I feel nervous especially when we know that our answers are incomplete). In this case, the student was challenged to handle their emotions, particularly when they thought that the teacher's feedback was not positively in their favor. Also, the manner of the communication might add up to this challenge since, aside from it uses online tools, when the teacher gives feedback, he directly speaks to an

individual or group who is presenting and not in a general manner. Above all, this reveals a beneficial challenge for students to develop more confidence in presenting in a group and to improve more skills in communicating with other people.

Promotes Healthy Communication. In the feedback mechanism used in this study, two-way communication was encouraged mainly because the mechanism was conducted through online communication tools where students and the teacher needed to interact. Hence, it is significant to describe how the feedback mechanism through the teacher's feedback affected students' communication skills. According to Brown (2013), healthy communication is the ability to communicate without offering hateful or undesirable responses and to receive a message with a welcoming spirit. It was observed that during the conduct of learning activities, no student disqualified the teacher and his feedback. The students oftentimes listened and received the given feedback with kindness. As a teacher-observer wrote, "On positive feedback, those [that] reinforce correct answers, [and] students are happy to hear it as it serves as motivation and confirmation of their understanding of the lesson, while on the negative feedback, those for the incorrect answers, they take it as a way to improve work. This can be reflected [in] the group chat messages." The statement indicates that students value both positive and negative feedback in order to enhance their performance.

This finding is in agreement with one instance that occurred in the large group discussion during the presentation of small groups' output. A presenter of one group was too confident in their answer that even after receiving feedback from the other group indicating that they were wrong in a particular problem, the student insisted that they were correct on that item. However, after the teacher provided feedback on every group's work, the student learned that the question was tricky and that they were incorrect. Immediately after knowing that, the student shared in their respective group chat, "*Mali pala answer ta. HAHAAHHA. Niyan ko lang na realize. Kala ko 6 [yadto]. 3 palan*" (Our answer was incorrect. HAHAAHHA. I just realized now. I thought it was 6. It was 3 actually), it can be said that students receive teacher's feedback warmly without losing their interest on the subject. Moreover, the common statements "*ahh ok po,*" "*thanks,*" and emojis "*heart,*" "*ok*" after every teacher's feedback affirms the claim that the mechanism promotes healthy communication. For instance, after the feedback of the teacher to group 2, one member of that small group asked a question concerning one item. Then, the teacher replied by sending a photo of the solution and an explanation of that solution. Later, the student again asked another question to support their group's answer. However, it is clear that their answer is incorrect. Hence, the teacher replied with another explanation regarding the second question. In the end, the student said, "*ahh ok po, thanks,*" which indicates that they accepted the feedback. Furthermore, throughout the conduct of the study, as a result of the teacher's feedback, there was no indication that students were offended or harmed in every possible way. This result might be probably because the feedback of the teacher was focused on the tasks rather than the student. The feedback that the teacher provided was all about describing the actual performance and telling students how to improve those performances.

Arouses Student Interest while Learning Mathematics. In an online interview, students mentioned that it was their first time attending such feedback mechanism, especially since it was online. Students also added that they really wanted to receive feedback on their output from their teacher. As one student wrote in the student journal, "*kung wala iyon [feedback mechanism] ay marahil di namin alam ang feedback ng aming guro sa aming ginawang output.*" (If without that [feedback mechanism], we might not be able to know our teacher's feedback on the output that we are doing). Throughout the whole utilization of the learning activity sheets, the feedback mechanism, as a result of the teacher's feedback, was able to arouse the interest of students in mathematics. In giving feedback, the teacher makes sure that performances and outputs are corrected but still does not invalidate student efforts and abilities. The teacher always reinforces positive performance by giving favorable feedback, which highlights the things the students did right and may continue doing. Through this, the students were able to gain confidence and motivation to learn the subject.

From the responses of students in the focus group discussion, it was mentioned that the teacher's feedback motivated and made them enjoy the lesson. One student said, "*...mas naghahatag po siya enjoyment or thrill lalo*

na po kung tama po ang simbag mo, mas naaraman mo kung may naaraman ka talaga sa lesson na yadto." (It gives enjoyment or thrill especially when our answers are correct, we can more identify that we understood the lesson). Likewise, in another journal of one student to answer the question, "did you find your teacher's feedback interesting and helpful? Why or why not?" it was written, "*Yes, because when your teacher [critiques] you, you are more motivated to improve your work[s].*" These imply that students considered the teacher's feedback as a reward for their performances and outputs. In addition, it was also noticed in one situation that after the teacher had provided feedback in favor of a group's output, a member of the group chatted these phrases, "*yey, tama us*" (yey, we're correct) followed by another member who replied, "Nice." The event was taken from LAS 1 - item 3. The group was able to present the correct answer and accompanied it with appropriate reasoning, while the rest of the small groups were incorrect. In the feedback, the teacher commended the group for thinking critically, identifying the errors of the given problems, and supplying the correct solution even though it was not asked in the problem. Hence, giving the group the highest score for that task.

In a different scenario, a student messaged, "*Ma pa party ako kay tama kita*" (I'll host a party since we're correct) after the teacher provided feedback that supports their group. This part was taken from LAS 9 - item 1, where students were asked to identify the pairs of triangles which can be proven similar using similarity theorems. Instead of identifying 3 answers out of 4 choices, the group was only able to select 1, but their choice and reason were seen to be interesting. It was not the typical explanation expected of the students, but it was an explanation that led to one. Hence, the reasoning was considered correct. Then, in the teacher's feedback, the students received a commendation but were still reminded of the best answer for that item. Henceforth, resulting in the reactions presented in Plate 9. Furthermore, in most cases, students share '*celebration*' and '*heart*' reactions in their group's messenger group chat every time the feedback for them sounds like praise. These all imply that students considered the teacher's feedback as a reward for their performances.

Peers' Feedback

Sparks Skepticism. Unlike teacher's feedback, where the learners just wholly receive the feedback without any feeling of doubt, in some cases, peers' feedback makes the students think twice. It was identified that some students' feedback made their other classmates confused about the topic. During the time of providing feedback, all students are allowed to give any feedback they decide based on their understanding of the lesson. There were those who focused on just one item while others focused on the whole output. However, some feedback caused uncertainty on the part of other students. For small groups, when there were students who mentioned a different comment from the majority of the members of the group, students tended to delay their decision of the final answer until the concept was clear to all of them. On the other hand, in the large group discussion, those who offered feedback often say that they are not sure about what they have said, and this has an impact on the one receiving the feedback.

In one case, during students' interaction in their small group for LAS 9, the leader started the discussion by asking the members to present their answers. For a particular item, one student said, "B" while another student mentioned "A". Both were trying to share their explanation. In this case, the students started to clash ideas since they already had an opposing answer right at the beginning of the lesson. Later, another member shared that his answer was as well for "A" and was accompanied by an explanation. But this even made the discussion confusing. Moreover, the fourth member added up that the correct answer was the letter "B" stating the reasons why "B" and why not the letters "A", "C", and "D". In the end, after minutes of discussion, the group decided to have the letter "B" as their group's answer. Nonetheless, the group got the correct answer since it was the letters "A", "B", and "D" that satisfied the problem. This shows that peers' feedback tends to confuse other students and made them doubtful of their own stance.

Moreover, as one student said in an online interview about the influence of peers' feedback: "*nalilibungan ako minsan sa tukdo nira*" (I am sometimes confused about what they are saying). Similarly, another student mentioned, "*Sir, minsan depende sa opinion nan base man sa kagrupong kay minsan seryoso na, di mo pa aram*

kung karaw” (Sir, it depends on the opinion and who said it because there were times that it was hard to identify whether they are serious or not). When somebody from the class gives his/her feedback, the students tend to first verify it with the help of the remaining members of the class. Also, the source and content of feedback were big factors in accepting it. Students most likely respond to the feedback in favor of them and when the source of feedback are students who they think are knowledgeable. Above all, during misconceptions, the teacher was the one who clarified everything in the whole class discussion.

Helps Form Better Relationship Among Students. In the feedback mechanism, students were given the opportunity to work together with their classmates in completing an activity and providing feedback. Students were allowed to give insights into their classmates' work through small group and whole class discussions. This feedback, similar to the teacher, did not just focus on correction of performances but also on reinforcing positive behavior, which resulted in the building of trust on the part of the students. Each student was able to provide honest feedback, which intends not to flatter but to help their classmate or groupmates.

It was observed during the conduct of the study that every time students were called to present their work during the checking of activities and presentation of each group's output in a whole class discussion, they actively participated. It was also noticed that students were able to share their output without fear of peers' feedback. As a teacher-observer mentioned, "*students welcomed all the ideas and suggestions presented during group discussion.*" In addition, as one student explained, "kay pag kunyare ngay, nararaway ka sabihon kay di ka sigurado kung tama o mali tapos pag insabi mo na siya may mareact nan masabi saimo kung yadto na inano mo kung kumusta yadto. sa irog sadto, diri makakaraway kay part siya sing lesson" (example, I am anxious to share something because I am not sure if it's right or wrong, then somebody will react to that, on that kind of process (feedback mechanism), I became more relax since it's already part of the lesson). It can be said that whatever feedback students give to their classmates will be considered and pondered without expressing any unethical behavior. Furthermore, one student gave an overall comment about the feedback mechanism and said, "*naging maganda naman ang aking karanasan dahil naging malapit ako sa ibang estudyante at sabay-sabay kaming natuto*" (I had a good experience because I was able build good relationship with my classmates and learned together with them). It can be concluded then that the feedback mechanism helped them to build good relationships with other students.

Makes the Completion of Tasks Easy. The formative assessments included in the developed learning activity sheet were designed to result in interaction between students and the teacher that needs to be facilitated by a feedback mechanism. During the quiz labeled *Let Us Practice*, the students were divided into small groups and were assigned to work cooperatively and collaboratively with their classmates to complete the tasks within a given time. It was observed, during this moment, that students had some discussion and were able to work with their classmates willingly, as revealed in their group chats. While doing the quiz, most of the time, students work from beginning to end, from one item to the next. It was the leader who frequently started the conversation and the one who facilitated the group's discussion. They begin by sharing one answer on a specific item, and then other members of the group will agree or disagree and have some discussions until such time that the group already has a consensus for their answer in that item. Afterward, they will go to the next item, following the same procedure until all items are answered.

As observed in one small group's GC, one student started the discussion by sharing a photo of their answer. It was then followed by other students giving feedback on the output. This led to the revision of answers and having a uniform answer for the group. Meanwhile, in another group, a similar procedure was presented. A member of the small group shared her output, and then another student gave affirmation while some students mentioned an observed correction. On that matter, the group had a discussion and then finally arrived at a unified output.

When asked by the question, "Did your classmates' feedback help you in understanding the lesson? Why or why not?" some of the answers in the student journal were: "*Yes, I was able to compare my errors to them*"; "*Yes, they made me know what would be the right thing to do*"; "*Opo, kapag may kulang or may mali kinocorrect nila ito*" (Yes, if there are incomplete or wrong answers, they correct it); and "*Yes, because sometimes in their*

cooperation there are parts of the lesson that [I] improve[d]." Based on these statements, it can be clearly inferred that the students were able to help each other through sharing ideas and thoughts and giving and receiving feedback which leads to saving more time and easy completion of tasks. This indicates that peers' feedback helped students to easily accomplish every task required for them, especially in group activities.

3.3 *Effects of the developed Learning Activity Sheets Using Interactive Formative Assessment and Feedback Mechanism*

Conceptual Understanding

Learning materials, such as self-learning modules and learning activity sheets, are designed to guide the learners in understanding the concepts and skills for which it is intended (DepEd, 2020). For that reason, the study sought to determine the effects of the developed learning activity sheets using interactive formative assessment and feedback mechanism in terms of students' conceptual understanding. According to the National Research Council (2001), A significant indicator of acquiring mathematical conceptual understanding is the ability to apply their gained knowledge to new situations and contexts. Hence, aside from the formative assessments included in the developed learning activity sheet, a separate 40-item multiple choice conceptual understanding test, which serves both pre-test and post-test, was administered. Table 4 presents the results of the students' conceptual understanding before and after the utilization of learning activity sheets for both experimental and control groups. The table also includes the mean scores, performance level, p-value, and effect size.

Table 4
Result of Students' Performance on Conceptual Understanding

Concepts	Experimental Group						Control Group					
	Pre-test			Post-test			Pre-test			Post-test		
	Mean	PL		Mean	PL		Mean	PL		Mean	PL	
	%	D	%		D	%		D	%		D	
Describing Proportion	3.06	61	AM	3.82	76	MTM	3.00	60	AM	3.12	62	AM
Properties of Proportion	1.71	34	LM	2.76	55	AM	1.53	31	LM	1.71	34	LM
Similarity of Figures	1.59	53	AM	1.88	63	AM	1.24	41	AM	1.41	47	AM
AA Similarity Theorem	2.06	51	AM	2.94	74	MTM	1.53	38	AM	1.82	46	AM
SSS Similarity Theorem	1.65	55	AM	1.76	59	AM	1.35	45	AM	1.47	49	AM
SAS Similarity Theorem	1.76	59	AM	2.18	73	MTM	1.18	39	AM	1.94	65	AM
Right Triangle Similarity Theorem	1.12	28	LM	1.47	37	AM	1.18	29	LM	1.18	29	LM
Special Right Triangles Theorems	0.94	31	LM	1.59	53	AM	1.18	39	AM	1.12	37	AM
Applying Triangle Similarity Theorems	1.71	28	LM	3.06	51	AM	1.35	23	LM	2.18	36	AM
Pythagorean Theorem	1.18	29	LM	2.29	57	AM	0.71	18	LM	1.35	34	LM
Total	16.76	42	AM	23.76	59	AM	14.24	36	AM	17.29	43	AM
Mean Gain	+7.00						+3.05					
p-value	0.00 (Highly Significant)						0.01 (Significant)					
Effect Size	2.01 (Huge Effect)						0.59 (Large Effect)					
	1.41 (Huge Effect)											

Legend:
p < .05 - significant D - Description PL – Performance Level
 AM - Average Mastery LM - Low Mastery MTM - Moving Towards Mastery

It is presented in table 4 that the pre-test mean scores of 16.76 and 14.24 acquired by the experimental and control group, respectively, both indicate average mastery level. Through an independent two-tailed *t*-test with equal variances, it was identified that there is no significant difference between their pre-test scores at a *p*-value of 0.18. This implies that the two groups were on the same level prior to the implementation of the study. Hence, the experimental and control group are said to be comparable in terms of conceptual understanding.

Subsequently, the table shows that the mean score of the pre-test and post-test of the experimental group was

16.76 and 23.76, respectively. The scores, though both indicate an average mastery level, reveal that there is an increase of 7.00 in the experimental group's mean score after the use of the developed learning activity sheets. The results were further analyzed using a dependent right-tailed *t*-test, and it was found that the increase between the scores in the two tests conducted on the experimental group was highly significant at a *p*-value of 0.00. Furthermore, the table also shows that there is a huge effect on the conceptual understanding of the experimental group between the tests.

In terms of mastery level per concept, the experimental group also showed significant increases. For topics, Properties of Proportion, Right Triangle Similarity Theorem, Special Right Triangle Theorems, Applying Triangle Similarity Theorems, and Pythagorean Theorem, the group transitioned from 'Low Mastery' to 'Average Mastery'. While for topics, Describing Proportion, AA Similarity Theorem, and SAS Similarity Theorem, performance improved from 'Average Mastery' to 'Moving Towards Mastery'. On the other hand, for the topics, Similarity of Figures and SSS Similarity Theorem, the experimental group maintained an 'Average Mastery' level for both pre- and post-test. This implies that after the utilization of the developed learning activity sheets using interactive formative assessment and feedback mechanism the students in the experimental group were able to improve their understanding of the concepts about similarity of triangles.

For the control group, the pre-test had a mean score of 14.24, while the post-test had 17.29. These values both correspond to average mastery level. As presented in table 4, there is a noticeable increase of 3.05 in the control group's mean score, and the *p*-value of 0.01 signifies that the increase in the pre-test and post-test scores of the control group was significant. The effect size of 0.59 shows that there is also a large effect on the conceptual understanding of the control group between the two tests. This means that the students in the control group were also able to improve their understanding of the concepts under similarity of triangles. This was probably because the learning activity sheets used in the control group also covered similar lesson's objectives to that of the experimental group, included parallel activities, and contained a key to correction for all the activities. Aside from that, the control group possibly received minimal guidance from their classmates, parents, or teacher during the process of learning the provided learning materials as others might also have access to the internet, which may help them learn the concepts included in their LAS.

These implications were consistent with some of the findings of the study by Bibon and Barcenas (2021) about the coping mechanism of students on problems encountered in Modular Distance Learning (MDL). They mentioned that to cope with the difficulties encountered in MDL, students seek help from more knowledgeable others due to the unavailability of an immediate support system, and students refer to the internet for independent learning. Hence, allowing the control group to grasp the lesson even in distance learning. However, the only difference is that the developed learning activity sheets used interactive formative assessment and feedback mechanism, which allows the experimental group to actively interact with their classmates and teacher, such as working together in groups, presenting the tasks, and giving each other feedback.

Moreover, though both experimental and control groups acquired 'average mastery' for pre-test and post-test, it can be seen in the mastery level per concept of the control group that students slightly improved in their conceptual understanding of the concepts about similarity of triangles. For concepts, Describing Proportion, Similarity of Figures, AA Similarity Theorem, SSS Similarity Theorem, SAS Similarity Theorem, and Special Right Triangle Theorems, the control group retained an 'Average Mastery' from pre-test to post-test. While for topics, Properties of Proportion, Right Triangle Similarity Theorem, and Pythagorean Theorem, the group was consistent to have 'Low Mastery'. Only for the concept, Applying the Triangle Similarity Theorems, the group improved from 'Low Mastery' to 'Average Mastery'.

Furthermore, in the table, it can be seen that the post-test mean score of the experimental group is 23.76 and the control group had 17.29. Both mean scores were interpreted as average mastery level. However, there is a difference of 6.47 in the post-test mean scores between the two groups, and that difference is said to be highly significant at a *p*-value of 0.00. It can also be seen further that the effect size of 1.41 indicates a huge effect in the

post-tests of the two groups. This implies that after the utilization of the developed learning activity sheets, the experimental group performed better than the control group in the conceptual understanding test.

This led to the conclusion that the learning activity sheets using interactive formative assessment and feedback mechanism offer a positive effect on the students' conceptual understanding of learning similarity of triangles. As one student said in the focus group discussion, *"I was able to better understand how to solve and provide proofs regarding similarity of triangles through the group activities and with the help of my teachers' and classmates' feedback."* This indicates that after the utilization of the developed learning activity sheets, the concepts and competencies that should be demonstrated or developed by the students were attained. The conclusion supports the claim of the study of Campit et al. (2015) that social interaction like peer tutoring can enhance the math achievement of the students and should be used by mathematics teachers. Additionally, the findings were also reinforced by the study of Alcantara and Roleda (2016), which mentioned that the use of feedback mechanism has a positive effect on the students' mastery of content.

Communication Skills

One important skill that this present study aimed to determine was students' skill to communicate with other people, specifically with their teacher and classmates. As defined by Indeed (2020), communication skills are the ability to give and receive different kinds of information, which includes listening, speaking, observing and empathizing, whether through face-to-face interactions or in a digital platform. Throughout the utilization of the developed learning activity sheets, students need to interact with their teacher and other students through a small group and whole class discussion. Students' communication skills were evaluated using four criteria, namely Sending Clear Messages, Listening, Giving and Getting Feedback, and Handling Emotional Interactions. These criteria were adopted from Learning Dynamics' (2002) Interpersonal Communication Skills Inventory which is composed of 40-item questions intended for ten items for each criterion. Table 5 shows the result of the students' communication skills before and after the implementation for both experimental and control groups. The table also presents the mean scores, p-value, and effect size.

Table 5
Students' Communication Skills Before and After Implementation

Criteria	Experimental Group					Control Group					p-value	Effect Size	
	Pre-test		Post-test		Mean Gain	Pre-test		Post-test		Mean Gain		d	D
	Mean	D	Mean	D		Mean	D	Mean	D				
Sending Clear Messages	12.41	NI	16.11	NMCA	+3.70	12.94	NI	13.24	NI	+0.30	0.01	0.92	Very Large Effect
Listening	12.18	NI	16.76	NMCA	+4.58	14.00	NI	14.12	NI	+0.12	0.03	0.75	Large Effect
Giving and Getting Feedback	11.41	NI	15.82	NMCA	+4.41	13.12	NI	13.47	NI	+0.35	0.04	0.72	Large Effect
Handling Emotional Interactions	15.71	NMCA	18.12	NMCA	+2.41	14.71	NI	14.94	NI	+0.23	0.02	0.82	Very Large Effect

Legend:
 p<.05 - significant D - Description d - Cohen's D
 NI - Need Improvement NMCA - Need More Consistent Attention

During the pre-test, both the experimental and control group need to have an improvement in their interpersonal communication skills, particularly in the areas of sending clear messages, listening, and giving and receiving feedback, as presented in table 5. While for handling emotional interaction, the experimental group was

identified to 'need more consistent attention' and the control group to 'need improvement'. Through an independent two-tailed t -test with equal variances, it was identified that the p-value between the pre-test of the experimental and control groups along the four criteria were 0.17, 0.54, 0.18, and 0.09, respectively. The computed p-value for each criterion indicates that there is no significant difference between the capacity of both groups to send clear messages, listen, give and receive feedback, and handle emotional interactions. This implies that the two groups were comparable in terms of communication skills prior to the conduct of the study.

Meanwhile, as shown in table 5, for each criterion, the experimental group had post-test mean scores of 16.11, 16.76, 15.82, and 18.12, respectively, which indicates an increase of 3.7, 4.58, 4.41, and 2.41, respectively, from the pre-test mean scores. This tells that from 'need improvement' in the pre-test for sending clear messages, listening, and giving and getting feedback, the students improved significantly to 'need more consistent attention' in the post-test while a constant 'need more consistent attention' for handling emotional interactions were identified in both pre-test and post-test. A p-value of 0.00, through a dependent t -test, implies that there is a highly significant difference between the experimental group's pre-and post-test scores in sending clear messages, listening, and giving and getting feedback, whereas a significant difference for handling emotional interactions at a p-value of 0.01.

To further substantiate these significant differences, the effect size was calculated, and it reveals that for the first three criteria, there is a Huge Effect, while for the last criteria, there is a Large Effect between pre-test and post-test. From these four criteria, Giving and Getting Feedback had the biggest effect size of 1.58, which served a favorable result since feedback was a vital element for every learning activity sheet and was the core component of the interactive formative assessments which resulted in student-to-student and student-to-teacher interactions. It was then followed by Listening at 1.38, then Sending Clear Messages at 1.24, and last Handling Emotional Interactions at 0.67. Specifically, these results tell that the students demonstrated an increase in each criterion which concludes that the students in the experimental group had improved their communication skills after the use of the developed learning activity sheets, which used interactive formative assessment and feedback mechanism. It can be explained further that the students in the experimental group were able to improve in sending clear messages by talking effectively to other people using appropriate words and emotions, listening attentively and paying proper attention to someone talking, responding at the appropriate time, and receiving the intended message of a speaker. In addition, in terms of giving and getting feedback, students are able to accept constructive criticism, give and receive praise and disagreement, and can discuss topics without being defensive. Likewise, students were able to display skills in handling emotional interactions by not being easily upset when someone disagrees, handling their differences properly, and admitting mistakes if there are. These skills were observed all throughout the implementation.

As for the control group, it can be seen in Table 5 that in all four criteria, for both pre-test and post-test, the descriptive interpretation for students' mean scores is 'need improvement'. This implies that students in the control group had low communication skills in Sending Clear Messages, Listening, Giving and Getting Feedback, and Handling Emotional Interactions before and after the implementation of the study as compared to the Experimental Group. There were still minimal mean gains recorded from pre-test to post-test along with the four criteria. However, when the p-value of each criterion was computed using a right-tailed dependent t -test, it was identified that the pre-test and post-test of the control group in all four criteria had no significant difference at p-values 0.34, 0.44, 0.27, and 0.33, respectively. Moreover, small effects were recorded using Cohen's d . This implies that the control group struggled to improve their communication skills throughout the conduct of the study. This is probably because the control group was not fully given an activity where the four criteria for interpersonal communication skills may be performed. Unlike the experimental group, the students were able to participate in small group and whole class discussions wherein they were able to speak, listen, give and receive feedback, and interact with their classmates and teacher. Nonetheless, as the table shows, there are minimal mean gains before and after the implementation, which reveals that the control group might be able to perform the skill under the four criteria (sending clear messages, listening, giving and getting feedback, and handling emotional interactions) but under their own mechanism. According to the study of Calo, Calo, and Bustamante (2021), one of the coping mechanisms

of the students in their struggle in modular distance learning was to seek support from their friends, parents, or teachers through pieces of advice, sympathy, and encouragement which is usually emotional or academic in nature. It was also mentioned by one respondent that it is through messenger that he/she communicates with someone with regard to the academic struggle.

Overall, after the conduct of the study, as table 5 shows, there is a significant difference between the experimental and control group in terms of interpersonal communication skills throughout the identified criteria at p-values 0.01, 0.03, 0.04, and 0.02 ranging from large to very large effect. It means that after using the developed activity sheets and involving in the interactive activities, the experimental group now shows higher communication skills than the control group. This is consistent with the result of the study conducted by Centeno (2021) that by using interactive activities and communication platforms, the teachers help the students improve their communication skills.

Interest in Learning Mathematics

The influence of student interest in a particular subject is considerable. It is essential in order for a student to make use of learning material and engage in all activities included therein. According to McCarthy (2014), when a topic is connected to what students enjoy doing, they are more likely to spend time thinking, dialoguing, and producing valuable ideas. Hence, the researcher also measured whether the developed learning activity sheets (LAS) using interactive formative assessment and feedback mechanism have helped increase students' interest in math or not. To determine the effects of the LAS using interactive formative assessment and feedback mechanism on students' interest in mathematics, the Mathematics Interest Inventory adopted from the study of Calleja (2018) was given as a pre-test and post-test for both experimental and control groups. Table 6 presents the results of the interest in learning math of experimental and control groups before and after the implementation.

Table 6

Students' Interest in Learning Mathematics Before and After Implementation

	Experimental Group		Control Group	
	Pre-test	Post-test	Pre-test	Post-test
Proportion	0.4196	0.6922	0.5588	0.5569
p-value	0.00 (Highly Significant)		0.48 (Not Significant)	
Effect Size	0.86 (Very Large Effect)		0.17 (Small Effect)	
	0.71 (Large Effect)			

Table 6 shows the proportion of the students who responded "Agree" and "Strongly Agree" to each of the 30 statements about interest in learning mathematics (See Appendix A: Math Interest Inventory Checklist). Each statement was rated by the students as Strongly Agree (5), Agree (4), Undecided (3), Disagree (2), and Strongly Disagree (1). In the experimental group, the table reveals that the proportion of students who responded "Agree" and "Strongly Agree" in the post-test is higher than the proportion in the pre-test, with 0.6922 and 0.4196, respectively, indicating that there is a highly significant (p-value = 0.00) increase in the proportion of students who responded "Agree" and "Strongly Agree" after the implementation. While in the control group, it shows that the proportion of the students in the pre-test (0.5588) and in the post-test (0.5569) reveals a decrease in the proportion who responded "Agree" and "Strongly Agree" after the use of the learning activity sheets in Grade 9, indicating that there is no significant (p-value = 0.48) change in the proportion of students who responded "Agree" and "Strongly Agree" after the use of the conventional learning activity sheets.

In addition, after the use of the developed learning activity sheets, the interest of the experimental group increased while the interest of the control group decreased. For the experimental group, from 3.44 (moderate interest) to 3.98 (high interest), a significant 0.54 increase was demonstrated. This has a Very Large Effect on the interest of the experimental group between the pre-test and post-test. On the other hand, the control group's interest dropped from 3.64 to 3.54, though it is still interpreted as a high interest level of interest. This minimal drop in students' interest in the control group might be a result of a few interactive activities and interactions with peers

and teachers. According to a study by Casiple et al. (2018), teachers and peers are some of the factors that affect the interest of students in learning mathematics. They asserted that direct motivation and interaction from teachers and peers largely influence math interest.

Furthermore, after the conduct of the study, the proportion of students who responded "Agree" and "Strongly Agree" in the Math Interest Inventory from the experimental group was significantly higher than that of the control group at a p-value of 0.00, which also reveals a Large Effect at Cohen's d of 0.71. This means that the use of the learning activity sheets using interactive formative assessment and feedback mechanism, particularly the use of online tools (i.e., messenger, google meet) to facilitate these activities, promote motivation leading the students to give more interest in mathematics. This is in accordance with the study of Insorio and Olivarez (2021) which mentioned that the utilization of facebook and messenger groups as platforms for delivering mathematics interventions in modular distance learning helps students better understand the mathematics lessons and enjoy learning at their own pace.

Overall, one student wrote a general comment in his journal on the use the developed activity sheet, "*Mas naging gusto at interesado nako sa larangan ng math kahit hindi ko 'to paboritong subject*" (I became more like and interested in the subject even though it's not my favorite). To conclude, the developed learning activity sheets heighten the interest of the students in learning math through its design, activities, features, online tools used, and the interaction and feedback it offers.

4. Conclusion

Based on the findings, the following conclusions are made:

- The development of learning activity sheets for Grade 9 classes on topics about triangle similarity can use interactive formative assessment and feedback mechanism.
- The feedback mechanism had positive results for students along with understanding the lesson, completion of tasks, communication, interest in learning math, and social relationships.
- The use of the developed learning activity sheets using interactive formative assessment and feedback mechanism resulted in improved conceptual understanding, communication skills, and interest in learning mathematics.

4.1 Recommendations

In accordance with the findings and conclusions drawn from the study, the following are recommended:

1. The learning activity sheets, interactive formative assessments, feedback mechanisms, and session guides developed in this study can be adopted and improved by the teachers teaching Grade 9 Mathematics applying a blended learning approach.

2. Teachers can incorporate the use of interactive formative assessment and feedback mechanism in the instructional materials that they will develop, specifically on learning activity sheets or self-learning modules.

3. Curriculum developers and administrators may consider these instructional materials as these may help to realize the twin goals of Mathematics education even in distance learning. They may conduct training and workshops about the development of such learning and teaching materials using interactive formative assessment and feedback mechanism.

4. Mathematics teachers may develop learners' materials and teachers' guides for other topics or Grade levels guided by the materials developed and implemented in this study.

5. For future local researches, further research on similar problems may be undertaken, such as:

- a. The use of learning activity sheets using interactive formative assessment and feedback mechanism at all levels in elementary, junior and senior high school for blended distance learning.
- b. Explore other online tools which can be used to provide feedback to students.
- c. Further study on the effectiveness of the learning activity sheets using interactive formative assessment and feedback mechanism in larger size of classes.
- d. Longer period of exposure to the use of learning activity sheets using interactive formative assessment and feedback mechanism to effectively observe its effect on the conceptual understanding, communication skills, and interest of the students.

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